LID ELEMENT #15: IMPERVIOUS PAVEMENT WITH UNDERDRAINS

OBJECTIVE

Promote stormwater infiltration through use of underdrains beneath impervious pavement.

CONSIDERATIONS

For the purposes of this element, only new construction has been analyzed.

RELATED ELEMENTS

Element 11 Bioretention Street Section
Element 14 Permeable Pavement

TRADITIONAL STORMWATER MANAGEMENT WITH IMPERVIOUS PAVING

Stormwater infiltration facilities located beneath pavements are commonly used to manage runoff on commercial, industrial and multifamily projects where space is at a premium. Underground stormwater systems, most often located under parking areas, are a space efficient solution. When on-site soils provide good infiltration, infiltration galleries or trenches are typically used, and the design and function of these systems are well established. Use of under-pavement infiltration is not common practice for roadways.

"Pavements contribute to increased peak flow, flow durations, and associated physical habitat degradation of streams and wetlands. Effective management of stormwater quality and quantity from paved surfaces is, therefore, critical for improving fresh and marine water conditions in Puget Sound."

Low Impact Development Technical Guidance Manual for Puget Sound, Puget Sound (2012)

CODES AND STANDARDS REVIEWED

Drainage Design and Erosion Control Manual (DDECM) Volumes 3 & 5
Engineering Design and Development Standards (EDDS) Chapter 4 & 5
Olympia Municipal Code (OMC) Section 18.38.220 (parking design standards)

BENEFITS OF USING UNDERDRAINS BELOW IMPERVIOUS PAVING

Infiltrating under impervious paving accomplishes the goal of distributing the area of infiltration across a larger area compared to isolated stormwater ponds and infiltration facilities. Using this technique achieves an infiltration pattern similar to that of pervious pavement, and can be achieved without the challenges and risks that are associated with use of permeable paving systems (see Element 14 for a discussion of these challenges).

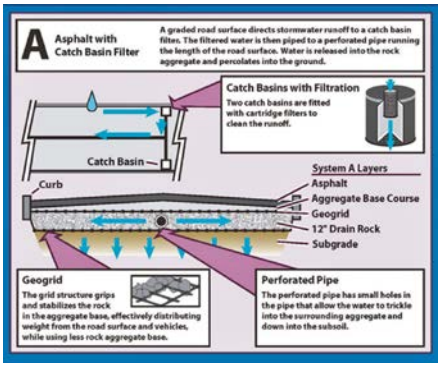
OLYMPIA CODE ANALYSIS

Paved surfaces typically consist of roadways, driveways, sidewalks, paths, and parking lots. These paved surfaces are placed both on private property and within public right-of-way.

Road, driveway, sidewalk, and pathway design are generally addressed in Chapter 4 of the EDDS. Stormwater design guidelines are addressed in Chapter 5 of the EDDS. Use of underdrain infiltration systems beneath roadway pavement is not specifically prohibited within the EDDS; however, it is inconsistent with street section details and standards.

Parking lot design is discussed in OMC Section 18.38.220. Drainage for parking lots is addressed in the DDECM and EDDS. In application, the City routinely approves under pavement infiltration systems for parking lots, most frequently on smaller parcels and infill lots with commercial uses.

The design requirements for infiltration systems under parking lots are discussed in both Volume 3 and Volume 5 of the DDECM. Per the manual, infiltration systems may be placed under impervious surfaces.



Current regulations for parking lot design do not specifically address the use of under pavement infiltration. In practice, these systems are routinely approved by the City under parking lots. Decatur Street in Olympia is a demonstration project for this technique under streets.

The City has no standards for required structural capacity of street sections with infiltration galleries.

In summary, current regulations for roadway and parking lot design do not specifically address the use of under pavement infiltration. In practice, these systems are routinely approved by the City under parking lots on private property. Design standards for infiltration systems are present in current codes.

HURDLES TO USE OF PAVEMENT WITH UNDERDRAINS

The use of under pavement infiltration systems presents the following challenges:

Higher Cost Than Standard Systems – Under pavement drainage systems are more expensive to construct than above ground systems. Above ground systems typically are composed of a surface pond that is created by excavating native soils and a series of catch basins and pipes that route runoff to the pond. Under pavement drainage systems are most often installed beneath parking lots. They require the use of catch basins and pipes to collect runoff, as well as many large peforated pipes that are installed several feet below the final surface. In addition, an overflow contingency plan is also required. The construction costs of the extra materials and excavating large areas for installation of the perforated pipes and drain rock can be quite costly and are usually installed when space is a factor - primarily on commercial and industrial sites and occasionally for multi-family projects.

