Figure 1. Commercial Parking Lot BMP Train (Bio-swale, Overflow to MS4)

PHOTO: CITY OF DOWNEY

Discussion: Low Impact Development

Runoff Water Conservation Associated with Urban Redevelopment

DESI ALVAREZ

MUNICIPALITIES IN SOUTHERN CALIFORNIA are confronted by many challenges and a dearth of resources with which to address them all. Urban runoff impairment, during dry and wet weather, constitutes one of the more significant future challenges to the efficient provision of public services, including public safety, transportation, education, and recreation, especially within current fiscal constraints. While we would welcome the elimination of impairment-causing pollutants from our receiving waters, the pollutants' divergent sources, physical characteristics, strict standards, monitoring costs, and difficulty of removal make controlling runoff pollutants a classic "tragedy of the commons" issue, in which the societal benefits and costs are incremental and impossible to fairly distribute.

Local agencies are being asked to resolve receiving water impairments resulting from conflicting objectives that are outside our historic purview. A significant share of the copper in our rivers appears to have resulted from a federal initiative to reduce braking distances (and save lives) by increasing the copper content in vehicle brake pads. A similar assertion could be made with respect to legacy and currently approved pesticides. Some organizations demand the revitalization of rivers, while ignoring past flooding that claimed lives and property and the future costs of condemning thousands of privately owned riverside parcels. Cities are also confronted with the desire of residential and commercial property owners to improve their land, which usually means more people, impervious structures, and demands for government services. Momentarily ignoring these tensions, cities can be induced into embracing water quality protection through incentives and shared agency commitments. Taking advantage of beneficial geographic attributes, the City of Downey has implemented a runoff reduction and water quality protection program tied to owner-initiated parcel-level redevelopment projects. Over the last five years, this program has resulted in Low Impact Development (LID) Best Management Practices (BMPs) or Stormwater Control Measures (SCMs) on more than 1,000, of the 22,000, parcels within our municipal boundary.

Similar to most communities within the southern portion of Los Angeles County, the City of Downey is built out and mostly residential, with other portions zoned for industrial, commercial, and public use. The 2010 census should identify about 115,000 residents within our 12.6 square mile boundary, or nearly 10,000 per square mile and 16 per acre. The eastern half of the City drains to the San Gabriel River, while most of the remainder drains west to the Rio Hondo and Los Angeles Rivers, and just over 200 acres drain south to the Los Cerritos Channel. For drivers, the majority of the City is within the 5, 605, 105, and 710 freeways. By area, the majority of publically owned land is streets, schools, parks, fire stations, and other public facilities. The drainage system was primarily built by the Los Angeles County Flood Control District, more than a half century ago and, partially due to subsequent home improvements, is often deficient to convey the 25-year storm. Fortunately, levee improvements brought most of the City out of the regional floodplain by 2002, saving residents millions of dollars per year in flood insurance costs.

Stormwater initiatives are primarily supported by the City of Downey General Fund, meaning that new initiatives and projects divert funds from other services such as public safety, public works, and community services programs. With these fiscal constraints, and an exponentially growing list of federal and state mandates, the Engineering Division of the City of Downey Department of Public Works decided to focus our municipal National Pollutant Discharge Elimination System (NPDES) permit compliance effort on encouraging infiltration, or runoff retention, in redevelopment projects (figure 1). This benefits the community and environment in several ways: 1) runoff, and the constituents it contains, is not lost to the ocean and can resupply upper groundwater levels, where it is available for non-potable uses; 2) the drainage system conveyance load is reduced, reducing the likelihood of regional flooding; and 3) the burden is placed on those property owners changing the status quo, while still being proportional to the project.

In our community, this focus on redevelopment was initiated as a requirement for the installation of a runoff retention device whenever a project constructed, or replaced, 400 square feet or more of impervious surfaces on a parcel. The runoff retention device is sized based on the project. This generally is equal to a moderately sized room addition, which requires a Building and Safety Department permit but ignores patio pads and walkways that do not. The next design parameter was the depth of rainfall to retain, which is correlated with BMP cost. Annual rainfall in the City of Downey is about 13 inches, while the 25-year storm

is more than 5 inches in 24 hours, or 10 inches over 4 days, which are clearly extreme criteria with costs that are disproportionate to the benefits. The Regional Water Board Municipal Separate Storm Sewer System (MS4) permit and Standard Urban Stormwater Mitigation Plan requirement of 0.75 inches or 0.0625 feet (85th percentile) must be applied to large residential and commercial projects, but there was no inherently indefensible reason why this requirement could not be applied to smaller projects.

