



Charles River Watershed Association

CRWA Commercial Property Retrofit Study

March, 2009

This document has been prepared to describe potential retrofit designs and estimate the cost of those designs on a commercial property in order to achieve a reduction in annual phosphorus loading of 65% over “no control” conditions. These sites are purely hypothetical sites. The square footage of each portion of each site was provided by Nancy Hammett, and attempts to reflect realistic site designs. The retrofit concepts were designed by Kate Bowditch, and were based upon the draft BMP performance curves provided by EPA/Tetra Tech. The BMP sizing and cost estimates were provided by Rich Claytor, P.E., of Horsley Witten, Inc. based upon his experience in the region.

To meet the TMDL, we assume the following:

Total P reduction required from site = 65% over “no control”

Credit will be given for changes in O&M, existing BMPs

Hypothetical Source control/O&M credits* based on:

- 10% P removal credit for monthly vacuum sweeping;
- 5% for twice per year vacuum sweeping; no credit for brush sweeping;
- 5% credit for the development of a landscape maintenance stormwater management plan, including leaf litter control, erosion control, and the use of no-phosphorus fertilizers in landscaping;
- 5% credit for implementing a no-idling program;
- 5% credit for planting trees to provide 20% cover of parking areas at maturity.

Costs shown are estimated for construction only and do not include design or permitting, nor the value of the land itself.

*Neither MassDEP nor EPA has indicated whether they will accept source control/O&M credits; if source control/O&M credits are to be given, it is not known how much credit would be given for what activities. It is assumed that no more than 20% P removal credit can be given for any combination of source control/O&M activities. CRWA has made the assumptions in this document without input from any agency.

Hypothetical Site Retrofits

2 acre commercial site

24,000 sq. ft. flat roof
47,000 sq. ft. parking lot
9,000 sq. ft. landscaped area
7,000 sq. ft. roads and other impervious area

Scenario 1:

Site conditions

A soils; no contamination; 8 feet to groundwater; not in a Zone II;

Current practice

Bi-annual sweeping with brush sweeper; all parking lot area graded to drain to several 2' sump catch basins, then piped to MS4; roof drains tied directly to MS4; no other BMPs.

TMDL Compliance Options:

Property owner obtains 15% P reduction credit by changing to bi-annual vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a “no idling” program.

Remaining 50% P reduction is obtained by a combination of:

Parking lot restriped and reconfigured to use existing grading to direct stormwater flows to new **bioinfiltration swales/rain gardens** throughout parking areas sized to treat all parking lot runoff from a 0.4 inch storm (~53% P reduction from parking areas); overflows discharge into existing piped infrastructure; construction of **cisterns** sized to capture rooftop runoff from a 0.4 inch event, to be used for irrigation and other outdoor watering (~5400 gallons; ~57% P reduction from rooftop); overflow goes to MS4 via existing pipes; conversion of CBs along roadways to **leaching CB with deep sumps** (~66% P reduction from roadways).

Scenario 1 estimated construction cost: \$35,000 (\$17,500 per acre)

Could generate small P reduction credit to sell to offset costs.

Bioinfiltration areas estimated to take 660 square feet, approximately 2 – 4 parking stalls lost depending on layout.

2 acre commercial site

24,000 sq. ft. flat roof
47,000 sq. ft. parking lot
9,000 sq. ft. landscaped area
7,000 sq. ft. roads and other impervious area

Scenario 2:

B soils; no contamination; 8 feet to groundwater; in a zone II;

Current practice

irregular sweeping with brush sweeper; all parking lot area drains via sheet flow to several 2' sump catch basins, then piped to MS4; roof drains tied directly to MS4; no other BMPs.

TMDL Compliance Options:

Property owner obtains 15% P reduction credit by adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; planting trees to cover 20% of parking lot at tree maturity; implementing a “no idling” program.

Remaining 50% P reduction is obtained by a combination of:

Lined Biofiltration swales throughout parking areas sized to treat all parking lot runoff from a 0.3” storm; swales (which do not infiltrate due to zone II) designed to bypass flows once filled (~52% P reduction from parking areas); overflows drain to existing CBs and drains; construction of **cisterns** sized to capture rooftop runoff from a 0.4 inch event, to be used for irrigation and other outdoor watering (5400 gallons; ~57% P reduction from rooftop); construction of one **rain garden** (without infiltration) at end of roadway to treat 0.4 inch storm from 3000 sq. ft. of roadway; overflow to existing infrastructure; installation of 1 **stormwater tree box planter** to collect runoff from remaining roadway, with overflow to existing catch basin (~55% P reduction from roadway).

