EPA Evaluation of Phosphorus Loading Reductions Likely to be Achieved Under Wisconsin MDV
WQSTS #WI2016-668

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A key component of the Wisconsin multi-discharger variance for phosphorus (MDV) is that, in lieu of requirements to comply with total phosphorus (TP) effluent limits reflecting the phosphorus loading reductions that could be achieved from installation and operation of treatment facilities to remove phosphorus from point source discharges, point source dischargers can instead implement measures that will reduce phosphorus loadings into area waters from nonpoint sources. For the reasons explained below, it is expected that, in most instances, the amount of phosphorus loadings that will be reduced from the nonpoint source measures required by the MDV will be greater (oftentimes significantly greater) than the reductions that would likely have occurred if the MDV instead required installation and operation of additional treatment facilities to remove phosphorus from point source discharges.

Under the MDV, dischargers have two options. First, a discharger could choose to be required to pay to a county $50 per pound of phosphorus it discharges over a target value of either 0.2 mg/L or a limit based on a wasteload allocation in a total maximum daily load (TMDL) approved by EPA on or before April 25, 2014 (this option is referred to as an "offset payment" in this document). Second, a discharger could choose to be required to implement, or enter into an agreement with a third party to implement, a plan or project to achieve annual reductions of phosphorus from other sources in the watershed in an amount equal to the difference between what the discharger discharges and the target value of 0.2 mg/L or a limit based on a wasteload allocation in a TMDL that was approved by EPA on or before April 25, 2014 (this option is referred to as a "direct offset" in this document). Both are evaluated below.

I. Phosphorus loading reductions if facility installed point source treatment technology

As a starting point, EPA considered the load reduction associated with achieving an end-of-pipe TP concentration of 0.015 mg/L, which is substantially more stringent than any limit that would actually be included in an NPDES permit if the MDV required installation of feasible phosphorus treatment equipment on point sources rather than the MDV's nonpoint source load reduction provisions. This limit is substantially more stringent than those limits because it reflects the most stringent phosphorus water quality based effluent limit (WQBEL) that would be included in any NPDES permit based upon Wisconsin's unvaried phosphorus criteria. No permittee covered by the MDV would be required to comply with a WQBEL reflecting the unvaried phosphorus criteria because the reason for variances is to avoid substantial and widespread economic and social impact by allowing permittees to be subject to less stringent limits than ones based on the unvaried phosphorus criteria. To state this differently, a permittee that is covered by a variance would be subject to limits that are less stringent than the WQBEL that the permittee would be otherwise required to meet if it did not have the variance because, if the permittee was subject to the WQBEL that the permittee would otherwise be required to meet, then the permittee would actually not be receiving a variance. Thus, by definition, permittees who are covered by a variance will have limits that are less stringent than limits reflecting the unvaried WQBEL. EPA nevertheless used 0.015 mg/L as a "worst case," conservative assumed limit for purposes of this analysis to ensure that it is capturing the maximum phosphorus load reduction that could be required from installation and operation of treatment facilities to remove phosphorus from point source discharges. EPA's use of 0.015 mg/L is especially conservative because Wisconsin's phosphorus criteria range in stringency from a low of 0.015 mg/L to a high of 0.100 mg/L, depending upon water body type. According to WDNR, there are no point sources that discharge into water bodies that are subject to the 0.015 mg/L phosphorus criterion and so the most stringent WQBEL that any discharger would likely be subject to would be 0.020 mg/L. (Based on the analyses conducted by EPA, however, it appears likely that 0.040 mg/L is the lowest phosphorus WQBEL that would be included in a permit.)

EPA assumed the facility would comply with the 0.015 mg/L limit at the outset of year five of the ten-year MDV period. This is because facilities required to meet limits reflecting installation and operation of new treatment facilities would likely need and be entitled to a compliance schedule in accordance with 40 CFR 122.47, providing time necessary to design, obtain funding for, and install new treatment facilities. EPA selected four years as the assumed compliance schedule length (i.e., achieve compliance after four full years, and hence start to comply at the outset of year five) because permits that EPA has issued that have included phosphorus limits of 0.2 mg/L or less have typically included compliance schedules of four years or more. See NPDES Permit No. MA0101702 for MFN Regional Water Pollution Control Facility, MA (5-year compliance schedule for 0.17 mg/L average phosphorus monthly limit); NPDES Permit No. MA0101591, Middleborough, MA (4-year compliance schedule for 0.15 mg/L phosphorus average monthly limit); NPDES Permit No. MA0100641, Bridgewater, MA (5-year compliance schedule for 0.20 mg/L average phosphorus monthly limit); NPDES Permit No. ID0020036, Grangeville, ID (4.5 year compliance schedule for 0.067 mg/L average phosphorus monthly limit); NPDES Permit No. ID0028037, Sorento Lactalis, Inc., ID (4.5 year compliance schedule for 0.07 mg/L average phosphorus monthly limit); NPDES Permit No. NM0024996, Mora Mutual Water and Sewer Works Assoc., NM (4 year compliance schedule for 0.03 mg/L average phosphorus 30-day limit); see also NPDES Permit No. MA0101567, Warren, MA (5-year compliance schedule for 4.9 lbs/day average phosphorus monthly limit).

Assuming a facility begins the 10-year variance period discharging one million gallons of effluent per day at a concentration of 1 mg/L, EPA calculated cumulative load reduction over the 10-year period as follows:

Table 1. Cumulative TP load reduction if 1 MGD facility decreases its end-of-pipe TP concentration from 1 mg/L to 0.015 mg/L beginning at the outset of year five of a ten-year discharge period.

Year	Volume discharged (L/d)	Concentration of discharge (mg/L)	Mass TP discharged (mg/d)	Mass TP discharged (lb./d)	Mass TP discharged (lb./yr.)	Cumulative reduction (lb.)
1	3785411.78	1	3785411.78	8.345404443	3046.072622	0
2	3785411.78	1	3785411.78	8.345404443	3046.072622	0
3	3785411.78	1	3785411.78	8.345404443	3046.072622	0
4	3785411.78	1	3785411.78	8.345404443	3046.072622	0
5	3785411.78	0.015	56781.1767	0.125181067	45.69108933	3000.381532
6	3785411.78	0.015	56781.1767	0.125181067	45.69108933	6000.763064

Year	Volume discharged (L/d)	Concentration of discharge (mg/L)	Mass TP discharged (mg/d)	Mass TP discharged (lb./d)	Mass TP discharged (lb./yr.)	Cumulative reduction (lb.)
7	3785411.78	0.015	56781.1767	0.125181067	45.69108933	9001.144596
8	3785411.78	0.015	56781.1767	0.125181067	45.69108933	12001.526128
9	3785411.78	0.015	56781.1767	0.125181067	45.69108933	15001.90766
10	3785411.78	0.015	56781.1767	0.125181067	45.69108933	18002.289192

II. Phosphorus loading reductions if facility chose county-payment option

A. Estimating the cost-effectiveness of implementing non-point source pollution control best management practices

There are two primary sources of phosphorus into water bodies from agricultural nonpoint sources: (1) application of fertilizer to the land (including manure) in excess of the amount needed by crops or at times that crops are unable to utilize the fertilizer and (2) inadequate management of manure from farm animals. Fertilizer application itself does not necessarily result in phosphorus getting into water bodies. This is because a certain amount of phosphorus is needed and taken up by plants for optimal growth and development, and phosphorus that is taken up by plants is not available to get into surface waters and contribute to eutrophication. However, application of fertilizer beyond what crop plants are able to use can result in water pollution. This is because the excess phosphorus that is not taken up by plants remains on the land and available to transport to surface waters by wind and water erosion. Similarly, animal manure itself is not a water pollution problem, but becomes a problem when not properly managed.

Nonpoint source control practices prevent phosphorus from getting to the water either by reducing the amount of phosphorus that is applied to cropland (thereby reducing the amount of phosphorus that is available to be transported into surface waters) or, once phosphorus is applied or released to land, by creating a barrier between farm activities that might mobilize phosphorus and surface waters. Most practices, if properly designed, implemented and maintained, should work immediately to achieve their intended purpose: e.g., most measures to reduce the amount of phosphorus applied or released to land will immediately reduce the amount of phosphorus applied or released to the land; most measures to prevent phosphorus that has been applied or released to the land from getting to water will immediately function to reduce the amount of phosphorus that is released into waters. However, depending on a number of site-specific factors -- such as proximity of the measure to the water body (e.g., is the portion of the farmland at issue 10 feet from the water or 1000 feet?), weather variability (e.g., frequency, duration, intensity and timing of rainfall and wind events), and topography of the land (slope, soil type) -- there could be a lag time between when the measure is implemented and when the resultant reduction in loadings to water bodies will occur.

The following table (Table 2), derived from Table 5 in WDNR's Justification Document at pp. 18-19, summarizes a number of specific nonpoint source control measures that are identified in Wisconsin's nonpoint source performance standards that WDNR anticipates could be implemented as a result of the MDV.

Table 2. Agricultural performance standards

Practice and NR citations	Definition from ATCP 50	How the practice reduces phosphorus load	Time needed for load reductions to begin
Manure Storage Systems NR 154.04(3)	"Manure storage system" means a manure storage facility and related practices needed for the environmentally safe storage of manure at that facility. ATCP 50.62	Prevents phosphorus from being released onto the land in an uncontrolled manner by collecting and storing manure	Phosphorus load reductions begin as soon as the storage system is constructed and begins being used.
Manure Storage System Closure NR 154.04(4)	"Manure storage system closure" means permanently disabling and sealing a leaking or improperly sited manure storage system. ATCP 50.63	Prevents phosphorus from being released onto the land in an uncontrolled manner by permanently eliminating the storage system	Nutrient load reductions begin immediately when the defective storage system is decommissioned. (months)
Barnyard Runoff Control Systems NR 154.04(5)	"barnyard runoff control system" means a system of facilities or practices used to contain, divert, retard, treat, or otherwise control the discharge of runoff from outdoor areas of concentrated livestock activity. ATCP 50.64	Prevents phosphorus from being released onto the land in an uncontrolled manner by controlling discharges of runoff from outdoor livestock areas	Nutrient load reductions begin immediately once the system is installed
Access Roads & Cattle Crossings NR 154.04(6)	"access road" means a road or pathway that confines or directs the movement of livestock, farm equipment, or vehicular traffic, and that is designed and installed to control surface water runoff, to protect an installed practice, or to prevent erosion. ATCP 50.65	Prevents phosphorus from being released into areas that do not control surface water run-off. Also creates a barrier to phosphorus transport to surface waters.	Physical control of erosion and runoff. Effective immediately upon installation
Animal Trails and Walkways NR 154.04(7)	"trail or walkway" means a travel lane to facilitate movement of livestock or people. ATCP 50.66	Prevents phosphorus from being released into areas that do not control surface water run-off. Also creates a barrier to phosphorus transport to surface waters.	Physical control of erosion and runoff. Effective immediately upon installation

Critical Area Stabilization NR 154.04(10)	"critical area stabilization" means planting suitable vegetation on erodible areas such as steep slopes and gullies, so as to reduce soil erosion or pollution from agricultural nonpoint sources. "Critical area stabilization" may also include treating areas that drain into bedrock crevices, openings, or sinkholes. ATCP 50.69	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective once vegetation is in place. (partial growing season)
Diversions NR 154.04(11)	"diversion" means a structure installed to divert excess surface runoff water to an area where it can be used, transported, or discharged without causing excessive soil erosion. "Diversion" includes a channel with a supporting earthen ridge on the lower side, installed across the slope with a self–discharging and non–erosive gradient. ATCP 50.70	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Field Windbreaks NR 154.04(12)	"field windbreak" means a strip or belt of trees, shrubs, or grasses established or renovated within or adjacent to a field, so as to control soil erosion by reducing wind velocities at the land surface. ATCP 50.71	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Filter Strips NR 154.04(13)	"Filter strip" means an area of herbaceous vegetation that separates an environmentally sensitive area from cropland, grazing land, or disturbed land. ATCP 50.72	Prevents phosphorus transport into surface waters through erosion.	Vegetative control of erosion and runoff. Effective within one growing season.

Grade Stabilization NR 154.04(14)	"grade stabilization structure" means a structure which stabilizes the grade in a channel in order to protect the channel from erosion, or to prevent gullies from forming or advancing. ATCP 50.73	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Heavy Use Area Protection NR 154.04(15)	The provisions for heavy use area protection included in s. ATCP 50.74, as it existed on October 1, 2002, shall apply.	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Lake Sediment Treatment NR 154.04(16)	"lake sediment treatment" is defined as a chemical, physical or biological treatment of polluted lake sediments for purposes of minimizing potential adverse impacts from the pollutants.	Addresses phosphorus that is already in lakes by reducing the amount of phosphorus available to fuel growth of nuisance plants and algae.	In lake treatment to control nutrients, such as alum. Chemical treatment is effective upon treatment. Biological treatment may take longer.
Livestock Fencing NR 154.04(17)	"livestock fencing" means either of the following: (a) Excluding livestock, by fencing or other means, in order to protect an erodible area or a practice under this subchapter. ATCP 50.75	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Livestock Watering Facilities NR 154.04(18)	"livestock watering facility" means a trough, tank, pipe, conduit, spring development, pump, well, or other device or combination of devices installed to deliver drinking water to livestock. ATCP 50.76	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Prescribed Grazing NR 154.04(22)	"prescribed grazing" or "rotational grazing" means a grazing system which divides pastures into multiple cells, each of which is grazed intensively for a short period and then protected from grazing	Reduces the amount of phosphorus being released onto the land and also prevents phosphorus transport into surface waters through erosion.	Land management practice to reduce erosion and runoff. Effective upon transition to this method of management.

	until its vegetative cover is restored. ATCP 50.80		
Relocating or Abandoning Animal Feeding Operations NR 154.04(23)	"Abandonment" means discontinuing an animal feeding operation in order to prevent surface water or groundwater pollution from that animal feeding operation. "Relocation" means discontinuing an animal feeding operation at one site and commencing that operation at a suitable alternate site in order to minimize the amount of surface water or groundwater pollution from that animal feeding operation. ATCP 50.81	Prevents phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation
Riparian Buffers NR 154.04(25)	"riparian buffer" means an area in which vegetation is enhanced or established to reduce or eliminate the movement of sediment, nutrients, and other nonpoint source pollutants to an adjacent surface water resource or groundwater recharge area, to protect the banks of streams and lakes from erosion, and to protect fish habitat. ATCP 50.83	Prevents phosphorus transport into surface waters through erosion.	Vegetative control of erosion and runoff. Effective within one growing season.
Roofs NR 154.04(26)	"Roof" means a weather–proof covering that shields an animal lot or manure storage structure from precipitation, and includes the structure supporting that weather–proof covering. ATCP 50.84	Prevents or reduces phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation
Roof Runoff Systems NR 154.04(27)	"roof runoff system" means facilities for collecting, controlling, diverting, and disposing of precipitation from roofs. A "roof runoff	Prevents or reduces phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation

	system" may include gutters, downspouts, erosion–resistant channels, subsurface drains, and trenches. ATCP 50.85		
Sediment Basins NR 154.04(28)	"Sediment basins" means permanent basins that reduce the transport of waterborne pollutants such as eroded soil sediment, debris, and manure sediment. Sediment basins may include containment walls or berms, pickets or screens to filter debris, orifices or weirs to control discharge, and conduits to direct runoff to treatment or discharge areas. ATCP 50.86	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Sinkhole Treatment NR 154.04(30)	"sinkhole treatment" means modifying a sinkhole, or the area around a sinkhole, to reduce erosion, prevent expansion of the hole, and reduce pollution of water resources. Modifications may include the diversion of runoff around a sinkhole, or the alteration of a sinkhole by excavation, cleanout, filter treatment, sealing, or refilling. ATCP 50.87	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Subsurface Drains NR 154.04(33)	"subsurface drain" means a conduit installed below the surface of the ground to collect drainage water and convey it to a suitable outlet. ATCP 50.90	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Terrace Systems NR 154.04(34)	"terrace system" means a system of ridges and channels installed on the contour with a non–erosive	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation

	grade and suitable spacing. ATCP 50.91		
Underground Outlets NR 154.04(35)	"underground outlet" means a conduit installed below the surface of the ground to collect surface water and convey it to a suitable outlet. ATCP 50.92	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Waste Transfer Systems NR 154.04(36)	"waste transfer system" means components such as pumps, pipes, conduits, valves, and other structures installed to convey manure and milking center wastes from buildings and animal feeding operations to a storage structure, loading area, or treatment area. ATCP 50.93	Prevents or reduces phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation
Wastewater Treatment Strips NR 154.04(37)	"wastewater treatment strip" means an area of herbaceous vegetation that is used as part of an agricultural waste management system to remove pollutants from animal lot runoff or wastewater, such as runoff or wastewater from a milking center. ATCP 50.94	Prevents phosphorus transport into surface waters through erosion.	Vegetative control of erosion and runoff. Effective within one growing season.
Water and Sediment Control Basins NR 154.04(38)	"Water and sediment control basin" means an earthen embankment or a ridge and channel combination which is installed across a slope or minor watercourse to trap or detain runoff and sediment. ATCP 50.95	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Waterway Systems NR 154.04(39)	"waterway system" means a natural or constructed waterway or outlet that is shaped, graded, and covered with a vegetation	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation

	or another suitable surface material to prevent erosion by runoff waters. ATCP 50.96		
Well Decommissioning NR 154.04(40)	"well decommissioning" means permanently disabling and sealing a well to prevent contaminants from reaching groundwater. ATCP 50.97	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Wetland Development or Restoration NR 154.04(41)	"wetland development or restoration" means the construction of berms, or the destruction of tile line or drainage ditch functions, to create or restore conditions suitable for wetland vegetation. ATCP 50.98	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Milking Center Waste Control Systems	"Milking center waste control system" means a system of facilities or equipment designed to contain or control the discharge of milking center waste. ATCP 50.77	Prevents or reduces phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation
Feed Storage Leachate	"Feed storage runoff control system" means a system of facilities or practices to contain, divert, retard, treat, or otherwise control the discharge of leachate and contaminated runoff from livestock feed storage areas. ATCP 50.705	Prevents or reduces phosphorus from being released onto the land	Physical control of erosion and runoff. Effective immediately upon installation
Stream Crossing	"stream crossing" means a road or pathway which confines or directs the movement of livestock, farm equipment, or vehicular traffic over a stream, and which is designed and installed	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation

	to improve water quality, reduce erosion, protect an installed practice, or control livestock access to a stream. ATCP 50.885		
Streambank/Shoreline rip-rapping	"streambank or shoreline protection" means waterbody–specific treatments used to stabilize and protect the eroding banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries. The practice is designed and installed to provide water quality benefits or control soil erosion including degradation from livestock and may protect fish habitat as an incidental benefit. ATCP 50.88	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Streambank/Shoreline Shaping & Seeding	See previous	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Contour Farming NR 154.04(8)	"contour farming" means plowing, preparing, planting, and cultivating sloping land on the contour and along established grades of terraces or diversions. ATCP 50.67	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation
Cover & Green Manure Crop NR 154.04(9)	"cropland cover" means close–growing grasses, legumes, or small grain grown for any of the following purposes: (a) To control erosion during periods when major crops do not furnish adequate cover.	Prevents phosphorus transport into surface waters through erosion.	Vegetative control of erosion and runoff. Effective within one growing season.

