MEMORANDUM

TO:	Mr. Paul Brinkman, P.E., Town Engineer, Wayland Department of Public Works
FROM:	Laura Nolan and Polly Crocker, Kleinfelder
DATE:	February 18, 2021
SUBJECT:	Loker Turf Field Stormwater Management Assessment for Phosphorus Removal

A portion of the Town of Wayland resides in the Charles River watershed and is thus subject to the total maximum daily load (TMDL) for phosphorus (P) assigned to the watershed. As part of their Municipal Small Municipal Separate Stormwater Sewer System (MS4) Permit, Wayland is required to achieve a 42 percent reduction in P loading, which equates to 19 kilograms per year (kg/yr). A proposed development to construct the Loker Turf Field Project is within the portion of Wayland in the Charles River watershed, providing an opportunity to reduce P loading.

This memorandum documents the expected P removal of the proposed stormwater best management practices (BMPs) of the Loker Turf Field Project. In addition, Kleinfelder assessed the proposed project for enhanced P removal opportunities via additional stormwater management strategies. Results presented herein represent estimates and further analysis would be required to verify P removal as part of the design process.

1 ESTIMATED PHOSPHORUS REMOVAL OF PROPOSED DEVELOPMENT

The proposed project design (see References, Section 4) includes two BMPs to enhance stormwater management including subsurface infiltration chambers under the parking lot and a turf field with 12-15 inch aggregate sub-base. Preliminary soil analysis suggests native A soils and therefore all facilities are designed to infiltrate. Kleinfelder estimated P removal potential for the BMPs using the methodology outlined in Appendix F of the MS4 Permit. Generally, this approach involved calculating the P load from proposed land uses draining to the BMP[1] and the P load reduction from the BMP[2]. All P loading and reduction rates represent average annual estimates.

For the infiltrating turf field, the land use is designated as pervious area with class A soils. P removal rates for porous pavement are used as a proxy for the infiltrating turf field. For the subsurface chambers in the parking lot, the land use of the impervious drainage area is designated as highway. A subsurface infiltration BMP is used for P reduction rates. As presented in Table 1, the proposed BMPs are estimated to remove roughly 0.3 kg/yr of P, or 2% of Wayland's required 19 kg/yr P reduction per the Charles River Watershed TMDL for P.

[1] *MS4 Permit Appendix F Attachment 3, Table 3-1*
[2] *MS4 Permit Appendix F, Attachment 3*

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Table 1. Estimated P Removal Summary

	Value	Unit	Source
Infiltrating Turf Field			
Turf field P load rate	0.03 (0.01)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Developed Land Pervious (DevPERV) - Hydro Soil Group A land use)
Porous pavement P load reduction	62	%	MS4 Permit, App F-A3, table 3-22 (assumes 12 inch filter course depth based on CD 5/L7.04)
Estimated drainage area	1.8	ac	Dimensions from construction drawings, sheet L4.01
Estimated P removal	*0.02*	*kg/yr*	
Parking Lot Infiltration Chambers			
Parking lot P load rate	1.34 (0.61)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use; directly connected impervious cover)
Subsurface chamber P load reduction	100	%	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use)
Estimated drainage area	0.5	ac	Stormwater Report, App E
Estimated P removal	*0.29*	*kg/yr*	
TOTAL ESTIMATED P REMOVAL	**0.31**	**kg/yr**	

Although the infiltrating turf field BMP is very large, it provides minimal P reduction because it is managing stormwater from a land use type with very low P loading rates. However, this BMP will infiltrate large volumes of stormwater, reducing stormwater volumes and flows to the existing stormwater system thereby improving conditions downstream. The stormwater chambers under the parking lot offer the largest P removal potential as they will treat stormwater from the impervious parking lot, which has high P loading rates. Based on the plan drawings and stormwater report, the impervious area associated with the parking lot is classified as directly connected impervious cover. Managing more stormwater from impervious surfaces will offer more P reduction benefits and get Wayland closer to compliance with the TMDL requirements. Additional P removal opportunities at this project site are discussed in Section 2.

