

# Integrated Planning Opportunities Alternatives Analysis – Alternative Livestock Watering Opportunity

Greene County, Missouri  
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## Introduction

*The City of Springfield (City), Greene County, and City Utilities of Springfield have developed an approach for integrated planning to best protect local environmental resources in an evolving regulatory landscape. The Integrated Plan (IP), titled "A Citizen Focused Approach," provides a holistic plan designed to prioritize investments based on the most effective solutions to address the most pressing problems that matter most to the community. Implementation of the IP includes a four-phased approach, which is designed to be iterative: 1) Assessment (What is the current status of the environment?), 2) Vision (Where do we want to be?), 3) Tactical (How will we get there?), and 4) Adaptive Management (What adjustments need to be made?).*

Identifying and prioritizing the most effective solutions using the Sustainable Return on Investment (SROI) approach is a critical component of the tactical phase. The SROI process is an economic analysis method for analyzing triple bottom-line (i.e., economic, social and environmental) outcomes of investments and policies. This approach provides a comparison between the costs of a solution to the benefits achieved so that a more informed investment decision can be made.

The SROI process was used here for estimating the sustainability value of installing an alternative water supply source at locations where livestock currently access the stream. This analysis includes social and environmental benefits as well as the financial costs of implementation and operation. The methodology entailed projecting the value of impacts over a 25-year planning horizon and applying a discount rate to bring future values into today's dollars. A description of this opportunity and details of the SROI analysis are provided below.

## Opportunity Description

This opportunity uses permanent fencing to minimize livestock access to streams and provides a new groundwater supply source. With this approach, water quality is improved by allowing vegetated stream corridors to develop and by eliminating the direct input of animal waste to the stream. In addition, by providing a centralized water supply, the rancher would be able to implement a rotational grazing system that improves vegetation cover, soil health and decreases soil erosion. The benefits to the rancher include improving the cattle density while also decreasing feed costs which results in a more profitable business.

Vegetated stream corridors stabilize soils and reduce runoff velocities which can improve stream habitat and reduce sediment transport to streams. In addition, vegetated stream corridors reduce the transport of bacteria and nutrients from feeding operations, animal waste, and fertilizer in stormwater runoff to streams. Excluding livestock from direct access also reduces the sources of animal waste and bacteria to waterbodies. Both direct and indirect livestock waste contribution to streams can pose health risks and increase drinking water treatment costs. Livestock access can also lead to significant stream channel instability and erosion. Implementation involves placing a livestock exclusion fence along the buffer, with cattle crossings placed across the stream as needed. An alternate cattle watering system consisting of a well, pump, solar cells, stock tank, and controls, is installed to supply water troughs for livestock. Electrical cross fencing is then installed to create paddocks that the rancher will rotate the cattle through. The rotational grazing benefits and costs followed the U.S. Department of Agriculture (USDA)-Missouri Natural Resources Conservation Service recommended approach.



Livestock with direct access to streams can impact water quality.

## Environmental and Social Benefits

A major social benefit to downstream users of implementing livestock exclusion and a rotational grazing system is improved water quality. Water quality improvements were determined using a water quality index (WQI) approach. The WQI is a composite scoring system that evaluates the conditions of a waterbody on a scale of 0 to 10 based on different community priorities and indicators. The economic value of a change in water quality is determined by the number of people that benefit and an individual’s “willingness-to-pay” for that change. A one point change to the WQI is worth about \$40 for a direct user and \$14 for in indirect user based on prior Environmental Protection Agency studies (Van Houtven et al., 2007).