	(b) To add organic matter to the soil. (c) To improve soil infiltration, aeration, or tilth. ATCP 50.68		
Nutrient Management NR 154.04(20)	"nutrient management" means controlling the amount, source, form, location, and timing of plant nutrient applications, including application of organic wastes, commercial fertilizers, soil reserves, and legumes, in order to provide plant nutrients while minimizing the movement of nutrients to surface water and groundwater. ATCP 50.78	Prevents or reduces phosphorus from being released onto the land	Management plan. Effective upon implementation.
Pesticide Management NR 154.04(21)	"pesticide management" means controlling the storage, handling, use, and disposal of pesticides used in crop production in order to minimize contamination of water, air, and nontarget organisms. ATCP 50.79		Included in the table in the justification document, but not relevant to nutrient load reduction.
Residue Management NR 154.04(24)	"residue management" means any of the following: (a) Preparing land surfaces for the planting and growing of crop plants using methods that result in a rough land surface which is covered in varying degrees by vegetative residues of a previous crop, and which provides a significant degree of resistance to soil erosion by raindrop impact, surface water runoff, or wind.	Prevents phosphorus transport into surface waters through erosion.	Physical control of erosion and runoff. Effective immediately upon installation

	(b) Planting crop seeds in a narrow slot or a narrow strip of tilled soil, in order to maintain residue cover and avoid disturbing the entire soil surface. ATCP 50.82		

EPA identified three sources upon which it relied in estimating the costs associated with implementing agricultural best management practices (BMPs; see Appendix 1 for a list of the general BMP types considered) to control NPS phosphorus in Wisconsin:

a. "Pennsylvania Fact Sheet," a November 2013 Chesapeake Bay Foundation document that summarizes several efforts to estimate costs associated with specific surface water quality improvement approaches, including BMPs to reduce phosphorus load to surface waters (on pp. 2 and 3). In this document, where there were multiple cost-effectiveness figures associated with implementing the same BMP type, EPA considered only the least cost-effective figure (i.e., the highest reported cost per pound of phosphorus reduction). This helps ensure that EPA's analysis captures the "worst-case scenario" in all instances, even though it is likely that in many instances the specific nonpoint source reduction practice would actually be more cost-effective (i.e., will result in greater phosphorus reductions) than EPA's analysis assumes.
b. "Analysis of Phosphorus Control Costs and Effectiveness for Point and Nonpoint Sources in the Fox-Wolf Basin," which was prepared in July 1999 by Resource Strategies, Inc. for Fox-Wolf Basin 2000. In this document, EPA identified each individual combination of agricultural BMPs included in Table A2 and adapted the information to document ranges, and high- and low estimates of cost-effectiveness for each BMP combination.
c. "Iowa Nutrient Reduction Strategy: A Science and Technology-Based Framework to Assess and Reduce Nutrients to Iowa Waters and the Gulf of Mexico." EPA specifically considered Table 13 in Section 2.3 – "Iowa Science Assessment of Nonpoint Source Practices to Reduce Phosphorus Transport in the Mississippi River Basin."

EPA used the information in these documents to identify a range of BMP cost-effectiveness values (i.e., dollars spent on BMPs per pound of phosphorus load removed from surface waters). A low cost per pound of phosphorus removed (e.g., 25^{th} percentile estimate) represents high cost-effectiveness and, conversely, a high cost per pound of phosphorus removed (e.g., 75^{th} percentile estimate) represents low cost-effectiveness. EPA chose to calculate high- (25^{th} percentile), medium- (50^{th} percentile), and low (75^{th} percentile) BMP cost-effectiveness estimates to characterize lower-, medium-, and higher-cost BMPs. Although studies indicate that there are a number of cost-saving or no-cost BMPs (i.e., BMPs that will either result in farmers saving as much or more money than is spent on implementing the practice or saving the same amount of money as is spent on implementing the practice), EPA chose to use the 25^{th} percentile value as its lowest cost-effectiveness estimate to limit the impact of very low cost-effectiveness figures on its analysis. EPA calculated the 50th percentile cost-effectiveness value as a way of reducing the influence of very high and very low cost-effectiveness values on its analysis. Similarly, although certain studies identified very costly BMPs, EPA used the 75th percentile value of BMP cost-effectiveness values because EPA assumes that counties will use the funds generated during the MDV's ten-year term on more cost effective BMPs than on these very high-cost/low cost-effective BMPs. To calculate cost-effectiveness estimates, EPA:

a. Created one Excel table for the Pennsylvania study, with rows for each phosphorus reduction BMP type considered.
b. Created three Excel tables for the Wisconsin study (one indicating the range of cost-effectiveness estimates for each phosphorus reduction BMP type considered, and one each for the low- and high cost-effectiveness estimates), with rows for each combination of BMP types considered in Table A2.
c. Created one Excel table for the Iowa study, with rows for each BMP type considered in Table 13 of Section 2.3.

In each of the above tables, EPA converted cost-effectiveness figures into 2016 dollars using the U.S. Bureau of Labor Statistics CPI inflation calculator available at http://data.bls.gov/cgi-bin/cpicalc.pl.[1] EPA then used Excel's built-in functions to identify 25th percentile-, 50th percentile-, and 75th percentile cost-effectiveness figures for all BMPs in the following tables: (1) Pennsylvania, (2) low-estimate Wisconsin, (3) high-estimate Wisconsin, and (4) Iowa. EPA calculated overall high-, medium-, and low cost-effectiveness estimates for implementing BMPs using the following approach:

a. To estimate a high cost-effectiveness figure (i.e., low BMP implementation cost per pound of phosphorus reduced) for use in further analyses, EPA calculated the mean of the 25th percentile Pennsylvania ($17/lb. reduced), low-estimate 25th percentile Wisconsin ($14/lb. reduced), and 25th percentile Iowa ($14/lb. reduced) cost-effectiveness numbers. As a result, the high cost-effectiveness figure that EPA used in further calculations was $15 per pound of phosphorus reduced.
b. To estimate a moderate cost-effectiveness figure for further analyses, EPA calculated the mean of the 50th percentile Pennsylvania ($38/lb. reduced), high-estimate 50th percentile Wisconsin (a conservative assumption; $38/lb. reduced), and 50th percentile Iowa ($58/lb. reduced) cost-effectiveness numbers. As a result, the moderate cost-effectiveness figure that EPA used in further calculations was $45 per pound of phosphorus reduced.
c. To estimate a low cost-effectiveness figure (i.e., high BMP implementation cost per pound of phosphorus reduced) for further analyses, EPA calculated the mean of the 75th percentile Pennsylvania ($58/lb. reduced), high-estimate 75th percentile Wisconsin ($69/lb. reduced), and 75th percentile Iowa ($147/lb. reduced) numbers.

[1] EPA performed these calculations from late summer through autumn of 2016.

As a result, the low cost-effectiveness figure that EPA used in future calculations was $91 per pound of phosphorus reduced.

To confirm the appropriateness of its approach for estimating the cost-effectiveness of nonpoint source controls, EPA also utilized an alternative approach for making those estimates and arrived at comparable results (see Appendix 1).

B. Estimating cumulative phosphorus load reduced through BMP implementation and comparing to load reduction associated with achieving end-of-pipe reductions

1. Facility discharges at 1 mg/L throughout MDV term

EPA used the cost-effectiveness figures described above to compare phosphorus load reduction associated with BMP implementation to load reduction associated with a facility meeting a specific end-of-pipe concentration. For illustrative purposes, EPA considered a hypothetical facility that discharges 1 million gallons of wastewater effluent daily (MGD) at a concentration of 1 mg/L TP.

Since the MDV allows participants to make offset payments to counties according to annual TP load discharged (i.e., $50/lb. of TP discharged in excess of the load associated with a discharge concentration of 0.2 mg/L), EPA was able to use the cost-effectiveness figures described above to estimate the TP load reductions that could result if the hypothetical 1 MGD/1 mg/L facility made offset payments to a county to be used for cost-share to fund nonpoint source phosphorus-reduction BMPs. EPA first calculated the annual payment that the facility would be expected to make if it maintained its discharge concentration at 1 mg/L over the course of the ten-year MDV period.

Table 3. TP load associated with a discharge volume of 1 MGD and discharge concentrations of 1 mg/L and 0.2 mg/L.

Discharge volume (MGD)	Discharge volume (L/d)	Discharge concentration (mg TP/L)	Mass discharged (mg TP/d)	Mass (lb. TP/d)	Mass (lb. TP/yr.)
1	3785411.78	1	3785411.78	8.34540444	3046.072622
1	3785411.78	0.2	757082.356	1.66908089	609.2145244

Therefore, the annual payment for this particular facility can be calculated as follows:

3,046.072622 lbs. TP/yr. – 609.2145244 lbs. TP/yr. = 2,436.858097 lbs. TP/yr.
2,436.858097 lbs. TP/yr. x $50/lb. TP/yr. = ~$121,843/yr.

Wisconsin's TP MDV statute requires that at least 65% of offset payments to counties be used as cost-share to be provided to farmers to implement BMPs to reduce nonpoint source phosphorus pollution. Therefore, EPA assumed that the hypothetical county would use exactly 65% of the hypothetical discharger's annual payments to fund BMP implementation. Per the MDV, by March 1 of the second year of the first permit issued to the discharger under the MDV, and each year thereafter for the remainder of the ten-year term of the MDV, the discharger would be required to pay the county its offset payment and, by March 1 of the third year of the first permit issued to the discharger under the MDV and each year thereafter for the remainder of the ten-year term of the MDV, the county would be required to develop and implement a plan for using the money it received in the prior calendar year on measures that have "the greatest potential to reduce the amount of phosphorus per acre entering the waters of the state, based on an assessment of the land and land use practices in the county." EPA assumed that any load reduction associated with cost-share payments and BMP implementation would begin to accrue in year four of the variance. Therefore, EPA calculated that the county would spend ~$79,198 on cost-share in years three through ten.

Although EPA did not account for them in the below calculations, it is likely that counties receiving variance-related funds would receive another year's worth of payments (i.e., to be spent in the 11th year after the variance is implemented) that would be used to implement additional BMPs. These funds would result in additional TP load reduction, which is also not accounted for in EPA's calculations. Therefore, although not reflected in the below calculations, it is likely that the MDV would unfold in the following way: discharger makes payments to county in years 2 – 10, county spends this funding in years 3 – 11, and benefits accrue in years 4 – 12.

Using the BMP cost-effectiveness figures calculated above, this annual expenditure would be expected to result in the following potential annual load offsets:

Table 4. Predicted new annual TP load reductions, based on Pennsylvania, Wisconsin, and Iowa BMP implementation data, using funding made available through offset payments to county.

Cost-effectiveness estimate	Available annual budget	Load reduction unit cost ($/lb. TP reduced)	New annual load reduction (lb. TP/yr.)
High	$79,198	15	5,279.87
Moderate	$79,198	45	1,759.96
Low	$79,198	91	870.31

EPA also considered a scenario in which a county would seek to first provide cost-share to fund the most cost-effective BMPs before funding less cost-effective BMPs. In this hypothetical scenario, EPA assumed that farmers would be able to implement highly cost-effective BMPs in years 3 through 5, BMPs of medium cost-effectiveness in years 6 through 8 and BMPs of low cost-effectiveness in year 9 – 10. Under this scenario, annual load reductions changed through the variance period, in concert with the load reductions associated with each of the cost-effectiveness estimates outlined in the table above.

EPA then calculated cumulative load reduction values assuming that the facility discharges at a continuous effluent TP concentration of 1 mg/L throughout the variance period and that the county implements BMPs under the following scenarios:

a. County implements highly cost-effective BMPs in years 3 through 10.
b. County implements moderately cost-effective BMPs in years 3 through 10.
c. County implements least cost-effective BMPs in years 3 through 10.
d. County implements highly cost-effective BMPs in years 3 through 5, implements moderately cost-effective BMPs in years 6 through 8, and implements least cost-effective BMPs in years 9 through 10.

Because Wisconsin's nonpoint source performance standard rules at NR 151 require that farmland that meets nonpoint source performance standards as a result of the provision of cost-share then meet nonpoint source performance standards in perpetuity, EPA assumed that any reduction in TP load realized as a result of the provision of cost-share to implement BMPs would be maintained and occur each year for the remainder the of the MDV's 10-year term. EPA calculated cumulative load reduction as follows:

Cumulative load offset in year 1 = n_1
Cumulative load offset in year 2 = $(2 \times n_1) + n_2$
Cumulative load offset in year 3 = $(3 \times n_1) + (2 \times n_2) + n_3$
...
Cumulative load offset in year 10 = $(10 \times n_1) + (9 \times n_2) + (8 \times n_3) + (7 \times n_4) + (6 \times n_5) + (5 \times n_6) + (4 \times n_7) + (3 \times n_8) + (2 \times n_9) + n_{10}$

Using the above approach, EPA calculated cumulative offset for the most cost-effective BMPs: [2]

Table 5. Annual and cumulative TP load reductions assuming that farmers implement highly cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lbs.)
1	$0.00	$0.00	-	0	0
2	$121,842.90	$0.00	-	0	0
3	$121,842.90	$79,197.89	-	0 [3]	0
4	$121,842.90	$79,197.89	15	5279.859211	5279.859211
5	$121,842.90	$79,197.89	15	5279.859211	15839.57763
6	$121,842.90	$79,197.89	15	5279.859211	31679.15527
7	$121,842.90	$79,197.89	15	5279.859211	52798.59211

[2] Note that both the Pennsylvania and Iowa documents used to estimate BMP cost-effectiveness indicate that there are BMPs that are effective in reducing phosphorus export to surface waters that either do not cost anything to implement or result in net savings to farmers. In the Pennsylvania document, there was conflicting information on cost of implementation of low- or no-cost BMPs, and EPA considered *only* the less cost-effective estimate of cost-effectiveness (which was greater than $0/lb. TP reduced). In considering information from the Iowa document, EPA calculated cost-effectiveness estimates using these negative cost-effectiveness numbers. However, the most cost-effective estimate used in EPA's calculations (mean 25th percentile; $15/lb. TP reduced) does not reflect the likelihood that farmers may be able to reduce TP export to surface waters for no additional (or negative) cost. When choosing which BMPs to implement, it is very likely that farmers would seek to implement zero-cost or cost-saving BMPs prior to implementing less cost-effective practices, including those that cost as little as $15/lb. of phosphorus reduced to implement.