2 ADDITIONAL PHOSPHORUS REMOVAL OPPORTUNITIES

Kleinfelder assessed the project site for additional opportunities to remove P with a goal of managing more runoff from impervious surfaces with high P loading rates. Each proposed opportunity and its estimated P removal rates are detailed further below.

Alternative 1 – Parking Lot Bioretention

Alternative 1 would include managing stormwater from the roughly 1,300 square feet (0.03 acres) of the parking lot that is not currently designed to drain to the subsurface chambers by converting

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one of the greened islands in the parking lot to a bioretention planter with curb cuts to allow stormwater to flow in (Figure 1). This alternative would provide an additional 0.02 kg/yr of P removal (see Table 2).

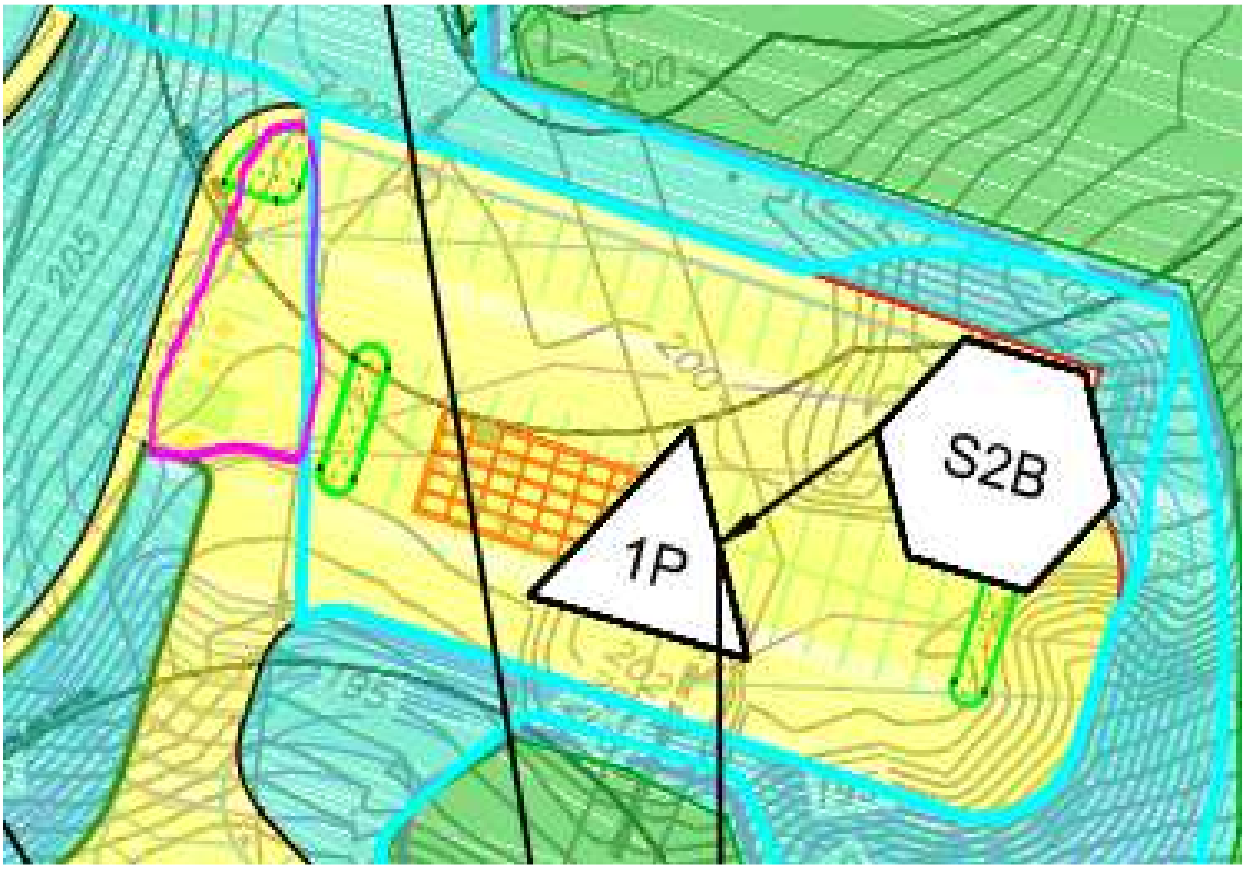

Figure 1. Alternative 1 drainage area (highlighted in pink) could be graded so that water would flow into the green island nearest the subsurface infiltration chambers.

Table 2. Alternative 1 Estimated P Removal Summary

	Value	Unit	Source
Parking lot P load rate	1.34 (0.61)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use)
