1.1 Stormwater Management Objectives for Development

This chapter presents eight primary objectives to guide a comprehensive approach to stormwater management on any land development project. Although some reflect regulatory requirements while others do not, planning with all these goals in mind will minimize the development's impact on Ohio's lakes, streams, rivers, and wetlands. They also offer the potential benefits of a more sustainable and valuable development.

Many of the tools available to achieve these objectives are discussed individually throughout this manual. Each objective below directs the reader to the chapters covering the applicable tools, which many refer to as Best Management Practices and Stormwater Control Measures. Apply the structural and non-structural tools that best fit the existing site conditions as well as the type, size, and complexities of the planned development.

Objective 1: Preserve the Natural Drainage System

The natural drainage system includes streams, their corridors and floodplains, and wetlands. It provides many benefits ranging from floodwater storage and drainage to pollutant removal and wildlife habitat, none of which are completely replicated in engineered storm drains, ditches, and treatment practices. Even swales and ephemeral drainage without well-defined channels provide valuable stormwater and drainage benefits.

Development that disrupts the natural drainage system not only fails to take advantage of its free services but may cause significant problems for future occupants. Property or new infrastructure may be damaged by flooding, natural or aggravated stream bank erosion, or the elevated ground water associated with saturated floodplains or wetlands. In addition, valuable aesthetics and recreational uses of on-site surface waters may be diminished.

For these reasons, developers and site designers are strongly encouraged to begin planning by defining the existing drainage system and then preserving as much of that drainage system as possible when laying out the development. In addition to complying with non-stormwater regulations regarding floodplains, streams, and wetlands, consider the practices described in **Chapter 1** to meet this objective.

Many communities have implemented drainage corridor protection setbacks or zones in local regulation as discussed in **Chapter 1.5**.

Objective 2: Improve Degraded Streams

In addition to preserving the natural drainage system as outlined in the first objective, take this opportunity to restore on-site streams and floodplains degraded by past land uses and/or upstream development.

Unfortunately, the typical pattern in urban areas is that a healthy stream - where bank erosion is balanced by deposition to develop a naturally stable form - becomes physically degraded. As watershed development produces faster stream flows on a regular basis, stream channels usually respond by adjusting their shape and size through erosion. The stream cuts downward, losing access to its floodplain and its many drainage functions. This results in deeply entrenched urban streams plagued with bank erosion that contribute more sediment to downstream areas, rarely maintain high quality habitat features (clean gravel substrates, deep pools,

Figure 1.1.1 This degrading stream is an obstacle rather than an amenity, requiring hardened banks and threatening utility infrastructure.

and stable riffles), and provide less storage and treatment of stormwater runoff.

Rehabilitating degraded streams is best accomplished and often more cost-effective when completed during initial construction of the development. There will be fewer impediments (site access, working around developed properties) coupled with a lower cost for materials and heavy equipment already on site at this time.

Restoration can return a stream corridor to a valued landscape feature that increases property values (Towe, 2021) and prevents continuing erosion from later endangering the new infrastructure. It may be possible to partner with third-party entities looking for a mitigation site, demonstration project, or watershed-scale restoration programs.

Although a key component of stormwater management, stream restoration techniques can require specialized knowledge of stream geomorphology in addition to hydrology and hydraulics. Designers are directed to the following external stream and wetland restoration references for technical guidance.

- Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group. USDA-NRCS National Engineering Handbook, Part 653. October 1998
- Stream Restoration Design. USDA-NRCS National Engineering Handbook, Part 654. August 2007.
- Wetland Restoration, Enhancement, or Creation. USDA-NRCS Engineering Field Handbook, Chapter 15. National Engineering Handbook Part 650. April 2008

Objective 3: Minimize and Disconnect Impervious Surfaces

Minimizing impervious landcover is a critical step in reducing stormwater runoff impacts. Numerous studies show that stormwater pollutant load, runoff volume, and peak discharge rates directly corollate to the percent of impervious area within a watershed or project area. This generally translates to stream quality decreasing with increasing watershed impervious cover (Schueler, 2009).

Paved areas (streets and parking) offer the first chance to reduce imperviousness. Layout residential streets that maximize the number of lots per length of street with the minimum pavement area to support the expected volume of traffic. Reduce excess imperviousness by not exceeding minimum parking ratios and requesting variances to replace excess parking with open space or landscaping. Parking standards traditionally promote excess parking even during peak use. Review the development strategies described in **Chapter 1.2** for other ways to minimize impervious surface and its impact. Consider alternative materials such as permeable pavement or green roofs to change the nature of impervious surfaces, especially those with infrequent use.

With total impervious area minimized, reduce the hydrologic impact of planned impervious surfaces by disconnecting them from the drainage system. By directing runoff to sheet flow through lawns, berms, swales, and open space prior to entering conveyance pipes or ditches provides initial filtering of pollutants, abstracts runoff volume from small storms, and reduces peak discharge rates. In a thoughtfully planned development, disconnection practices described in **Chapter 2** can reduce cost of hard drainage infrastructure and the need for large stormwater management practices.

Local communities are encouraged to reduce mandated parking space ratios to minimize the impact on stormwater, implement programs to encourage greenspace, and promote disconnecting impervious surfaces.