[3] In year 3, the county is expected to be developing and implementing a plan for using the money it received in the prior calendar year. Despite the fact that funding is available and being spent at this time, TP load reductions are not yet realized.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lbs.)
8	$121,842.90	$79,197.89	15	5279.859211	79197.88817
9	$121,842.90	$79,197.89	15	5279.859211	110877.0434
10	$121,842.90	$79,197.89	15	5279.859211	147836.0579

Using the above approach, EPA calculated cumulative offset for the moderately cost-effective BMPs:

Table 6. Annual and cumulative TP load reductions assuming that farmers implement moderately cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lbs.)
1	$0.00	$0.00	-	0	0
2	$121,842.90	$0.00	-	0	0
3	$121,842.90	$79,197.89	-	0	0
4	$121,842.90	$79,197.89	45	1759.95307	1759.95307
5	$121,842.90	$79,197.89	45	1759.95307	5279.859211
6	$121,842.90	$79,197.89	45	1759.95307	10559.71842
7	$121,842.90	$79,197.89	45	1759.95307	17599.5307
8	$121,842.90	$79,197.89	45	1759.95307	26399.29606
9	$121,842.90	$79,197.89	45	1759.95307	36959.01448
10	$121,842.90	$79,197.89	45	1759.95307	49278.68597

Using the above approach, EPA calculated cumulative offset for the least cost-effective BMPs:

Table 7. Annual and cumulative TP load reductions assuming that farmers implement least cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lbs.)
1	$0.00	$0.00	-	0	0
2	$121,842.90	$0.00	-	0	0
3	$121,842.90	$79,197.89	-	0	0
4	$121,842.90	$79,197.89	91	870.3064634	870.3064634
5	$121,842.90	$79,197.89	91	870.3064634	2610.91939
6	$121,842.90	$79,197.89	91	870.3064634	5221.83878
7	$121,842.90	$79,197.89	91	870.3064634	8703.064634
8	$121,842.90	$79,197.89	91	870.3064634	13054.59695
9	$121,842.90	$79,197.89	91	870.3064634	18276.43573
10	$121,842.90	$79,197.89	91	870.3064634	24368.58097

Using the above approach, EPA also calculated cumulative offset for an approach in which county funds are initially used to implement the most cost-effective BMPs (three years), then used to implement moderately cost-effective BMPs (three years), and, finally, used to implement the least cost-effective BMPs (two years; 2nd year not reflected in table):

Table 8. Annual and cumulative TP load reductions assuming that farmers sequence implementation of BMPs (most cost-effective to least cost-effective) throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share (S/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lbs.)
1	$0.00	$0.00	-	0	0
2	$121,842.90	$0.00	-	0	0
3	$121,842.90	$79,197.89	-	0	0
4	$121,842.90	$79,197.89	15	5279.859211	5279.859211
5	$121,842.90	$79,197.89	15	5279.859211	15839.57763
6	$121,842.90	$79,197.89	15	5279.859211	31679.15527
7	$121,842.90	$79,197.89	45	1759.95307	49278.68597
8	$121,842.90	$79,197.89	45	1759.95307	68638.16974
9	$121,842.90	$79,197.89	45	1759.95307	89757.60659
10	$121,842.90	$79,197.89	91	870.3064634	111747.3499

To aid in visualizing the information in Tables 5 – 8 (relative to the cumulative load reduction associated with achieving an end-of-pipe TP concentration of 0.015 mg/L, as detailed in Table 1, EPA created the following chart:

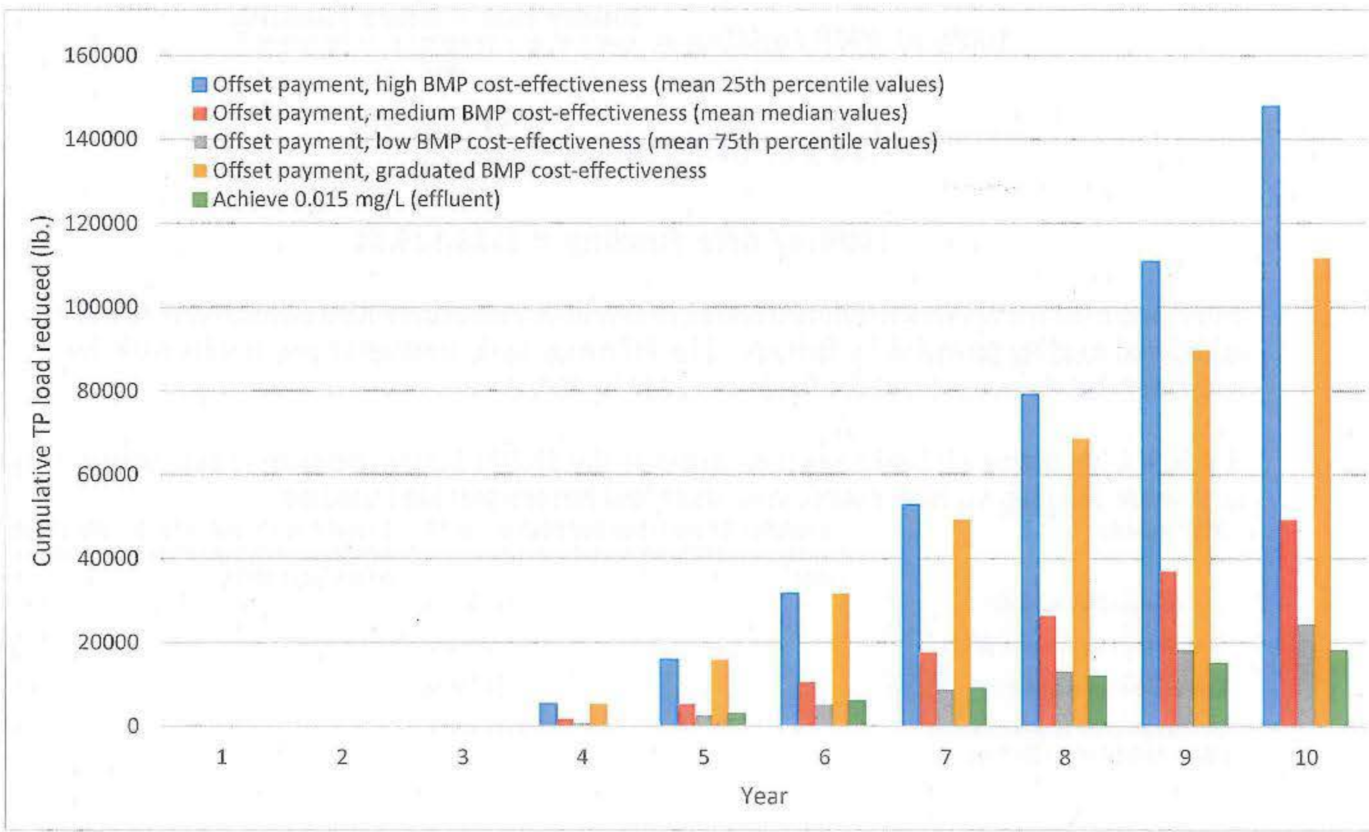

Figure 1. Cumulative TP load reductions associated with BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. Cumulative TP load reductions: highly cost-effective

BMPs: 147,836 lbs.; moderately cost-effective BMPs: 49,279 lbs.; least cost-effective BMPs: 24,369 lbs.; graduated BMP cost-effectiveness: 111,747 lbs.; achieving 0.015 mg/L limit in year 5: 18,002 lbs.

This figure compares projected cumulative TP load reduction associated with BMP implementation with the cumulative TP load reduction associated with achieving an end-of-pipe TP concentration of 0.015 mg/L beginning in the 5th year after permit issuance. Offset payment-based figures assume that the facility continues to discharge at an effluent TP concentration of 1 mg/L throughout the ten-year period depicted. These figures also assume that the only funding available to implement BMPs comes from discharger payments made to the county (i.e., farmers pay nothing toward BMP implementation). Figures associated with graduated cost-effectiveness are based on the assumption that counties fund most cost-effective BMPs in years 3 through 5, moderately cost-effective BMPs in years 6 through 8, and least cost-effective BMPs in years 9 and 10.

EPA also projected cumulative TP load reduction if farmers provided 30% of funding to implement BMPs, as required by Wisconsin's nonpoint source performance standards rule at NR 151.

To calculate total available BMP implementation funding, EPA used the following approach:

$$100\%\ of\ BMP\ funding = \frac{county\ cost - share\ funding}{0.7}$$

$$100\%\ of\ BMP\ funding = \frac{\$79{,}197.89}{0.7}$$

$$100\%\ of\ BMP\ funding = \$113{,}139.84$$

EPA then used the approach outlined above to calculate cumulative load reduction with the additional funding provided by farmers. The following table contrasts these results with the estimates that do not account for funds provided by farmers:

Table 9. Cumulative TP load reductions associated with BMP implementation using only county cost-share funding, vs. both county cost-share and farmer-provided funding.

BMP scenario	Cumulative TP load reduction (lbs.) in year 10 (county pays 100% BMP implementation costs)	Cumulative TP load reduction (lbs.) in year 10 (county pays 70% BMP implementation costs, farmer pays 30%)
Highly cost-effective BMPs	147,836.06	211,194.37
Moderately cost-effective BMPs	49,278.69	70,398.12
Least cost-effective BMPs	24,368.58	34,812.26
Graduated BMP implementation (most- to least cost-effective)	111,747.35	159,639.07

Figure 2, below, contrasts the TP load reductions in Table 9 (i.e., the load reductions that are possible if farmers contribute 30% of the cost of implementing BMPs to reduce TP load from agricultural operations) with the TP load reduction associated with achieving an end-of-pipe TP limit of 0.015 mg/L at the outset of year five of the variance period.

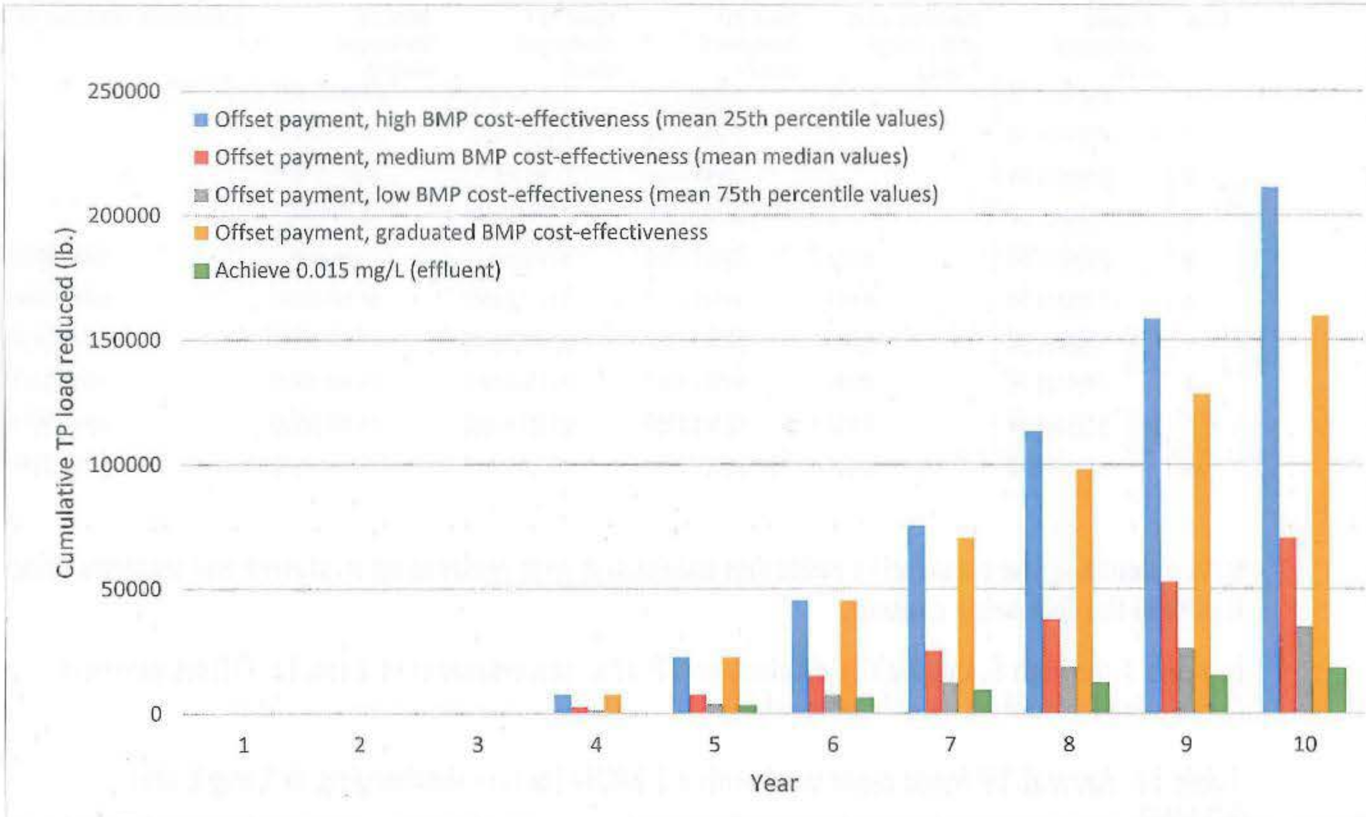

Figure 2. Cumulative TP load reductions associated with BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. These figures assume that farmers pay 30% of BMP implementation costs. Cumulative TP load reductions: highly cost-effective BMPs: 211,194 lbs.; moderately cost-effective BMPs: 70,398 lbs.; least cost-effective BMPs: 34,812 lbs.; graduated BMP cost-effectiveness: 159,639 lbs.; achieving 0.015 mg/L limit in year 5: 18,002 lbs.

2. Facility achieves interim effluent target of 0.8 mg/L

As noted, the above calculations assume that the hypothetical facility discharges at a TP concentration of 1 mg/L at the outset of the variance term and that its discharge concentration remains the same throughout the variance period. Because Wisconsin's MDV requires participating facilities to meet interim effluent targets (unless a facility certifies that it cannot meet a target without a major facility upgrade), EPA also modeled cumulative TP load reduction at a facility that discharged TP at 1 mg/L at the outset of the MDV period but, starting in year six, met the 0.8 mg/L interim effluent target. EPA contrasted cumulative load reduction under this scenario with the cumulative load reduction if the facility simply met an end-of-pipe effluent concentration of 0.015 mg/L beginning in year five after permit issuance.

The cumulative reduction associated with meeting a 0.015 mg/L end-of-pipe effluent concentration remains the same as those calculated in Tables 1 and 3:

Table 10. Cumulative TP load reduction associated with reducing TP discharge concentration from 1 mg/L to 0.015 mg/L in year 5 of the MDV period.

Year	Volume discharged (L/d)	Concentration of discharge (mg/L)	Mass TP discharged (mg/d)	Mass TP discharged (lb./d)	Mass TP discharged (lb./yr.)	Cumulative reduction (lb.)
1	3785411.78	1	3785411.78	8.345404443	3046.072622	0
2	3785411.78	1	3785411.78	8.345404443	3046.072622	0
3	3785411.78	1	3785411.78	8.345404443	3046.072622	0
4	3785411.78	1	56781.1767	0.125181067	45.69108933	0
5	3785411.78	0.015	56781.1767	0.125181067	45.69108933	3000.381532
6	3785411.78	0.015	56781.1767	0.125181067	45.69108933	6000.763065
7	3785411.78	0.015	56781.1767	0.125181067	45.69108933	9001.144597
8	3785411.78	0.015	56781.1767	0.125181067	45.69108933	12001.52613
9	3785411.78	0.015	56781.1767	0.125181067	45.69108933	15001.90766
10	3785411.78	0.015	56781.1767	0.125181067	45.69108933	18002.28919

EPA calculated the cumulative reduction associated with optimizing treatment and implementing BMPs in the following manner.

In years 1 through 5, the facility discharges TP at a concentration of 1 mg/L. Offset payments for this load would be calculated as above.

Table 11. Annual TP loads associated with a 1 MGD facility discharging at 1 mg/L and 0.2 mg/L.

Discharge volume (MGD)	Discharge volume (L/d)	Discharge concentration (mg TP/L)	Mass discharged (mg TP/d)	Mass (lb. TP/d)	Mass (lb. TP/yr.)
1	3785411.78	1	3785411.78	8.34540444	3046.072622
1	3785411.78	0.2	757082.356	1.66908089	609.2145244

Therefore, the annual payments (and cost-share funds) for the facility during years 1 through 5 would be calculated as follows:

3,046.072622 lbs. TP/yr. – 609.2145244 lbs. TP/yr. = 2,436.858097 lbs. TP/yr.

2,436.858097 lbs. TP/yr. x $50/lb. TP/yr. = ~$121,843/yr.

$121,843 x 65% = ~$79,198

In years 6 through 10, the facility discharges at a concentration of 0.8 mg/L. Offset payments for this load would be calculated as follows:

Table 12. Annual TP loads associated with a 1 MGD facility discharging at 0.8 mg/L and 0.2 mg/L.

Discharge volume (MGD)	Discharge volume (L/d)	Discharge concentration (mg TP/L)	Mass discharged (mg TP/d)	Mass (lb. TP/d)	Mass (lb. TP/yr.)
1	3785411.78	0.8	3028329.424	6.676323555	2436.858097
1	3785411.78	0.2	757082.356	1.66908089	609.2145244

Therefore, the annual payments (and cost-share funds) for the facility for years 6 through 10 can be calculated as follows:

2,436.858097 lbs. TP/yr. – 609.2145244 lbs. TP/yr. = 1,827.6435726 lbs. TP/yr.

1,827.6435726 lbs. TP/yr. x $50/lb. TP = ~$91, 382/yr.

$91,382 x 65% = ~$59,398

Following the approach to calculating cumulative load reductions from above (Tables 5 – 8), EPA calculated cumulative offset for the most cost-effective BMPs:

Table 13. Annual and cumulative TP load reductions assuming that farmers implement highly cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lb.)
1	$0.00	$0.00	15	0	0
2	$121,842.90	$0.00	15	0	0
3	$121,842.90	$79,197.89	15	0	0
4	$121,842.90	$79,197.89	15	5279.859211	5279.859211
5	$121,842.90	$79,197.89	15	5279.859211	15839.57763
6	$91,382.18	$79,197.89 [4]	15	5279.859211	31679.155176
7	$91,382.18	$59,398.42	15	3959.894408	514786.627251
8	$91,382.18	$59,398.42	15	3959.894408	75237.993757
9	$91,382.18	$59,398.42	15	3959.894408	102957.254603
10	$91,382.18	$59,398.42	15	3959.894408	134636.409878

Because the discharger realized additional TP load reduction due to treatment optimization, EPA added this load reduction to the cumulative totals above.

EPA calculated the annual load reduction realized through treatment optimization as follows:

3,046.072622 lbs. TP/yr. – 2,436.858097 lbs. TP/yr. = 609.21365 lbs. TP/yr.

[4] Because offset payments are made in arrears, funding for BMP cost-share in year 6 reflects offset payments made in year 5.

Table 14. Annual TP loads associated with a 1 MGD facility discharging at 1 mg/L and 0.8 mg/L.

