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Road Services Division
Engineering Services Section
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TO: Doug Navetski, Engineer IV, Regulations and Compliance, Water and Land Resources Division

FM: Lydia Reynolds-Jones, Project Support Services Manager, Engineering Services Section, Road Services Division

RE: Additional Road Services Division Comments - NPDES Permit Proposal for use of Permeable Pavement

Thank you for the opportunity to respond to the Washington State Department of Ecology (DOE) NPDES municipal permit proposed language that directs jurisdictions to adopt regulations for implementing low impact development (LID) Best Management Practices (BMPs) where feasible.

We are pleased to see that the proposal exempts road maintenances in the following areas: pothole and square cut patching, overlaying existing asphalt or concrete pavement with asphalt or concrete without expanding the area of coverage, shoulder grading, reshaping/regrading drainage systems, crack sealing, resurfacing with in-kind material without expanding the road prism, and vegetation maintenance.

The Road Services Division (RSD) is very supportive of the use of LID BMPs on road and drainage projects; however, we are very concerned about the DOE proposal to require the placement of permeable pavement wherever a new or replaced roadway surface is being created by roadway projects subject to drainage review. Our concerns are supported by studies that have been performed and what we have learned through our research to date regarding permeable pavement. Additionally, for roadside safety purposes, all BMPs that are proposed to be located above surface must adhere to the minimum clear zone requirements of the King County Road Design and Construction Standards (Standards).

In addition to the comments already submitted by the Road Services Division (RSD) regarding the requirement to use porous asphalt on newly constructed roadways, we offer the following:

Low Traffic Volume Usage

Porous asphalt does not perform well on roadways with medium to heavy traffic. Several studies and the Environmental Protection Agency have concluded that porous asphalt may perform well in pedestrian walkways, sidewalks, driveways, parking lots, and low-volume roadways. Since we haven’t had the opportunity to study the use of porous asphalt, the type of low volume roadway within unincorporated King County where its use might be successful is residential dead-end culde-sacs that serve a maximum of sixteen lots with soil and groundwater conditions conducive to storm drainage. These roadways have very low-traffic volumes and would be ideal for studying the use of porous asphalt. Even under these conditions, placement of porous asphalt isn't feasible under the following conditions as stated in the proposed NPDE municipal permit:

- Within an area designated as a Landslide Hazard Area.
- Geotechnical evaluation recommends infiltration not be used anywhere within the project area due to reasonable concerns about erosion, or slope failure.
- Within 100 feet of a known contaminated site or abandoned landfill.
- Within 100 feet of a drinking water well, or a spring used for drinking water supply.
- Within 10 feet of a small on-site sewage disposal drainfield. For setbacks from a "large on-site sewage disposal system", see Ch 246-272B WAC.
- The site cannot reasonably be designed to have a porous asphalt surface at less than 5 percent slope, or a pervious concrete surface at less than 6 percent slope. Portions of pavements that must be laid at greater than 5 percent slope must prevent drainage from upgradient base courses into its base course.
- Native soils below the permeable pavement do not meet the soil suitability criteria for providing treatment (pertinent to pollution-generating surfaces only). Note: In these instances, the applicant has the option of placing a six-inch layer of media meeting the site suitability criteria (Volume III, Section 3.3.7), or the sand filter specification (Volume V, Section 8.6).
- Site design cannot avoid putting pavement in areas likely to have long-term excessive sediment deposition after construction (e.g., construction and landscaping material yards).
- Down slope of steep, erosion prone areas that are likely to deliver sediment.
- Where the risk of concentrated pollutant spills is more likely such as gas stations, truck stops, and industrial chemical storage sites.
- Where seasonal high groundwater creates prolonged saturated conditions at the ground surface, within the wearing course, or within one foot of the bottom of the lowest gravel base course.
- Fill soils are used that can become unstable when saturated.
- Regular, heavy applications of sand occur to maintain traction during winter.
- Infiltrating and ponded water below new permeable pavement area would compromise adjacent impervious pavements.

- Infiltrating water below new permeable pavement area would threaten existing below grade basements.