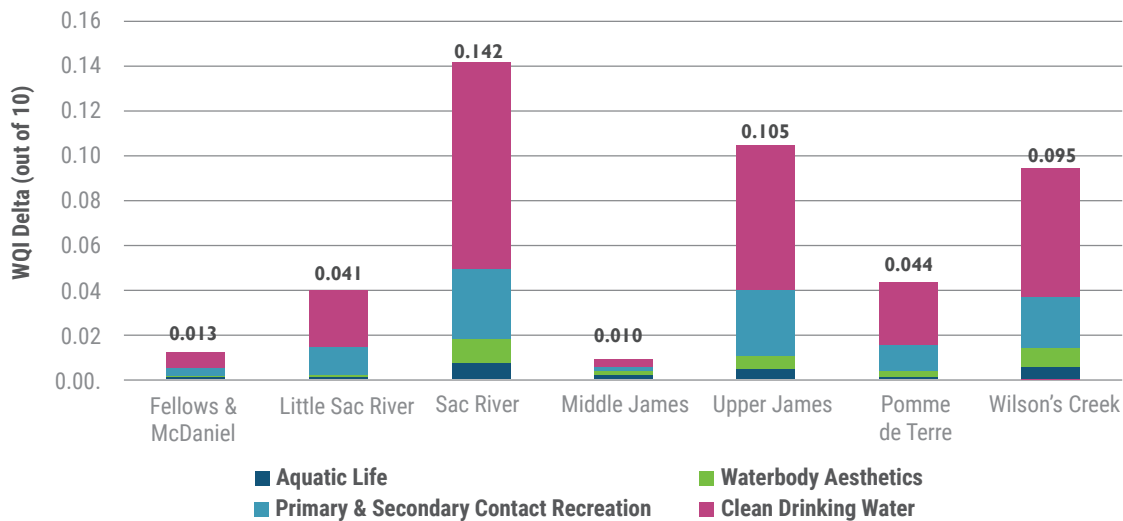
HDR evaluated the change in the WQI from livestock exclusion based on a number of factors including bacteria (as measured by *E. coli*), nutrients (as measured by total phosphorus and total nitrogen), and physical habitat. Water quality impacts were estimated for each of the seven watersheds that cover most of Greene County, which include Fellows & McDaniel Lake, Little Sac River, Sac River, Middle James, Upper James, Pomme de Terre River, and Wilson’s Creek (**Table 1**).

**Table 1. Estimated Pollutant Loadings from Livestock in Greene County Watersheds**

Description	Fellows & McDaniel Lake	Little Sac River	Sac River	Middle James	Upper James	Pomme de Terre River	Wilson’s Creek	Total
Estimated Number of Beef Cattle with Direct Access to Streams*	99	646	2,981	99	1,639	596	1,689	7,750
Estimated Annual Nitrogen Discharge to Surface Water (lbs/yr)	723	4,700	21,700	723	11,900	4,340	12,300	56,400
Estimated Annual Phosphorus Discharge to Surface Water (lbs/yr)	196	1,270	5,870	196	3,230	1,170	3,330	15,300
Estimated <i>E. coli</i> Discharge to Main Rivers (count/day)	8.5E+09	1.1E+11	4.9E+11	8.5E+09	2.3E+11	8.5E+10	2.7E+11	1.4E+13

\*Based on Missouri Cattle County Estimates (USDA 2016)

Estimated improvements from livestock exclusion will have a positive impact on a number of community priorities including aquatic life, waterbody aesthetics, primary and secondary contact recreation, and clean drinking water. These results indicate that the WQI would increase between 0.010 points in the Middle James to 0.142 points in the Sac River (**Figure 1**).



**Figure 1. Changes to the Water Quality Index from Providing an Alternative Livestock Water Supply and Implementing a Rotational Grazing System**

In addition to water quality benefits, USDA studies have shown that providing cattle with an alternative water source and implementing a rotational grazing system can result in a more profitable ranching operation. Based on information provided by the University of Missouri Extension services in their grazing school examples, it was estimated that the rancher will benefit by approximately \$62 per acre per year (MU Extension, 2019). This is based on increasing the cow calf pairs by 30%, a 580 pound selling weight, \$1.66 per lb. average selling price for steers and heifers, the increased labor and operating costs of actively rotating the cattle between the paddocks but also the financial benefit of more efficient grazing which results in less fertilizer and hay feeding expenses.

## Cost Considerations

For the SROI analysis, costs were estimated for installing fencing and solar powered watering systems (Table 2). Estimated costs of improvements assumed \$215 per acre for fencing, \$15,000 for a solar pump system with well, and \$5,000 for distribution piping and troughs. Estimated annual maintenance cost of fencing was assumed to be \$0.05 per foot. On a countywide basis, the total estimated cost of improvements was approximately \$4,630,000 with an estimated annual fencing cost of \$52,200.