Discharge volume (MGD)	Discharge volume (L/d)	Discharge concentration (mg TP/L)	Mass discharged (mg TP/d)	Mass (lb. TP/d)	Mass (lb. TP/yr.)
1	3785411.78	1	3785411.78	8.34540444	3046.072622
1	3785411.78	0.8	3028329.424	6.676323555	2436.858097

EPA calculated the cumulative load reduction realized through treatment optimization as follows:

Table 15. Cumulative TP load reduction associated with achieving interim effluent target of 0.8 mg/L, beginning in year 6 of the MDV period.

Year	Annual load reduction (lbs. TP)	Cumulative load reduction (lbs. TP)
6	609.21365	609.21365
7	609.21365	1218.429049
8	609.21365	1827.643573
9	609.21365	2436.858097
10	609.21365	3046.072622

EPA added the cumulative load reduction figures associated with treatment optimization to the cumulative load reduction figures associated with BMP implementation.

Table 16. Annual and cumulative TP load reductions assuming that the facility achieves its interim effluent target of 0.8 beginning in year 6 and assuming that farmers implement highly cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lb.)
1	$0.00	$0.00	15	0	0
2	$121,842.90	$0.00	15	0	0
3	$121,842.90	$79,197.89	15	0	0
4	$121,842.90	$79,197.89	15	5279.859211	5279.859211
5	$121,842.90	$79,197.89	15	5279.859211	15839.57763
6	$91,382.18	$79,197.89 [5]	15	5279.859211	32288.36979
7	$91,382.18	$59,398.42	15	3959.894408	52697.05636
8	$91,382.18	$59,398.42	15	3959.894408	77065.63733
9	$91,382.18	$59,398.42	15	3959.894408	105394.1127
10	$91,382.18	$59,398.42	15	3959.894408	137682.4825

[5] Because offset payments are made in arrears, funding for BMP cost-share in year 6 reflects offset payments made in year 5.

EPA followed the procedure described above for moderately- and least cost-effective BMPs, as well as the scenario in which farmers implement decreasingly cost-effective BMPs over the course of the MDV period, and produced the following figure, which is similar to Figure 1.

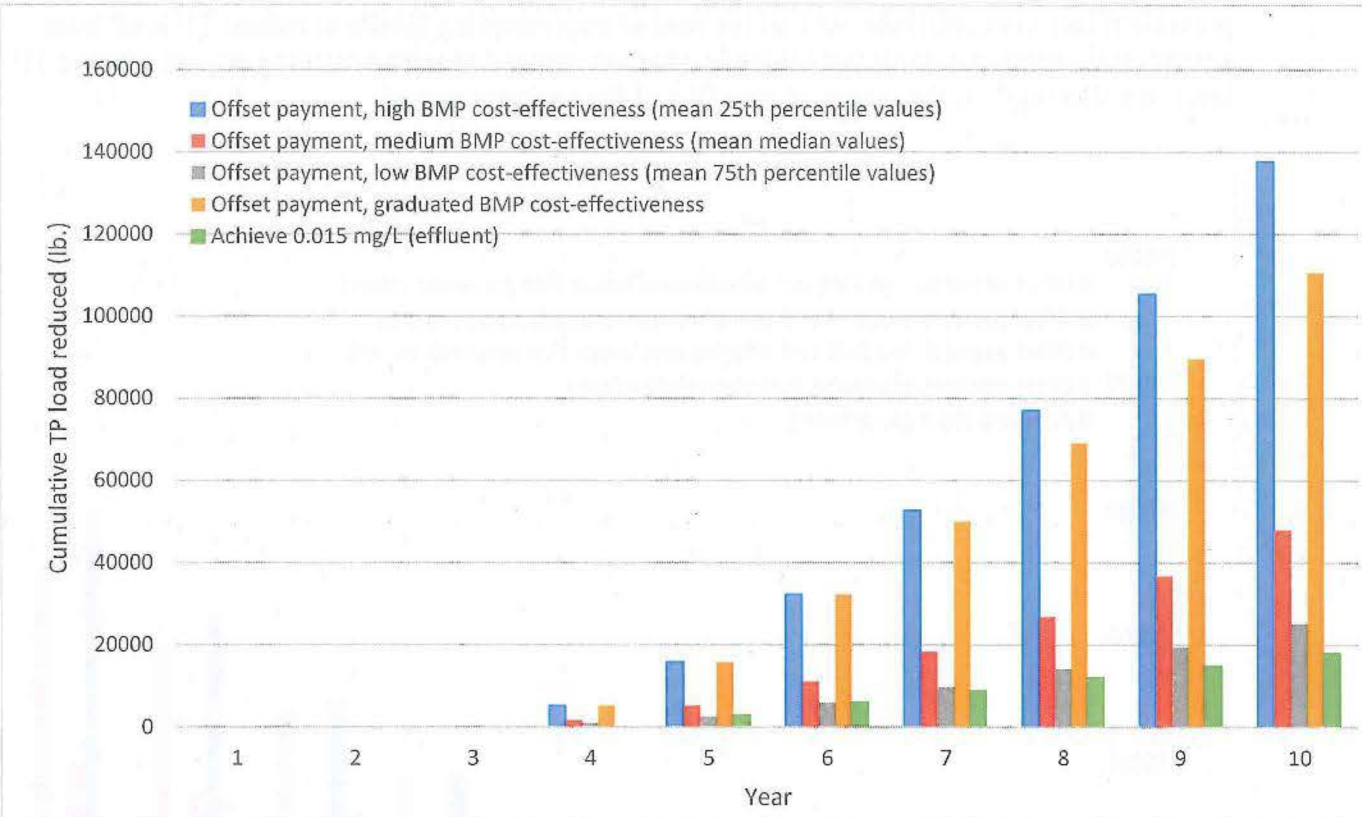

Figure 3. Cumulative TP load reductions associated with treatment optimization and BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. Cumulative TP load reductions: highly cost-effective BMPs: 137,682 lbs.; moderately cost-effective BMPs: 47,925 lbs.; least cost-effective BMPs: 25,239 lbs.; graduated BMP cost-effectiveness: 110,616 lbs.; achieving 0.015 mg/L limit in year 5: 18,002 lbs.

EPA followed the same approach used to create Table 9 (and added the cumulative load reduction due to treatment optimization from Table 15) to estimate cumulative load reductions if farmers were to contribute 30% of BMP implementation costs.

Table 17. Cumulative TP load reductions associated with treatment optimization and BMP implementation using only county cost-share funding, vs. both county cost-share and farmer-provided funding.

BMP scenario	Cumulative TP load reduction (lbs.) in year 10 (county pays 100% BMP implementation costs)	Cumulative TP load reduction (lbs.) in year 10 (county pays 70% BMP implementation costs, farmer pays 30%)
Highly cost-effective BMPs	137,682.48	195,383.81
Moderately cost-effective BMPs	47,924.88	67,158.65

Least cost-effective BMPs	25,238.89	34,750.09
Graduated BMP implementation (most- to least cost-effective)	110,615.95	156,717.33

Figure 4, below, contrasts the TP load reductions in Table 17 (i.e., the load reductions that are possible if farmers contribute 30% of the cost of implementing BMPs to reduce TP load from agricultural operations) with the TP load reduction associated with achieving an end-of-pipe TP limit of 0.015 mg/L at the outset of year five of the variance period.

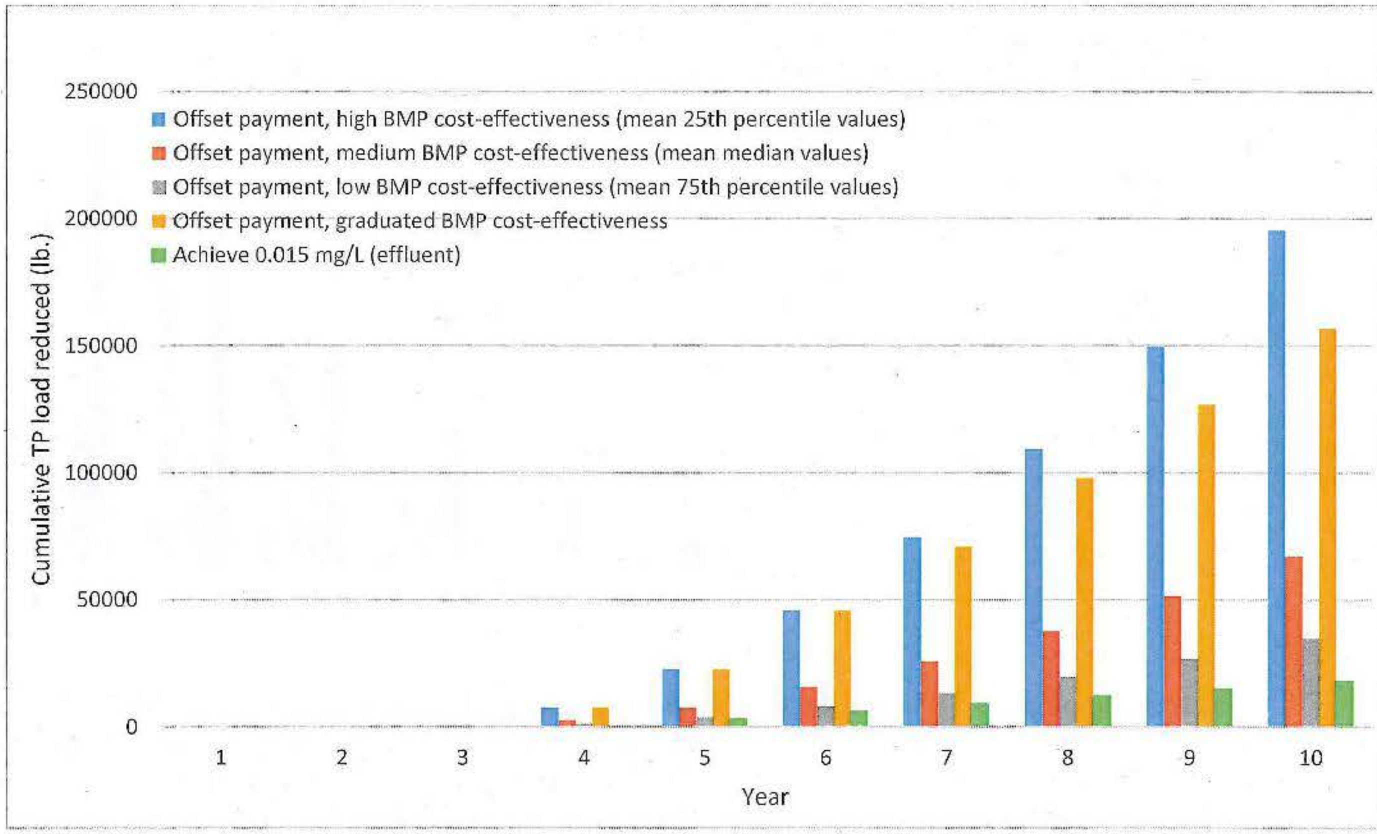

Figure 4. Cumulative TP load reductions associated with treatment optimization and BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. These figures assume that farmers pay 30% of BMP implementation costs. Cumulative TP load reductions: highly cost-effective BMPs: 195,384 lbs.; moderately cost-effective BMPs: 67,159 lbs.; least cost-effective BMPs: 34,750 lbs.; graduated BMP cost-effectiveness: 156,717 lbs.; achieving 0.015 mg/L limit in year 5: 18,002 lbs.

3. Facility discharges at 0.5 mg/L throughout MDV term

Because offset payments decrease as facilities come closer to achieving TP effluent concentrations of 0.2 mg/L, and so the counties' funding of nonpoint source reduction measures under cost share would be reduced, it is important to consider how decreasing effluent concentrations would impact the amount of nonpoint source load reductions that would likely occur from the MDV.

As in the previous scenarios, EPA first considered the cumulative TP load reduction of this facility meeting an end-of-pipe effluent TP concentration of 0.015 mg/L.

Table 18. Cumulative TP load reduction if 1 MGD facility decreases its end-of-pipe TP concentration from 0.5 mg/L to 0.015 mg/L in year 5 of the MDV period.

Year	Volume discharged (L/d)	Concentration of discharge (mg/L)	Mass TP discharged (mg/d)	Mass TP discharged (lb./d)	Mass TP discharged (lb./yr.)	Cumulative reduction (lb.)
1	3785411.78	0.5	1892705.89	4.172702222	1523.036311	0
2	3785411.78	0.5	1892705.89	4.172702222	1523.036311	0
3	3785411.78	0.5	1892705.89	4.172702222	1523.036311	0
4	3785411.78	0.5	1892705.89	4.172702222	1523.036311	0
5	3785411.78	0.015	56781.1767	0.125181067	45.69108933	1477.345222
6	3785411.78	0.015	56781.1767	0.125181067	45.69108933	2954.69044
7	3785411.78	0.015	56781.1767	0.125181067	45.69108933	4432.03566
8	3785411.78	0.015	56781.1767	0.125181067	45.69108933	5909.38088
9	3785411.78	0.015	56781.1767	0.125181067	45.69108933	7386.7261
10	3785411.78	0.015	56781.1767	0.125181067	45.69108933	8864.07132

Next, EPA projected cumulative TP load reductions if the facility maintained its discharge concentration of 0.5 mg/L and made offset payments to fund BMP implementation. EPA first calculated the annual offset payment that the facility would make:

Table 19. TP load associated with a discharge volume of 1 MGD and discharge concentrations of 0.5 mg/L and 0.2 mg/L.

Discharge volume (MGD)	Discharge volume (L/d)	Discharge concentration (mg TP/L)	Mass discharged (mg TP/d)	Mass (lb. TP/d)	Mass (lb. TP/yr.)
1	3785411.78	0.5	1892705.89	4.1727022216	1523.03631088
1	3785411.78	0.2	757082.356	1.66908089	609.2145244

Therefore, the annual payment for this particular facility would be calculated as follows:

1,523.03631088 lbs. TP/yr. – 609.2145244 lbs. TP/yr. = 913.82178648 lbs. TP/yr.

913.82178648 lbs. TP/yr. x $50/lb. TP/yr. = ~$45,691/yr.

EPA calculated the amount of offset payment available for cost-share, per Wisconsin's MDV:

$45,691 x 65% = ~$29,699

Using the BMP cost-effectiveness figures calculated above, this expenditure would be expected to result in the following potential load offsets:

Table 20. Predicted annual TP load reductions, based on Pennsylvania, Wisconsin, and Iowa BMP implementation data, using funding made available through offset payments to county.

Cost-effectiveness estimate	Available annual budget	Load reduction unit cost ($/lb. TP reduced)	New annual load reduction (lb. TP/yr.)
High	$29,699	15	1,979.93
Moderate	$29,699	45	659.98
Low	$29,699	91	326.36

Following the approach to calculating cumulative load reductions from above (Tables 5 – 8), EPA calculated cumulative offset for the most cost-effective BMPs:

Table 21. Annual and cumulative TP load reductions assuming that farmers implement highly cost-effective BMPs throughout the term of the MDV.

Year	Offset payment to county ($/yr.)	Funding for BMP cost-share ($/yr.)	BMP cost-effectiveness ($/lb. TP reduced)	Annual TP reduction (lbs.)	Cumulative TP reduction (lb.)
1	$0.00	$0.00	-	0	0
2	$45,691.09	$0.00	-	0	0
3	$45,691.09	$29,699.21	-	0	0
4	$45,691.09	$29,699.21	15	1979.947204	1979.947204
5	$45,691.09	$29,699.21	15	1979.947204	5939.841612
6	$45,691.09	$29,699.21	15	1979.947204	11879.68322
7	$45,691.09	$29,699.21	15	1979.947204	19799.47204
8	$45,691.09	$29,699.21	15	1979.947204	29699.20806
9	$45,691.09	$29,699.21	15	1979.947204	41578.89129
10	$45,691.09	$29,699.21	15	1979.947204	55438.52172

EPA followed the above procedure for moderately- and least- cost-effective BMPs, as well as the scenario in which farmers implement decreasingly cost-effective BMPs over the course of the MDV period, and produced the following figure, which is similar to Figure 1.