- Installation of permeable pavement would threaten the safety or reliability of pre-existing underground utilities or pre-existing underground storage tanks.

Design

The suitability of the use of permeable pavement for a particular roadway depends on the loading criteria, soil and groundwater conditions and the operational life of the roadway. To provide satisfactory performance, the subgrade must be able to sustain traffic loading without excessive deformation. The granular capping and sub-base layers should give sufficient load-bearing to provide an adequate construction platform and base for the overlying pavement layers and the pavement materials should not crack or suffer excessive rutting under the influence of traffic. Studies show that most applications of permeable pavement are on facilities with no vehicular traffic or areas of very low speed with very low-traffic volume.

Porous asphalt by design contains a significant volume of air voids in the pavement versus conventional pavement. Rainfall then flows through these voids in the pavement, into a gravel bed for storage and ultimately percolates into the ground, mimicking natural infiltration. The necessary air voids reduce the strength of the pavement and reduce the pavement’s ability to resist loading from high traffic volumes or from truck traffic. The infiltration of water into the soil below the pavement structure reduces the soil strength, again reducing the pavements ability to resist loading from high traffic volumes or from truck traffic.

Maintenance

The public roadway infrastructure is aging and requires significant rehabilitation or replacement. Unfortunately, agencies are lacking the necessary public funding and are losing revenue yearly. It is imperative that we become more efficient at maintaining our remaining infrastructure by utilizing new technologies that increase the longevity while reducing maintenance costs. Widespread usage of porous asphalt on roadways will increase the need for road maintenance, increase the cost of pavement repair and replacement, and reduce the overall efficiency of the Division in maintaining the infrastructure.

Porous asphalt is more susceptible to studded tire damage, increasing maintenance, repair, and replacement. During winter months, freeze-thaw, and sand and deicing processes, and studded tires are all expected to have adverse impact on system performance. WSDOT reports some data indicates a reduction in hydraulic conductivity by 96% for surfaces treated with sand and salt mix.

Porous asphalt will develop cracks quicker then normal dense graded asphalt. It will be much more difficult to perform isolated maintenance repairs of porous asphalt because of the lack of availability. Instead, maintenance will have to repair isolated road failures for safety with dense graded asphalt creating a patch work surface.

Sand is a major maintenance tool to reduce the safety impacts of ice on a roadway. Sand will fill the porous asphalt pores very quickly reducing infiltration. This may require that maintenance shift over to salts in an effort to reduce the clogging effects of sand. Because of the open pores, the salt is washed into the depression and ice forms at the top of the pavement (ice hats); therefore

the dangerous slippery conditions remain. This results in increased call outs of staff and salt usage, up to 50 percent more. Again, resources are used up more readily for porous asphalt.

One of the major contributors to pavement failure is subgrade water and softening of the supporting soils. Porous asphalt allows for water infiltration into the supporting soils. If this product is to be utilized, the supporting soils must be studied to insure compatibility with the proposed pavement. Under no circumstances should water be allowed to remain within the pavement support soils.

Safety

Porous asphalt roadways would need to be overlayed within a shorter time cycle to prevent overall failure. Because of limited funding and the cost of overlays many porous asphalt roads with accelerated distress would not be overlayed before complete failure. These roadways would remain in a failed condition for a long period of time until funding is available. This could become a safety and commerce issue for the roadway users.

Air voids reduce the strength and durability of the pavement. High void content reduce pavement's ability to resist loading from high traffic volumes or from truck traffic. Air voids allow rainwater to infiltrate into the soil beneath the pavement, potentially decreasing the strength of that soil; thereby, creating maintenance and safety concerns such as roadway settlement.

Costs

The Federal Highway Administration in cooperation with academia and StateDOT's developed a new dense graded asphalt mix design and procedure (SuperPave) to improve the performance and longevity of asphalt pavement under various traffic loading conditions. SuperPave is now widely accepted throughout the United States and has proven to be effective in increasing the longevity of the asphalt pavement and reducing the maintenance costs associated with early pavement distress. The use of porous asphalt on County roadways will completely reverse this cost saving trend greatly increasing long term maintenance and roadway construction costs.