**Table 2. Estimated Costs**

Description	Fellows & McDaniel Lake	Little Sac River	Sac River	Middle James	Upper James	Pomme de Terre River	Wilson's Creek	Total
Estimated Cost of Improvements	\$45,200	\$439,000	\$1,700,000	\$62,600	\$1,050,000	\$467,000	\$862,000	\$4,630,000
Estimated Annual Maintenance Costs of Fencing	\$129	\$5,470	\$20,100	\$1,070	\$12,300	\$6,170	\$7,050	\$52,200

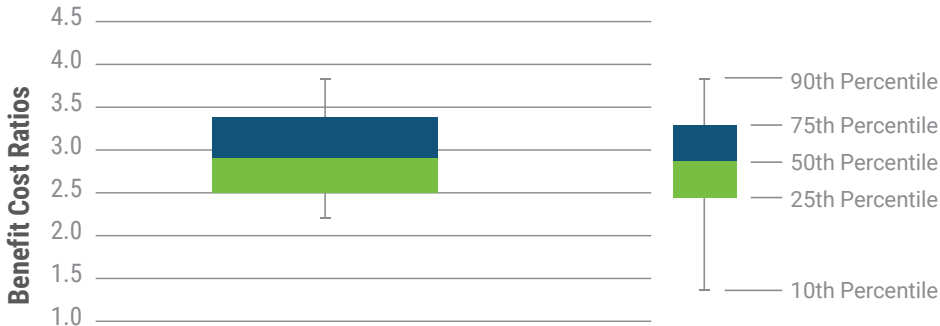
**SROI Results**

**Table 3** presents final results of costs and benefits of implementing and maintaining this opportunity over the 25 year planning period. The 25-year present value of costs (Capital plus Residual plus O&M) amount to about \$6.1 million based on a 20-year life cycle for the fencing. However, these costs are more than offset by improvements in water quality and increased market value of cattle, which total about \$17.6 million. Overall, the total net value would generate about \$11.5 million more in benefits than total lifecycle costs with a benefit-cost ratio of 2.9.

**Table 3. Summary of Present Value Costs for Providing an Alternative Livestock Water Supply and Implementing a Rotational Grazing System (\$2018, Millions)**

Types of Benefits and Costs	Present Value of Impact
<b>Environmental</b>	
Water Quality Impacts	\$7.3
<b>Social</b>	
Increased Market Value of Cattle	\$10.3
<b>Costs</b>	
Capital Expenditures	(\$6.9)
Residual Value of Capital Cost	\$1.7
Operations & Maintenance	(\$0.9)
<b>Totals</b>	
Financial Lifecycle Cost	(\$6.1)
Total Social, Environmental Benefits	\$17.6
Total Value - All Costs and Benefits	\$11.5
Benefit-Cost Ratio	2.9

**Figure 2** provides a graphical estimate of value created relative to cost by accounting for several uncertainties that can raise or lower the perspective on total value. Taking into account these uncertainties, it is estimated that that the benefit-cost ratio could range from about 2.2 to 3.9 with a 20% chance of it being above or below that range.



**Figure 2. Range of Potential Benefit Cost Ratios for Providing an Alternative Livestock Water Supply and Implementing a Rotational Grazing System**

## Summary

Providing an alternative livestock water supply and implementing a rotational grazing system will likely realize benefits that would outweigh the costs. The rotational grazing economic benefits to the rancher have been presented previously by the USDA as part of their grazing school and these economic costs and benefits have been incorporated in this analysis. The SROI analysis expanded on the USDA economic analysis to include water quality benefits within the stream. Implementing this opportunity within Greene County would result in approximately \$7.3 million in water quality improvements and approximately \$10.3 million in increased market value of cattle. Accounting for uncertainty, the benefit-cost ratio potentially ranges from 2.2 to 3.9, with an average of 2.9. More detailed information on this SROI analysis can be provided in a separate technical appendix.

## References

- MU Extension (University of Missouri Extension). 2019. Economics of Management Intensive Grazing.
- USDA (U.S. Department of Agriculture). 2016. Missouri Cattle County Estimates. National Agricultural Statistics Service, Heartland Regional Field Office. May 2016.
- Van Houtven, G., J. Powers, S.K. Pattanayak. 2007. Valuing Water Quality Improvements in the United States Using Meta-Analysis: Is the Glass Half-Full or Half-Empty for National Policy Analysis? *Resource and Energy Economics*. 29(2007), 206-228.