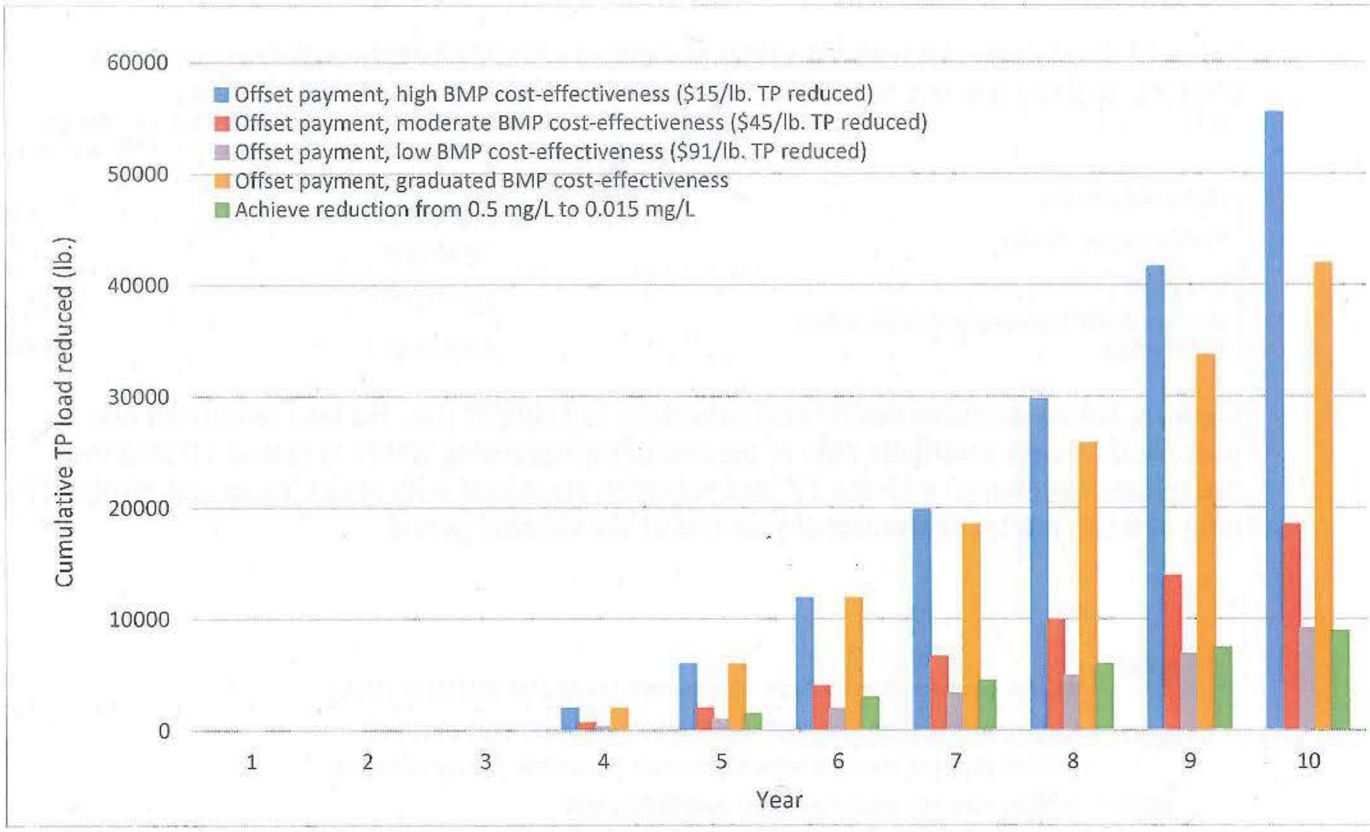

Figure 5. Cumulative TP load reductions associated with BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. Cumulative TP load reductions: highly cost-effective BMPs: 55,439 lbs.; moderately cost-effective BMPs: 18,480 lbs.; least cost-effective BMPs: 9,138 lbs.; graduated BMP cost-effectiveness: 41,905 lbs.; achieving 0.015 mg/L limit in year 5: 8,864 lbs.

EPA also projected cumulative TP load reduction if farmers provided 30% of funding to implement BMPs:

To calculate total available BMP implementation funding, EPA used the following approach:

$$100\%\ of\ BMP\ funding = \frac{county\ cost - share\ funding}{0.7}$$

$$100\%\ of\ BMP\ funding = \frac{\$26{,}699}{0.7}$$

$$100\%\ of\ BMP\ funding = \$42{,}427$$

EPA then calculated cumulative load reduction with the additional funding provided by farmers. The following table contrasts these results with the estimates that do not account for funds provided by farmers:

Table 22. Cumulative TP load reductions associated with BMP implementation using only county cost-share funding, vs. both county cost-share and farmer-provided funding.

BMP scenario	Cumulative TP load reduction (lbs.) in year 10 (county pays 100% BMP implementation costs)	Cumulative TP load reduction (lbs.) in year 10 (county pays 70% BMP implementation costs, farmer pays 30%)
Highly cost-effective	55438.52172	79197.888
Moderately cost-effective	18479.50724	26399.296
Least cost-effective	9138.217865	13054.59692
Graduated BMP implementation (most- to least cost-effective)	41905.25621	59864.6516

Figure 6, below, contrasts the TP load reductions in Table 22 (i.e., the load reductions that are possible if farmers contribute 30% of the cost of implementing BMPs to reduce TP load from agricultural operations) with the TP load reduction associated with achieving an end-of-pipe TP limit of 0.015 mg/L at the outset of year five of the variance period.

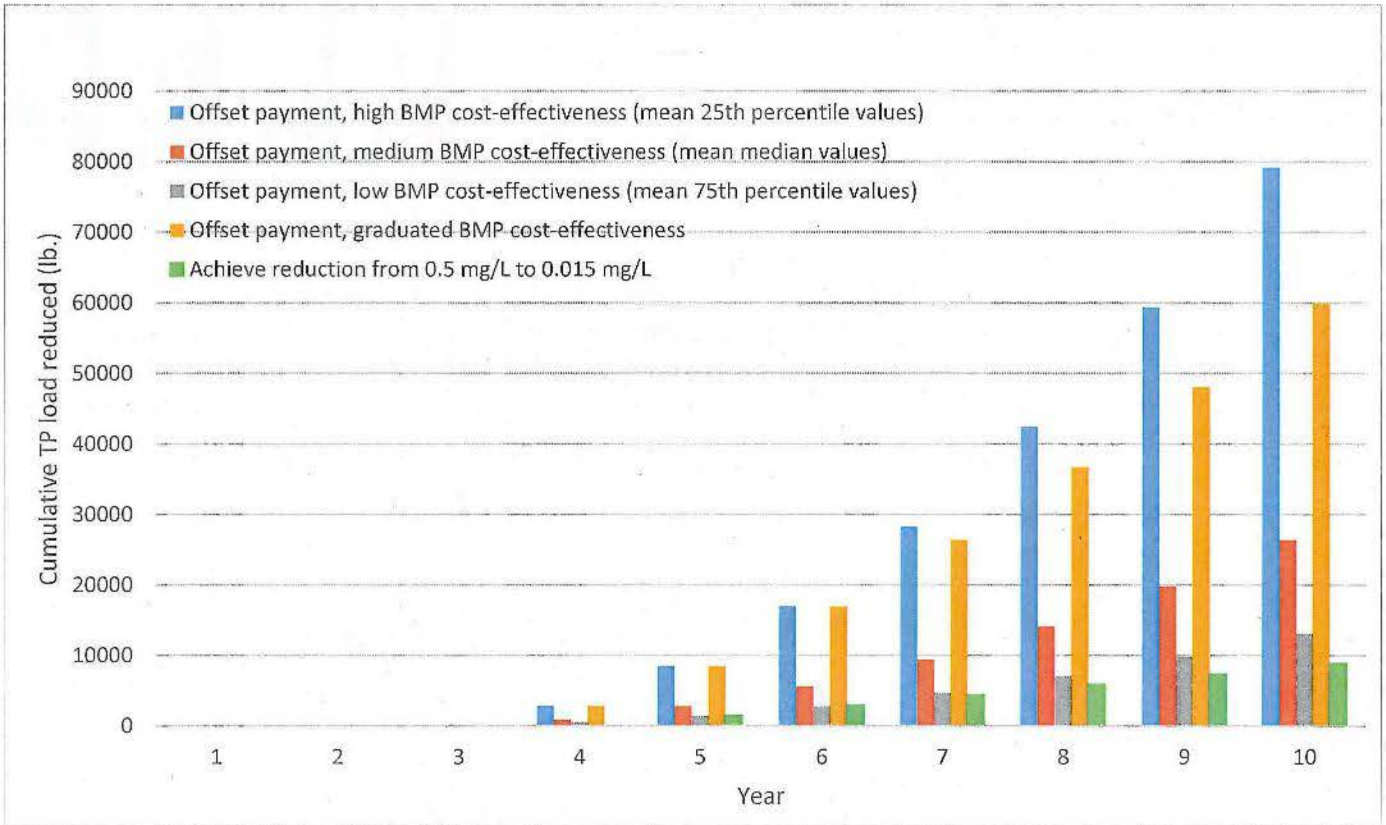

Figure 6. Cumulative TP load reductions associated with BMP implementation, vs. meeting an end-of-pipe effluent limit of 0.015 mg/L. These figures assume that farmers pay 30% of BMP implementation costs. Cumulative TP load reductions: highly cost-effective BMPs: 79,198 lbs.; moderately cost-effective BMPs: 26,399 lbs.; least cost-effective BMPs: 13,055 lbs.; graduated BMP cost-effectiveness: 59,865 lbs.; achieving 0.015 mg/L limit in year 5: 8,864 lbs.

As demonstrated above, when farmers contribute 30% of BMP implementation costs, cumulative phosphorus load reductions associated with BMP implementation always exceed those associated with meeting a limit of 0.015 mg/L at the outset of year 5 of the MDV period.

4. **Facility achieves effluent concentration, below which nonpoint source loading reductions are unlikely to exceed loading reduction associated with achieving end-of-pipe reductions**

As described above, when facilities that discharge effluent with a phosphorus concentration equal to or greater than 0.5 mg/L participate in the MDV and choose the offset payment option, the phosphorus loading reductions from nonpoint sources as a result of the MDV will likely exceed the phosphorus loading reductions that would have been achieved through end-of-pipe point source treatment technology. However, as phosphorus effluent concentrations approach 0.2 mg/L, the likelihood that this will occur decreases.

When calculating the effluent concentrations at which BMP-based nonpoint source load reductions would be unlikely to at least equal those associated with meeting phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges, EPA considered a range of potential effluent limitations that theoretically might be included if dischargers were required to install feasible treatment technology and meet end-of-pipe limits under the MDV rather than implement measures intended to reduce nonpoint sources of phosphorus, cost-effectiveness of phosphorus reduction BMPs, and whether farmers would provide funding to implement BMPs. These "break-even" values can be calculated using the following approach (EPA used a similar approach on pp. 36-9):

To begin, EPA assumed that a facility's discharge (i.e., phosphorus concentration and effluent volume) would be consistent throughout the 10-year MDV period and that the cost-effectiveness of the BMPs implemented using offset payments would not change over the same period. In this case, the MDV-associated load reduction one would expect from that facility can be characterized as follows:

year 1: n
year 2: 2n + n
year 3: 3n + 2n + n
...
year 10: 7n + 6n + 5n + 4n + 3n + 2n + n = 28n

Conversely, if a facility were to discharge at the same elevated concentration as the above facility in years one through four and meet its end-of-pipe TP limit at the outset of year five, over the course of the remaining six years of the 10-year MDV period this facility would realize six times the difference between its initial load and the load when the discharge concentration equals the end-of-pipe limit.

If x = the facility's average annual effluent concentration (in mg/L), v = the volume of effluent discharged annually by the facility (in L), the target value = 0.2 mg/L (i.e., this facility is not subject to a TMDL-based alternative target value), the WQBEL = 0.015 mg/L, the BMP cost-effectiveness figure is \$45/lb. P reduced, and offset funding is the only source of funds for BMP implementation (i.e., farmers contribute no funding toward BMP implementation), then:

$$n = \frac{\left((\$50\ per\ lb.P\ discharged\ in\ excess\ of\ target\ load * 65\%) * \frac{xv - 0.2v}{453{,}592\ mg\ per\ lb.}\right)}{\$45\ per\ lb.phosphorus\ reduced}$$

One can determine the effluent concentration at which the load offset under the MDV exceeds the reduction associated with meeting the WQBEL by solving the following inequality:

$$28 * \left(\frac{\left(50 * 0.65 * \left(\frac{xv - 0.2v}{453{,}592}\right)\right)}{45}\right) > 6 * \left(\frac{xv - 0.015v}{453{,}592}\right)$$

$$28 * \left(\frac{\left(32.5 * \left(\frac{xv - 0.2v}{453{,}592}\right)\right)}{45}\right) > \frac{6xv - 0.09v}{453{,}592}$$

$$\left(\frac{\left(\frac{910xv - 182v}{453{,}592}\right)}{45}\right) > \frac{6xv - 0.09v}{453{,}592}$$

$$\left(\frac{910xv - 182v}{453{,}592}\right) > \frac{270xv - 4.05v}{453{,}592}$$

$$910xv - 182v > 270xv - 4.05v$$

$$910xv > 270xv + 177.95v$$

$$910x > 270x + 177.95$$

$$640x > 177.95$$

$$x > 0.278$$

Therefore, when x, the facility's TP effluent concentration is *less than* 0.278 mg/L, the TP load reduction achieved under the MDV is not equal to or greater than that achieved if the facility were to meet its end-of-pipe limit at the outset of year five of the MDV period.

The following table summarizes the results of EPA's calculations of these "break-even" TP effluent concentrations. Using Excel, EPA also calculated break-even concentrations when farmers contribute 30% of BMP implementation costs; these figures are also represented in the table below:

Table 23. Effluent concentrations under which load reductions associated with discharger-funded (and discharger- and farmer-funded) BMP implementation will not meet or exceed load reduction associated with meeting end-of-pipe phosphorus limits.

Effluent limitation (mg/L), funding scenario	**BMP cost-effectiveness: $15/lb. P reduced**	**BMP cost-effectiveness: $45/lb. P reduced**	**BMP cost-effectiveness: $91/lb. P reduced**
0.015, farmers don't pay anything	< 0.220 mg/L	< 0.278 mg/L	< 0.478 mg/L
0.015, farmers pay 30% of BMP costs	< 0.214	< 0.249	< 0.334
0.020, farmers don't pay anything	< 0.220	< 0.276	< 0.470
0.020, farmers pay 30% of BMP costs	< 0.213	< 0.247	< 0.330
0.030, farmers don't pay anything	< 0.219	< 0.272	< 0.455
0.030, farmers pay 30% of BMP costs	< 0.213	< 0.245	< 0.323
0.040, farmers don't pay anything	< 0.218	< 0.268	< 0.440
0.040, farmers pay 30% of BMP costs	< 0.212	< 0.242	< 0.316
0.075, farmers don't pay anything	< 0.214	< 0.253	< 0.388
0.075, farmers pay 30% of BMP costs	< 0.209	< 0.233	< 0.291
0.10, farmers don't pay anything	< 0.211	< 0.242	< 0.350
0.10, farmers pay 30% of BMP costs	< 0.207	< 0.226	< 0.272

As described in Section V.B of this document, EPA obtained effluent data for 605 dischargers in Wisconsin to evaluate the extent to which there could be dischargers that could be eligible for the MDV that could fall into the category of being ones whose effluent concentrations are sufficiently low that their participation in the MDV might not result in BMP-based nonpoint source load exceeding those associated with meeting phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges. The results of that evaluation are set forth in Section V.B of this document.

III. Phosphorus loading reductions if facility chooses direct offset option

As described above, rather than paying money to counties, dischargers under the MDV can instead choose to be required to implement, or enter into an agreement with a third party to implement, a plan or project designed to result in annual reductions of phosphorus from other sources in the watershed in an amount equal to the difference between what the discharger discharges and the amount that the discharger would discharge if its effluent concentration equaled the target value of 0.2 mg/L. Except in instances where a facility's phosphorus effluent concentrations are close to the 0.2 mg/L target value used under the MDV for determining offset amounts, the amount of phosphorus loading reduction achieved under the MDV for dischargers that choose the offset option will exceed the amount that would be achieved through installation and operation of point source phosphorus control technology. This is due to the fact that the

MDV requires that offsets under this option be achieved in year one of the MDV while, as described above, compliance with an effluent limitation requiring installation and operation of point source phosphorus control technology would likely not be required to be achieved until at least the outset of year five.

EPA performed the following calculations (where x represents effluent phosphorus concentration and y represents effluent volume) to identify effluent concentrations above which a facility's offset to achieve the phosphorus load associated with an effluent concentration of 0.2 mg/L would exceed that associated with meeting end-of-pipe limits consistent with Wisconsin's approved total phosphorus criteria. Consistent with compliance schedules for phosphorus in permits issued by EPA, in its calculations, EPA assumed that the facility in question would achieve its end-of-pipe phosphorus limit at the outset of year five of the ten-year MDV period.

In addition, consistent with Wisconsin's MDV, EPA assumed that the facility would achieve its offset beginning in year one of the MDV.

a. End-of-pipe concentration = 0.015 mg/L

$10\,(xy - 0.2y) > 6\,(xy - 0.015y)$
$10xy - 2y > 6xy - 0.09y$
$4xy - 2y > -0.09y$
$4x - 2 > -0.09$
$4x > 1.9$
$x > 0.475$ mg/L

b. End-of-pipe concentration = 0.020 mg/L

$10\,(xy - 0.2y) > 6\,(xy - 0.02y)$
$10xy - 2y > 6xy - 0.12y$
$4xy - 2y > -0.12y$
$4x - 2 > -0.12$
$4x > 1.88$
$x > 0.47$ mg/L

c. End-of-pipe concentration = 0.030 mg/L

$10\,(xy - 0.2y) > 6\,(xy - 0.03y)$
$10xy - 2y > 6xy - 0.18y$
$4xy - 2y > -0.18$
$4x - 2 > -0.18$
$4x > 1.82$
$x > 0.455$ mg/L

d. End-of-pipe concentration = 0.040 mg/L

$10\ (xy - 0.2y) > 6\ (xy - 0.04y)$
$10xy - 2y > 6xy - 0.24y$
$4xy - 2y > -0.24y$
$4x - 2 > -0.24$
$4x > 1.76$
$x > 0.44$ mg/L

e. End-of-pipe concentration = 0.075 mg/L

$10\ (xy - 0.2y) > 6\ (xy - 0.075y)$
$10xy - 2y > 6xy - 0.45y$
$4xy - 2y > -0.45y$
$4x - 2 > -0.45$
$4x > 1.55$
$x > 0.3875$ mg/L

f. End-of-pipe concentration = 0.10 mg/L

$10\ (xy - 0.2y) > 6\ (xy - 0.1y)$
$10xy - 2y > 6xy - 0.6y$
$4xy - 2y > -0.6y$
$4x - 2 > -0.6$
$4x > 1.4$
$x > 0.35$ mg/L

Table 24 reflects conditions under which a facility directly offsetting its phosphorus load to achieve a net discharge equivalent to the phosphorus discharge associated with an effluent concentration of 0.2 mg/L would be unlikely to equal or exceed that associated with meeting the following end-of-pipe limits:

Table 24. Effluent concentrations under which load reductions associated with discharger-led offset projects will not meet or exceed load reduction associated with meeting end-of-pipe phosphorus limits.