Objective 4: Manage Post-Construction Stormwater Runoff

As noted, the addition of impervious surfaces, along with compacted urban soils, increases runoff volume, energy, and peak discharge frequency. Along with these hydrologic impacts, the change in land use introduces pollutants to stormwater that are transported in runoff to surface waters. **Chapter 2** details permanent stormwater management practices that protect the quality as well as the stability and biological integrity of the receiving surface waters through sedimentation, filtration, detention, and/or infiltration.

Permanent stormwater management practices should be viewed as a valuable utility for the development and community. They can encompass many local needs including drainage, flood control, and protection of local drinking and recreational waters.

Designers are encouraged to integrate these post-construction stormwater management practices not only into the drainage system, but into the development such that they become amenities, furthering their value. In some cases, practices may be dispersed throughout the development as described in **Chapter 1.2** to manage stormwater "at the source" whereas centralized or "end of pipe" controls may be better suited for other sites.

Local communities are encouraged to consider the cumulative impacts of development and employ regional or watershed-based stormwater management strategies. Consider state-endorsed watershed action plans, Ohio EPA's total daily maximum loads (TMDLs), critical stream discharge, and other waterbody-specific water quality data and tools in developing these local strategies.

Note post-construction stormwater management practices in this manual are directed at typical urban runoff pollutants and pollutant concentrations, in particular total suspended solids. Some industrial and municipal land uses may have a higher risk of releasing specific (and potentially more significant) pollutants. U.S. EPA and Ohio EPA NPDES permit programs offer other resources regarding pollution prevention and good housekeeping for industrial and municipal operations. Removing pollutant exposure to stormwater runoff altogether will be the primary practice in many situations.

Objective 5: Ensure Long-term Access to and Maintenance of the Post-construction Stormwater Management Practices

Regular inspection and maintenance of permanent stormwater management practices are necessary if they are to consistently perform as designed. Practices that are inaccessible and/or lack the features discussed in **Chapter 2** to conduct maintenance can become ineffective to the point of presenting a nuisance or hazard. Developers, designers, and regulated communities must address long-term operation and maintenance of the stormwater management practices during the design phase. This includes implementing low-maintenance practices, providing direct access to them, and identifying the party responsible for conducting inspections and maintenance.

Local communities are encouraged to ensure a truly reliable party with adequate funding to perform maintenance is identified at the project's inception. Often an uninformed property owner, unstable homeowner's association, or non-descript party is relied on to perform maintenance that must ultimately be assumed by others, often the community and at a higher cost.

Objective 6: Plan Sustainable Drainage Improvements

Plan stable drainage improvements and conveyances that will not contribute additional sediment and pollutants to stormwater runoff through erosion. This involves both careful estimation of runoff volumes and flow rates for conveyance sizing and the application of permanent stabilization practices. Areas to address commonly include steep slopes, open drainage channels (ditches and swales), and areas receiving concentrated flow such as the outlets of storm sewers systems. **Chapter 4** provides guidance on permanent runoff control practices to install at the time of development to safely convey runoff and control erosion.

Local communities should ensure their stormwater and drainage regulations reflect the most current precipitation data, design standards, and runoff estimation methods with realistic data inputs and selected coefficients.

Objective 7: Minimize the Stormwater Discharge of Sediment During Construction

Soil disturbed by earthmoving and other construction activity can temporarily produce high sediment loads in stormwater runoff. Minimizing the discharge of sediment during construction requires an adaptive, multi-level strategy. It begins with the temporary runoff control practices in **Chapter 5** and the soil stabilization practices in **Chapter 7** to minimize the exposure of soil to erosion. Then apply the sediment control practices in **Chapter 6** to remove sediment carried in stormwater runoff before it leaves the site. Simply limiting the area disturbed is a vital practice for all projects to minimize the erosion and sediment control practices needed and improve their effectiveness.

Erosion and sediment control is a dual responsibility. While the implementation and maintenance of temporary practices on the construction site is often left to the contractor, a pre-planned strategy in the construction documents must be developed by the designer to guide that contractor. The size, type, design, location, and timing of erosion and sediment control practices must be detailed in the Stormwater Pollution Prevention Plan or SWP3 discussed in **Chapter 1.3**.

Objective 8: Prevent the Stormwater Discharge of Non-sediment Construction Pollutants

Much of the focus of this manual is on minimizing the discharge of suspended solids as sediment in stormwater but the construction process can generate many other pollutants, many of which are prohibited from being discharged.

Runoff from material storage and handling, equipment fueling and service, equipment cleaning, waste storage, or similar pollutant-producing areas must be prevented entirely by eliminating its exposure to stormwater or otherwise be directed to advanced treatment practices such as the sanitary sewer system. **Chapter 3** gives descriptions of non-sediment pollutant concerns on construction sites and recommendations for their management.

References

Ohio Environmental Protection Agency. 2018. Ohio EPA Permit No. OHC000005. General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System.

Schueler, T., L. Fraley-McNeal, and K. Cappiella. 2009. Is Impervious Cover Still Important? Review of Recent Research. J. of Hydrologic Engineering, Vol. 14, 4:309-315. American Society of Civil Engineers. Reston, VA.

Towe, C., H. Klaiber, J. Maher, and W. Georgic. 2021. A Valuation of Restored Streams Using Repeat Sales and Instrumental Variables. Environmental and Resource Economics, 80:199–219. doi.org/10.1007/s10640-021-00575-9.