Introduction

Best management practices (BMPs) vary dramatically in effectiveness, cost, and longevity. With more than a dozen BMPs to select from, how does the resource manager choose? What criteria should be used? How can a limited budget be allocated to achieve the greatest result?

This section addresses these questions and provides a cost benefit/life cycle cost selection process designed to achieve the maximum pollution reduction for a given watershed and budget. Funding opportunities are also provided in this section and can help resource managers target available grant funds.

Cost-benefit Analysis

The BMP selection problem represents the classic investment problem where more than one alternative is available and each has its own cost and temporal characteristics. For watershed planning each BMP has a distinct:

- Initial or capital cost
- Annual maintenance expense (in some cases zero)
- Nutrient reduction effectiveness
- Lifespan

The most basic and popular method for selecting among alternatives is to use simple "payback" analysis, which divides the alternative's initial cost by the annual value of the alternative's benefit. The selected alternative takes the least time to recover its initial cost. This method has two major flaws. It ignores the length of the benefit stream beyond initial cost recovery and the time value of money (see sidebar). This tool often does not yield the alternative that maximizes the investor's return, which is the primary objective of the selection process.

A superior method uses cost-benefit analysis (CBA) also know as life-cycle costing (see Appendix E). Cost benefit analysis' advantage stems from its ability to effectively compare alternatives with varying income and cost streams even if the alternatives have different life spans. Further it takes explicit account of the "time value of money". For this plan's purpose, cost-benefit analysis is used to supply the discounted present value of each BMP's cost over a 20 year period.

With this technique the most cost-effective BMP or combination of BMPs can be determined that results in the greatest pollution

Time value of money

The future value of money is less than its present value due to the potential interest to be gained from the interest that could be earned by investing current dollars.

Simply stated the value of a dollar to be received at some point in the future is reduced by the amount of interest one could earn between now and when that dollar is received.

For example,

The present value of $1 to be received in fifteen years would be $0.64 if the annual interest earned equaled 3%.

An investor who receives 3% interest would be equally well off if s/he received $0.64 today or a payment of $1 fifteen years in the future.

reduction for a set budget. The following tables summarize applicable watershed BMPs for each land cover type.

Tables 4-1, 4-2, and 4-3 list the present value of each BMP's cost for a twenty year time horizon. In some cases, e.g., cover crops the initial project cost is incurred each of the 20 years. In other cases, e.g., tree planting, a large initial cost is followed by small annual maintenance charges.

The discounted present values of the varying BMP cost streams per acre are listed in the "Present Value (PV) per Acre Expense" column. The amounts in this column represent the value, which would be required as an initial investment at three percent interest to equal the amount spent for the each BMPs initial investment and annual maintenance costs over the life of the project.

To compare BMPs the second column in the tables shows the present value of the cost per pound of nitrogen reduced by the BMP. To calculate this cost, the pounds of nitrogen reduced per acre for each BMP was calculated. The present value of the cost per acre was then divided by the pounds of nitrogen reduced to yield the discounted cost per pound.

The BMP with the lowest cost per pound of nitrogen reduced provides the most pollutant reduction for the dollars spent. Therefore this figure can be used to create a priority ranking among the BMPs. This ranking appears in the first column of the tables.

BMP Strategy

To create the BMP strategy the steps below should be followed:

1. Set the total budget available for BMP implementation
2. Select BMP with the lowest cost per pound of nitrogen reduction
3. Implement the BMP until fully implemented or the budget is completely committed. If funds remain go to step 4.
4. Select the BMP with the next lowest cost per pound of nitrogen reduction. Return to step 3.