End-of-pipe limit (mg/L)	Effluent concentrations at which load reduction does not equal or exceed that associated with end-of-pipe limit (mg/L)
0.015	< 0.475
0.020	< 0.47
0.030	< 0.455
0.040	< 0.44
0.075	< 0.3875
0.10	< 0.35

Thus, for dischargers that discharge phosphorus above the concentrations set forth in Table 23 that would otherwise have limits reflecting installation of phosphorus point source treatment control facilities set forth in Table 23, the MDV's nonpoint source phosphorus load reductions will likely exceed what would be achieved through installation of phosphorus point source treatment control facilities. The scenarios where a facility discharges at low phosphorus concentrations are evaluated in Section V.B of this document.

IV. Scenarios under which the target value is based on a wasteload allocation in a TMDL that was approved by EPA on or before April 25, 2014

In all scenarios where the phosphorus target value is based on a wasteload allocation in a TMDL rather than 0.2 mg/L, the MDV's nonpoint source phosphorus load reductions will likely exceed what would be achieved through installation of phosphorus point source treatment control facilities. Wasteload allocations in approved TMDLs serve as the basis for WQBELs. See 40 CFR 122.44(d)(vii)((B). Thus, for these facilities, the amount of phosphorus offset that must be achieved by facilities under the direct offset option, or the amount of money that must be paid to counties under the offset payment option, would be based on the difference between what the facility actually discharges and the WQBEL.

As described above in Section I of this document, the WQBEL represents a "worst case," conservative limit that would be more stringent than any interim limit that would be included in a variance if the variance required installation of all feasible point source treatment equipment. Consequently, using the WQBEL as the assumed interim limit ensures that this analysis is capturing the maximum phosphorus load reduction that could be required from installation and operation of treatment facilities to remove phosphorus from point source discharges. As also described above in Section I of this document, it is appropriate to assume that a facility that is required to install feasible treatment equipment to reduce phosphorus to the maximum extent feasible would likely need and be entitled to a minimum of a 4-year compliance schedule in accordance with 40 CFR 122.47, providing time necessary to design, obtain funding for, and construct and install new treatment facilities. Thus, for facilities subject to a TMDL wasteload allocation, the load reductions that would be achieved through point source control would be the difference between the amount actually discharged and the TMDL-wasteload-allocation-based-WQBEL from the outset of year 5 of their first permit issued under the MDV. Facilities that are subject to a TMDL wasteload allocation and are covered by the MDV that choose the direct offset option, on the other hand, are required by the MDV to achieve offsetting nonpoint source load reductions equal to the difference between the amount actually discharged and the TMDL-wasteload-allocation-based-WQBEL from the outset of year 1 of their first permit under the MDV: i.e., the same amount of annual loading reduction that would be achieved from nonpoint sources starting from year 1 of the MDV would not start to be achieved until year 5 if point source controls were installed instead. Thus, in every scenario where there is a facility that is subject to a TMDL wasteload allocation that is covered by the MDV that chooses the direct offset option, the MDV's nonpoint source phosphorus load reductions required by the MDV will always exceed what would be achieved through installation of phosphorus point source treatment control facilities.

To evaluate scenarios where facilities subject to TMDL wasteload allocations choose the offset payment option, EPA considered at what effluent concentration facilities operating under these conditions would be likely to realize greater phosphorus load reduction by participating in the MDV than they would by meeting their WQBELs.

To begin, EPA assumed that such a facility's discharge (i.e., phosphorus concentration and effluent volume) would be consistent throughout the 10-year MDV period and that the cost-effectiveness of the BMPs implemented using offset payments would not change over the same period. In this case, the load reduction one would expect from that facility can be characterized as follows:

year 1: n
year 2: 2n + n
year 3: 3n + 2n + n
...
year 10: 7n + 6n + 5n + 4n + 3n + 2n + n = 28n

Conversely, if a facility were to discharge at the same elevated concentration as the above facility in years one through four and meet its WQBEL at the outset of year five, over the course of the remaining six years of the MDV period this facility would realize six times the difference between its initial load and the load when the discharge concentration equals the WQBEL.

If x = the facility's average annual effluent concentration (in mg/L), v = the volume of effluent discharged annually by the facility (in L), the target value and WQBEL based upon the TMDL wasteload allocation = 0.1 mg/L, the BMP cost-effectiveness figure is \$45/lb. P reduced, and offset funding is the only source of funds for BMP implementation (i.e., farmers contribute no funding toward BMP implementation), then:

$$n = \frac{\left((\$50\ per\ lb. P\ discharged\ in\ excess\ of\ target\ load * 65\%) * \frac{xv - 0.1v}{453{,}592\ mg\ per\ lb.}\right)}{\$45\ per\ lb.\ phosphorus\ reduced}$$

One can determine the effluent concentration at which the load offset under the MDV exceeds the reduction associated with meeting the WQBEL by solving the following inequality:

$$28 * \left(\frac{\left(50 * 0.65 * \left(\frac{xv - 0.1v}{453{,}592}\right)\right)}{45}\right) > 6 * \left(\frac{xv - 0.1v}{453{,}592}\right)$$

$$28 * \left(\frac{\left(32.5 * \left(\frac{xv - 0.1v}{453{,}592}\right)\right)}{45}\right) > \frac{6xv - 0.6v}{453{,}592}$$

$$\left(\frac{\left(\frac{910xv - 91v}{453{,}592}\right)}{45}\right) > \frac{6xv - 0.6v}{453{,}592}$$

$$\left(\frac{910xv - 91v}{453{,}592}\right) > \frac{270xv - 27v}{453{,}592}$$

$$910xv - 91v > 270xv - 27v$$

$$910xv > 270xv + 64v$$

$$910x > 270x + 64$$

$$640x > 64$$

$$x > 0.1$$

Similarly, if x = the facility's average annual effluent concentration (in mg/L), v = the volume of effluent discharged annually by the facility (in L), the target value and WQBEL based upon the TMDL wasteload allocation = 0.02 mg/L, the BMP cost-effectiveness figure is $45/lb. P reduced, and offset funding is the only source of funds for BMP implementation (i.e., farmers contribute no funding toward BMP implementation), then:

$$n = \frac{\left((\$50\ per\ lb.P\ discharged\ in\ excess\ of\ target\ load * 65\%) * \frac{xv - 0.02v}{453{,}592\ mg\ per\ lb.}\right)}{\$45\ per\ lb.phosphorus\ reduced}$$

One can determine the effluent concentration at which the load offset under the MDV exceeds the reduction associated with meeting the WQBEL by solving the following inequality:

$$28 * \left(\frac{\left(50 * 0.65 * \left(\frac{xv - 0.02v}{453{,}592}\right)\right)}{45}\right) > 6 * \left(\frac{xv - 0.02v}{453{,}592}\right)$$

$$28 * \left(\frac{\left(32.5 * \left(\frac{xv - 0.02v}{453{,}592}\right)\right)}{45}\right) > \frac{6xv - 0.12v}{453{,}592}$$

$$\left(\frac{\left(\frac{910xv - 18.2v}{453{,}592}\right)}{45}\right) > \frac{6xv - 0.12v}{453{,}592}$$

$$\left(\frac{910xv - 18.2v}{453{,}592}\right) > \frac{270xv - 5.4v}{453{,}592}$$

$$910xv - 18.2v > 270xv - 5.4v$$

$$910xv > 270xv + 12.8v$$

$$910x > 270x + 12.8$$

$$640x > 12.8$$

$$x > 0.02$$

Furthermore, by replacing the $45 per lb. P BMP cost-effectiveness measure with a variable, *y*, one can identify the cost-effectiveness figure at which a facility operating under a TMDL-based WQBEL would no longer produce greater load reductions by participating in the MDV than it would by simply attaining the WQBEL:

$$28 * \left(\frac{\left(50 * 0.65 * \left(\frac{xv - 0.02v}{453{,}592}\right)\right)}{y}\right) = 6 * \left(\frac{xv - 0.02v}{453{,}592}\right)$$

$$28 * \left(\frac{\left(32.5 * \left(\frac{xv - 0.02v}{453{,}592}\right)\right)}{y}\right) = \frac{6xv - 0.12v}{453{,}592}$$

$$\left(\frac{\left(\frac{910xv - 18.2v}{453{,}592}\right)}{y}\right) = \frac{6xv - 0.12v}{453{,}592}$$

$$910xv - 18.2v = y * (6xv - 0.12v)$$

$$910x - 18.2 = y * (6x - 0.12)$$

$$\left(\frac{(910x - 18.2)}{(6x - 0.12)}\right) = y$$

$$y = 151.67$$

Thus, when the cost of reducing a pound of phosphorus via BMP implementation is less than $151.67, whenever effluent concentration discharged by a facility participating in the MDV that is subject to TMDL-based permit limits exceeds the WQBEL/target concentration, the phosphorus load reduced through implementation of BMPs funded through offset payments is expected to exceed the phosphorus load reduction achieved by meeting the WQBEL at the outset of year 5 of the MDV period. Since even EPA's low cost-effectiveness estimate of BMP cost-effectiveness is $91 per lb. P reduced, EPA expects that MDV-associated TP load reductions at facilities operating under TMDLs will always exceed those at facilities that do not participate in the MDV, but instead meet their WQBEL at the outset of year five of the 10-year MDV period.

V. Scenarios under which there may be a lower likelihood that the MDV's nonpoint source load reductions from a single permittee would be greater than would be achieved if the permittee were able to achieve its end-of-pipe limit through installation of point source treatment technology

As explained above in Sections II-IV of this document, EPA expects that, in most instances, the amount of phosphorus loadings reduced from the nonpoint source measures required by the MDV will be greater (oftentimes significantly greater) than the reductions that might have occurred if the MDV instead required installation and operation of additional treatment facilities to remove phosphorus from point source discharges to the degree necessary to meet permit limits. However, there are two scenarios described below in which facilities participating in the MDV might not realize equal or greater phosphorus load reductions through participation in the MDV, when compared to load reductions that they might achieve if they were to comply with phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges.

One scenario is where a facility's annual offset payment is capped at $640,000, which could arise both where the target value under the MDV is 0.2. mg/L or where it is based on a wasteload allocation in a TMDL that was approved by EPA on or before April 25, 2014. The second scenario is where a facility discharges a relatively low concentration of phosphorus, such that its phosphorus load is close to the load that the facility would discharge at a phosphorus concentration of 0.2 mg/L, and the target value under the MDV for determining the amount of money that must be paid to a county is 0.2 mg/L, rather than based on a wasteload allocation in a TMDL that was approved by EPA on or before April 25, 2014. Depending upon the end-of-pipe permit limit, in this scenario, the facility's annual county payment amount or required offset may not produce nonpoint source load reductions equivalent to or exceeding those reductions associated with meeting phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges.

A. Scenario where a facility reaches the MDV's $640,000 payment cap

1. Identifying facilities that could exceed the $640,000 annual offset payment cap

If, per the MDV, a facility's annual payment is capped at $640,000, it is possible that the offset funding available to pay for BMP implementation may be too little to pay for nonpoint source load reductions that equal or exceed the reductions associated with meeting phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges. EPA considered the circumstances under which a facility might exceed the $640,000 annual offset payment cap. Because the MDV requires dischargers to pay $50 per pound of phosphorus discharged in excess of the amount that would be discharged if the facility met a 0.2 mg/L TP effluent concentration, to exceed the cap in any given year a permittee would have to discharge greater than 12,800 lbs. more phosphorus than it would if its effluent phosphorus concentration were 0.2 mg/L. EPA expressed this condition mathematically where x represents the facility's effluent phosphorus concentration (mg/L) and v represents the facility's daily flow (L):

$$\left(365\ days\ per\ year * \left(\frac{xv}{453{,}592\ mg\ per\ lb.}\right)\right) - \left(365 * \left(\frac{0.2v}{453{,}592}\right)\right) > 12{,}800\ lbs.TP$$

This equation represents the following:

annual TP load (lbs.) – annual TP load at a concentration of 0.2 mg/L (lbs.) exceeds 12,800 lbs.

By solving for x, one can identify the concentration (mg/L) that will result in an annual offset payment of $640,000 at a given daily flow volume, v (L/d). Any greater concentration at the same daily flow, therefore, would result in an offset payment that exceeds the $640,000 annual cap.

To solve for x:

$$\left(365 * \left(\frac{xv}{453{,}592}\right)\right) - \left(365 * \left(\frac{0.2v}{453{,}592}\right)\right) > 12{,}800$$

$$\left(365 * (xv)\right) - \left(365 * (0.2v)\right) > 453{,}592 * 12{,}800$$

$$(365xv) - (73v) > 5{,}805{,}977{,}600$$

$$365x - 73 > \frac{5{,}805{,}977{,}600}{v}$$

$$365x > \left(\frac{5{,}805{,}977{,}600}{v}\right) + 73$$

$$x > \frac{\left(\frac{5{,}805{,}977{,}600}{v}\right) + 73}{365}$$

$$x > \left(\frac{5{,}805{,}977{,}600}{365v}\right) + 0.2$$

Using Excel, EPA produced a table of flow and concentration values that result in an annual payment of $640,000 (Appendix 2). For flow volumes between 0.1 and 50 million gallons per day (378,541.178 and 189,270,589 liters per day), the table produces the following figure:

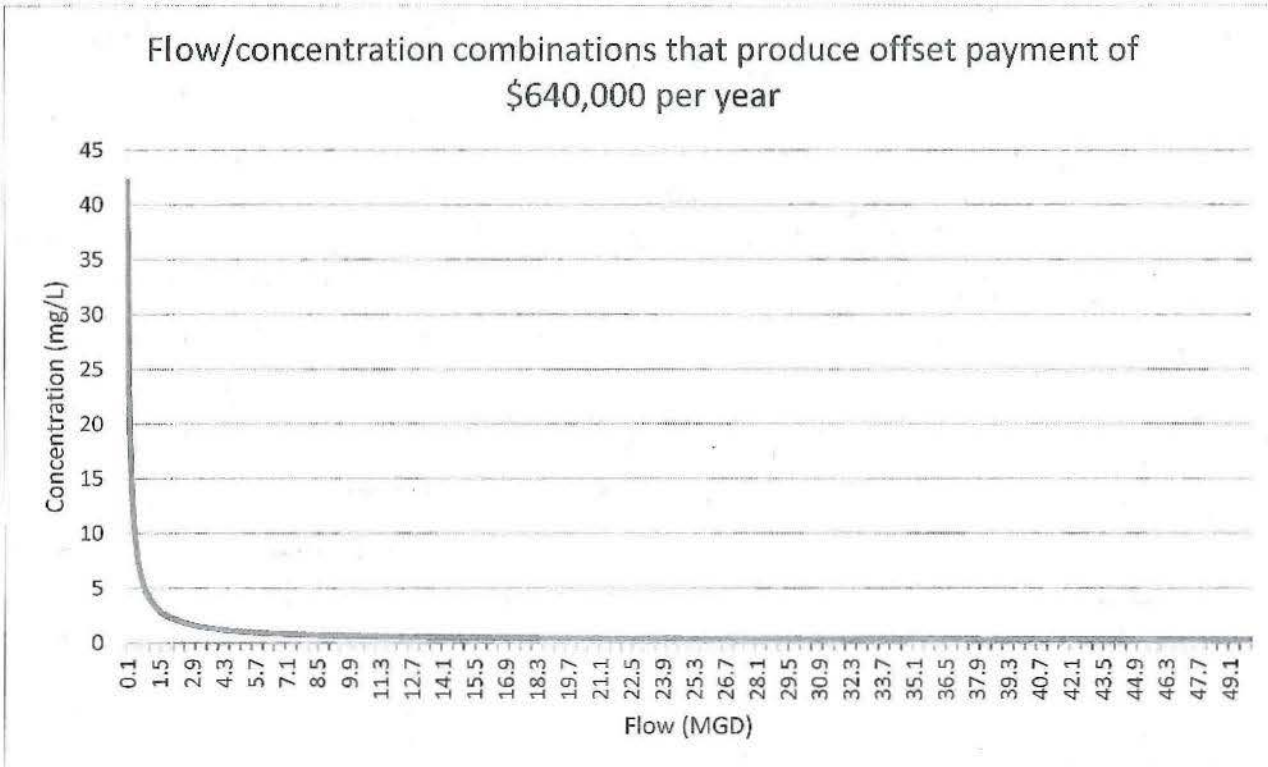

Figure 7. Flow volume and total phosphorus combinations that produce offset payments of \$640,000 annually (assuming offset payments of \$50/lb. in excess of phosphorus load associated with a discharge concentration of 0.2 mg/L).

Because Wisconsin's MDV requires that dischargers achieve an effluent phosphorus concentration of $\leq$ 1 mg/L to be eligible for coverage under the variance, EPA was able to identify the minimum discharge volume at which dischargers could both qualify for the variance (i.e., total phosphorus discharge concentration $\leq$ 1 mg/L) and exceed the \$640,000 annual offset payment cap. EPA found that facilities discharging greater than ~5.2 MGD would exceed the \$640,000 cap if they were to discharge at a total phosphorus concentration of 1 mg/L.