Bioretention planter P load reduction	100	%	MS4 Permit, App F-A3, table 3-10 (assumes 1.5 in BMP capacity)
Estimated drainage area	0.03	ac	Estimated from construction drawing measurements (sheet L4.02)
TOTAL ESTIMATED P REMOVAL	**0.02**	**kg/yr**	

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Alternatively, the parking lot could be redesigned to allow this portion of impervious cover to drain to the proposed subsurface chamber that is designed for the rest of the parking area. The P load reduction would be the same for either option.

Alternative 2A – Access Road Water Quality Swale

Alternative 2A would include managing stormwater from the access road leading from Commonwealth Road to the proposed parking lot with water quality swales on each side of the road or one side of the road, depending on final grading and design goals (Figure 2). This alternative would provide an additional 0.01 kg/yr of P removal (see Table 3).

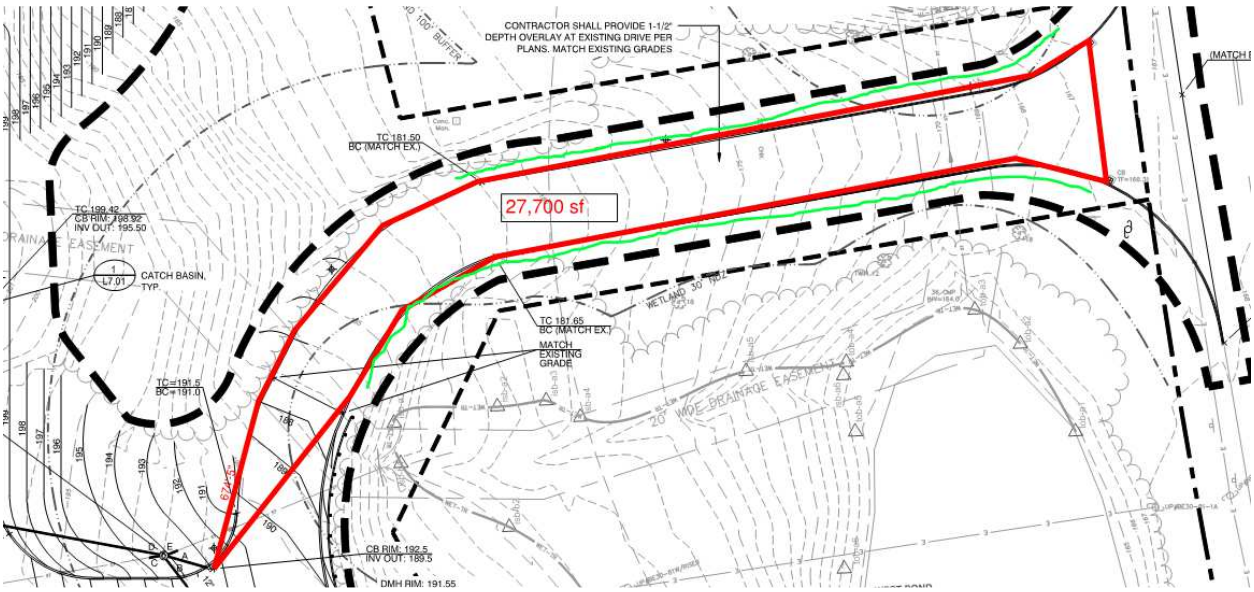

Figure 2. Alternative 2A drainage area (highlighted in red) could be graded so that runoff would flow into a water quality swale on each side of the road or to one side of the road for treatment before reaching the stormwater collection system.