Scenario 2 estimated construction cost: \$40,000 (\$20,000 per acre)

Swales and rain garden estimated to take 600 square feet, or 2 – 4 parking stalls depending on layout

2 acre commercial site

24,000 sq. ft. flat roof
47,000 sq. ft. parking lot
9,000 sq. ft. landscaped area
7,000 sq. ft. roads and other impervious area

Scenario 3:

B soils; no contamination; 4 feet to groundwater; partially in a buffer zone; constructed to meet MA SW stds. in 2000.

Current practice

monthly sweeping with brush sweeper; all parking lot area drains to 4' sump catch basins with hoods, then piped to dry detention basin; roof drains tied directly to basin; no other BMPs.

TMDL Compliance Options:

Property owner obtains 20% P reduction credit by changing to monthly vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a "no idling" program. Deep sump catch basins provide 10% P removal credit.

Remaining 35% P reduction is obtained by a combination of:

Retrofitting basin to a gravel wetland, sized to treat 0.4 inch storm from all parking lot and roadway areas (~ 41% P removal from parking lot and roadways); construction of ***cisterns*** sized to capture rooftop runoff from a 0.25 inch event, to be used for irrigation and other outdoor watering (3375 gallons; ~38% P removal from rooftop).

Scenario 3 estimated construction costs: \$29,000 (\$14,500 per acre)

Could generate small P reduction credit to sell to offset costs.

No loss in parking.

2 acre commercial site

24,000 sq. ft. flat roof
47,000 sq. ft. parking lot
9,000 sq. ft. landscaped area
7,000 sq. ft. roads and other impervious area

Scenario 4:

D soils/contamination (no infiltration allowed);

Current practice

monthly sweeping with brush sweeper; all parking lot area drains by sheet flow to off-site vegetated area or into public right of way and into MS4 system; no other BMPs.

TMDL Compliance Options:

Property owner obtains 20% P reduction credit by changing to monthly vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a “no idling” program.

Remaining 45% P reduction is obtained by a combination of:

Lined Biofiltration swales throughout parking areas sized to treat all parking lot runoff from a 0.4” storm (~ 53% p reduction from parking areas); overflow piped to MS4; construction of **cisterns** sized to capture rooftop runoff from a 0.25 inch event, to be used for irrigation and other outdoor watering (~3375 gallons; ~38% P removal from rooftop); remaining P removal (to be determined by estimator tool) to be obtained through trade with another property owner.

Scenario 4 estimated cost: \$29,000 (\$14,500 per acre)

Swales and rain garden estimated to take 650square feet, or 3-5 parking stalls depending on layout

20 acre shopping mall

200,000 sq. ft. flat roof
536,000 sq. ft. parking lot, loading dock, and other impervious area
44,000 sq. ft. landscaped area
90,000 sq. ft. roadways

Scenario 1:

Site conditions

A soils; no contamination; 8 feet to groundwater; not in a Zone II;

Current practice

Monthly sweeping with brush sweeper; all parking lot and road areas graded to drain to 2' sump catch basins, then piped to MS4; roof drains tied directly to MS4; no other BMPs.

TMDL Compliance Options:

Property owner obtains 20% P reduction credit by changing to monthly vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a "no idling" program.

Remaining 45% P reduction is obtained by a combination of:

Parking lot restriped and reconfigured to use existing grading to direct stormwater flows to new **bioinfiltration swales/rain gardens** throughout parking areas sized to treat all parking lot runoff from a 0.4 inch storm (~53% P reduction from parking areas); construction of **cisterns** sized to capture rooftop runoff from a 0.2 inch event, to be used for irrigation and other outdoor watering (22,500 gallons; ~ 33% P reduction from rooftop); roadway flows directed to off-line gravel wetland sized to treat 0.6 inch storm (~51% P reduction from roadways); overflow goes to MS4 via existing pipes.