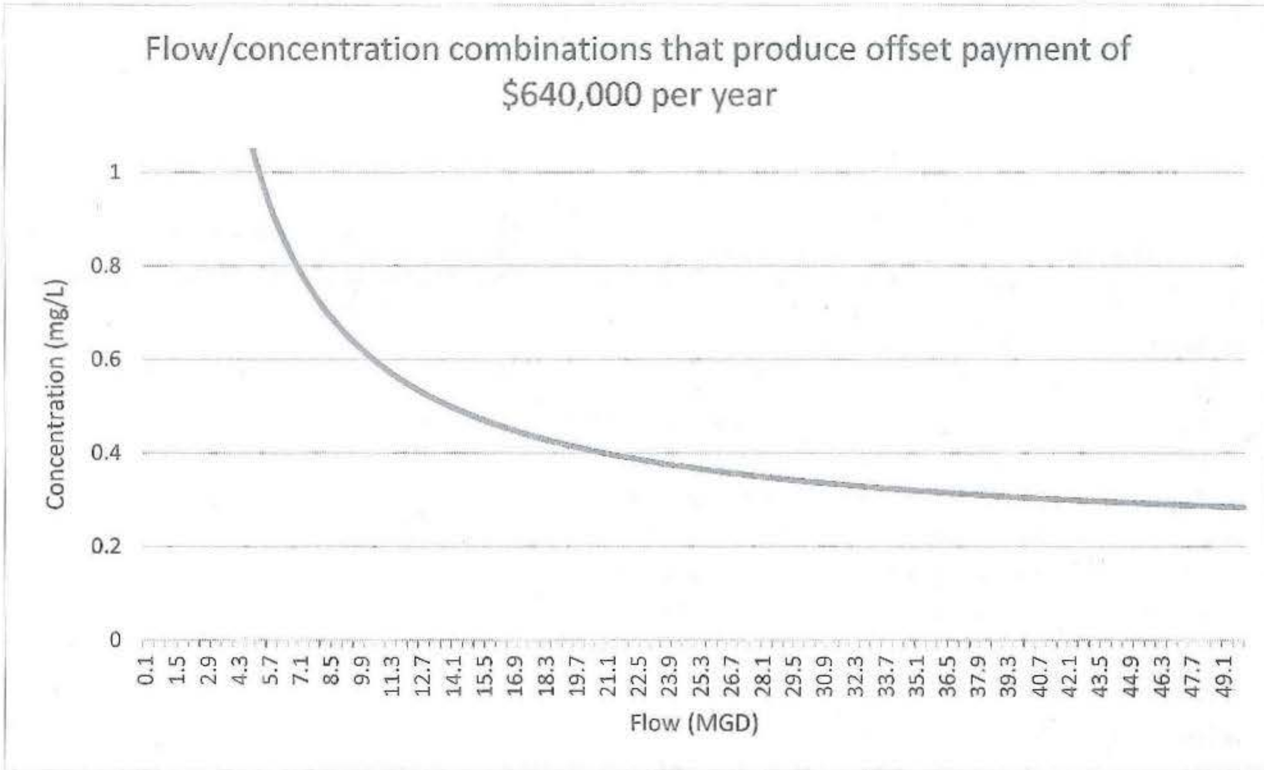

Figure 8. Detail of portion of Figure 4 that is relevant to dischargers operating under Wisconsin's MDV.

Because WDNR's approach to calculating annual offset payments for dischargers in watersheds with TMDLs approved on or before April 25, 2014 differs from that discussed above, later in this analysis EPA used WDNR's TMDL documents to identify Wisconsin dischargers in watersheds for which TMDLs were approved prior to April 25, 2014 and considered whether these facilities might exceed the $640,000 annual offset payment cap.

2. EPA review of discharger data from Wisconsin

a. Municipal facilities

EPA performed an Integrated Compliance Information System (ICIS) search that identified municipal Wisconsin dischargers with design flow discharges greater than or equal to 5.2 MGD and retrieved average daily flow and monthly average total phosphorus effluent data for these facilities for the period from August 1, 2015 through July 31, 2016. EPA selected this time period because Wisconsin dischargers are actively engaged in efforts to optimize wastewater treatment for the removal of phosphorus from wastewater effluent, older discharge data may not be representative of current effluent quality, and these were the most current data available at the time of EPA's query of the ICIS system. EPA reviewed these data to identify any dischargers that could exceed the $640,000 offset payment cap.

In its query of the ICIS system, EPA identified 22 municipal wastewater treatment facilities with design flow discharge values greater than or equal to 5.2 MGD. [6]

Table 25. Municipal Wisconsin facilities with design discharge volumes greater than or equal to 5.2 MGD. Facilities that are subject to total phosphorus TMDLs will receive additional review in the TMDL analysis portion of this document.

Permit number	Facility name	Subject to phosphorus TMDL approved prior to April 25, 2014?
WI0023370	BELOIT WASTEWATER TREATMENT FA	Yes – Rock River
WI0023469	BROOKFIELD, CITY OF	
WI0023604	CHIPPEWA FALLS WWTP	
WI0023850	EAU CLAIRE WASTEWATER TREATMEN	Yes – Lake St. Croix
WI0023990	FOND DU LAC WATER POLLUTION CO	
WI0024597	MADISON METROPOLITAN SEWERAGE	
WI0024601	MANITOWOC WASTEWATER TREATMENT	
WI0025038	OSHKOSH WASTEWATER TREATMENT F	
WI0025194	RACINE WASTEWATER UTILITY	
WI0025411	SHEBOYGAN WASTEWATER TREATMENT	
WI0025739	WAUSAU WATER WORKS WW TREATMEN	
WI0025763	WEST BEND CITY	
WI0026085	NEENAH MENASHA SEWER COMMISSIO	Yes – Lower Fox River and Lower Green Bay
WI0028541	WATERTOWN WASTEWATER TREATMENT	Yes – Rock River
WI0028703	KENOSHA WASTEWATER TREATMENT F	
WI0028819	SOUTH MILWAUKEE WASTEWATER TRE	
WI0029581	La Crosse, City of	
WI0029971	WAUKESHA CITY	
WI0030350	JANESVILLE WASTEWATER UTILITY	Yes – Rock River
WI0031232	HEART OF VALLEY MSD WW TRTMNT	Yes – Lower Fox River and Lower Green Bay
WI0036820	MILWAUKEE METRO SEW DIST COMBI	
WI0065251	Green Bay Metropolitan Sewerage District Combined	Yes – Lower Fox River and Lower Green Bay

[6] When conducting its analysis of facilities discharging within watersheds for which TMDLs were approved prior to April 25, 2014, EPA identified three additional municipal wastewater treatment facilities with design flow values ≥ 5.2 MGD (i.e., Appleton Wastewater Treatment Facility (WI0023221), Grand Chute-Menasha West Sewerage Commission (WI0024686), and Walworth County Metro (WI0031461)). Although it is not clear why these facilities did not appear in the results of EPA's initial ICIS query, on November 8, 2016, EPA verified with WDNR that the 22 municipal wastewater treatment facilities identified through EPA's ICIS query, plus the additional three identified through EPA's subsequent analyses, represent the entire universe of municipal wastewater facilities with design flows ≥ 5.2 MGD in Wisconsin. EPA reviewed whether the remaining three facilities would exceed the $640,000 annual offset payment cap in the TMDL portion of this analysis.

In considering whether to perform additional analyses on specific facilities' effluent data, EPA considered information provided by WDNR on whether certain facilities would likely be eligible for the MDV. Specifically, in an October 18, 2016 e-mail, WDNR indicated to EPA that the following facilities would likely not be eligible to participate in the MDV:

Table 26. Municipal Wisconsin facilities with design flows greater than or equal to 5.2 MGD that likely will not be eligible to participate in MDV.

Permit number	Facility name	Rationale
WI0036820	MILWAUKEE METRO SEW DIST COMBINED	Does not need a major facility upgrade to comply with TP limits
WI0024597	MADISON METROPOLITAN SEWERAGE DISTRICT WWTF	Based on information available at the time of the Final Determination, it is unlikely that this facility will meet the determination economic impact eligibility criteria
WI0025194	RACINE WASTEWATER UTILITY	Does not need a major facility upgrade to comply with TP limits
WI0028703	KENOSHA WASTEWATER TREATMENT FACILITY	Does not need a major facility upgrade to comply with TP limits
WI0025411	SHEBOYGAN WASTEWATER TREATMENT PLANT	Does not need a major facility upgrade to comply with TP limits

EPA did not consider the five facilities in Table 26 further in this portion of its analysis. EPA reviewed average monthly effluent flow data reported for the period from August 2015 through July 2016 to determine whether the remaining facilities' actual flow values were high enough to possibly result in offset payments exceeding the $640,000 cap and found the following:

Table 27. Mean of monthly mean effluent flow values reported between August 2015 and July 2016. Effluent flow values for facilities whose flows are marked with asterisks were calculated based upon the sum of mean monthly flow values for multiple outfalls.

Permit number	Facility name	Mean of reported monthly mean effluent flow values (8/2015 – 7/2016) (MGD)
WI0023370	BELOIT WASTEWATER TREATMENT FA	3.79
WI0023469	BROOKFIELD, CITY OF	9.20
WI0023604	CHIPPEWA FALLS WWTP	2.64
WI0023850	EAU CLAIRE WASTEWATER TREATMEN	No values reported
WI0023990	FOND DU LAC WATER POLLUTION CO	No values reported
WI0024601	MANITOWOC WASTEWATER TREATMENT	No values reported
WI0025038	OSHKOSH WASTEWATER TREATMENT F	13.13*
WI0025739	WAUSAU WATER WORKS WW TREATMEN	5.32
WI0025763	WEST BEND CITY	No values reported
WI0026085	NEENAH MENASHA SEWER COMMISSIO	No values reported

Permit number	Facility name	Mean of reported monthly mean effluent flow values (8/2015 – 7/2016) (MGD)
WI0028541	WATERTOWN WASTEWATER TREATMENT	3.20
WI0028819	SOUTH MILWAUKEE WASTEWATER TRE	3.12
WI0029581	La Crosse, City of	9.36
WI0029971	WAUKESHA CITY	9.08
WI0030350	JANESVILLE WASTEWATER UTILITY	13.17
WI0031232	HEART OF VALLEY MSD WW TRTMNT	3.41
WI0065251	Green Bay Metropolitan Sewerage District Combined	39.63*

Based on this analysis, EPA concluded that, if they participated in the MDV, the following wastewater treatment facilities would be unlikely to exceed the $640,000 annual offset payment cap: **Beloit**, Chippewa Falls, **Watertown**, South Milwaukee, and **Heart of the Valley**. These facilities were therefore not considered further in this portion of EPA's analysis (though facilities in bold are subject to TMDL-based target values and were further considered in the TMDL portion of this analysis, below).

EPA therefore narrowed the pool of municipal Wisconsin permittees considered in this portion of its analysis to the following facilities:

Table 28. Municipal Wisconsin permittees that, based on flow volume alone, might exceed the annual $640,000 offset payment cap, if they were to participate in Wisconsin's MDV.

Permit number	Facility name	Mean of reported monthly mean effluent flow values (8/2015 – 7/2016) (MGD)
WI0023469	BROOKFIELD, CITY OF	9.20
WI0023850	EAU CLAIRE WASTEWATER TREATMEN	No values reported
WI0023990	FOND DU LAC WATER POLLUTION CO	No values reported
WI0024601	MANITOWOC WASTEWATER TREATMENT	No values reported
WI0025038	OSHKOSH WASTEWATER TREATMENT F	13.13
WI0025739	WAUSAU WATER WORKS WW TREATMEN	5.32
WI0025763	WEST BEND CITY	No values reported
WI0026085	NEENAH MENASHA SEWER COMMISSIO	No values reported
WI0029581	La Crosse, City of	9.36
WI0029971	WAUKESHA CITY	9.08
WI0030350	JANESVILLE WASTEWATER UTILITY	13.17
WI0065251	Green Bay Metropolitan Sewerage District Combined	39.63

As indicated above, five of the remaining 12 facilities of interest did not report monthly mean effluent flow values in ICIS for the time period of interest. To estimate daily effluent flow volume for August 2015 through July 2016, EPA reviewed ICIS data on monthly average influent wastewater volume for these facilities. EPA assumed that influent flow volume would approximate effluent flow volume and, where the values were different, it would be because the facility did not discharge as much wastewater as it took in. Estimating effluent based on influent is therefore conservative. The results are reported in Table 29, below:

Table 29. Mean of monthly mean influent flow values reported between August 2015 and July 2016 at five municipal Wisconsin facilities.

Permit number	Facility name	Mean of reported monthly mean effluent flow values 8/2015 – 7/2016 (MGD)	Mean of reported monthly mean influent flow values 8/2015 – 7/2016 (MGD)
WI0023850	EAU CLAIRE WASTEWATER TREATMEN	No values reported	4.86
WI0023990	FOND DU LAC WATER POLLUTION CO	No values reported	8.00
WI0024601	MANITOWOC WASTEWATER TREATMENT	No values reported	7.54
WI0025763	WEST BEND CITY	No values reported	4.23
WI0026085	NEENAH MENASHA SEWER COMMISSIO	No values reported	11.83

EPA did not further consider the Eau Claire and West Bend City wastewater treatment facilities in this portion of its analysis because their mean influent flow volumes indicate that, to produce annual offset payments of greater than $640,000, their effluent concentrations would need to exceed 1 mg/L and dischargers whose effluent exceeds 1 mg/L are not eligible to participate in the MDV. (Though, because it is subject to the Lake St. Croix phosphorus TMDL, Eau Claire will be further considered in the TMDL-based portion of this analysis.)

EPA reviewed monthly mean total phosphorus values reported in ICIS for each of the below facilities and then calculated overall mean values for use in determining whether individual facilities might exceed the $640,000 annual payment cap. Facilities for which the most recent available effluent data suggest that they may exceed the cap are indicated in italics in Table 30.

Table 30. Municipal dischargers not previously excluded from EPA's analysis and associated flow and phosphorus concentration data. Facilities that may exceed the $640,000 annual offset payment cap are indicated in italics. Concentration marked with an asterisk indicates that concentration was calculated by EPA (by first calculating total volume and total load using flow and concentration data from two outfalls and dividing total load by total volume).

Permit number	Facility name	Mean of reported monthly mean effluent flow values (8/2015 – 7/2016) (MGD)	Mean of reported monthly mean influent flow values 8/2015 – 7/2016 (MGD)	Mean of reported monthly mean total phosphorus concentration values (mg/L)
WI0023469	*BROOKFIELD, CITY OF*	*9.20*	*N/A*	*0.758*

Permit number	Facility name	Mean of reported monthly mean effluent flow values (8/2015 – 7/2016) (MGD)	Mean of reported monthly mean influent flow values 8/2015 – 7/2016 (MGD)	Mean of reported monthly mean total phosphorus concentration values (mg/L)
WI0023990	*FOND DU LAC WATER POLLUTION CO*	*No values reported*	*8.00*	*0.716*
WI0024601	MANITOWOC WASTEWATER TREATMENT	No values reported	7.54	0.438
WI0025038	OSHKOSH WASTEWATER TREATMENT F	13.13	N/A	0.282
WI0025739	WAUSAU WATER WORKS WW TREATMEN	5.32	N/A	0.624
WI0026085	NEENAH MENASHA SEWER COMMISSIO	No values reported	11.83	0.280
WI0029581	La Crosse, City of	9.36	N/A	0.383
WI0029971	WAUKESHA CITY	9.08	N/A	0.153
WI0030350	JANESVILLE WASTEWATER UTILITY	13.17	N/A	0.427
WI0065251	Green Bay Metropolitan Sewerage District Combined	39.63	N/A	0.274*

Based on this analysis, EPA concluded that, if they participated in the MDV, the following wastewater treatment facilities would be unlikely to exceed the $640,000 annual offset payment cap: Manitowoc, Oshkosh, Wausau, **Neenah Menasha**, LaCrosse, Waukesha, **Janesville**, and **Green Bay**. These facilities were therefore not considered further in this portion of EPA's analysis (though facilities in bold are subject to TMDL-based target values and were further considered in the TMDL portion of this analysis, below). Thus, the only two municipal facilities that, based on the most recent available effluent data, may exceed the $640,000 annual cap are Brookfield and Fond du Lac.

In the following analysis, for the two municipal facilities that might exceed the $640,000 annual offset payment cap, EPA used the mean values of monthly average flow and monthly average TP concentration (for the period from August 2015 through July 2016) to estimate annual offset payments over the course of the MDV, and modeled the cumulative load reductions associated with those payments against the cumulative load reductions associated with these two facilities meeting end-of-pipe limits.

Brookfield

Using the above figures on Brookfield's existing discharge (flow: 9.20 MGD, TP concentration: 0.758 mg/L), EPA calculated that the facility's existing phosphorus load would result in annual payments to the county of ~$781,867 (assuming that Brookfield continues to discharge at the same flow and concentration over the ten-year MDV period). In projecting load reductions (Figures 9 and 10), EPA capped the payments at $640,000 annually, subtracted 35% of each annual payment, per Wis. Stat. 283.16, and calculated load reductions assuming both that farmers: (1) would not; and, (2) would pay 30% of BMP implementation costs. Farmers are required to pay a portion of BMP implementation costs by Wisconsin NR 151. EPA assumed that BMP-based load reductions would be realized for the first time in year four of the MDV period, whereas end-of-pipe load reductions associated with meeting phosphorus effluent limitations reflecting installation and operation of additional treatment facilities to remove phosphorus from point source discharges would begin to accrue at the start of year five of the permit period (consistent with phosphorus compliance schedules in EPA-issued NPDES permits). EPA referred to WDNR's August 3, 2012 WQBEL memo to determine Brookfield's phosphorus WQBEL.