This parameter was easy to explain and calculate[1], and eliminated the need and expense for an engineer's determination for most projects. In application, this parameter is generally determined as a "dead" or "blind," rather than dynamic, water quality volume, meaning that we ignore infiltration rates. This is important for several reasons: first, the City can exert little control on soil compaction under small BMPs; second, BMP percolation rates are likely to slowly drop over time (although they can be "recovered" when the parcel is redeveloped); third, for the design storm infiltration BMPs generally focus infiltration by a ratio around 30 to 1, meaning that for every 30 square feet of impervious surface area, there is typically about 1 square foot of infiltration area; and finally, this parameter eliminated debates about infiltration rates and the need for engineered percolation studies that rarely resulted in design savings commensurate with costs. For reference, the Los Angeles County Department of Public Works Hydrology Design Manual Soil Maps suggest an infiltration rate of 0.35 inches per hour is appropriate for Downey. Since the most commonly used BMPs hold about 30 inches of water, percolation time is about 85 hours, slightly higher than the optimal 72-hour mosquito maturation time, but these BMPs are generally underground and cool, which significantly retards development.

Implementation of this program was devised based on the normal City of Downey plan check process. Project proponents, be they residents, developers, or code violators, begin at the Planning Counter, where zoning, setback, and landscaping requirements for the project are defined. The project is then reviewed by the Building and Safety Department, which clarifies on-site issues and determines the level of plan checking for the project. The proponents are then referred to the Department of Public Works, which reviews easement issues, traffic visibility, and encroachment. In cases of fences or walls, which have little impact on infiltration, the project is generally approved and returned to the Building Department, but for other projects, the proponents are introduced to the City of Downey runoff retention policy and given some BMP examples for how the project might proceed. Typically, this interaction highlights rain gardens, porous pavers, pervious pavement, and underground retention/infiltration systems (Figure 2). While a significant portion of naïve proponents are initially unreceptive to this requirement, they usually acknowledge the impact of state and federal regulations on local government and our reluctance to devote tax dollars toward the purchase and construction of regional treatment facilities that are needed a few weeks per year but must be continuously maintained by the City. Counter staff are trained to explain that large private and, most importantly, public projects must implement comparable measures, point

Figure 2. Residential Infiltration System at the Installation Midpoint

PHOTO: CITY OF DOWNEY

to some nearby examples, and then interactively discuss alternative proposals and concepts to gain proponent buy-in. The most recalcitrant proponents are encouraged to propose other (compliant) alternatives or abandon their projects, but most eventually select plastic half-barrel-shaped devices[2] surrounded by rock, and placed 4 feet underground, in the front yard. Rock pits are occasionally proposed and accepted with calculations, but since the void area is only about 35%, these pits are typically at least twice as large and use several times more rock.

Although no formal surveys have been conducted, proponents seem to favor these BMPs for the following reasons: 1) Sizing has been provided by the City, 2) City inspectors and local contractors are familiar with installation and inspection, 3) the BMP is essentially invisible to the property owner and can be placed away from any foundations, and 4) the City does not require a Covenant and Agreement since, once the BMP is installed, there is little incentive to fill or remove the BMP before the next redevelopment cycle. Once the BMP has been sized and shown on the building plans in sufficient detail to allow construction, they are approved by the Engineering Division and returned to the normal building process. (Larger Standard Urban Stormwater Mitigation Plan [SUSMP] or General Construction projects receive a greater level of attention and oversight, but similar criteria apply.)

For smaller, particularly residential, remodeling projects, "mitigation" is allowed whereby the proponent is allowed to build at the rear of the property, while installing the BMP in the mandatory setback area of the front yard. The runoff is collected from roof gutter downspouts or trench drains set in the driveway or near the front of the "side yard" areas. From the drainage inlet, filter fabric-lined rock trenches with an effective cross section of 1 square foot or effectively similar conveyances bring the runoff to the BMP. These BMPs are usually constructed as "blind sacs" that, once filled with the first flush of runoff, allow any additional water to surface flow, usually through turf grass, to the convey system. The incremental installation costs of these small parcel-level BMP projects is typically about $1 per square foot of impervious surface, while rain gardens are likely to cost significantly less. However, in our community, there seems to be either a reluctance to construct sunken "ponding" areas within the front landscape or, more likely, the government is perceived as intruding in the form of a

Figure 3. Municipal Golf Course Parking Lot Passing Bio-swale With Infiltration Inlet

PHOTO: CITY OF DOWNEY

Covenant and Agreement that is the restricting factor. Unfortunately, without such an agreement, there would be no constraint to filling in the rain garden, and enforcement would be nearly impossible.