Scenario 1 estimated construction cost: \$271,320 (\$13,566 per acre)

Swales and rain garden estimated to take ~9000 square feet, or 18 - 24 parking stalls depending on layout

20 acre shopping mall

200,000 sq. ft. flat roof
536,000 sq. ft. parking lot, loading dock, and other impervious area
44,000 sq. ft. landscaped area
90,000 sq. ft. roadways

Scenario 2:

B soils; no contamination; 8 feet to groundwater; in a zone II;

Current practice

irregular sweeping with brush sweeper; all parking lot area drains via sheet flow to numerous 2' sump catch basins, then piped to MS4; roof drains tied directly to MS4; no other BMPs.

TMDL Compliance Options:

Property owner obtains 15% P reduction credit by adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; bi-annual vacuum sweeping; implementing a "no idling" program.

Remaining 50% P reduction is obtained by a combination of:

Lined biofiltration swales throughout parking areas sized to treat all parking lot runoff from a 0.4" storm (which do not infiltrate due to zone II) designed to bypass flows once filled (~ 53% P reduction from parking areas); overflows drain to existing CBs and drains; construction of **cisterns** sized to capture rooftop runoff from a 0.2 inch event, to be used for irrigation and other outdoor watering (22,500 gallons; ~ 33% P reduction from rooftop); construction of four **lined rain gardens** (without infiltration) to treat 0.5 inch storm from 70,000 sq. ft. of roadway (~ 58% of P reduction from 77% of roadway); overflow to existing infrastructure; installation of 4 **stormwater tree box planters** to collect runoff from remaining roadway, with overflow to existing catch basin (~ 60% P reduction from remaining roadway).

Scenario 2 estimated construction cost: \$358,782 (\$17,939 per acre)

Swales and rain garden estimated to take ~9000 square feet, or 18 - 24 parking stalls depending on layout

20 acre shopping mall

200,000 sq. ft. flat roof
536,000 sq. ft. parking lot, loading dock, and other impervious area
44,000 sq. ft. landscaped area
90,000 sq. ft. roadways

Scenario 3:

B soils; no contamination; 4 feet to groundwater; partially in a buffer zone; constructed to meet MA SW stds. in 2000.

Current practice

monthly sweeping with brush sweeper; all parking lot area drains to 4' sump catch basins with hoods, then piped to one wet (near wetland area) and one dry (in upland area) detention basin; roof drains tied directly to basin; no other BMPs.

TMDL Compliance Options:

Property owner obtains 20% P reduction credit by changing to monthly vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a "no idling" program. Deep sump catch basins provide 10% P removal credit. Wet basin receives 10% P removal credit (25% P reduction credit, treats flows from 40% of parking and roadway areas).

Remaining 25% P reduction is obtained by a combination of:

Retrofitting dry basin to a gravel wetland, sized to treat 0.4 inch storm from 60% of parking lot and roadway areas (~ 41% P removal from 60% of parking and roadways); construction of ***cisterns*** sized to capture rooftop runoff from a 0.2 inch event, to be used for irrigation and other outdoor watering (~22,500 gallons; ~ 33% P reduction from rooftop).

Scenario 3 estimated construction cost: \$176,850 (\$8,800 per acre)

No loss of parking

20 acre shopping mall

200,000 sq. ft. flat roof

536,000 sq. ft. parking lot, loading dock, and other impervious area

44,000 sq. ft. landscaped area

90,000 sq. ft. roadways

Scenario 4:

D soils/contamination (no infiltration allowed);

Current practice

monthly sweeping with brush sweeper; all parking lot area drains by sheet flow to off-site vegetated area or into public right of way and into MS4 system; no other BMPs.

TMDL Compliance Options:

Property owner obtains 20% P reduction credit by changing to monthly vacuum sweeping; adopting a landscape stormwater management plan, including no-phosphorus fertilizer on landscaped areas; implementing a “no idling” program.

Remaining 45% P reduction is obtained by a combination of:

Lined biofiltration swales throughout parking areas sized to treat all parking lot runoff from a 0.4” storm (~ 53% P reduction from parking areas); overflow piped to MS4; construction of ***cisterns*** sized to capture rooftop runoff from a 0.2 inch event, to be used for irrigation and other outdoor watering (22,500 gallons ~ 33% P reduction from rooftop); remaining P removal to be obtained through trade with another property owner.

Scenario 4 estimated construction cost: \$281,934 + costs of trade (\$14,000 per acre)