Larger than Above Ground Systems – Most under pavement infiltration systems are constructed of rock and pipe. The volume available for stormwater storage is within the voids between the rock and within the pipe. To achieve the same storage volume as an open pond, the underground facilities typically are much larger.

Long Term Maintenance/Replacement – Underground infiltration systems are inherently difficult to maintain due to lack of access. Per the DDECM, access ports are required for on-going maintenance activities but access is still fairly limited. Maintenance activities typically cost more than maintenance of above ground systems and could require reconstruction of the roadway.

Should a system begin to plug and not provide the design infiltration rate, a partial or even complete replacement is often the only viable option. The expense of this replacement includes the cost of removing the improvements (usually parking lot) above the facility, excavating to expose the system, making the necessary repairs, and replacing the improvements once repairs are complete. Given the costs and inconveniences, requiring long-term maintenance is challenging.

Site Suitability Criteria – The DDECM Volume 3 Section 3.36 includes site suitability criteria for design of infiltration systems. These include:

- Setbacks – Ensures that infiltration facilities are setback a sufficient distance from sensitive areas such as wells, septic tanks, building foundations, and steep slopes.
- Ground Water Protection – Ensures the preservation of aquifers and wellhead protection zones.
- High Vehicle Traffic Areas – Specifies additional pollutant removal needed for industrial and high vehicle traffic areas.
- Contingency Planning – Requires a back-up plan in case design infiltration rates are lower than expected.
- Infiltration Rates/Drawdown Time – Provides criteria for infiltration facilities that are providing stormwater treatment and determination of design infiltration rates.
- Soil Physical and Chemical Suitability for Treatment – Criteria to ensure that the soils will support this use.

Should a system begin to clog and not provide the design infiltration rate, typically a partial or even complete replacement is the only viable option.

Utility Conflicts – The space under roadways is typically used for utility corridors (water, sewer, power, and communication lines). Placement of stormwater facilities beneath roadways can create conflicts with these utilities and compete for limited space. In some instances stormwater systems could be placed beneath the utilities but this may have limited feasibility. Maintenance of existing utilities would be more complex and cost more.

Construction Challenges – Areas proposed for infiltration need to be protected from compaction and sediment-laden runoff during construction. Construction sequencing and erosion control need to be carefully planned to ensure areas planned for infiltration are not compacted or clogged. Additionally, the design depth of the under pavement infiltration facility needs to ensure that the compaction necessary for the pavement does not impact or compact the stormwater facility below.

Inspection and Enforcement – Underground systems with limited access are difficult to inspect and ensure on-going functionality. Because they are located out of sight, they are less likely to be maintained regularly. Problems with system functionality are often not caught until flooding occurs.

OPTIONS

The options considered are as follows:

- Option 1: Keep codes as is (no change).
- Option 2: Allow under streets where feasible (private or public).

ANALYSIS

Option 1 would keep the status quo. The result would be continued use of under pavement infiltration, largely under parking lots where space is at a premium. For projects where space is not a factor, above ground systems will likely continue to be preferred given the lower cost of construction and maintenance for these facilities.

Option 2 would require additions to either Chapter 4 or 5 of the EDDS to address allowance of drainage facilities below streets. Specific language would be needed to address where under pavement drainage is and is not allowed. A cross reference to the DDECM would also be beneficial. The DDECM discusses design requirements and feasibility criteria for infiltration systems.

Option 2 would likely result in some level of increased use of under pavement infiltration. Under pavement infiltration would allow maximum flexibility for street stormwater management system design. System design can balance the requirements for right-of-way acquisition or dedication. However, risks, uncertainties, conflicts, and long-term maintenance implications are relatively high at this time.

RECOMMENDATION

Staff recommends Option 1. The City already allows use of under pavement infiltration under parking lots and other on-site hardscapes. Therefore, current City code already encourages this LID practice where it is most appropriate and feasible.

Placement of under pavement infiltration systems under streets has too many risks and conflicts to be feasible.