Table 3. Alternative 2A Estimated P Removal Summary

	Value	Unit	Source
Access road P load rate	1.34 (0.61)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use)
Swale P load reduction	29	%	MS4 Permit, App F-A3, table 3-10 (assumes 1.5in BMP capacity)
Estimated drainage area	0.6	ac	Estimated from construction drawing measurements, sheet L5.02
TOTAL ESTIMATED P REMOVAL	**0.1**	**kg/yr**	

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Alternative 2B – Access road grass swales and rain gardens

Alternative 2B would include managing stormwater from the access road leading from Commonwealth Road to the proposed parking lot by constructing grass swales to drain to rain gardens for treatment before ultimately flowing to the existing stormwater collection system (Figure 3, Figure 4). This alternative would provide an additional 0.4 kg/yr of P removal (see Table 4) offering better P removal than Alternative 2A. However, high groundwater was noted in the soil investigation, which may prohibit infiltrative rain gardens; further soil testing would be required prior to final design.

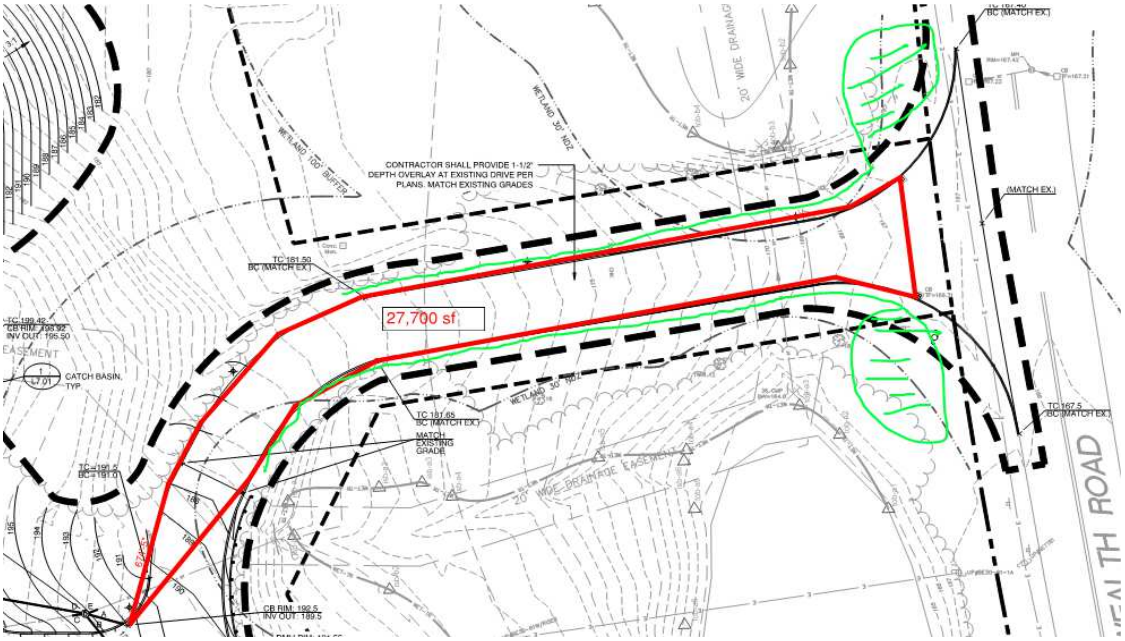

Figure 3. Alternative 2B drainage area (highlighted in red) would flow to a grass swale on each side of the road which would flow to a rain garden for treatment before reaching the existing stormwater collection system.

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Figure 4. a) Eastern rain garden potential footprint and b) Western rain garden potential footprint.