Porous asphalt roadways will need to be overlayed within a shorter time cycle to prevent overall failure. Because of limited funding and the cost of overlays many porous asphalt roads with accelerated distress would not be overlayed before complete failure. These roadways will remain in a failed condition for a long period of time until funding is available. This becomes a safety and commerce issue for commuters.

Porous asphalt has the risk of total replacement of the pavement at the end of its life due to its durability.

Porous asphalt pavement must be inspected and cleaned regularly to maintain the hydrologic performance of the pavement system. The porous asphalt must be cleaned of debris using high pressure water spray and vacuuming. If porous asphalt is used widespread, new equipment will need to be purchased and maintained to accommodate the cleaning practices required for porous pavement. This is not only a maintenance cost, but is a resource cost of using increased personnel, equipment and maintenance, water and gasoline.

The County road system is subjected to numerous utility cuts and replacements from upgrading and new developments. The utility replacements are under a franchise agreement where the utility company is responsible for pavement and underlying utility line failures. If King County incorporates porous asphalt pavement over a utility cut allowing water infiltration and trench degradation, the County runs the risk of assuming responsibility for the utility repairs due to the porous roadway. This is a financial and liability risk that the County isn't willing to endure.

Porous asphalt with its high void content is more susceptible to oxidation damage. Oxidation degrades the asphalt by reducing its elasticity making it more brittle. Under traffic loading, the porous asphalt will ravel and crack at a faster pace then dense graded asphalt and require replacement quicker, resulting in increased maintenance costs.

Pavement design incorporates a structural number for the various pavement support layers. Porous asphalt structural number is about one half of conventional graded asphalt. Therefore the pavements will be much thicker and costlier with porous asphalt.

Increased maintenance for porous asphalt roadways would include checking to see that the porous pavement dewaters during large storms and does not pond into surface. This increase maintenance task would increase the overall labor and material maintenance cost.

The criterion of the NPDES permit proposal and increased pavement deformation created by porous asphalt pavement designs will result in shorter roadway life-cycles and higher facility rehabilitation costs. With very limited revenue, Roads can not afford the decreased roadway life-cycle of porous asphalt or the increased cost of roadway restoration and rehabilitation.

Dense graded asphalt and concrete pavement have a longer life with less maintenance then permeable pavement on traffic routes

Under certain circumstances you would still need a water drainage system to handle major storm events even with the air voids; thereby, increasing the project costs even more with the placement of porous asphalt and a typical storm drainage system.

Testing

Currently, WSDOT does not have a standard specification for testing and acceptance of porous asphalt. Moreover, there isn't any porous asphalt AASHTO or ASTM test methods for quality of product.

Porous asphalt is not a standard mix and requires special asphalt oil; a stiffer blend currently proposed PG 70-22. Local suppliers do not stock PG 70-22 in their tanks and many suppliers only have one storage tank. The suppliers in our area currently store PG 64-22 in their tanks, which is the standard oil for our area. The availability of PG 70-22 is problematic

Additional Research Required

Porous asphalt is an engineering tool that must be evaluated for use on a case by case basis based on the specific site conditions. Widespread usage of porous asphalt on County roadways could have long term adverse effects on the roadway system. It is common practice that new or proposed policies be studied under controlled conditions prior to implementation to evaluate the impact and feasibility. With that goal in mind, if porous asphalt is to be considered for widespread usage, it needs to be studied on different roadway classes under controlled test section conditions. Once these test sections are in place they need to be evaluated for performance over a long period of time. Once the long term studies are complete, the County can make an intelligent decision as to the applicability of such a pavement system and the questions of longevity and maintenance of porous asphalt can be better addressed. Such test section must include a means of measuring the different variables of interest. Additionally, study and research will need to be sought out to evaluate how to overlay porous asphalt and maintain the pervious nature.

Unfortunately, the review deadline was really short and we did not have an opportunity to respond to the proposal as thoroughly as we would have liked. In anticipation of further discussions we are continuing to review the details and potential impacts of the proposal. If you have any questions regarding the comments please e-mail at Lydia.reynolds-jones@kingcounty.gov or call me at 206-296-8210.