For larger projects, or impervious areas that are likely to generate pollutants such as parking lots, project proponents are directed to first convey the runoff through at least 20 feet of bio-swale or across a narrower bio-strip (Figure 3). The waxy cuticle of the vegetation absorbs oils and grease and holds these pollutants so that later microbial processes can encourage the pollutants' decomposition. Solids and trash are likewise trapped among the grass blades where the pollutants can be collected during the next mowing or become enmeshed in the root mass. Very light storms, first flush from larger storms, and irrigation overspray can be trapped in a well-designed system and allowed to infiltrate into the landscape and be taken up by the vegetation. We have had the greatest success with Fescues and similar turf grasses, although some thick ground covers (e.g., Dutch Apple or Gazanias) also appear to work well. More drought-tolerant and slow-growing vegetation may eventually work as well but has generally required a degree of patience that exceeds regulatory constraints and is usually applied with mulch, which is easily mobilized by moderate storms and can produce problems of its own. After pre-treatment through the bio-swale or strip, significant runoff is allowed to pond slightly (< 6 inches) and then flow into a raised inlet and the infiltration portion of the BMP treatment system. The raised inlet is intended as a spill capture precaution, in case the parking lot is illegally used for oil changes or other car maintenance activities. Once the "blind sac" infiltration system captures the most contaminated runoff, additional runoff is allowed to enter the drainage conveyance system.

While the examples presented here relate to mostly residential and commercial parcel projects, including the City of Downey–owned Rio Hondo Event Center and Golf Course, the City of Downey has also undertaken several unique regional and sub-regional projects on public properties. A public street, Congressman Steve Horn Way, was constructed with an inverted median, meaning that flows are allowed to cross the traffic lanes and are then conveyed along a gutter and through periodic curb breaks and into a vegetated center median, which is lower than the paved street sections. Initial runoff and irrigation flows settle into the landscaping and evapotranspirate or infiltrate, while higher flows overspill into a drainage system. Along most of this street, which accepts runoff from a mostly impervious area of 60 acres, this drainage overflow is conveyed through twin continuous deflective separator (CDS) hydrodynamic separators to remove trash and debris and then into an infiltrating/detention basin constructed under Discovery Park (Figure 4). The 25-year storm runoff from this catchment is 120 cubic feet per second (CFS), and before this project, the downstream conveyance system was deficient and unable to convey more than a 3-year storm. In addition to allowing percolation at the two CFS, the multi-million-dollar BMP can store the difference between the 120 CFS design storm and the 20 CFS downstream conveyance capacity.

Since more than 1,000 parcels have been constructed to include runoff-retaining BMPs in the City of Downey, local agencies can clearly be motivated to support water quality protection. However, the regulatory process needs to encourage this effort and regulations such as Total Maximum Daily Loads (TMDLs) written to accommodate the slow path upon which redevelopment occurs. Alternatively, the current regulatory- and litigation-based stalemate will likely continue as few communities are able to afford the privately held land needed for regional BMPs or, worse yet, construct expensive treatment facilities that must operate only a few days per year.

Figure 4. Regional Infiltrating Detention System Construction Under City (Discovery) Park

PHOTO: CITY OF DOWNEY

(Endnotes)

[1] The calculation is impervious area in square feet, times 0.0625 feet = the retention volume in cubic feet.

[2] Examples include Cultec®, Stormtech®, and Trident®, but many other similar devices exist and are welcomed.

DESI ALVAREZ *is a California Registered Professional Engineer and the Deputy City Manager for the City of Downey, where he has implemented a variety of major Public Works programs and projects over the last dozen years. Mr. Alvarez has also held public sector positions in the East Bay Metropolitan Utility District and in the Cities of Redondo Beach, Glendale, and Santa Monica, where he oversaw reconstruction of the Third Street Promenade and Santa Monica Pier, gateway to the Santa Monica Bay.*