Table 4. Alternative 2B P Removal Summary

	Value	Unit	Source
Access road P load rate	1.34 (0.61)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use)
Bioretention P load reduction	100	%	MS4 Permit, App F-A3, table 3-10 (assumes 1.5in BMP capacity)
Estimated drainage area	0.6	ac	Estimated from construction drawing measurements, sheet L5.02
TOTAL ESTIMATED P REMOVAL	**0.4**	**kg/yr**	

Alternative 2C – Access road & Commonwealth Road grass swales and rain gardens
Alternative 2C would include managing stormwater from the access road and Commonwealth Road (surface flow and/or catch basin flow) for the area shown in Figure 5. This alternative would direct runoff to rain gardens for treatment before ultimately flowing to the existing stormwater collection system. Modifications to the stormwater system would be required to redirect surface flow from a portion of Commonwealth Road to/from the proposed rain gardens. This alternative would provide an additional 0.7 kg/yr of P removal (see Table 5). It should be noted that high groundwater was noted in the soil investigation, which could prohibit infiltrative rain gardens; further soil testing would be required prior to final design.

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Figure 5. Alternative 2C drainage area from access road and Commonwealth Road (existing catch basins are circled in red)

Table 5. Alternative 2C P Removal Summary

	Value	Unit	Source
Access road & Commonwealth Road P load rate	1.34 (0.61)	lbs/ac/yr (kg/ac/yr)	MS4 Permit, App F-A1, Table 1-2 (assumes Highway land use)
Bioretention P load reduction	100	%	MS4 Permit, App F-A3, table 3-10 (assumes 1.5 in BMP capacity)
Estimated drainage area	1.2	ac	Estimated from Google Earth measurements
TOTAL ESTIMATED P REMOVAL	**0.7**	**kg/yr**	

The alternatives identified herein represent a potential improvement in P removal, allowing the Town to incrementally work toward their required P load reduction of 19 kg/yr. Alternative 1 may be combined with any of the Alternative 2 options for improved P removal. As shown in Table 6, Alternative 2C would provide the greatest P removal but could also require more complicated design and construction than the other alternatives. Each of these alternatives should be further examined for feasibility through the design process.

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Table 6. Combined Alternative P Removal Summary

BMP	BMP P removal (kg/yr)	Combined P Removal (kg/yr)*	Percent of Required P Reduction**
Project as Designed	0.31	-	1.63%
Alternative 1	0.02	0.33	1.73%
Alternative 2A	0.11	0.42	2.22%
Alternative 2B	0.39	0.70	3.66%
Alternative 2C	0.70	1.01	5.31%

*P reduction when alternative BMP performance is combined with the performance of the project as designed

**19 kg/yr required P reduction

3 OTHER MS4 PERMIT COMPLIANCE OPPORTUNITIES

This project provides several excellent opportunities for community outreach, education and stewardship that align with Minimum Control Measures (MCM) 1 of the MS4 Permit. Vegetated systems such as rain gardens and swales offer community planting opportunities. Educational signage describing the purpose and benefits of the stormwater management elements of the project would be seen by the many visitors to the new facilities. Wayland Middle School is a 20-minute walk, which could be used as an outdoor classroom. Adding more visible stormwater management infrastructure would greatly enhance the long-term community benefits of this project while reducing P and improving water quality.

4 REFERENCES

Construction Drawings – Bid Set (2/28/2019):
https://www.wayland.ma.us/sites/g/files/vyhlif4016/f/pages/19-1054_loker_bid_plans_02_28_2019.pdf

Stormwater Report (9/10/2018):
https://www.wayland.ma.us/sites/g/files/vyhlif4016/f/uploads/_20180910_wayland_loker_sw_report-combined.pdf

Soil Assessment (4/4/18):
https://www.wayland.ma.us/sites/g/files/vyhlif4016/f/pages/loker_assessment_areas_memo_04.04.18_-_final2_0.pdfv

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