Table 4-1. Agricultural BMP Cost-Benefit Analysis Economic Summary

Rank	Agricultural BMPs	Present Value (PV) per Acre Expense	PV Expense to Reduce 1 lb Nitrogen
1	Agricultural Nutrient Management Planning	$ 119.26	$ 0.92
2	Cereal Cover Crops (Conventional-Till)	635.10	3.27
3	Cereal Cover Crops (Conservation-Till)	635.10	3.27
4	Conservation-tillage	269.92	3.91
5	Out of stream watering and stream fence	1,000.00	3.86
6	Off-stream watering without fencing (Pasture)	670.00	5.17
7	Tree planting-agriculture	1,730.81	7.03
8	Conservation Plans (Conventional-Till)	280.00	8.10
9	Conservation Plans (Pasture)	280.00	12.96
10	Riparian grass buffers	1,255.81	17.10
11	Conservation Plans (Conservation-Till and Hay)	280.00	21.60
12	Barnyard runoff control/Loading lot management	11,253.45	26.05
13	Riparian forest buffers	1,595.10	29.54
14	Wetland restoration	5,582.85	51.69
15	Water control structure	n/a	n/a

Table 4-2. Urban BMP Cost-Benefit Analysis Economic Summary

Rank	Urban BMPs	Present Value (PV) per Acre Expense	PV Expense to Reduce 1 lb Nitrogen
1	Nutrient Management (Urban)	$ 10.33	$ 0.41
2	Dry extended detention ponds	6,103.56	135.63
3	Dry ponds & hydrodynamic structures	6,103.56	813.81
4	Erosion and sediment control	5,800.00	199.72
5	Filtering practices	6,103.56	101.73
6	Infiltration practices	6,103.56	81.38
7	Riparian forest buffers	1,200.00	32.00
8	Stream restoration (lbs/ft)	385.82	128.61
9	Tree planting	4,356.00	n/a
10	Wet ponds and wetlands	6,103.56	135.63
11	Wetland restoration	25,000.00	387.60
12	Impervious surface/Urban growth reduction/forest conservation	-----	-----

Table 4-3. Mixed Open BMP Cost-Benefit Analysis Economic Summary

Rank	Mixed Open BMPs	Present Value (PV) per Acre Expense	PV Expense to Reduce 1 lb Nitrogen
1	Nutrient Management (Mixed Open)	$ 10.33	$ 0.69
2	Riparian forest buffers	1,200.00	32.00
3	Infiltration practices	6,103.56	81.38
4	Filtering practices	6,103.56	101.73
5	Stream restoration (lbs/ft)	385.82	128.61
6	Wet ponds and wetlands	6,103.56	135.63
7	Dry extended detention ponds	6,103.56	135.63
8	Erosion and sediment control	5,800.00	199.72
9	Wetland restoration	25,000.00	387.60
10	Dry detention ponds and hydrodynamic structures	6,103.56	813.81
11	Impervious surface/urban growth reduction/forest conservation	-----	-----
12	Tree planting	4,356.00	-----

Table 4-4. Resource and Septic BMP Cost-Benefit Analysis Economic Summary

Rank	Resource and Septic BMPs	Present Value (PV) per Acre Expense	PV Expense to Reduce 1 lb Nitrogen
1	Forest harvesting practices	$ 8.00	$ 0.67
2	Septic denitrification	11,963.24	107.78
3	Septic pumping	1,062.28	95.70
4	Septic connections/hook-ups	27438.74	224.72

Table 4-5. Surface and Groundwater Resource BMP Cost-Benefit Analysis Economic Summary

Rank	Surface and Groundwater Resource BMPs	Present Value (PV) per Acre Expense	PV Expense to Reduce 1 lb Nitrogen
1	Clean Air Act	-----	$ 10.00
2	Groundwater protection (lbs/yr)	-----	-----

Funding opportunities

Funding assistance can be received from several grant programs. In Maryland, they include the Maryland Coastal Bays Program in Worcester County, Targeted Watershed grant, 5-Star program, Bay Restoration Fund, MDE's 319 nonpoint source grant, forest conservation mitigation funds, and agricultural programs like the Cover Crop Program (funded by the general fund and bay restoration fund) and Conservation Reserve enhancement program. To learn more about these grant programs review appendix F.

Conclusion

This section provided resource managers with a cost-benefit analysis approach that designed to maximize the effectiveness of limited funds and achieve the maximum nutrient reduction. This section also highlighted grant programs that could fund a BMP implementation program. The next section is a discussion about prioritizing BMP recommendations which has considered the results of the nitrogen assessment and cost-benefit analysis as well as stakeholder input.