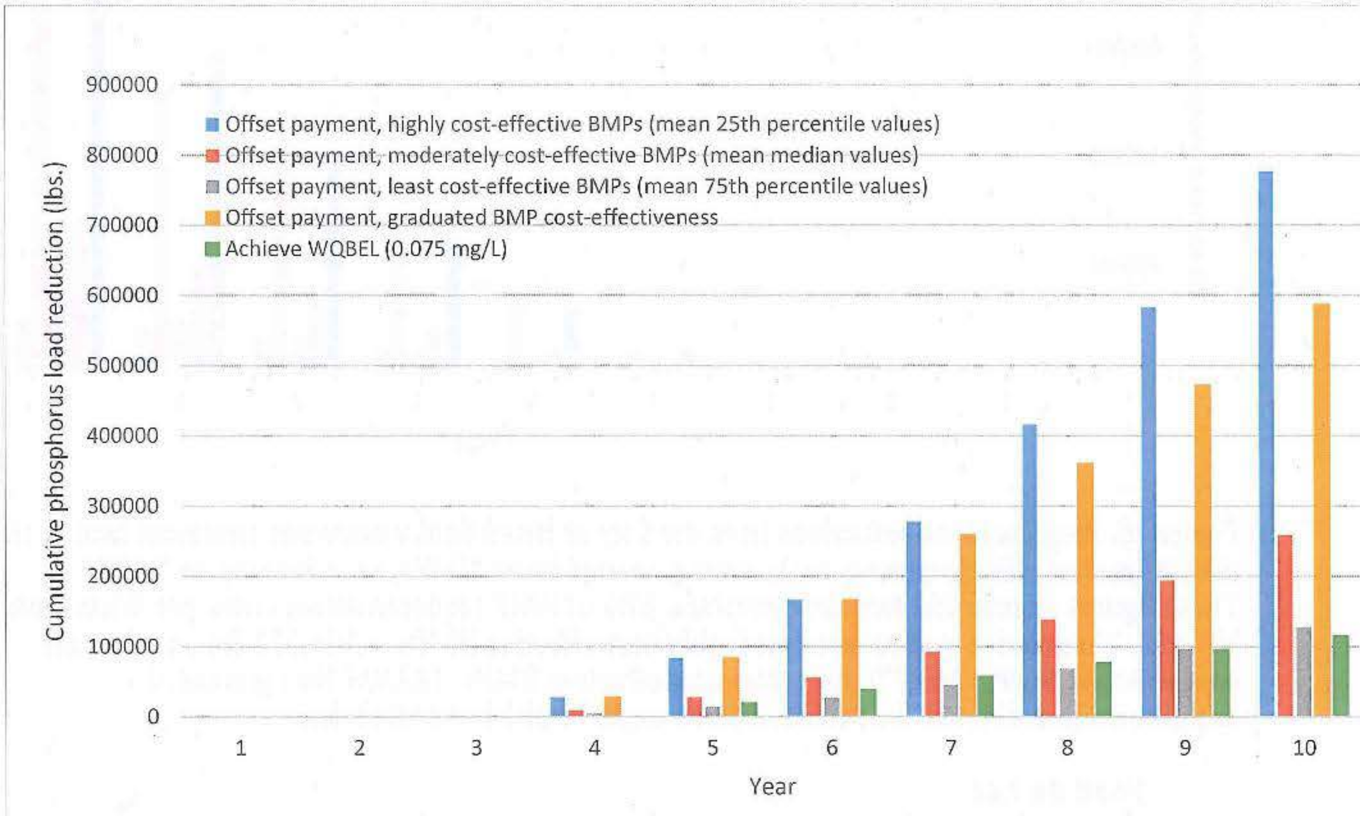

Figure 9. Projected load reductions from the City of Brookfield wastewater treatment facility if the City makes offset payments to the county to implement BMPs, vs. achieving its WQBEL. These figures assume that farmers do not contribute funding toward BMP implementation costs, as required by Wisconsin NR 151. Cumulative load reductions: highly cost-effective BMPs: 776,533 lbs.; moderately cost-effective BMPs: 258,844 lbs.; least cost-effective BMPs: 128,000 lbs.; graduated implementation: 586,971 lbs.; achieve 0.075 mg/L WQBEL: 114,842 lbs.

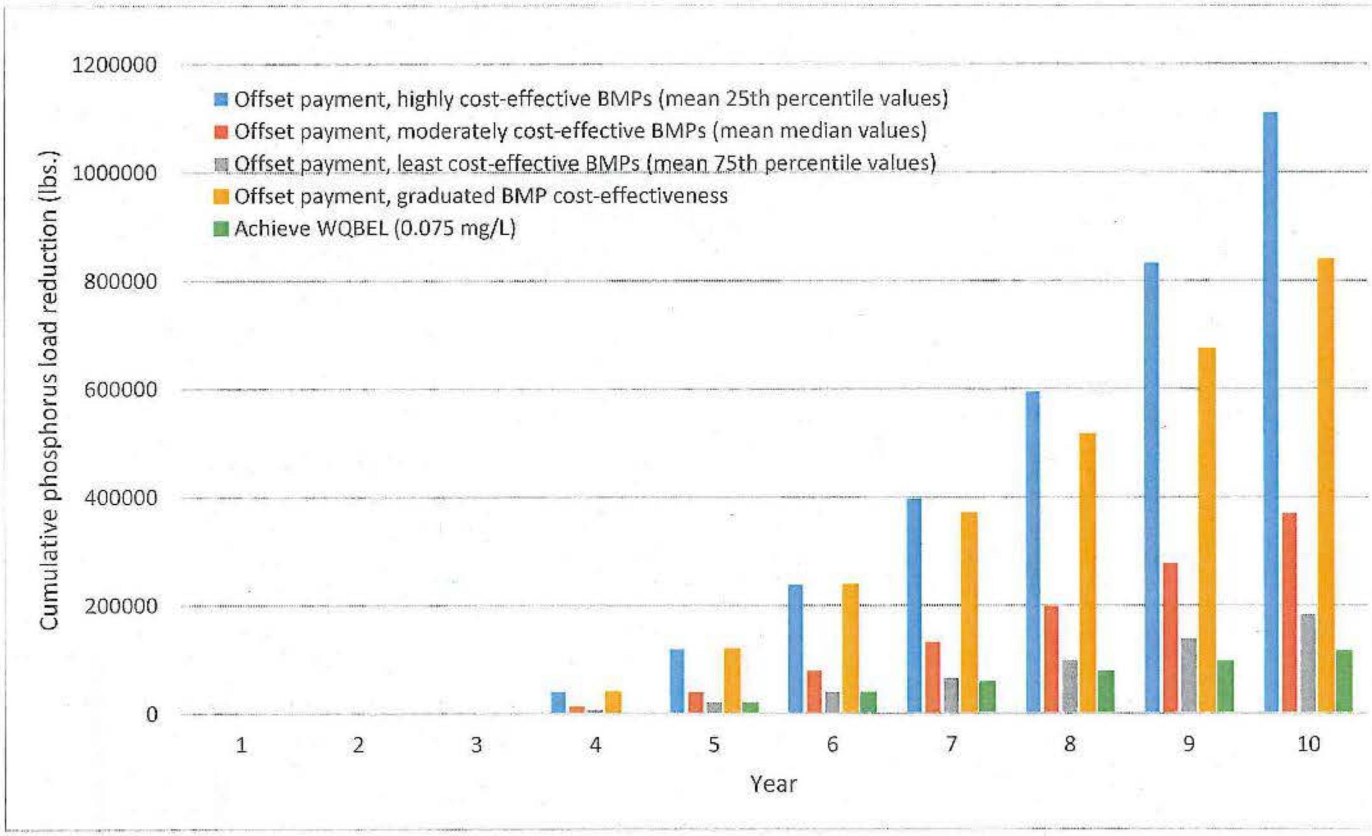

Figure 10. Projected load reductions from the City of Brookfield wastewater treatment facility if the City makes offset payments to the county to implement BMPs, vs. achieving its WQBEL. These figures assume that farmers contribute 30% of BMP implementation costs, per Wisconsin NR 151. Cumulative load reductions: highly cost-effective BMPs: 1,109,333 lbs.; moderately cost-effective BMPs: 369,778 lbs.; least cost-effective BMPs: 182,857 lbs.; graduated implementation: 838,531 lbs.; achieve 0.075 mg/L WQBEL: 114,842 lbs.

Fond du Lac

Using the above figures on Fond du Lac's existing discharge (flow: 8.00 MGD, phosphorus concentration: 0.716 mg/L), EPA calculated that Fond du Lac's existing phosphorus load would require the facility to make annual payments to the county of ~$628,710 (assuming that Fond du Lac continues to discharge at the same flow and concentration over the ten-year MDV period). Although the most recent available data suggest that the facility may not exceed the $640,000 annual offset payment cap, because the difference between the facility's projected annual payment and the payment cap is relatively small, EPA calculated projected load reductions (Figures 11 and 12) associated with BMP implementation and meeting the facility's WQBEL.

Again, EPA subtracted 35% of the annual offset payment, per Wis. Stat. 283.16, and assumed that farmers: (1) would; and, (2) would not pay 30% of BMP implementation costs, per Wisconsin NR 151. EPA assumed that BMP-based load reductions would be realized for the first time in year four of the MDV period, while WQBEL-based load reductions would be realized at the beginning of year five of the MDV period (again, consistent with phosphorus compliance schedules in EPA-issued permits). EPA referred to WDNR's May 23, 2011 WQBEL memo to determine Fond du Lac's phosphorus WQBEL.

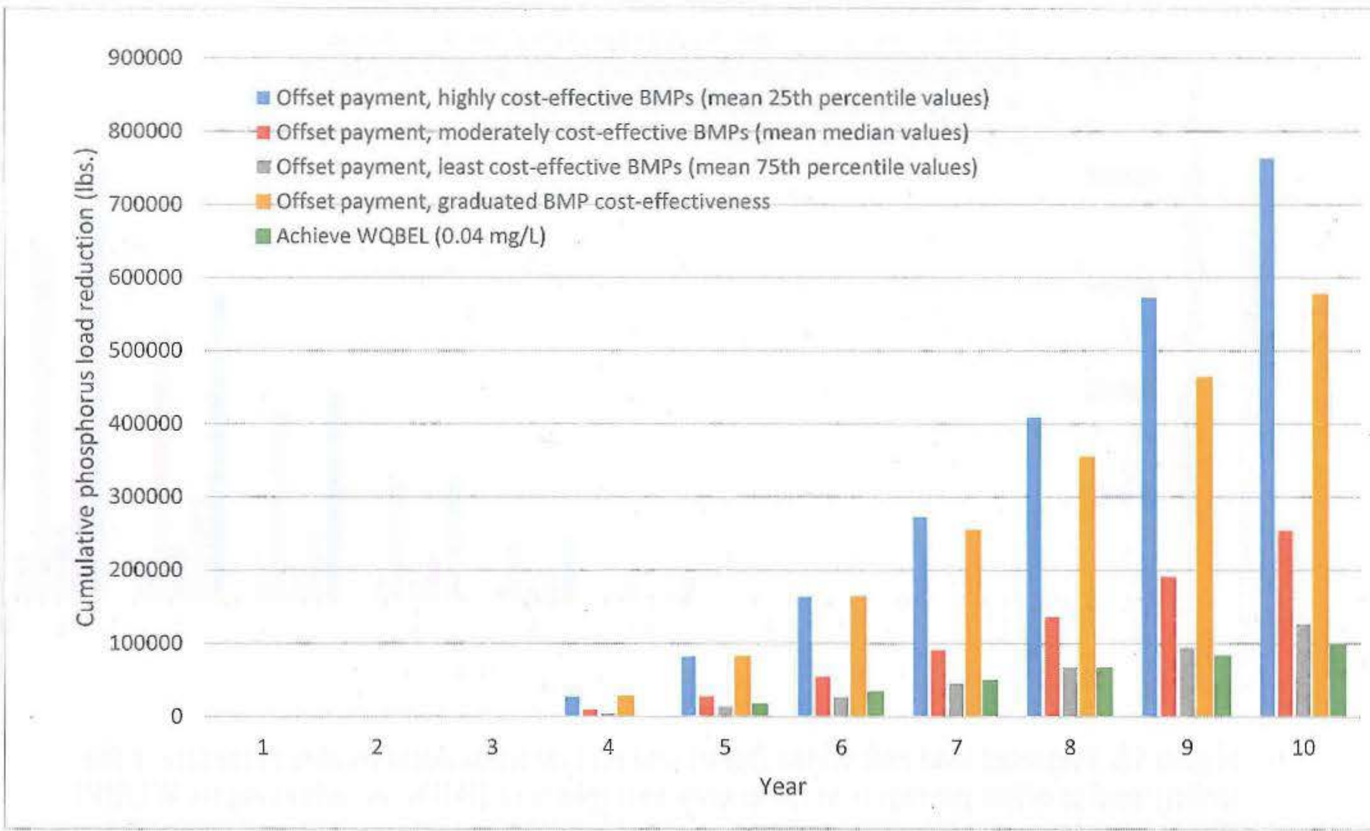

Figure 11. Projected load reductions from Fond du Lac wastewater treatment facility if the facility makes offset payments to the county to implement BMPs, vs. achieving its WQBEL. These figures assume that farmers do not contribute funding toward BMP implementation costs, as required by Wisconsin NR 151. Cumulative load reductions: highly cost-effective BMPs: 762,835 lbs.; moderately cost-effective BMPs: 254,278 lbs.; least cost-effective BMPs: 125,742 lbs.; graduated implementation: 576,617 lbs.; achieve 0.04 mg/L WQBEL: 98,839 lbs.

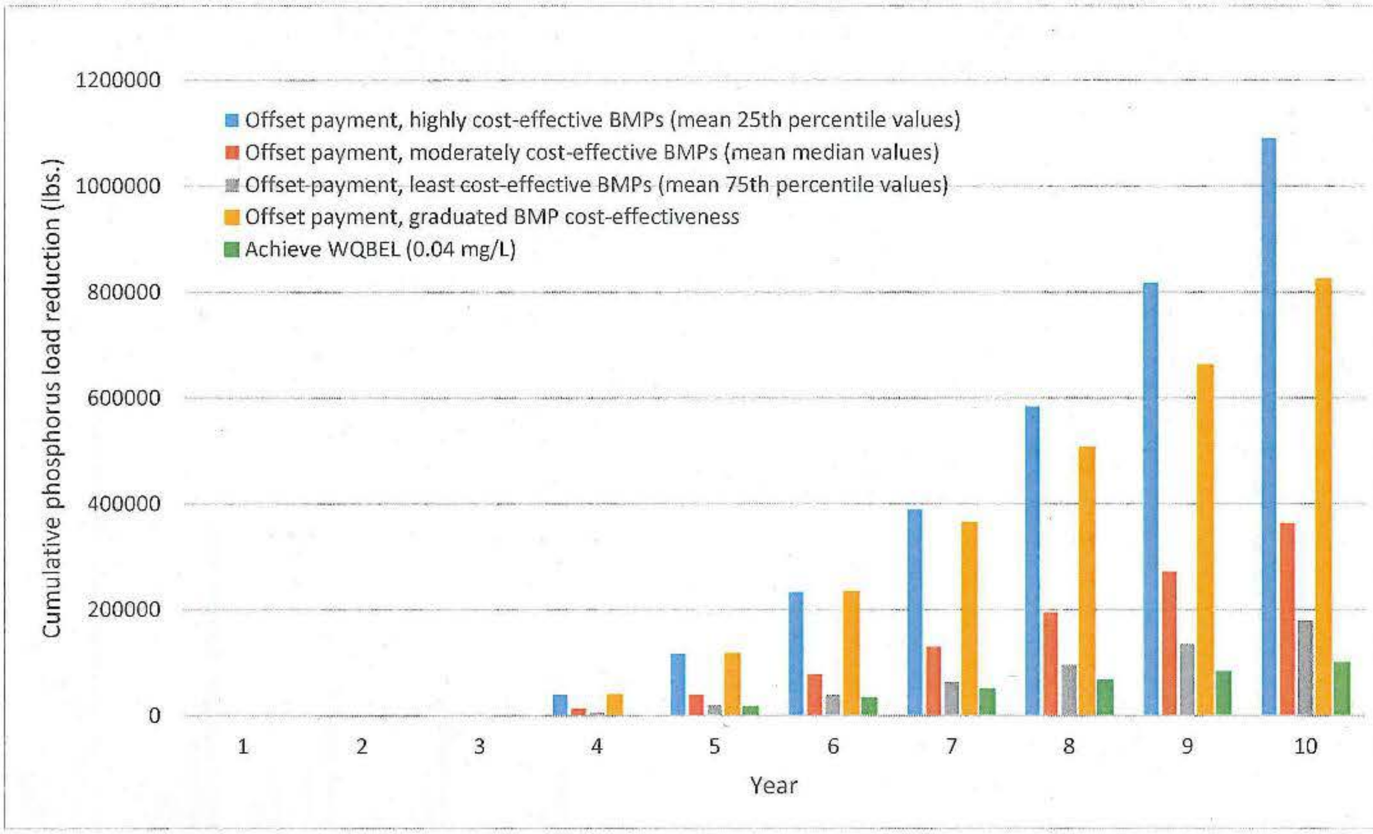

Figure 12. Projected load reductions from Fond du Lac wastewater treatment facility if the facility makes offset payments to the county to implement BMPs, vs. achieving its WQBEL. These figures assume that farmers contribute 30% of BMP implementation costs, per Wisconsin NR 151. Cumulative load reductions: highly cost-effective BMPs: 1,089,764 lbs.; moderately cost-effective BMPs: 363,255 lbs.; least cost-effective BMPs: 179,631 lbs.; graduated implementation: 823,738 lbs.; achieve 0.04 mg/L WQBEL: 98,839 lbs.

b. Industrial facilities

EPA queried the ICIS database for effluent data (flow, TP concentration) on the wastewater effluent discharged by major industrial facilities in Wisconsin during the period beginning August 1, 2015 and ending July 31, 2016. This query produced data on 39 dischargers, including the Green Bay Metropolitan Sewerage District (permit number WI0065251). EPA did not consider the Green Bay Metropolitan Sewerage District in this portion of its analysis, since the facility is a municipal treatment facility and is addressed in the municipal discharger and TMDL discharger portions of this document. The remaining facilities are included in Table 31, below: