CHAPTER 3

LANDSCAPE STRATEGIES



Fig. 3-01



Negley Station - Photo by PRT

3. LANDSCAPE STRATEGIES

LANDSCAPE STRATEGIES OVERVIEW

The landscape strategies developed as part of these guidelines provide PRT with a system-wide approach to respond to critical landscape areas or conditions, which have been identified for improvement and/or intervention.

Strategies include:

	Trees	pg. 82
	Native Plant Diversity	pg. 86
	Manage Invasives	pg. 100
	Forest Rehabilitation	pg. 104
	Slope Stabilization	pg. 108
	Green Stormwater Infrastructure	pg. 114
	Depaving	pg. 120
	Traffic Calming	pg. 124
	Public Art	pg. 128
	Amenities	pg. 130

The goal of these strategies is to improve rider and employee experience and engagement throughout the PRT system by enhancing community connectivity, aligning landscape management with PRT's Climate Action Plan and carbon reduction goals, promoting landscape resilience through implementation of durable landscapes, and reducing the burden of landscape management by decreasing maintenance requirements and expanding operational efficiency.

The landscape strategies discussed in the subsequent sections will highlight key aspects and benefits of each design approach and provide an overview of how the strategy can respond to landscape conditions and lead to positive outcomes through goal attainment.



Fig. 3-02

Native plant diversity landscape strategy implemented at PRT's Negley Station along the MLK Jr. East Busway.

GOALS

ALIGN MAINTENANCE & LAND MANAGEMENT STRATEGIES

- convert high maintenance landscapes to low maintenance native alternatives

CREATE MORE DURABLE LANDSCAPES

- consider life cycles and how landscapes will evolve over time

IMPROVED RESILIENCE & BIODIVERSITY

- select diverse native species for planting designs
- manage invasive species
- reduce soil erosion and bare soil areas

ALIGN WITH CLIMATE ACTION PLAN & CARBON REDUCTION GOALS

- minimize the use of traditional concrete
- reduce the use of hardscape
- preference plant species with high carbon sequestration and storage potential

IMPROVE PASSENGER EXPERIENCE

- create comfortable, shaded, welcoming entry plazas and station areas
- maintain visibility for rider convenience and safety

INCREASE TREE CANOPY COVERAGE

- identify opportunities for tree planting

OUTCOMES

Increased ridership & revenue

Landscapes that PRT can maintain

Mitigate climate impacts

Net zero carbon emissions by 2045

TREES

Benefits

Establishing trees within the urban environment provides many important benefits including **traffic calming, stormwater management, improved air quality, shielding winds, cooling local heat island effects, energy efficiency, and enhanced mental health**. Tree planting also contributes to the design of **more attractive entry plazas and gathering spaces** that contribute to positive rider and employee experience and increased public engagement.

Applicability

Tree planting is most appropriate where each individual tree is provided a minimum volume of accessible soil for rooting (200 cubic feet). The location of new trees should also be selected to maintain all required offsets from right-of-way intersections and utilities.

Tree species selection should also consider the site specific context to avoid potential conflicts with utilities or other adjacent conditions. For example, designers should choose trees with less aggressive root systems to avoid upturned pavement surrounding tree pits and avoid locating trees that are expected to reach over 15 ft height at maturity beneath overhead wires where those conditions are present. Only certain tree species are appropriate for planting on steep slopes, exceeding (3:1), to avoid the risk of overturning. Further information about appropriate tree species for steep slopes is provided in the Slope Stabilization Landscape Strategy section.

STREET TREES

- Pittsburgh Code (§918.02) dictates at least one (1) street tree for every 30 LF of public street. Additionally it states that street trees have a minimum non-paved planting area of 30 sq ft, with a minimum depth of 3'. Where feasible a minimum planting area of 50 sf and 3ft depth should be provided.
- Maintain intersection site lines by implementing a minimum distance of 40' from stop signs and in the absence of a stop sign maintaining the same distance from intersecting rights-of-way.
- Tree pit/trench soil shall have an acidity range of pH 6.0 to 7.0 and a clay content of no more than 30%, contain not less than 3% organic material, and will be free of subsoil, slag, stones, and other forms of refuse/debris.
- Minimum street tree size is 2" caliper ball-burlapped. In the absence of overhead wires, select shade trees and if present select utility-compatible trees.
- Minimum spacing for large shade trees is 30' off-center and 25' off-center for utility compatible trees.
- Maintain a minimum distance of 5' from water and/or gas utility boxes and a minimum distance of 3' from edge of sidewalks, maintain ADA compliance.
- Stormwater tree pits and trenches should be considered where feasible.



Fig. 3-03

Street trees provide other benefits besides shade such as traffic calming, improved aesthetic, and reduced stormwater impacts.



London Plane (Platanus acerifolia), a common street tree known for their rapid growth, large canopy, and tolerance within an urban setting.

CANOPY TREES

- Utilize shade/canopy trees within plazas and parking areas to improve aesthetics, provide cooling, and manage stormwater. Aim for a goal of 1 tree per 5 spaces, vegetated islands in lots with more than 50 spaces, and maintain 10% of the total parking area as vegetated landscape.
- Plant shade trees near gathering spaces and entry plazas to make these spaces more inviting. Place seating and/or resting areas within shaded zones.
- Utilize trees to create traffic calming within parking areas, create areas of refuge for pedestrians, and direct circulation to and from stations and/or platforms.

URBAN TREE CANOPY CONSERVATION

Pittsburgh's zero net loss canopy policy, which was adopted under the City's Climate Action Plan, aims to increase canopy from 42% to 60% by 2030. To achieve this goal requires thoughtful planting strategies and conservation of existing wooded areas and shade trees.

- Preserve existing shade/canopy trees. During construction, do not disturb/impact more than 10% of an existing tree's root base. To estimate size of the root base, imagine a wine glass on a dinner plate.
- If a canopy tree is required to be removed, include replacement trees to mitigate its loss. The minimum replacement shall equal the combined caliper of the removed tree, which often results in a ratio of 2:1 or 3:1.



White Oak (Quercus alba), a common landscaping tree known for its longevity and hardiness, shade/cooling effects, and environmental benefits.



Entry plazas landscaped with trees create shade and make for an inviting gathering space, leading to an improved experience.

TYPES OF STREET TREES

COMMON NAME / CULTIVARS	SCIENTIFIC NAME	MATURE HEIGHT	BLOOM PERIOD	FLOWER/ FRUIT COLOR	SALT TOLERANCE	SUNLIGHT/ MOISTURE
STREET TREES: RECOMMENDED FOR PLANTING IN SIDEWALKS, MEDIANS, AND PARKING LOTS						
American Hornbeam	*Carpinus caroliniana*	20-35’	Apr-May	Yellow-green	-	
Ginkgo / ‘Magyar’ (Male Only)	*Ginkgo biloba*	40-50’	Apr-May	-		
Hackberry / ‘Chicagoland’ ‘Prairie Pride’	*Celtis occidentalis*	50-70’	Apr-May	Greenish		
Honeylocust	*Gleditsia triacanthos*	40-70’	May-Jun	Green-yellow		
Kentucky Coffee / Fruitless Cultivars Only	*Gymnocladus dioicus*	60-75’	May-Jun	Green-white		
London Plain / ‘Exclamation’ ‘Columbia’ (not ‘Bloodgood’)	*Platanus x acerifolia*	60-80’	Apr	Yellow-green	-	
Silver Linden	*Tilia tomentossa*	50-70’	Jun-Jul	Creamy-yellow	-	
Zelkova	*Zelkova serrata*	50-70’	Apr-May	Yellow-green	-	
SHADE TREES: RECOMMENDED FOR PLANTING IN PLAZAS AND OTHER PUBLIC SPACES TO ENHANCE THE URBAN TREE CANOPY AND INTEREST						
Bald Cypress	*Taxodium distichum*	50-70’	Apr-May	Greenish	-	
Bur Oak	*Quercus macrocarpa*	60-80’	Apr-May	Yellow-green		
Carolina Silverbell	*Halesia tetraptera*	20-40’	Apr-May	White	-	
Chinkapin Oak	*Quercus muehlenbergii*	40-60’	Apr-May	Yellow-green		
Downy Serviceberry	*Amalanchier arborea*	15-25’	Mar-Apr	White	-	
Flowering Cherry	*Prunus, spp.*	20-30’	Mar-Apr	Pink/white	-	
Hophornbeam	*Ostrya virginiana*	30-50’	Apr-May	Yellow-green	-	
Overcup Oak	*Quercus lyra*	40-60’	Apr-May	Yellow-green	-	
Smoke Tree	*Cotinus coggygria*	10-15’	May-Jun	Pink/purple	-	
Swamp White Oak	*Quercus bicolor*	50-60’	Apr-May	Yellow-green	-	

= Salt Tolerant [1] *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained [2]* *= Drought Tolerant [3]*

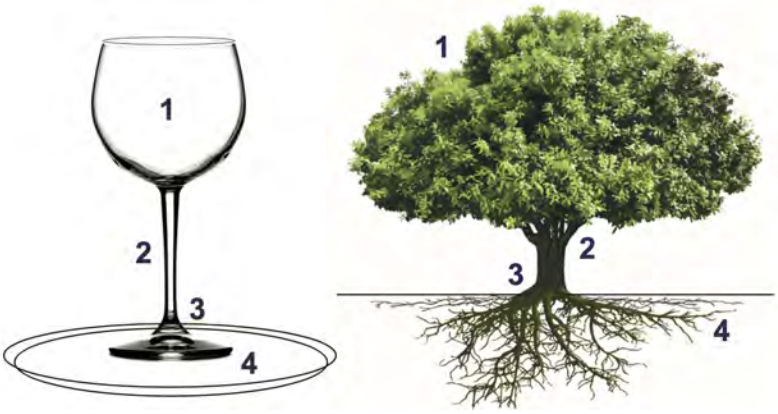


Fig. 3-07

1. Tolerant of road salts.
2. Allows water to infiltrate and move through the soil profile at a moderate rate, preventing prolonged saturation, and ensuring plant roots receive enough oxygen and avoid root rot and other water-related stresses.
3. Prolonged period of little to no rainfall that leads to excessively dry soil conditions, lower water table, and can cause significant stress or damage to plants not adapted to drought conditions.

A tree is like a wine glass sitting on a dinner plate. The top of the glass represents (1) leaves and branches, (2) tree stem, and (3) the structural root plate. A dinner plate (4) represents the feeder root system. Limit impacts to no more than 10% of the tree’s root system.

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

CITY OF PITTSBURGH LANDSCAPING AND SCREENING STANDARDS; CHAPTER 918 OF THE ZONING CODE

Encourages the planting of appropriate new vegetation and the preservation of existing vegetation and reduces potential nuisances by requiring a visual screen between different uses. Applies to all developments that are subject to Site Plan Review provisions.

URBAN FORESTRY STANDARDS

Guidelines for the planting, maintenance, and protection of trees within urban areas.

- ANSI A-300 Tree Maintenance Standards
- Pittsburgh Shade Tree Commission declaration of tree protection measures and standards[1]

TREE PITTSBURGH "ZERO NET LOSS" POLICY

Principle adopted by the City of Pittsburgh to maintain and grow its urban tree canopy by ensuring no net loss of trees occurs due to development or infrastructure projects. While Tree Pittsburgh itself is a nonprofit advocacy and education organization, the policy is embedded in city government practices and is supported by planning and permitting requirements.

- The goal is to replace every public tree removed with a new tree, at a 1:1 ratio at minimum—and often more if the removed tree was mature or had high ecological value.
- Replacement trees must be appropriate for the site, non-invasive, and approved species listed in the city's Street Tree List or relevant urban forestry standards.
- Projects must submit a tree replacement plan as part of their permit process if public trees are impacted.
- Public Tree Removal Permits are required for any work that may remove or damage trees within the public right-of-way.
- For projects unable to plant trees on-site, off-site planting or in-lieu fees may be required to maintain canopy goals.

Pennsylvania Standards/Guidelines

VEGETATION AND LANDSCAPING

PADEP encourages the use of native vegetation in landscaping to promote biodiversity and reduce maintenance needs. This includes guidelines for re-vegetating disturbed areas and using plants that are well-suited to local conditions.

Organization Standards/Guidelines

ISI Envision Standards

CLIMATE AND RESILIENCE

This category addresses climate impacts and ensures resilience to future challenges. Credits might focus on reducing greenhouse gas emissions, improving resilience to climate change, and preparing for natural disasters.

1. http://pittsburgh-pa.elaws.us/code/coor_titlefour_artxiii_ch487_sec487.02

NATIVE PLANT DIVERSITY

Benefits

Native plant diversity is a strategy to improve the aesthetic value of PRT landscapes while also reducing maintenance burdens throughout its system. Additionally, native landscapes will improve stormwater management outcomes, introduce cost and energy efficiencies, and benefit human and environmental health, all while increasing biodiversity that is vital to support native fauna and the local ecosystems in which we live and rely on.

Applicability

Allegheny County, Pennsylvania is mapped within the North American Ecoregion identified as Appalachian Mixed Mesophytic Forest. This ecoregion is globally recognized for its high level of biodiversity, species richness, and vital habitat warranting protection and conservation.[1] The region's unique topography and varied geology significantly contributes to the level of biodiversity observed and makes it a "hot spot" for many neotropical migratory bird species and other wildlife.[2]

While the above ecoregion represents large forest systems, the species makeup within these vegetative communities is essential for development of landscaping guidelines and identification of native plants suitable for the PRT system. By selecting local ecotype native species deemed suitable for the ecoregion, the result will be plants that are well adapted to the local climate regime, soil, and are resistant to pests reducing the need for extensive fertilization, watering, and/or pest control. This natural adaptation directly correlates to lower maintenance costs over time.

NATIVE PLANT COMMUNITY REFERENCES

The landscape untouched, within this ecoregion, would ultimately revert to a successional forest typology. However, wooded areas may not always be appropriate throughout the PRT system. This presents an opportunity for PRT to create, enhance, and/or restore critical microhabitats throughout its system, supporting a wide array of flora and fauna, while also reducing its maintenance burdens. Many forbs (i.e., flowering herbaceous plants), grasses, sedges, rushes, and shrubs thrive in areas of forest disturbance, which result in canopy gaps such as fallen trees, wildfire, and storm damage. Therefore, maintaining an herbaceous (i.e., meadow) and/or thicket/shrub landscape in strategic areas throughout the system will maintain an elevated level of diverse microhabitats critical to specialized species while also serving PRT's landscape needs.

Using local native ecosystems as a reference, the suggested appropriate native planting strategies for PRT include:

1. Tall grass meadow
2. Woody ground cover
3. Shrub thicket
4. Layered woodland
5. Native turf grass alternatives

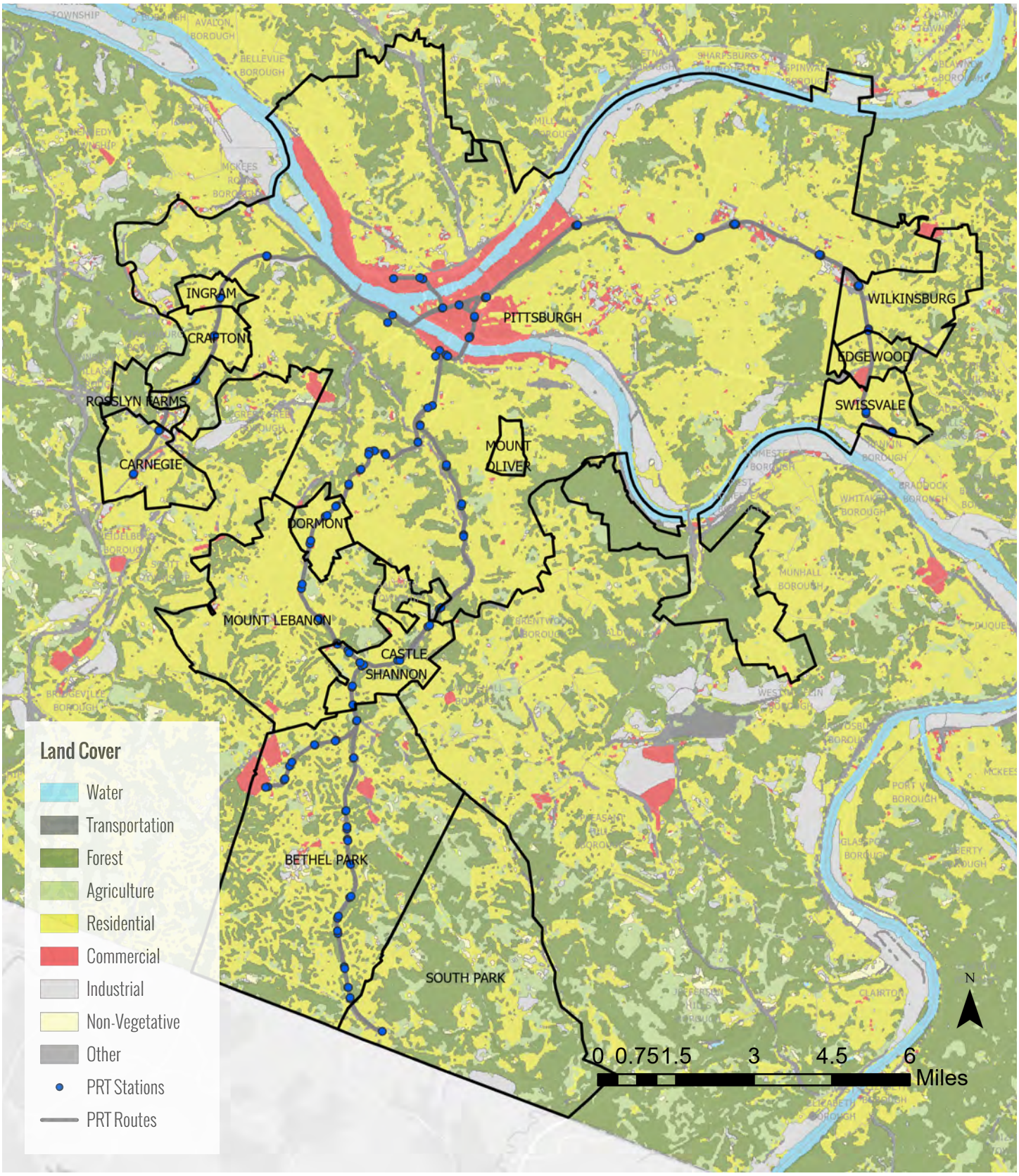
The following subsections identify strategies for implementation of these native landscape typologies throughout the PRT system and provide PRT staff with general guidance on species composition, function, and design/maintenance considerations for each landscape type through the establishment phase to long-term management.

The map featured to the right utilizes Allegheny County land cover data, last updated May 14, 2023, to identify land cover types (e.g., water, grassland, wooded, urban) present throughout the City of Pittsburgh and in relation to the PRT system (i.e., PRT owned parcels and routes).

As depicted, much of the developed space within the City of Pittsburgh consists of residential areas and commercial space. The dominant vegetative community consists of woodlands with small patches of grasslands. Implementation of these guidelines can help to improve regional habitat connectivity.

1. Ricketts et al. 1999
2. Collins et al. 2006

LAND COVER MAP



TALL GRASS MEADOW

A meadow landscape is a structure comprised of grasses and forbs (i.e., wildflowers). Meadows are cost-effective landscaping options that are relatively easy to install, require less frequent mowing, do not require irrigation, and provide ecological uplift. Other benefits include the natural aesthetic and beauty, increased access to nature and community engagement, urban cooling, reduction of stormwater/flood impacts, and climate resilience.

Design Considerations

- Soil characteristics such as texture (e.g., sand/loam/clay), pH (i.e., are soils acidic), and amount of organic matter;
- Assess sun exposure at the site and select species suited for the condition (i.e., full sun to shade);
- Evaluate moisture levels and drainage patterns within the site;
- Maintain site triangles, height of some species can impact site lines (Indian grass can grow to a height of 2.5-8');
- Generate seasonal interest (e.g., bloom period, winter seed pod retention and structure);
- Native grasses have deep growing roots (i.e., root systems extend up to 16' below ground surface), providing improved soil and slope stability.

Maintenance Considerations

- Low maintenance landscape that requires infrequent mowing (every 3 to 5 years; can be cut annually if desired);
- Leaf litter can largely be left in place, with a maximum thickness of 2-4" of leaves (excess may require removal);
- Climate adapted landscape, does not require irrigation;
- Annual inspection of landscape during growing season to identify invasive species for removal;
- Native seeding performed in early spring and/or fall (prior to frost) for best performance;
- Native seed typically applied at a rate of 20 lbs/ac and with a cover crop at a rate of 40 lbs/ac.



Mixed meadow grasses in this meadow including Little Bluestem (foreground) and Big Bluestem (background).

Establishment Phase

Typically ranges from 2-3 years and requires increased levels of maintenance and care for controlling invasive vegetation, implementation of adaptive management strategies, and length of time for species to establish (e.g., grasses spend the first 1-2 years growing their roots). Aim to maintain less than 10% total vegetative cover for invasive species within the landscape to reduce competition with selected species. Cover crops should be cut before they go to seed to further reduce competition. Once native grasses and forbs have established (i.e., have a total vegetative cover greater than 85%), pressure from invasive vegetation will be significantly reduced within the landscape. Meadow landscapes often appear flashy with vibrant dense wildflower blooms in year 1 (yellows) and 2 (yellows, purples, and whites). Once grasses have established, bloom density is expected to significantly decrease unless the landscape is artificial disturbed (i.e., mowing and/or herbicide).

Long-Term

Meadows enter the long-term management phase from 3-5 years after establishment. Once in this phase, management needs for the landscape are significantly reduced, requiring less frequent removal of invasive vegetation, mowing, and/or adaptive management.

1. https://www.naturalheritage.state.pa.us/factsheets/16079.pdf

TYPICAL TALL GRASS MEADOW SPECIES

Plant palette design should include 10 species at minimum, including 3-4 grass species, 5-6 herbaceous perennials, and 1-2 herbaceous biennials.

COMMON NAME	SCIENTIFIC NAME	MATURE HEIGHT	BLOOM PERIOD	FLOWER/ FRUIT COLOR	SALT TOLERANCE	SUNLIGHT/ MOISTURE
Allegheny Pachysandra	*Pachysandra procumbens*	0.5-1'	Apr-May	Pinkish-white		
Beardstongue	*Penstemon digitalis*	2-5'	May-Jul	White		
Big Bluestem	*Andropogon gerardii*	2-6.5'	Jun-Sep	-		
Black-Eyed Susan	*Rudbeckia fulgida*	2-3'	May-Sep	Yellow		
Butterfly Weed	*Asclepias tuberosa*	1-3'	May-Sep	Orange		
Clustered Mountain Mint	*Pycnanthemum muticum*	1-3'	Jul-Aug	White-purple		
Common Milkweed	*Asclepias syriaca*	2-6'	Jun-Aug	Purple		
False Sunflower	*Heliopsis helianthoides*	2-4'	Jun-Aug	Yellow		
Hollow Joe-Pye-Weed	*Eutrochium fistulosum*	6-10'	Jul-Sep	Purple		
Indian Grass	*Sorghastrum nutans*	2.5-8'	Aug-Sep	-		
Late-Flowering Thoroughwort	*Eupatorium serotinum*	3-6'	Aug-Oct	White		
Little Bluestem	*Schizachyrium scoparium*	1-5.5'	Aug-Oct	-		
New England Aster	*Symphyotrichum novae-angliae*	4-6'	Aug-Sep	Purple		
Partridge Pea	*Chamaecrista fasciculata*	1.5-2'	Jul-Aug	Yellow		
Pennsylvania Sedge	*Carex pensylvanica*	0.5-1'	-	-		
Plains Coreopsis	*Coreopsis tinctoria*	2-3'	Jun-Oct	Yellow		
Purple Coneflower	*Echinacea purpurea*	2-4'	Jun-Aug	Purple		
Purpletop Grass	*Tridens flavus*	3-5'	Aug-Oct	Purple		
Rough-Stemmed Goldenrod	*Solidago rugosa*	1-3'	Sep-Oct	Yellow		
Swamp Milkweed	*Asclepias incarnata*	3-5'	Jul-Aug	Purple		
Switch Grass	*Panicum virgatum*	3-6'	Jul-Oct	-		
White Snakeroot	*Ageratina altissima*	2-3'	Jul-Oct	White		
White Wood Aster	*Eurybia divaricata*	1-3'	Jul-Oct	White		
Wild Bergamot	*Monarda fistulosa*	2-5'	Jul-Aug	Purple		
Wild Columbine	*Aquilegia canadensis*	1-3'	Apr-Jun	Red		
Wild Geranium	*Geranium maculatum*	1-2'	Apr-Jul	Lavender-pink		

= Salt Tolerant *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained* *= Drought Tolerant*



Common Milkweed
(Asclepias syriaca)



New England Aster
(Symphyotrichum novae-angliae)



Little Bluestem
(Schizachyrium scoparium)



Wild Bergamot
(Monarda fistulosa)



Black-Eyed Susan
(Rudbeckia fulgida)



Clustered Mountain Mint
(Pycnanthemum muticum)

Pennsylvania is home to many native and naturalized plant suppliers. Many of these suppliers are incredibly knowledgeable on the establishment of native plants and can be a valuable resource to PRT staff. They can provide guidance on seed mixes, plant availability, recommended growing conditions, and can assist in the creation of customized seed mixes appropriate for PRT's needs.[1]

1. https://www.pa.gov/agencies/dcnr/conservation/wild-plants/landscaping-with-native-plants/buy-native-plants.html

WOODY GROUND COVER

Many native straight species of wooded shrubs can grow to heights of 12-25', which can create landscaping challenges within the urban or constructed landscape where plant massing is not desired, for example, when it is necessary to maintain vehicular and pedestrian sight lines. The use of low-growing woody ground cover presents a landscaping option that not only allows maintaining these important sight lines, but also provides other benefits such as reducing soil erosion, weed suppression, low maintenance, and provides a natural aesthetic. This planting design often relies on the use of short form native species cultivars; however there are native straight species that also have a naturally compact growth habit.

Design Considerations

- Low growing woody ground cover cultivars are a low maintenance strategy appropriate within urban, constructed, or highly altered landscapes;
- Maintain vehicular and pedestrian sight lines. Plant height within vehicular triangles should not exceed 30";
- Many of the species identified in the table on the following page are highly tolerant of a wide array of growing conditions and are well suited to more harsh environments;
- Well suited for garden beds, with defined boundaries. Although not invasive, some species tend to be aggressive colonizers such as Virginia creeper;
- Well suited to tree pits and/or trenches located along roadways, paths, and in parking areas;
- Used to control circulation by restricting desire lines and/or unintended pathways.

Maintenance Considerations

- Low maintenance landscape that requires occasional pruning and/or removal of deadwood (i.e., pruning is generally not required more than once per year and also does not need to be performed every year);
- Leaf litter can largely be left in place, with a maximum thickness of 2-4" of leaves (excess may require removal to prevent smothering);
- Climate adapted landscape, does not require irrigation except during periods of severe drought;
- Annual inspection of landscape during growing season to identify invasive species for removal.

Establishment Phase

Ranges from 3-5 years, depending on species composition, and requires increased levels of maintenance and care for controlling invasive vegetation, pruning of deadwood, repair/replacement of damaged shrubs, and implementation of adaptive management strategies. Optimal spacing for shrub plantings is 6-8' on center using triangular spacing (more dense spacing will result in quicker colonization). For a more naturalized aesthetic plants shrubs in diverse clusters. If including woody vines, in the planting, vine training or pruning may be required to prevent impacting other plants within the landscape. Leave duff (i.e., leaf litter) in place as it is critical to the health of the planting, reduces risk of erosion, and provides vital habitat for fauna. Irrigation of shrubs may be required if severe drought is encountered, especially in the first year of establishment.

Long-Term

After approximately 5 years, woody ground covers enter the long-term maintenance phase and require little intervention beyond performing annual inspections to help keep the plantings free of invasive species, pruning of deadwood, and to document overall health of the plantings. If over colonizing, cutback or periodical removal of some shrubs may be necessary.



Canby's Mountain Lover (Paxistima canbyi) ground cover provides a touch of color to the winter landscape and can help maintain the visual structure outside of the growing season.

TYPICAL WOODY GROUND COVER SPECIES

COMMON NAME	SCIENTIFIC NAME	MATURE HEIGHT	BLOOM PERIOD	FLOWER/ FRUIT COLOR	SALT TOLERANCE	SUNLIGHT/ MOISTURE
Black Chokeberry	*Aronia melanocarpa 'UCONNAM165' LOW SCAPE MOUND*	3-4'	May	White		
Canby's Mountain-lover	*Paxistima canbyi*	0.5-1'	May	Green		
Dwarf Bush-Honeysuckle	*Diervilla 'Copper'*	2-3'	Jun	Yellow		
Fragrant Sumac	*Rhus aromatica 'Gro-Low'*	1.5-2'	Apr-May	Yellowish		
Juniper	*Juniper horizontalis*	0.5-1.5'		Blue		
New Jersey Tea, Redroot	*Ceanothus americanus*					
Sweet Pepperbush	*Clethra alnifolia 'Hummingbird'*	2-4'	Jul-Aug	Creamy White		
Virginia Creeper*	*Parthenocissus quinquefolia*	Ground/ Climbing	Apr-May	Greenish		
Virginia Sweetspire	*Itea virginica 'Sprich' LITTLE HENRY*	2-2.5'	Jun-Jul	White		
Yellowroot	*Xanthorhiza simplicissima*	0.5-2.5'	Apr-May	Dark Purple		

= Salt Tolerant *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained* *= Drought Tolerant*

**Can be an aggressive colonizer and should be planted with careful consideration (e.g., not appropriate in small garden beds)*



Fig. 3-16

Dwarf Bush-Honeysuckle (Diervilla 'Copper'), is a hardy plant that is easily grown in average, medium moisture, and well drained soils in areas of full sun or part-shade. This plant is highly tolerant of a wide array of growing conditions and spreads with the use of runners or stolens. The plant can be propagated by transplanting suckers. The plant is naturally deer resistant and is viable in areas with high deer traffic. Its low height makes it a beneficial ground cover within the urban/ constructed landscape. It produces a yellow sweet smelling flower in the early summer (i.e., June).



Fig. 3-17

An example of Fragrant Sumac (Rhus aromatica 'Gro-Low') being utilized as a ground cover within a tree pit installed in the urban landscape. This cultivar is often referred to as a workhorse within constructed landscapes due to its hardy nature and wide tolerance for soil conditions. This species is relatively easily grown in average soil conditions and provides many benefits within a designed space such as maintaining of sight lines, weed suppression, and texture.

SHRUB THICKET

A shrub hedge thicket is a relatively quick landscape to establish that offers several design benefits such as reduced maintenance, landscape screening, define circulation, increased aesthetics, and stormwater management through erosion control, evapotranspiration, and infiltration. Additional benefits include increased access to nature, community engagement opportunity, and improved biodiversity.

Design Considerations

- Utilize as landscaping screening to mask undesirable sight lines, utilities, and/or areas where foot traffic is unwanted or unsafe;
- Evaluate soil characteristics, sun exposure, moisture levels, and drainage patterns;
- Consider establishment period of different species such as the fast-growing serviceberry, chokeberry, and/or sumac;
- Recommend 8’ on center for shrubs when planting;
- Provides high level of soil and slope stability and is well suited for this purpose;
- Mind height restrictions within the design site, some species can reach heights of 30’;
- Without appropriate deer protection/mitigation measures, shrubs can be susceptible to herbivory.

Maintenance Considerations

- Once established, is a low maintenance landscape requiring little intervention;
- Leaf litter (no more than 2-4" thick) and deadwood (e.g., small snags and branches) can be left in place;
- Climate adapted landscape, does not require irrigation except for periods of severe drought;
- Annual inspection of landscape during growing season to identify invasive species for removal;
- Planting performed in early spring and/or fall (prior to frost) for best performance.



The Mixed Hardwood Floodplain Thicket occurs in all major river basins of Pennsylvania.

Establishment Phase

Ranges from 3 to 5 years depending on the species composition and requires routine maintenance to manage invasive species, prune deadwood, repair/replace damaged shrubs, and implement adaptive management strategies. Optimal spacing for shrub plantings is 8’ on center using triangular spacing. Shrub species should be planted in diverse clusters, limiting groupings of the same species, for improved establishment. Install temporary deer fencing or individual cages around planted specimens until resistant to deer herbivory. Leave duff (i.e., leaf litter) in place as it is critical to the health of the stand, reduces risk of erosion, and provides vital habitat for fauna.

Long-Term

Shrub or hedge thickets enter the long-term management phase after a period of 5 years, requiring little intervention. Perform annual inspections to help keep the thicket free of invasive species, that deadwood and/or snags are not endangering the public or PRT resources, and document overall health of the thicket. Recommend deadwood and/or snags be left in place if not identified as a risk given they are vital habitat for many native species.

TYPICAL SHRUB THICKET SPECIES

COMMON NAME	SCIENTIFIC NAME	MATURE HEIGHT	BLOOM PERIOD	FLOWER/ FRUIT COLOR	SALT TOLERANCE	SUNLIGHT/ MOISTURE
Allegheny Foamflower	*Tiarella cordifolia*	< 1'	Apr-Jul	White		
Allegheny Pachysandra	*Pachysandra procumbens*	0.5-1'	Apr-May	Pinkish-white		
Black Chokeberry	*Aronia melanocarpa*	3-6'	Apr-May	Blue/black berry	●	
Blackhaw	*Viburnum prunifolium*	8-15’	Apr-May	Blue/black berry		
Flowering Dogwood	*Cornus florida*	15-30'	Apr-May	White		
Golden Ragwort	*Packera aurea*	1-2’	Apr-May	Yellow		
Mountain Laurel	*Kalmia latifolia*	12-20’	May-Jul	White/pink		
Northern Spicebush	*Lindera benzoin*	6-12'	Mar-Apr	Yellow & red berry		
Pennsylvania Sedge	*Carex pensylvanica*	0.5-1'	-	-		
Red Chokeberry	*Photinia pyrifolia*	5-10’	Mar-May	Red berries	●	
Serviceberry	*Amelanchier canadensis*	10-25'	Apr-May	White		
Southern Arrow-Wood	*Vibrunum dentatum*	6-12’	May-Jun	Red berries	●	
Staghorn Sumac	*Rhus typhina*	15-25'	May-Jul	Green-Yellow	●	
White Snakeroot	*Ageratina altissima*	2-3'	Jul-Oct	White		
White Wood Aster	*Eurybia divaricata*	1-3'	Jul-Oct	White		
Wild Columbine	*Aquilegia canadensis*	1-3'	Apr-Jun	Red		
Wild Geranium	*Geranium maculatum*	1-2'	Apr-Jul	Lavender-pink		
Witch-Hazel	*Hamamelis virginiana*	8-20’	Sep-Nov	Gold		

● = Salt Tolerant *● = Full Sun* *● = Part-Shade* *● = Full Shade*
● = Dry *● = Moist* *● = Wet* *● = Well Drained* *● = Drought Tolerant*


Fig. 3-19

Serviceberry (Amelanchier canadensis)


Fig. 3-20

Black Chokeberry (Aronia melanocarpa)


Fig. 3-21

Flowering Dogwood (Cornus florida)


Fig. 3-22

Northern Spicebush (Lindera benzoin)


Fig. 3-23

Red Chokeberry (Photinia pyrifolia)


Fig. 3-24

Witch Hazel (Hamamelis virginiana)


Fig. 3-25

Southern Arrowwood (Vibrunum dentatum)


Fig. 3-26

Pennsylvania Sedge (Carex pensylvanica)


Fig. 3-27

White Wood Aster (Eurybia divaricata)


Fig. 3-28

Allegheny Pachysandra (Pachysandra procumbens)

LAYERED WOODLAND

References local forest ecosystems and microhabitats to create stratified woodland environments consisting of herbaceous groundcover, shrub/sapling, and canopy strata. This planting approach requires increased upfront investment, but it is often more cost-effective over time compared to other strategies, and reduces long-term maintenance or irrigation. Other benefits include ecological uplift, natural aesthetics, increased access to nature and community engagement, urban cooling, reduction of stormwater/flood impacts, and climate resilience.

Design Considerations

- Layered Woodland plantings should include a diverse selection of recommended species, comprised of a minimum of 2 species within the canopy layer, 2 species within the shrub layer, and 3 species in the ground cover;
- Long-term strategy that can be phased (e.g., tall grass meadow > shrubland > woodland);
- Evaluate soil characteristics, sun exposure, moisture levels, and drainage patterns;
- Consider establishment period of different species such as the fast-growing tulip poplar vs the slow growing oak tree (i.e., early vs late successional species);
- Recommend 10’ on center for trees and 8’ on center for shrubs when planting;
- Provides the highest level of soil and slope stability and is well suited for this purpose;
- Mind height restrictions within the design site, some species can reach heights of 90’; and
- Without appropriate deer protection/mitigation measures understory plants can be susceptible to over browsing.

Maintenance Considerations

- Once established, is a low maintenance landscape requiring little intervention;
- Leaf litter (no more than 2-4" thick) and deadwood (e.g., small snags and branches) can be left in place;
- Climate adapted landscape, does not require irrigation except for periods of severe drought;
- Annual inspection of landscape during growing season to identify invasive species for removal; and
- Planting performed in early spring and/or fall (prior to frost) for best performance.

Establishment Phase

Ranges from 5-10 years depending on species composition and requires routine maintenance to manage invasive species, prune deadwood, repair/replace damaged tree shelters, and implement adaptive management strategies. Remove excess herbaceous material from the base of shelters annually as this can negatively impact planted trees. Remove shelters after a period of 2-4 years or once the sapling has matured (e.g., the specimen reaches 3-5” above the top of the shelter, can stand without the shelter, and can withstand deer rubbing and/or rodent damage). The use of shelters can be reduced if utilizing larger container sizes, but this will increase the costs for planting materials for the project. As the stand matures, transition the herbaceous stratum to a shade tolerant plant mix using plugs. For quicker establishment of herbaceous material plan for 12-18” spacing using triangular spacing and/or a staggered grid pattern. Leave duff (i.e., leaf litter) in place as it is critical to the health of the stand, reduces risk of erosion, naturally suppresses weeds, and provides vital habitat for fauna.

Long-Term

Woodlands enter the long-term management phase after a period of 10-15 years, requiring little intervention. Perform annual inspections to confirm that the understory contains less than 20% invasive species, that deadwood and/or snags are not endangering the public or PRT resources, and document overall health of the stand. Recommend deadwood and/or snags be left in place if not identified as a risk given they are vital habitat for many native species.

TYPICAL LAYERED WOODLAND SPECIES [1]

COMMON NAME	SCIENTIFIC NAME	MATURE HEIGHT	BLOOM PERIOD	FLOWER/ FRUIT COLOR	SALT TOLERANCE	SUNLIGHT/ MOISTURE
TREES						
American Hornbeam	*Carpinus caroliniana*	20-35'	Apr-May	White		
Bitternut Hickory	*Carya cordiformis*	50-80'	Apr-May	Green		
Black Oak	*Quercus velutina*	50-60'	Apr-May	Yellow-green		
Box Elder	*Acer negundo*	30-50'	Mar-Apr	Green-yellow		
Burr Oak	*Quercus macrocarpa*	70-80'	Apr-May	Yellow-green		
Chestnut Oak	*Quercus prinus*	60-70'	Apr-May	Yellow-green		
Green Ash	*Fraxinus pennsylvanica*	50-60'	Apr-May	Green		
Mockernut Hickory	*Carya tomentosa*	60-80'	Apr-May	Yellow-green		
Red Maple	*Acer rubrum*	40-70'	Mar-Apr	Red		
Red Oak	*Quercus rubra*	60-75'	Apr-May	Yellow-green		
Red Pine	*Pinus resionsa*	50-80'	May-Jun	Yellow		
Shagbark Hickory	*Carya ovata*	70-90'	Apr-May	Green-yellow		
Silver Maple	*Acer saccharinum*	50-80'	Mar-Apr	Green-yellow		
Sugar Maple	*Acer saccharum*	40-80'	Apr	Green-yellow		
Sweet Birch	*Betula lenta*	40-75'	Apr-May	Green-yellow		
Tulip Poplar	*Liriodendron tulipifera*	70-90'	May-Jun	Yellow-green		
White Oak	*Quercus alba*	50-80'	Apr-May	Yellow-green		
White Pine	*Pinus strobus*	50-80'	May-Jun	Yellow		
Yelow Birch	*Betula allegheniensis*	60-75'	Apr-May	Purple-yellow		
SHRUBS						
Black Chokeberry	*Aronia melanocarpa*	3-6'	Apr-May	Blue/black berry		
Blackhaw	*Viburnum prunifolium*	8-15’	Apr-May	Blue/black berry		
Mountain Laurel	*Kalmia latifolia*	12-20’	May-Jul	White/pink		
Northern Spicebush	*Lindera benzoin*	6-12'	Mar-Apr	Yellow & red berry		
Red Chokeberry	*Photinia pyrifolia*	5-10’	Mar-May	Red berries		
Serviceberry	*Amelanchier canadensis*	10-25'	Apr-May	White		
Southern Arrow-Wood	*Vibrunum dentatum*	6-12’	May-Jun	Red berries		
Witch-Hazel	*Hamamelis virginiana*	8-20’	Sep-Nov	Gold		
GROUNDCOVER						
Allegheny Foamflower	*Tiarella cordifolia*	< 1'	Apr-Jul	White		
Allegheny Pachysandra	*Pachysandra procumbens*	0.5-1'	Apr-May	Pinkish-white		
Pennsylvania Sedge	*Carex pensylvanica*	0.5-1'	-	-		
White Snakeroot	*Ageratina altissima*	2-3'	Jul-Oct	White		
White Wood Aster	*Eurybia divaricata*	1-3'	Jul-Oct	White		
Wild Columbine	*Aquilegia canadensis*	1-3'	Apr-Jun	Red		
Wild Geranium	*Geranium maculatum*	1-2'	Apr-Jul	Lavender-pink		

= Salt Tolerant *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained* *= Drought Tolerant*

TURF GRASS

Turf grass is widely used as a landscape cover type within PRT properties. The benefits of turf grass include low installation costs, a relatively short establishment period, and the stabilization of site soils compared to an unvegetated condition. However, these benefits must be weighed against the more frequent maintenance requirements, limited aesthetic value, and reduced environmental benefits. Wherever possible, designers should consider alternatives to turf grass cover that may reduce maintenance requirements and provide additional benefits.

Design Considerations

- Avoid planning for turf grass along steep slopes or extremely constrained areas that will be challenging to mow;
- Minimize turf grass in areas where informal pedestrian traffic (people taking shortcuts across the grass) may cause “desire lines” to be formed;
- Consider the best species mix for site specific conditions, note that most turf grass species prefer full sun. PennDOT Formula B is a recommended general purpose seed mix;
- Eco-lawns should be prioritized where feasible. Eco lawns are comprised of species, such as “no mow” sedges and clovers, that reduce maintenance efforts and enhance biodiversity;
- Consider adjacent uses around turf grass areas to cleary define extents of maintenance activities and avoid potential conflict, for example, string trimnmning can damage adjacent site furnishings as well as other plants like trees and shrubs; and
- Ensure turf grass areas are well graded to prevent isolated ponding conditions during wet weather.



Large turf grass lawn at the entrance to Washington Junction Station.

Maintenance Considerations

- Turf grass areas are to be mowed to a height of 3 - 4” at least every 4 weeks during the growing season (May - October);
- Re-seed as needed during the appropriate season (March 1 - June 1 and August 1 - October 15. If utilizing a pre-emergent herbicide in the spring to suppress common lawn weeds, seeding must be performed at the end of the season (i.e., fall);
- Dethatch turf grass periodically (~3 years) to encourage a more dense and healthier lawn area;
- Aerate turf grass plantings in highly compacted areas as needed.

Establishment Phase

Turf grass establishment occurs primarily within the first growing season. Newly seeded turf grass areas should be protected from wind and erosion with a layer of straw mulch. Straw mulch is typically applied at a rate of 3 tons/acre for turf grass seed and secured with a tackifer. The straw mulch should be maintained until successful germination is achieved. Any bare areas where grass is not growing after germination should be immediately reseeded and mulched. Watering newly seeded areas during dry periods is critical to successful turf establishment.

Long-Term

Long-term management of turf grass is, at minimum, comprised of regular mowing during the growing season. Designing for eco-lawn species mixes can reduce the required mowing effort and include species that will more easily spread and fill in following disturbances. Existing traditional turf grass plantings can be transitioned over the long-term maintenance period to include eco-lawn species that will provide added benefits to those areas.

TYPICAL ECO-LAWN SPECIES

COMMON NAME	SCIENTIFIC NAME	SUNLIGHT/MOISTURE
SEDGES		
Appalachian Sedge	*Carex appalachia*	
Common Wood Sedge	*Carex blanda*	
Pennsylvania Sedge	*Carex pensylvanica*	
Texas Sedge	*Carex texensis*	
Wood Sedge	*Carex woodii*	
FINE FESCUES		
Chewings Fescue	*Festuca rubra ssp. commutata*	
Creeping Red Fescue	*Festuca rubra*	
Hard Fescue	*Festuca trachyphylla*	
Sheep Fescue	*Festuca ovina*	
CLOVERS		
Crimson clover	*Trifolium incarnatum*	
Microclover	*Trifolium repens var. Pipolina*	
White clover	*Trifolium repens*	

= Salt Tolerant *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained* *= Drought Tolerant*

PENNDOT FORMULA B MIX

SPECIES	% BY WEIGHT	MINIMUM % PURITY	MINIMUM % GERMINATION	MAXIMUM % WEED SEED	SEEDING RATE LB./1,000 YD2
Perennial Rygrass Mixture *(Lolium perenne).* A combination of improved certified varieties with no one variety exceeding 50% of the total ryegrass component.	20	97	90	0.10	8.5
Creeping Red Fescue or Chewings Fescue *(Festuca rubra or ssp commutate)* (Improved and certified)	30	97	85	0.10	12.5
Kentucky Bluegrass Mixture *(Poa pratensis).* A combination of improved certified varieties with no one variety exeeding 50% of the total bluegrass componant.	45	97	80	0.15	21.0
Annual Ryegrass *(Lolium multiflorum)*	5	95	90	0.10	2.0

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

CITY OF PITTSBURGH LANDSCAPING AND SCREENING STANDARDS; CHAPTER 918 OF THE ZONING CODE

Encourages the planting of appropriate new vegetation and the preservation of existing vegetation and reduces potential nuisances by requiring a visual screen between different uses. Applies to all developments that are subject to Site Plan Review provisions.

URBAN FORESTRY STANDARDS

Guidelines for the planting, maintenance, and protection of trees within urban areas.

- ANSI A-300 Tree Maintenance Standards
- Pittsburgh Shade Tree Commission declaration of tree protection measures and standards[1]

Pennsylvania Standards/Guidelines

VEGETATION AND LANDSCAPING

PADEP encourages the use of native vegetation in landscaping to promote biodiversity and reduce maintenance needs. This includes guidelines for re-vegetating disturbed areas and using plants that are well-suited to local conditions.

Organization Standards/Guidelines

ISI Envision Standards

NATURAL WORLD

This category focuses on protecting and restoring ecosystems and biodiversity. Credits might include siting projects to minimize environmental impact, conserving natural habitats, and enhancing ecological functions.

CLIMATE AND RESILIENCE

This category addresses climate impacts and ensures resilience to future challenges. Credits might focus on reducing greenhouse gas emissions, improving resilience to climate change, and preparing for natural disasters.

1. http://pittsburgh-pa.elaws.us/code/coor_titlefour_artxiii_ch487_sec487.02

INVASIVE SPECIES MANAGEMENT

Benefits

Invasive species management is a critical ongoing effort to help maintain the integrity of planted landscapes. An Integrated Species Management (ISM) approach combines several control and treatment strategies in order to achieve an appropriate level of management in response to site specific conditions and the long terms goals for each management area.

Applicability

Invasive species management will apply in different ways across the PRT system. Public facing landscapes are subject to more intensive maintenance strategies than interstitial landscapes that are less visible to riders and employees, and therefore better suited to incorporating invasive species management with routine maintenance efforts to achieve both short and long-term goals. Less public facing areas should be evaluated to determine the highest needs for responsible stewardship of the natural resources within the PRT system and may be managed to achieve long term goals.

The primary management strategies for use on PRT property include:

- Prevention
- Mechanical control
- Chemical control

PREVENTION

Prevention of invasive vegetation is one of the most critical steps in establishment of a native landscapes and also has the benefit of being much easier and more cost effective that reactive management. Prevention can be achieved through implementation of the following best management practices:

- Site Preparation - Remove existing vegetation (e.g., lawn) through smothering or herbicide application to eliminate existing vegetation and reduce weed seed bank. Minimize tilling and/or soil disturbance;
- Specify that native seed mixes are free of weed seed and that seed is purchased from reputable suppliers;
- Avoid importing topsoil if feasible, but if required, specify that imported fill material is free of weed seed. Note, many native species are not only tolerant, but can thrive in subsoil (i.e., nutrient-poor), which can also suppress weeds;
- When mulching after seed application, specify that mulch is free of weed seed. Example, specify that straw be used and not hay, which contains weed seed;
- Seed application in the fall is preferable and mix with a cover crop to out compete weeds.

MECHANICAL

Mechanical control includes the physical removal of invasive vegetation from the landscape through pulling, cutting, or mowing. The benefit of this method is it avoids the use of chemicals such as herbicides and is highly effective. However, mechanical control is labor intensive, expensive, and is only viable in small or accessible areas.



Mugwort plant growing in a wild field.

HERBICIDES

Chemical control of invasive vegetation is another tool in the toolbox and is often necessary for successful management of native landscapes. However, it needs to be used thoughtfully and selectively to minimize impacts to non-target vegetation, soil, and water.

The two most common herbicides utilized for management of invasive vegetation are Glyphosate (e.g., Roundup Pro and Rodeo) and Triclopyr (e.g., Garlon 3A and Garlon 4). Glyphosate is a non-selective, systemic, foliar herbicide used to control a broad spectrum of vegetation. Triclopyr is an herbicide designed to control woody and broadleaf plants and can be applied without significant damage to grasses.

Application methods include foliar spray, spot treatment, or cut-stump/basal bark treatment. Typical spray practices consist of backpack or boom sprayers. Boom sprayers can be effective in treatment of large areas of invasive vegetation (i.e., during site prep), but use should be limited as there is a high risk of over-spray. Spot treatments with backpack sprayers are the most effective treatment option in that it protects non-target species and limits environmental exposure. Cut-stump or basal bark treatment consists of herbicide application directly to cut woody stems or to the base of trees, which is also effective at treating only undesired plants and avoiding impact to non-target species.

TIMING IS EVERYTHING

- Apply herbicide when target plants are growing and before seeds set, generally mid-to-late summer/early fall;
- Avoid spraying just before rain or in windy conditions (i.e., prevent over-spray);
- One treatment may not be enough, check treated plants approximately two (2) weeks after treatment and if still green, perform a followup treatment;
- Understand the treatment site (e.g., soil type, slope, proximity to water, and surrounding vegetation.

HERBICIDE APPLICATOR LICENSE

All businesses both non-profit and for-profit and government agencies are required to have a commercial or public applicators license if applying herbicide.[1]

- Have at least one (1) certified applicator;
- Meet financial responsibility and insurance requirements;
- Maintain annual application ($35/year as of 2025).

If PRT does not maintain an herbicide applicators business license, one alternative is to contract a reputable firm who specializes in invasive species management, establishment of native landscapes, and maintains an herbicide applicators business license.

1. https://www.pa.gov/agencies/pda/plants-land-water/plant-industry/pesticide-programs.html

COMMON INVASIVE SPECIES


Fig. 3-31

Common mugwort
(Artemisia vulgaris)


Fig. 3-32

Japanese knotweed
(Polygonum cuspidatum)


Fig. 3-33

Oriental bittersweet
(Celastrus orbiculatus)


Fig. 3-34

Crown vetch
(Coronilla varia L.)


Fig. 3-35

Japanese barberry
(Berberis thunbergii)

PARTNERSHIPS

Engage with local community stakeholders. Many community groups, non-profits, or extension services have vested interest in reduction of lawn space and establishment of native landscapes and can be a valuable resource through guidance, volunteer work, and/or assistance in maintaining of these spaces. Additionally, forming partnerships is a way of increasing connectivity and engagement with the PRT system.

The Pennsylvania Department of Agriculture and **Penn State Extension** offer several resources to guide the management of non-weed biological pests such as spotted lanternflies, beech leaf disease, western conifer seed bug, and spongy moth and eastern tent caterpillars.


Fig. 3-36

Public facing landscapes are subject to more intensive maintenance strategies than interstitial landscapes that are less visible to riders and employees.

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

URBAN FORESTRY STANDARDS

Guidelines for the planting, maintenance, and protection of trees within urban areas.

- ANSI A-300 Tree Maintenance Standards
- Pittsburgh Shade Tree Commission declaration of tree protection measures and standards[1]

TREE PITTSBURGH "ZERO NET LOSS" POLICY

Principle adopted by the City of Pittsburgh to maintain and grow its urban tree canopy by ensuring no net loss of trees occurs due to development or infrastructure projects. While Tree Pittsburgh itself is a nonprofit advocacy and education organization, the policy is embedded in city government practices and is supported by planning and permitting requirements.

- The goal is to replace every public tree removed with a new tree, at a 1:1 ratio at minimum—and often more if the removed tree was mature or had high ecological value.
- Replacement trees must be appropriate for the site, non-invasive, and approved species listed in the city's Street Tree List or relevant urban forestry standards.
- Projects must submit a tree replacement plan as part of their permit process if public trees are impacted.
- Public Tree Removal Permits are required for any work that may remove or damage trees within the public right-of-way.
- For projects unable to plant trees on-site, off-site planting or in-lieu fees may be required to maintain canopy goals.

Pennsylvania Standards/Guidelines

PENNSYLVANIA PESTICIDE CONTROL ACT OF 1973

This law governs the use of herbicides in Pennsylvania. In addition to defining the specific requirements for herbicide procurement, application and disposal, the law promotes the use of Integrated Pest Management (IPM) techniques, including cultural practices and biological controls.

VEGETATION AND LANDSCAPING

PADEP encourages the use of native vegetation in landscaping to promote biodiversity and reduce maintenance needs. This includes guidelines for re-vegetating disturbed areas and using plants that are well-suited to local conditions.

1. http://pittsburgh-pa.elaws.us/code/coor_titlefour_artxiii_ch487_sec487.02

FOREST REHABILITATION

Benefits

Forest Rehabilitation isn't just about trees, it's about transit resilience. Opportunities to restore and enhance woodlands reduces stormwater runoff, protects native biodiversity, improves air quality and nutrient cycling, reduces atmospheric carbon, and contributes to the urban tree canopy. When applied to naturalized areas that are currently maintained as periphery landscapes (i.e. mowed lawn or edge conditions), forest rehabilitation can also significantly reduce long term maintenance needs. Restoring lost or existing degraded woodlands is a smart investment in safer, more efficient, and more sustainable public infrastructure.

Applicability

Priorities for forest rehabilitation should center on the selection of problem areas that have the potential to increase future maintenance needs, such as increased stormwater runoff, sediment and soil erosion, and tree fall risks. Rewilding is most relevant at locations where lawn area can be reduced by reforesting edges adjacent to existing woodlands.

WOODLAND RESTORATION

Woodland restoration within PRT's system could involve replacing invasive, unstable vegetation on steep slopes with deep-rooted native trees, shrubs, and groundcovers that stabilize soil, reduce erosion, and prevent treefalls onto transit infrastructure. This process may include selective removal of hazardous trees, controlling aggressive non-native species, and replanting with low-maintenance, site-adapted natives that support biodiversity. Restoration would enhance slope stability, reduce maintenance costs, and manage stormwater more effectively, all while improving the appearance and ecological function of wooded areas along transit corridors. Ultimately, it would protect infrastructure, improve safety, and align PRT with broader regional sustainability and resilience goals.

Refer to strategies covered within the following sections: Native Biodiversity; Invasive Species Management; and/or Slope Stabilization and Riparian Restoration.



Restoring native woodlands with deep-rooted trees and shrubs strengthens slopes, protects transit infrastructure, and boosts regional biodiversity.



A cutting site in a pine forest prepared for new plantings to create safer, low-maintenance landscapes that support biodiversity, manage stormwater, and showcase environmental leadership

REWILDING

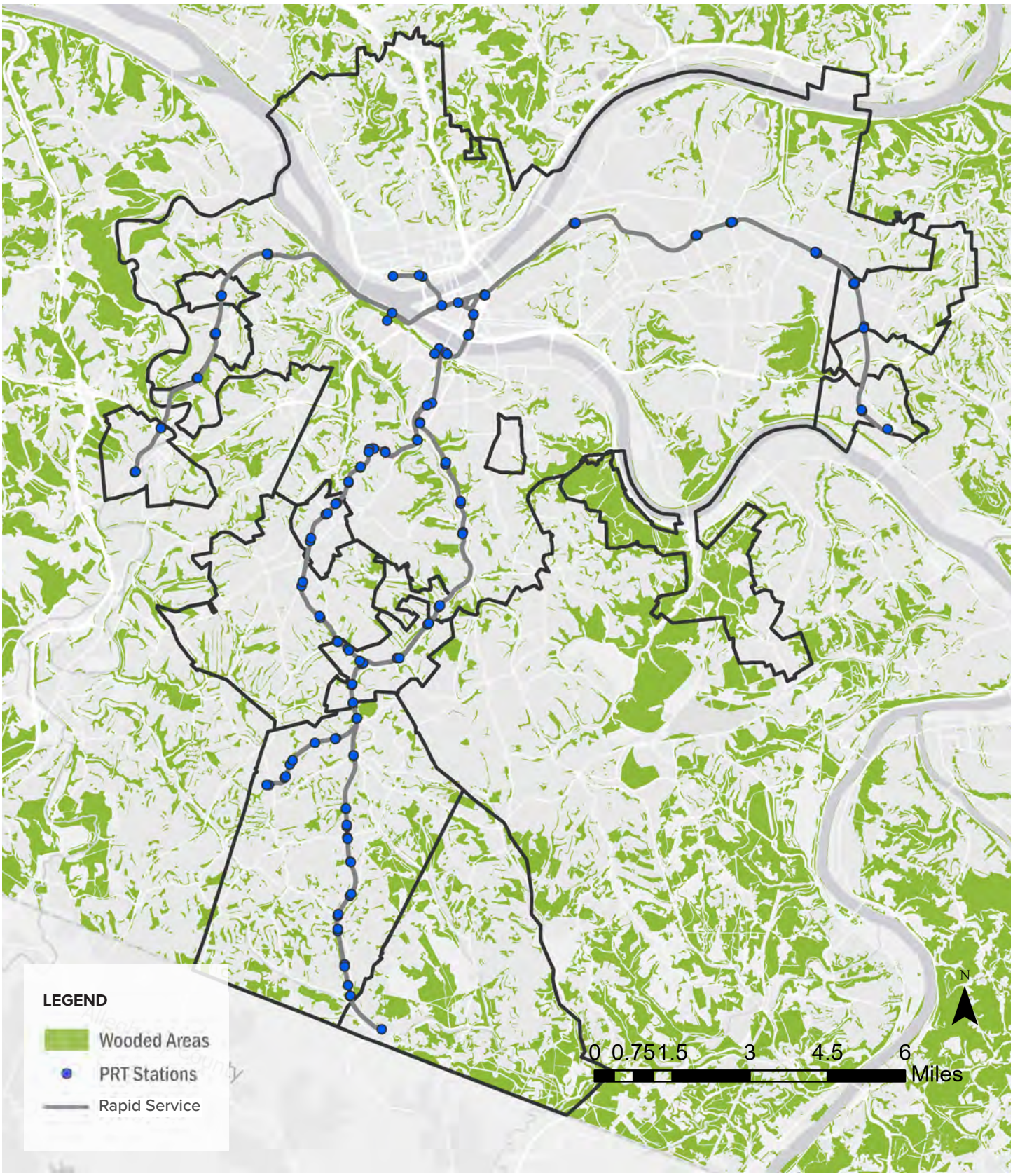
Rewilding existing landscapes benefits PRT by reducing maintenance costs, lessens risks of falling trees, improves stormwater management and climate resiliency, and enhances public perception through environmental leadership.

- A well-designed native plant community is self-sustaining over time and outcompetes invasives, reducing long-term maintenance costs. Passive rewilding or managed succession can reduce labor needs.
- Transitioning to shorter native trees or shrubby woodland (e.g., serviceberry, viburnum, Gro-Low) in critical zones limits the height and weight of vegetation near transit lines, reducing the risk of treefalls.
- Healthy, biodiverse woodland soils improve infiltration and act like a sponge, reducing stormwater surges and helping reduce stormwater impacts on the system.
- Visibly managed wild spaces using native plants create a more appealing, natural environment for riders. It also positions PRT as a leader in sustainability and ecological stewardship, aligning with regional climate goals.

Public GIS Datasets such as the **Urban Tree Canopy Cover layers** (featured on the following page) provide insights into the PRT system and can help PRT strategically **manage its lands and identify priority areas for wooland rehabilitation and/or rewilding**.

- **Identifying degraded or vulnerable areas** - Areas with low tree canopy and high impervious surface near slopes, tracks, or stations can be flagged as vulnerable to stormwater runoff, erosion, and heat island effects.
- **Prioratize Invasive-Dominated Sites** - Where canopy exists but is patchy or dominated by early-successional or invasive vegetation, restoration may focus on understory replanting or invasive removal.
- **Data Analysis to Assess Slope Stability Risks** - By combining canopy cover with elevation and slope data, PRT can identify steep, sparsely vegetated slopes at risk of landslides or treefall. These areas may benefit from native woody plantings to anchor soil and prevent infrastructure damage.
- **Opportunities for Passive Rewilding** - Vacant lots, unpaved rights-of-way, or low-traffic zones with existing herbaceous green space but no canopy could be passively rewilded by allowing natural succession or through minimal intervention.

URBAN TREE CANOPY COVER



KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

URBAN FORESTRY STANDARDS

Guidelines for the planting, maintenance, and protection of trees within urban areas.

- ANSI A-300 Tree Maintenance Standards
- Pittsburgh Shade Tree Commission declaration of tree protection measures and standards[1]

TREE PITTSBURGH "ZERO NET LOSS" POLICY

Principle adopted by the City of Pittsburgh to maintain and grow its urban tree canopy by ensuring no net loss of trees occurs due to development or infrastructure projects. While Tree Pittsburgh itself is a nonprofit advocacy and education organization, the policy is embedded in city government practices and is supported by planning and permitting requirements.

- The goal is to replace every public tree removed with a new tree, at a 1:1 ratio at minimum—and often more if the removed tree was mature or had high ecological value.
- Replacement trees must be appropriate for the site, non-invasive, and approved species listed in the city's Street Tree List or relevant urban forestry standards.
- Projects must submit a tree replacement plan as part of their permit process if public trees are impacted.
- Public Tree Removal Permits are required for any work that may remove or damage trees within the public right-of-way.
- For projects unable to plant trees on-site, off-site planting or in-lieu fees may be required to maintain canopy goals.

1. http://pittsburgh-pa.elaws.us/code/coor_titlefour_artxiii_ch487_sec487.02

Pennsylvania Standards/Guidelines

VEGETATION AND LANDSCAPING

PADEP encourages the use of native vegetation in landscaping to promote biodiversity and reduce maintenance needs. This includes guidelines for re-vegetating disturbed areas and using plants that are well-suited to local conditions.

Federal Standards/Guidelines

NEPA

National Environmental Policy Act (NEPA) compliance is required when a project involves federal funding, permits, or approvals

- Federal permits or approvals: If the project impacts wetlands, navigable waters, endangered species habitat, or cultural resources, triggering involvement from agencies like the U.S. Army Corps of Engineers or the U.S. Fish and Wildlife Service.

Organization Standards/Guidelines

ISI Envision Standards

NATURAL WORLD

This category focuses on protecting and restoring ecosystems and biodiversity. Credits might include siting projects to minimize environmental impact, conserving natural habitats, and enhancing ecological functions.

CLIMATE AND RESILIENCE

This category addresses climate impacts and ensures resilience to future challenges. Credits might focus on reducing greenhouse gas emissions, improving resilience to climate change, and preparing for natural disasters.

SLOPE STABILIZATION + RIPARIAN RESTORATION

Benefits

Slope stabilization is essential for protecting both nearby communities and critical transit infrastructure. Beyond mitigating landslide hazards, stabilization strategies also play a key role in reinforcing stream channels, embankments, and riparian zones. These strategies reduce erosion, enhance stormwater management, and contribute to improved water quality, creating both ecological and infrastructure resilience.

Applicability

Approximately 25-30% of land area near PRT routes features a slope greater than 25%, placing these areas at elevated risk for erosion, landslides and problematic runoff. Strategies for stabilizing steep and eroding slopes should be determined by the potential for layering benefits and meeting additional long term goals when possible, including reduced maintenance requirements, enhancing native biodiversity, and improving rider experience.

SLOPE MAINTENANCE CHALLENGES

Mowing native landscapes, such as meadows, is an important maintenance practice to suppress woody encroachment, recycle nutrients, and promote desirable herbaceous species. However, when these landscapes occur on steep slopes, mowing to the required height of 6–12” becomes logistically and ecologically complex. Challenges include equipment limitations, soil erosion risks, operator safety, and the potential for habitat disturbance. The table to the right summarizes these challenges and identifies practical strategies to mitigate them, helping to ensure both ecological integrity and maintenance safety.

ENGINEERED SOLUTIONS

A variety of engineering and bioengineering controls are available to stabilize steep slopes and reduce erosion. These methods range from natural solutions like living stems and coir logs that encourage vegetation growth and soil binding, to structural approaches like gabion walls and rip rap that provide immediate and long-lasting reinforcement. Intermediate techniques such as fiber-reinforced soils blend natural and engineered materials to improve slope strength without the visual or ecological impact of hard infrastructure. Selecting the appropriate strategy depends on site conditions, budget, long-term goals, and the desired balance between ecological value and structural stability.



Fig. 3-39

Fascines provide both structural and biological slope stabilization and can provide quicker vegetation establishment as the fascines contain living plants.

CHALLENGE	DESCRIPTION	MITIGATION STRATEGIES
Difficulty Maintaining Mowing Height	Maintaining a consistent 6–12" cut is hard with standard rotary mowers, especially on uneven ground.	Use adjustable-height flail or sickle-bar mowers; perform test passes to calibrate cutting height.
Equipment Limitations on Steep Slopes	Conventional mowers are unsafe or ineffective on slopes due to rollover risks and traction loss.	Use slope-rated equipment (e.g., remote-controlled, walk-behind, or track-mounted mowers).
Habitat Disruption	Mowing may disturb overwintering insects or nesting birds, reducing biodiversity.	Time mowing after bird fledging and before insect emergence; rotate mowing zones each year; leave some uncut refuge patches to support habitat continuity.
Limited Seasonal Access	Slopes may be inaccessible during key mowing windows due two wet or frozen soil conditions.	Schedule mowing during late-winter freezes or dry early spring windows; choose low-impact equipment suitable for marginal conditions.
Obstruction and Visibility Issues	Tall vegetation can hide hazards such as rocks or holes, posing risks to equipment and operators.	Conduct pre-mow hazard inspections; flag obstacles; use high-clearance or manual trimming tools for tricky areas.
Operator Safety Risks	Increased risk of injury from equipment rollover or slips when operating on slopes.	Train staff in steep-slope operation; use PPE and ROPS-equipped machinery; restrict mowing to safe weather conditions.
Soil Disturbance and Erosion Risk	Mowing equipment can compact or disturb soil, leading to erosion on steep slopes.	Mow in dry conditions; use low-ground-pressure equipment; mow along contours; stabilize slopes with deep-rooted native grasses.

Living Stems

Fascines are bundles of dormant woody cuttings installed along contour lines on slopes to control erosion and promote vegetation establishment. The cuttings root into the soil, forming a living barrier that reinforces the slope, reduces runoff velocity, and traps sediment. Ideal for moderate slopes and cost-effective stabilization in areas where heavy equipment access is limited.

- Dormant cuttings from native species with strong rooting capacity, that are 1.5-2” in diameter and 3-6’ in length;
- Install fascines along contours of slope, spaced 3–5’ vertically, depending on slope steepness. Trenches should be 4–6” deep and wide enough to hold the bundle. Place bundles in trenches and secure with wooden stakes every 2–3';
- Effective on slopes up to 2:1 (50%); ideal on low- to moderate-energy slopes. Combine with erosion control blankets or coir logs for added stability if needed;
- Monitor through first growing season for moisture and rooting; replant failed sections as needed.

Gabion Walls

Gabion walls are structures composed of rock-filled wire mesh baskets, stacked and tied together to form retaining walls or toe-of-slope reinforcements. They are especially effective in areas with active erosion, high runoff, or the need for immediate structural stabilization. Gabions provide excellent drainage, long lifespan, and strength, but have limited aesthetic and ecological benefits.

- Galvanized or PVC-coated steel mesh baskets, typically 3–6’ in length and filled with angular, well-graded stone (6–12” size); must be durable and frost-resistant;
- Ideal for toe-of-slop stabilization, streambanks, or cut/fill slopes and in areas readily accessible by heavy equipment;
- Inspect annually for corrosion or displacement, remove vegetation/debris that could damage the mesh, replace mesh is signs of structural failure.

TYPICAL SLOPE STABILIZATION + RIPARIAN SPECIES

Riparian sites are highly specialized and the designer should carefully consider conditions such as erosion potential, moisture levels, slope, etc.

COMMON NAME	SCIENTIFIC NAME	SLOPE STABILIZATION POTENTIAL	BLOWDOWN POTENTIAL	SALT TOLERANCE	SUNLIGHT/ MOISTURE
TREES					
American Hornbeam	*Carpinus caroliniana*	Excellent; dense roots, small stature	Very Low		
Bitternut Hickory	*Carya cordiformis*	Good; deep roots	Low		
Black Oak	*Quercus velutina*	Excellent; deep-rooted, stabilize slopes	Low		
Burr Oak	*Quercus macrocarpa*	Excellent; deep-rooted, stabilize slopes	Low		
Chestnut Oak	*Quercus prinus*	Excellent; deep-rooted, stabilize slopes	Low		
Gray Dogwood	*Cornus racemosa*	Excellent; suckering growth creates dense thickets	Low		
Green Hawthorn	*Crataegus viridis*	Moderate; Deep root system	Moderate		
Mockernut Hickory	*Carya tomentosa*	Good; deep roots	Low		
Red Oak	*Quercus rubra*	Excellent; deep-rooted, stabilize slopes	Low		
Redbud	*Cercis canadensis*	Moderate; Spreading shallow roots	Low		
Shagbark Hickory	*Carya ovata*	Good; deep roots	Low		
White Oak	*Quercus alba*	Excellent; deep-rooted, stabilize slopes	Low		
SHRUBS / WOODY GROUND COVER					
Black Chokeberry	*Aronia melanocarpa 'UCONNAM165' LOW SCAPE MOUND*	Good; compact form, good root mass	Low		
Blackhaw	*Viburnum prunifolium*	Good	Low		
Common Snowberry	*Symphoricarpos albus*	Excellent; Suckering shrub that forms dense colonies	Low		
Dwarf Bush-Honeysuckle	*Diervilla 'Copper'*	Good; dense, suckering roots	Very Low		
Fragrant Sumac	*Rhus aromatica 'Gro-Low'*	Excellent for erosion control due to dense root system and spreading habit	Very Low		
Mountain Laurel	*Kalmia latifolia*	Excellent; evergreen, dense roots	Very Low		
New Jersey Tea, Redroot	*Ceanothus americanus*	Moderate; deep taproot but not a vigorous spreader	Low		
Northern Spicebush	*Lindera benzoin*	Moderate; spreads by suckers	Low		

TYPICAL SLOPE STABILIZATION + RIPARIAN SPECIES (CONTINUED)

COMMON NAME	SCIENTIFIC NAME	SLOPE STABILIZATION POTENTIAL	BLOWDOWN POTENTIAL	SALT TOLERANCE	SUNLIGHT/ MOISTURE
Red Chokeberry	*Photinia pyrifolia*	Good	Low		
SHRUBS / WOODY GROUND COVER (CONTINUED)					
Running Serviceberry	*Amelanchier stolonifera*	Excellent; Spreads by stolons to form dense colonies	Low		
Serviceberry	*Amelanchier canadensis*	Moderate	Low		
Smooth Rose	*Rosa blanda*	Excellent; Spreads by suckers, forms dense thickets	Low		
Southern Arrowwood	*Viburnum dentatum*	Good; suckering habit	Low		
Virginia Sweetspire	*Itea virginica 'Sprich' LITTLE HENRY*	Good; suckering habit, spreads well	Low		
Witch-Hazel	*Hamamelis virginiana*	Moderate; multi-stemmed	Low		
Yellowroot	*Xanthorhiza simplicissima*	Excellent; suckering, dense roots	Very Low		
WOODY VINES					
Virginia creeper*	*Parthenocissus quinquefolia*	Excellent; vigorous climber and ground cover	Low		
HERBACEOUS GROUND COVER					
Big Bluestem	*Andropogon gerardii*	Excellent; Deep, dense root system	N/A		
Blue Mistflower	*Conoclinium coelestinum*	Good; Spreading rhizomes offer soil stabilization in moist, well-drained areas	N/A		
Bride's Feathers	*Aruncus dioicus*	Okay-Good; Low-growing mat-forming; shallow soil coverage	N/A		
Butterflyweed	*Asclepias tuberosa*	Good; Tall perennial with fibrous root system	N/A		
Indiangrass	*Sorghastrum nutans*	Excellent; Deep roots	N/A		
Lanceleaf Tickseed	*Coreopsis lanceolata*	Okay-Good; Fibrous roots help stabilize shallow soils	N/A		
Little Bluestem	*Schizachyrium scoparium*	Excellent; Dense, fibrous root system	N/A		
Texas Sedge	*Carex texensis*	Excellent; Dense root mass	N/A		
Wild Bergamot	*Monarda fistulosa*	Good; Fibrous root system	N/A		

= Salt Tolerant *= Full Sun* *= Part-Shade* *= Full Shade*

= Dry *= Moist* *= Wet* *= Well Drained* *= Drought Tolerant*

**May climb trees and structures, which could exacerbate blowdown risks*

Fiber Reinforcement

Fiber-reinforced soils integrate short synthetic or natural fibers into soil to enhance shear strength, reduce deformation, and stabilize shallow slope failures. Used for increasing slope resistance in revegetation projects or when structural reinforcement is needed below the surface without visible hard infrastructure.

- Common fiber types: polypropylene, coir, or jute; lengths range from 1-3”; typically 0.5–2.0% by soil volume;
- Ideal for revegetated slopes, cut slopes, or under erosion control blankets. Effective on slopes up to 1.5:1 (66%);
- Monitor vegetative cover and surface erosion as vegetation establishes.

Rip Rap

Placement of large, angular stone along slopes or streambanks to absorb water energy, control erosion, and prevent slope failure. Used for immediate, high-energy erosion control in areas with concentrated stormwater or flooding risk. While highly durable, rip rap has limited ecological or aesthetic value.

- Angular, non-friable stone sized for energy conditions: 6–12” for low to moderate flow and 18–36” for high-energy sites;
- Ideal for streambanks, culvert outfalls, slope toes, and drainage channels;
- Inspect after major storm events for displaced rock. Replace missing or undercut stones to maintain slope toe integrity.

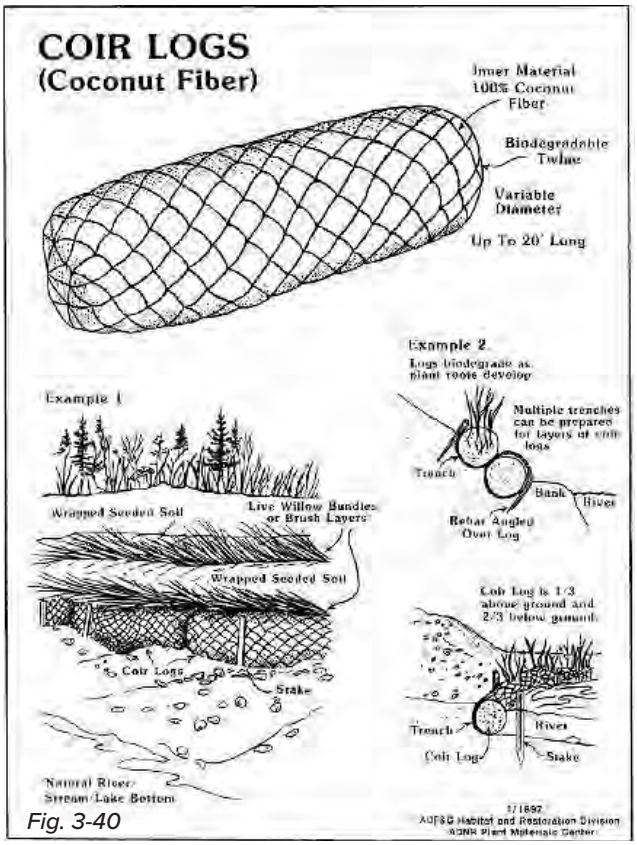


Fig. 3-40

Coir logs provide immediate structural stabilization of steep slopes and allows for vegetation to establish as they biodegrade.

Coir Logs

Coir logs are biodegradable coconut fiber rolls installed along contours or water edges to provide temporary erosion control, sediment capture, and a base for vegetation establishment. Best suited for low to moderate slope gradients or riparian edge stabilization, coir logs slowly degrade over time as native plants root through and stabilize the area.

- Logs range from 12–20” diameter, 10–20’ in length. Select density and size based on flow velocity and slope steepness;
- Excavate shallow trench (~⅓ log depth), seat log firmly, anchor with hardwood stakes (every 2–3’) and secure with biodegradable twine;
- Ideal for slope breaks, streambanks, and riparian zones and best on slopes up to 3:1 (33%), not suitable for high-velocity flows alone;
- Inspect after storms for displacement or loosening, re-anchor as needed until vegetation becomes dominant.

KEY COMPLIANCE STANDARDS

Pennsylvania Standards/Guidelines

ENVIRONMENTAL PROTECTION STANDARDS

Ensuring that landscape designs comply with local, state, and federal environmental regulations.

- Clean Water permits/allocations/Stormwater/Sewer/WQM: PADEP water quality permits, compliance measures, and reporting requirements[1]
- Air Quality permits and reporting documentation[2]
- PA DEP Applicable Rules and Regulations[3]

EROSION AND SEDIMENT CONTROL

PADEP requires erosion and sediment control plans for construction activities. These plans must include measures to prevent soil erosion and manage sediment during and after construction

VEGETATION AND LANDSCAPING:

PADEP encourages the use of native vegetation in landscaping to promote biodiversity and reduce maintenance needs. This includes guidelines for re-vegetating disturbed areas and using plants that are well-suited to local conditions.

Federal Standards/Guidelines

NEPA

National Environmental Policy Act (NEPA) compliance is required when a project involves federal funding, permits, or approvals

ENVIRONMENTAL PROTECTION STANDARDS

The U.S. Army Corps of Engineers (USACE) regulates wetlands under Section 404 of the Clean Water Act. This regulation ensures that discharges of dredged or fill material into all waters of the United States, including wetlands, are authorized. USACE determines wetland boundaries using three main characteristics: vegetation, soil, and hydrology.

Organization Standards/Guidelines

ISI Envision Standards

NATURAL WORLD

This category focuses on protecting and restoring ecosystems and biodiversity. Credits might include siting projects to minimize environmental impact, conserving natural habitats, and enhancing ecological functions.

CLIMATE AND RESILIENCE

This category addresses climate impacts and ensures resilience to future challenges. Credits might focus on reducing greenhouse gas emissions, improving resilience to climate change, and preparing for natural disasters.

1. https://greenport.pa.gov/elibrary/GetFolder?FolderID=3664
2. https://greenport.pa.gov/elibrary/GetFolder?FolderID=3623
3. https://www.pa.gov/agencies/dep/programs-and-services.html

GREEN STORMWATER INFRASTRUCTURE

Benefits

Green Stormwater Infrastructure (GSI) features within the landscape are defined as nature-based best management practices (BMPs) that manage stormwater runoff and improve water quality. Potential co-benefits include improved air quality, mitigation of urban heat island effect, enhanced ecological function, and social and economic benefits. GSI provides the greatest benefits when integrated with other intentionally designed site elements such as parking islands and entry plazas.

Applicability

Relevant technical guidance for the design of green stormwater infrastructure practices is provided by the Allegheny County Model Stormwater Management Ordinance, the City of Pittsburgh Stormwater Design Manual, and local municipal and town standards and regulations. This includes a description of the requirements under the applicable codes as well as the planning and design standards and considerations for different individual practice types.

GENERAL REQUIREMENTS

Stormwater management requirements for new and redeveloped PRT Facilities within city limits are defined by Title's 13, 9 and 14 of the City of Pittsburgh Code. Under Title 13, development projects must submit a Stormwater Management (SWM) Site Plan for review and approval. Any SWM Site Plan that does not include green infrastructure or a low impact design practices, must demonstrate that they are infeasible in accordance with the City of Pittsburgh Stormwater Design Manual.

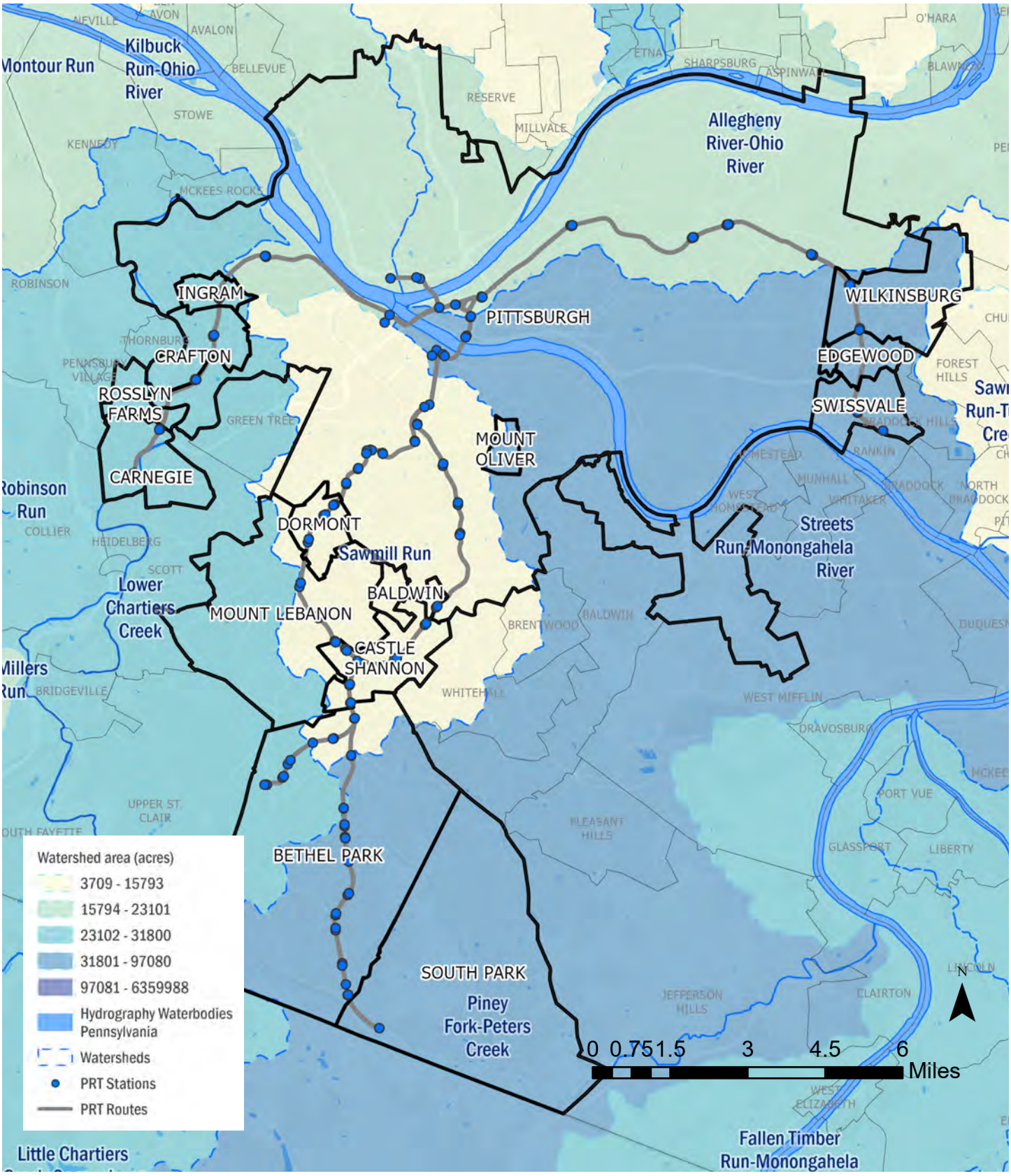
Outside of city limits, stormwater and GSI requirements are defined by the municipality in which the project/facility is located. As a goal, PRT should aim to implement stormwater management BMPs consistently throughout the system, while confirming the minimum standards set by the municipality are met. Designing above the minimum specification and standard can help PRT future proof its stormwater infrastructure and potentially avoid the need for costly retrofits and/or replacement of substandard infrastructure.

PROJECT SPECIFIC REGULATIONS

Project specific development considerations resulting in different stormwater management requirements include the total area of planned impervious cover and then extents of site disturbance. Projects that propose less than 5,000SF of additional impervious area compared to existing conditions and will result in earth disturbances less than 5,000SF are generally exempt from the city's stormwater management code requirements to submit a SWM site plan.

Additional requirements are defined by project location specific regulations. These requirements should be reviewed and planned for at the outset of the design process.

ALLEGHENY COUNTY WATERSHED MAP



Pittsburgh Location Specific Regulations

- Riverfront District
- Uptown Public Realm
- Combined Sewer System
- Municipal Stormwater System
- Non Special Regulation Watershed
- Allegheny County Act 167 Watersheds
- In Both Allegheny County Act 167 and Public Health and Saftey Watersheds
- Non-Sewered Areas
- Groundwater Seeps and Springs
- Riparian Buffers

STRUCTURAL BMP INTEGRATION

Structural green stormwater BMP's should be implemented where feasible to meet stormwater management requirements. Opportunities for BMP integration may differ within each of the different PRT Landscape Typologies. The subsections below include recommendations for SWM opportunities identified throughout the PRT system, but other approaches may be considered.

Public Entry / Plaza

Public entry plazas are designed for high public use and typically include attractive plantings to enhance rider experience. **Bioretention** practices are well suited to address these aesthetic design goals while also meeting stormwater management requirements.

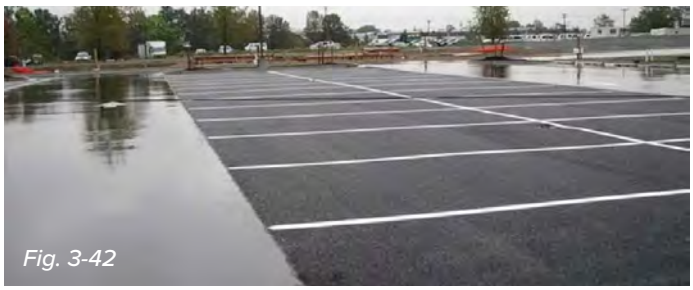
Where there isn't sufficient space available for bioretention, **Porous Pavement** can be used to manage the required stormwater runoff volume or partially reduce stormwater runoff to the extent that it can be managed by a bioretention practice that fits within the available area.



Bioretention

Space Constrained

Space constrained sites provide many design challenges. In these areas **Porous Pavement** is recommended to manage stormwater runoff volume within circulation areas such as roadways and sidewalks.



Porous Pavement

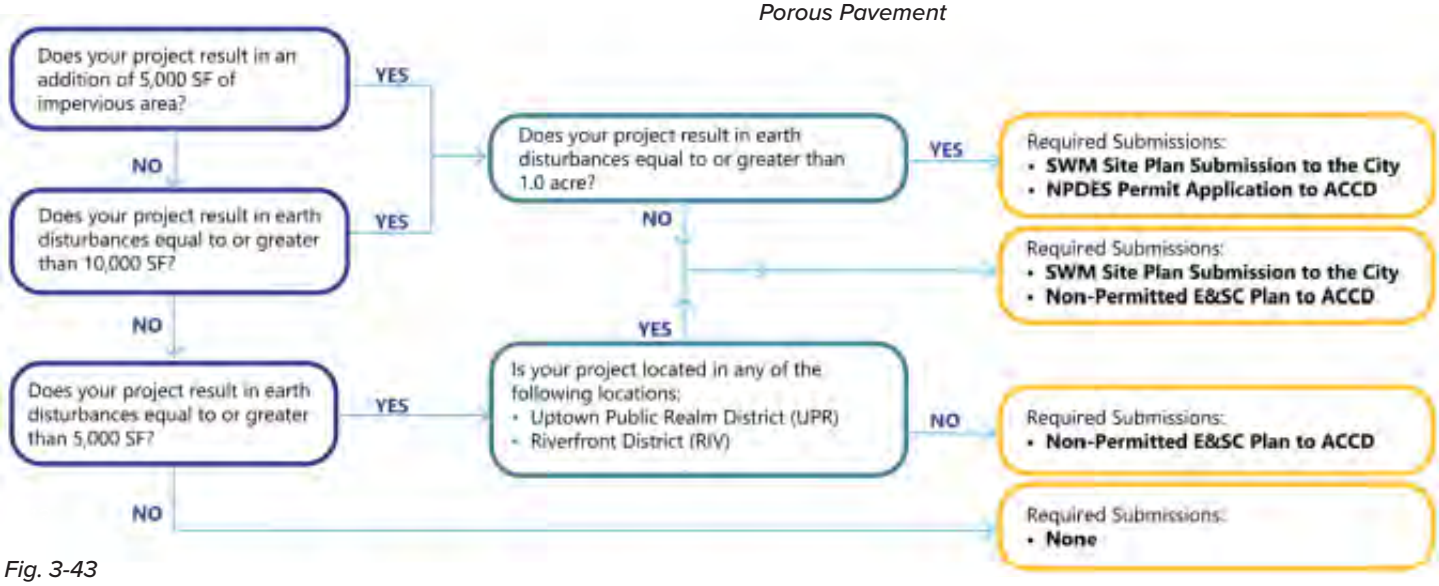


Fig. 3-43

Regulated activities and required submissions flow chart from the City of Pittsburgh Stormwater Design Manual (Figure 2.1)

Parking Lot / Park and Ride

Parking lots provide multiple opportunities for the implementation of stormwater BMPs. **Bioretention** practices can be integrated with parking lot planting requirements. Paving within parking areas can also be specified as **Porous Pavement** without compromising functionality. Finally, parking areas are well suited to **Subsurface** practices which can be installed beneath the paving areas.



Subsurface

Landscape Buffers

Long linear landscape buffers are ideal for the implementaiton of **Bioretention** practices such as bioswales. These are best suited to flatter areas, however steeper grades can be managed through the use of check dams within the practice. Another stormwater management BMP that works well within this landscape typology is **Media Filter** practices, which may be integrated within typical landscape elements such as street tree planting pits.



Media Filter

Steep Slopes

Structural BMP's are not recommended for implementation on very steep slopes. Stormwater green infrastructure practices generally rely on holding water for infiltration or to slowly release back to the grey stormater infrastructure system over time. Holding water on steep slopes may result in increase erosion and will require excessive grading to construct.



Green Roof

Public Amenity

Like public entry/plaza spaces, public amenity areas are highly designed spaces that provide several functions to riders. Several BMP's can be integrated into these spaces. **Porous Pavement** practices can be implemented in place of traditional paving for sidewalks and open spaces. Where structures are provided to house public amenities, **Green Roofs** may be considered. If Green Roofs are not feasible to structural considerations, attractive above ground **Cisterns** may be installed to help manage stormwater runoff from roofs.



Cisterns

Creek Adjacent

Riparian buffers are subject to setback requirements from stream banks to protect sensitive environmental areas. For this reason, stormwater management BMPs are not recommended in the area immediately adjacent to creeks, however there are other beneficial landscape practices that can be applied within these buffers, such as Native Planting, Slope Stabilization and Riprarian Restoration.

Roadway

Opportunities for stormwater management within the busway corridors may be limited by several constraints due to existing utilities and maintenance access. Linear **Bioretention** practices such as bioswales may be considered here where feasible. Additional considerations may include sections of **Porous Pavement** outside of the primary drive lanes to manage stormwater run-on.

PRT LANDSCAPE TYPOLOGIES	RECOMMENDED STRUCTURAL BMP'S					
	Bioretention	Subsurface	Porous Pavement	Green Roof	Media Filters	Cisterns
Public Entry Plaza	✓		✓			
Space Constrained			✓			✓
Parking Lot / Park & Ride	✓	✓	✓			
Landscape Buffer	✓				✓	
Steep Slope*	–	–	–	–	–	–
Creek Adjacent*	–	–	–	–	–	–
Public Amenity		✓	✓	✓		✓
Roadway	✓		✓			

Ponds and basins are also defined as Structural BMP's in the City of Pittsburgh Stormwater Design Manual. These practices are not highly recommended because they generally require large level areas for implementation and cannot be easily integrated with other landscape design features.

** Structural BMP's would not typically be recommended on or under steep slopes or creek adjacent.*

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

THE CITY OF PITTSBURGH STORMWATER DESIGN MANUAL

Provides technical guidance for developers and planners to comply with stormwater management requirements.

Pennsylvania Standards/Guidelines

STORMWATER MANAGEMENT REGULATIONS

Ensuring that landscape designs incorporate features to manage stormwater runoff effectively.

- PADEP SWM requirements and standards[1]
- PADEP's Stormwater Best Management Practices (BMP) Manual provides guidelines for managing stormwater runoff. This includes the design and implementation of BMPs such as infiltration basins, rain gardens, and vegetated swales to manage stormwater on-site[2]
- Managed Release Concept (MRC): This design standard focuses on controlling the release rate of stormwater from BMPs to minimize downstream flooding and erosion. It includes specific design values and standards for BMPs, such as maximum ponding depth, media depth, and infiltration rates[3]

EROSION AND SEDIMENT CONTROL

PADEP requires erosion and sediment control plans for construction activities. These plans must include measures to prevent soil erosion and manage sediment during and after construction

Organization Standards/Guidelines

ISI Envision Standards

NATURAL WORLD

This category focuses on protecting and restoring ecosystems and biodiversity. Credits might include siting projects to minimize environmental impact, conserving natural habitats, and enhancing ecological functions.

DEPAVING

Benefits

Reducing impervious cover in the landscape is a low-impact design (LID) principal that has several benefits, including stormwater management, water quality improvement, the mitigation of urban heat island effect, and reduced carbon footprint. Depending on the alternative cover type selection, impervious cover reduction can also reduce construction costs (including the cost of stormwater management systems) and long term maintenance efforts.

Applicability

When planning for the reduction of impervious cover, whether through the design of new landscapes or retrofitting existing facilities, the primary consideration should be to provide pedestrian-friendly spaces while maintaining accessibility.

ALTERNATIVE MATERIALS

Hardscapes are typically comprised of concrete or asphalt. However, there are alternative options for pervious cover types that meet varying degrees of performance standards relative to the traditional options. Alternatives to consider include the following:

- Decomposed granite
- Interlocking pavers
- Permeable concrete
- Permeable asphalt
- Gravel mulch
- Low maintenance planting

Maintenance considerations can be addressed during the design process when these materials are proposed. Decomposed granite should be installed with an appropriate binder to limit maintenance requirements. Geogrids can also be installed to hold gravel and other permeable materials in place when used in walkways and plaza areas that are accessible to pedestrians.

LIMIT CONCRETE AND ASPHALT SURFACING

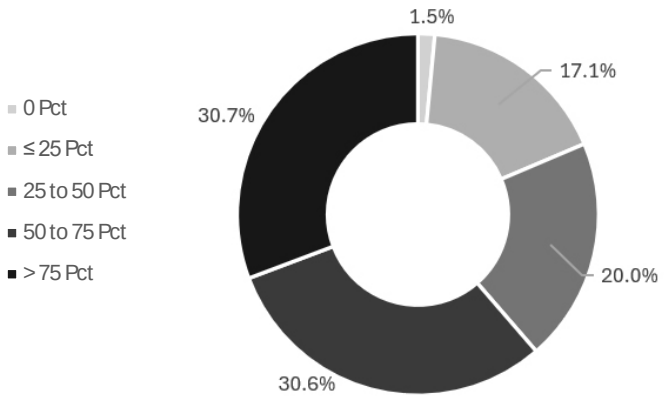
Impervious cover reduction should be prioritized through all design and planning processes. Proposed areas of hardscape cover are often guided by accessible design criteria and the understanding of the numbers of users that a facility expects to serve. It is important to maintain critical performance standards and design for an appropriate level of need.

While some alternatives to impervious surfacing, such as gravel or planting, may not meet accessibility requirements, pedestrian walkways, for example, can be designed to provide the minimum required accessible area for traditional paving while using pervious materials to account for remaining path width, as required to accommodate the total number of expected users.

Permeable pavement options should be considered where alternative cover types for depaving are not feasible. Permeable pavement design options are further described in the Green Stormwater Infrastructure section of these guidelines.

When considering surface alternatives, the designer should take into consideration the life cycles of the proposed materials vs typical concrete and/or asphalt and assess the pros and cons of the material.

PERCENT IMPERVIOUSNESS ACROSS ALL FACILITIES [1]



1. U.S. Geological Survey Annual National Land Cover Database 2023 (based on a 5m x 5m grid)

BEFORE



Fig. 3-48

AFTER

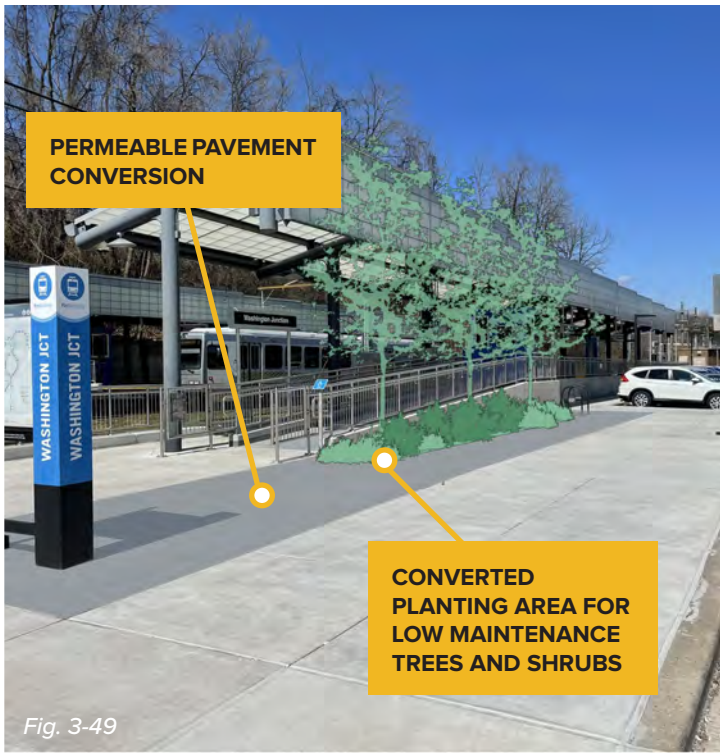
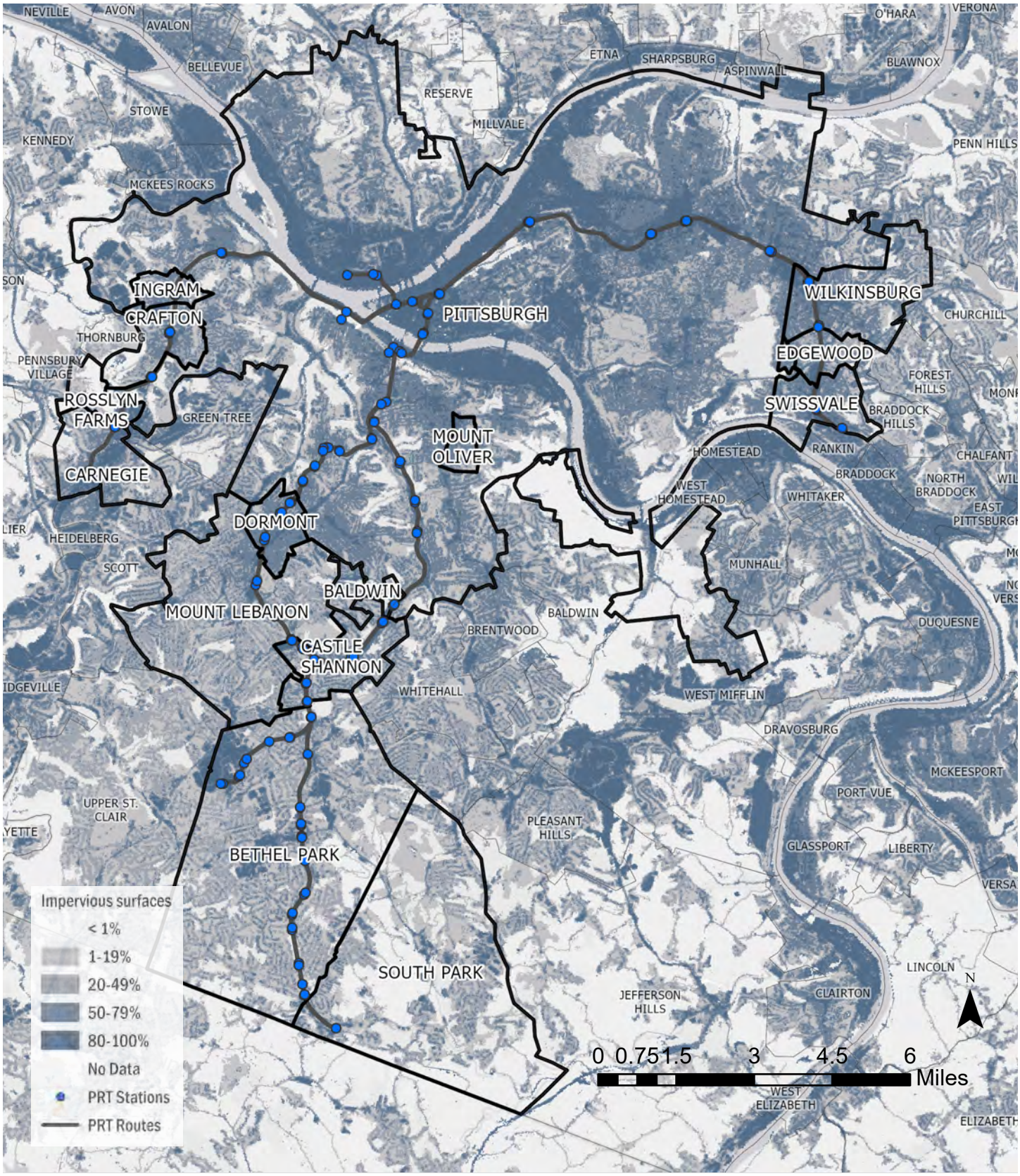


Fig. 3-49

Renderings of the Washington Junction Station before and after conversion to permeable pavement.

IMPERVIOUS COVER MAP



KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

CITY OF PITTSBURGH'S DEPARTMENT OF MOBILITY AND INFRASTRUCTURE (DOMI) 2070 MOBILITY VISION PLAN

This document defines the long-term planning efforts and describes the approach to improving mobility justice.

THE CITY OF PITTSBURGH STORMWATER DESIGN MANUAL

Provides technical guidance for developers and planners to comply with stormwater management requirements.

Pennsylvania Standards/Guidelines

RIGHT-OF-WAY PROCEDURES MANUAL

Guidelines for construction and maintenance within public rights-of-way.

STORMWATER MANAGEMENT REGULATIONS

Ensuring that landscape designs incorporate features to manage stormwater runoff effectively.

- PADEP SWM requirements and standards[1]
- PADEP's Stormwater Best Management Practices (BMP) Manual provides guidelines for managing stormwater runoff. This includes the design and implementation of BMPs such as infiltration basins, rain gardens, and vegetated swales to manage stormwater on-site[2]
- Managed Release Concept (MRC): This design standard focuses on controlling the release rate of stormwater from BMPs to minimize downstream flooding and erosion. It includes specific design values and standards for BMPs, such as maximum ponding depth, media depth, and infiltration rates (MRC)

EROSION AND SEDIMENT CONTROL

PADEP requires erosion and sediment control plans for construction activities. These plans must include measures to prevent soil erosion and manage sediment during and after construction.

Federal Standards/Guidelines

ADA STANDARDS FOR ACCESSIBLE DESIGN

Ensuring that all landscape features are accessible to individuals with disabilities.

ACCESSIBLE ROUTES

ADA Standards for Accessible Design be provided within the site, connecting accessible buildings, facilities, elements, and spaces. This includes ensuring that walkways, ramps, and curb cuts are designed to be accessible.

PARKING AND PASSENGER LOADING ZONES

Standards specifying number and design of accessible parking spaces and passenger loading zones. These must be located on the shortest accessible route to the accessible entrance of the building or facility.

OUTDOOR DEVELOPED AREAS

The United States Access Board provides guidelines for outdoor developed areas, including trails, picnic and camping facilities, viewing areas, and beach access routes.[3]

Organization Standards/Guidelines

ISI Envision Standards

RESOURCE ALLOCATION

This category covers the efficient use of resources such as materials, energy, and water. Credits might focus on reducing material waste, improving energy efficiency, and conserving water resources.

CLIMATE AND RESILIENCE

This category addresses climate impacts and ensures resilience to future challenges. Credits might focus on reducing greenhouse gas emissions, improving resilience to climate change, and preparing for natural disasters.

1. https://www.pa.gov/agencies/dep/programs-and-services/water/clean-water/stormwater-management.html
2. https://www.dep.state.pa.us/dep/subject/advcoun/Stormwater/Manual_DraftJan05/Appendix-E-jan-rev.pdf
3. https://files.dep.state.pa.us/water/bpnpsm/StormwaterManagement/ConstructionStormwater/MRC_BMP_Design_Summary_Sheet.pdf

TRAFFIC CALMING

Benefits

Traffic calming measures are defined as localized safety features that slow traffic and/or increase driver awareness. The benefits of traffic calming are an increase in pedestrian and cyclist safety and the creation of more attractive and inviting streetscapes.

Applicability

Traffic calming measures are best applied when designed to be integrated seemlessly with other recommended landscape strategies. The most common opportunites to achieve traffic calming while layering the benefits of other landscape strategies are with the implementation of GSI, Tree Planting, Depaving, Public Art, and Amenities such as shelters, bike racks, and expanded sidewalks. These measures are appropriate for station driveways, entry plazas, parking lots and bus stops.

Traffic calming benefits are greatest in multi-modal streetscapes where there is higher risk to cyclists and pedestrians in close proximity to motorists.

DESIGN OPPORTUNITIES

Many of PRT's sites include access driveways or PRT-owned roadways where traffic calming design features can provide greater safety and comfort for PRT's riders and employees. They are often, but not always, constructed physical improvements within the streetscape, such as:

- Speed humps
- Speed cushions
- Speed tables
- Raised crosswalks and intersections
- Pedestrian islands
- Reduced travel lanes
- Traffic circles
- Chicanes

Examples of not structural saftey features include visual cues such as:

- Signage
- Tactile warning strips
- Textured or reflective paint
- Striping
- Lighting

When planning for traffic calming measures, it is important to consider all of the circulation needs for each site. Accomodations must typically be considered for emergency service vehicles, such as fire trucks and also for larger, non-emergency vehicles such as garbarge trucks, snow plows, and tractor trailers.



Fig. 3-50

St. Anne Park and Ride access driveway on Rockwood Avenue.

Resources

There are several design resources to support the implementation of traffic calming measures within the streetscape.

The U.S. Department of Transportation Federal Highway Administration (FHWA) has published a "**Traffic Calming ePrimer**", which presents an openly available online review of advanced design approaches to traffic calming. It is divided into 8 modules, wherein Module 3 provides a toolbox of individual traffic calming measures.

The Port Authority of Allegheny County **Transit-Oriented Development Guidelines** also includes a discussion of traffic calming and it the relevant local benefits in multi-modal streetscapes.

Additional key compliances include, but are not limited to Pennsylvania Department of Transportation (PennDOT) and National Association of City Transportation Officials (NACTO).



Corner extension with bioswale.



Raised mid-block crosswalk.

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

CITY OF PITTSBURGH'S DEPARTMENT OF MOBILITY AND INFRASTRUCTURE (DOMI) 2070 MOBILITY VISION PLAN

This document defines the long-term planning efforts and describes the approach to improving mobility justice.

- Accessible Design[1]
- Bike Parking Design[2]
- Complete Streets Policy[3]
- Construction[4]
- Curbs[5]
- Electric Vehicle Charging Guidelines[6]
- 2070 Mobility Vision Plan

Pennsylvania Standards/Guidelines

RIGHT-OF-WAY PROCEDURES MANUAL

Guidelines for construction and maintenance within public rights-of-way.

Federal Standards/Guidelines

ADA STANDARDS FOR ACCESSIBLE DESIGN

Ensuring that all landscape features are accessible to individuals with disabilities.

ACCESSIBLE ROUTES

ADA Standards for Accessible Design be provided within the site, connecting accessible buildings, facilities, elements, and spaces. This includes ensuring that walkways, ramps, and curb cuts are designed to be accessible.

PARKING AND PASSENGER LOADING ZONES

Standards specifying number and design of accessible parking spaces and passenger loading zones. These must be located on the shortest accessible route to the accessible entrance of the building or facility.

OUTDOOR DEVELOPED AREAS

The United States Access Board provides guidelines for outdoor developed areas, including trails, picnic and camping facilities, viewing areas, and beach access routes.[7]

SIGNAGE

Proper signage required to indicate accessible routes, entrances, and facilities. Signs must be designed to be easily readable and include Braille and raised characters where necessary.

Organization Standards/Guidelines

ISI Envision Standards

QUALITY OF LIFE

This category includes credits related to enhancing community well-being, mobility, and community development. Credits might focus on improving public health, increasing accessibility, and fostering community cohesion.

1. https://www.ada.gov/law-and-regs/design-standards/2010-stds/
2. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/23405_domi_bike_guide.pdf
3. https://pittsburgh.legistar.com/LegislationDetail.aspx?ID=2876655&GUID=58D1D58A-BAA3-4C2A-B9A1-E040B0F44D64&Options=ID|Text|&Search=2016-0935
4. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/17897_row_procedures_manual_2022_fin.pdf
5. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/24453_curb_cut_specifications_for_off_street_parking_-_march_2024_updates.pdf
6. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/18958_ev_row_charging_guidelines_final.pdf
7. https://www.access-board.gov/aba/guides/chapter-10-outdoor/

PUBLIC ART

Benefits

Public Art is an expansive landscape design strategy that can be approached in many different ways. However, one unifying goal that PRT can work to achieve through public art is **public engagement**. The benefits of engaging riders, employees, and other users within and around the PRT system may include:

- Community stewardship
- Placemaking
- Beautification
- Shared cultural expression
- Education & communication
- Economic value

Applicability

The landscape typologies that are most likely to create a wide range of opportunities for public art are public entry plazas and walls. However, park and rides, landscape buffers and roadways should all be considered good opportunities for the integration of public art interventions. Through careful planning and design, creative public art interventions ranging from very large to very small scales can be envisioned to enhance the ridership experience throughout the PRT system.

PLANNING AND IMPLEMENTATION

Open calls for public art proposal submissions and working with local artists, in particular, can help build support within the communities where PRT is operating and help foster a community identity within PRT landscapes. The community may also be involved in general artist selection/nomination process and provide comment on the most preferred art experiences.

Partnerships with existing arts and advocacy organizations, such as Pittsburgh Cultural Trust, should also be considered as a way to activate public spaces. Such institutions can leverage large networks of support and publicity and assist with program management and funding opportunities.

Public art in the landscape is commonly provided in the form of a wall mural or a sculpture, however alternative creative formats should be considered as well. Some examples of how public works of art can be integrated with other important landscape design components may include: interpretive signage campaigns, crosswalk and sidewalk painting to support traffic calming, or wayfinding installations to help integrate PRT property with the local community.

Landscape designers can begin to identify opportunities to integrate public art at the earliest stages and work with artists through an iterative process to implement meaningful interventions that will maximize public engagement. If it is necessary to separate the landscape design from the implementation of public art interventions due to schedule or budgetary reasons, landscape designers can help identify key features and locations that may be of interest to artists for further activating the public space.



Fig. 3-53

Interpretive signage at Round Hill Park

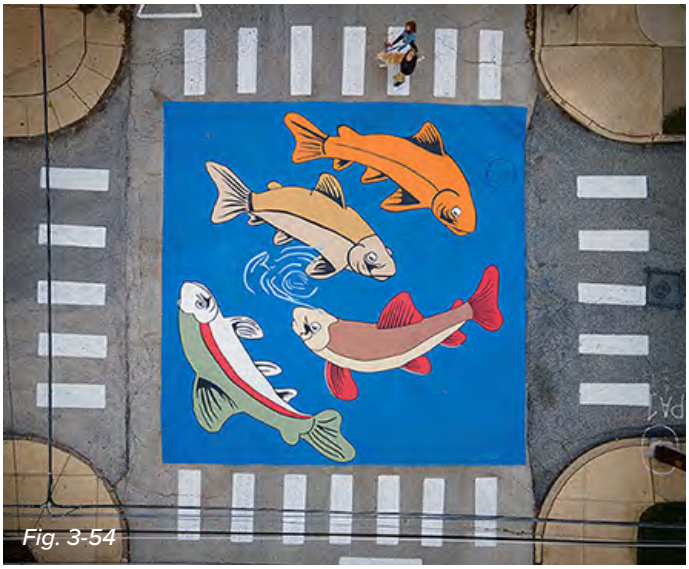

Fig. 3-54



Fig. 3-55

Traffic calming street paintings at intersections in Media, PA produced through a collaboration with the Media Arts Council and the Traffic Calming Project with volunteer support. "Trout at Borough Hall" (top) and "Squirrels at Monroe" (bottom).


Fig. 3-56

Public art bike rack project produced by a collaboration between Pittsburgh Cultural Trust, Bike Pittsburgh, and the City of Pittsburgh

KEY COMPLIANCE STANDARDS

Organization Standards/Guidelines

ISI Envision Standards

QUALITY OF LIFE

This category includes credits related to enhancing community well-being, mobility, and community development. Credits might focus on improving public health, increasing accessibility, and fostering community cohesion.

AMENITIES

Benefits

In the context of landscape design, an amenity refers to any feature that enhances the comfort, convenience, and enjoyment of the user. Amenities enhance public spaces and make them more pleasant and inviting. The integration of public amenities into the landscape at PRT facilities presents one of the strongest opportunities to improve rider and employee experience while supporting critical infrastructure needs.

Applicability

Each of the landscape strategies described in these guidelines has the potential to be designed intentionally to provide a public amenity with stacked benefits. For example, **Tree Plantings** can be located to improve seasonal comfort in the form of shade in the summer and wind screen in the winter, and **Traffic Calming** measures can include protected pedestrian waiting areas and bike racks.

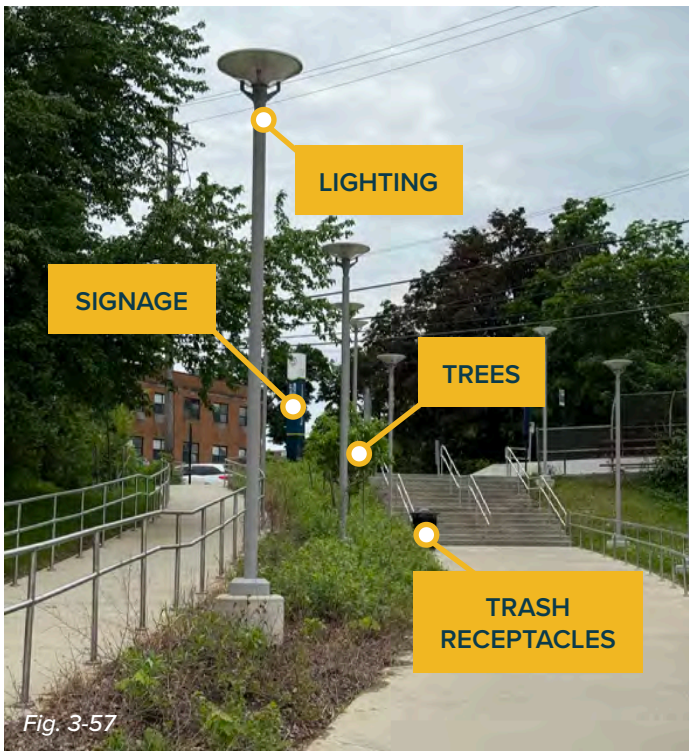
PLANNING AND DESIGN

Planning for amenities such as seating, trash and recycling receptacles, benches, and lighting should be considered at the earliest stages of the design process so that they can be thoughtfully integrated within the overall landscape design for PRT. All public amenities should be composed of durable materials and designed for ease of maintenance and replacement.

Specific siting and design criteria for certain amenity types are provided within both PRT's "**Light Rail Transit Station Design Guidelines**" and the "**Bus Stop and Street Design Guidelines**". This guidance includes:

- Signage (basic and electric)
- Expanded sidewalks
- Benches & leaning bars
- Trash Receptacles
- Shelters
- Lighting
- Bike racks
- Vending machines
- Windscreens
- Call boxes & emergency buttons
- Technology integration

These references provide a basis for including amenities within the landscape.



Layers of public amenities working together at the recently improved Negley Station.

Whenever possible, stakeholders should be engaged during the design process to help inform the decision making and select the specific amenities that are most preferred by local site users. Stakeholder engagement can take many forms ranging from an online survey to in-person community workshops.

Integrated seating design guidance can be found in the Port Authority of Allegheny County Light Rail Transit Station Design Guidelines.

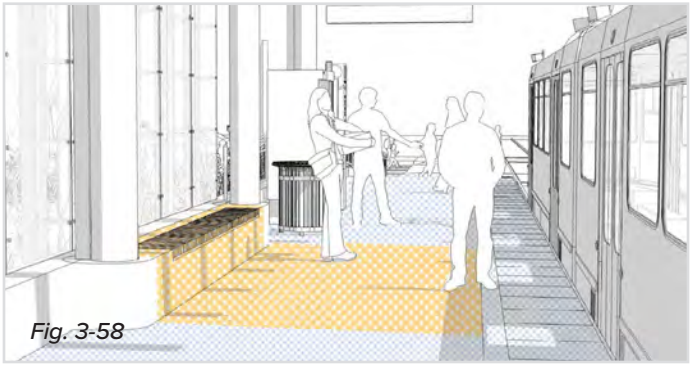


Fig. 3-58

KEY COMPLIANCE STANDARDS

Pittsburgh Specific Standards/Guidelines

CITY OF PITTSBURGH'S DEPARTMENT OF MOBILITY AND INFRASTRUCTURE (DOMI) 2070 MOBILITY VISION PLAN

This document defines the long-term planning efforts and describes the approach to improving mobility justice.

- Accessible Design[1]
- Bike Parking Design[2]
- Complete Streets Policy[3]
- Electric Vehicle Charging Guidelines[4]

Federal Standards/Guidelines

ADA STANDARDS FOR ACCESSIBLE DESIGN

Ensuring that all landscape features are accessible to individuals with disabilities.

ACCESSIBLE ROUTES

ADA Standards for Accessible Design be provided within the site, connecting accessible buildings, facilities, elements, and spaces. This includes ensuring that walkways, ramps, and curb cuts are designed to be accessible.

PARKING AND PASSENGER LOADING ZONES

Standards specifying number and design of accessible parking spaces and passenger loading zones. These must be located on the shortest accessible route to the accessible entrance of the building or facility.

OUTDOOR DEVELOPED AREAS

The United States Access Board provides guidelines for outdoor developed areas, including trails, picnic and camping facilities, viewing areas, and beach access routes.[5]

SIGNAGE

Proper signage required to indicate accessible routes, entrances, and facilities. Signs must be designed to be easily readable and include Braille and raised characters where necessary.

Organization Standards/Guidelines

ISI Envision Standards

QUALITY OF LIFE

This category includes credits related to enhancing community well-being, mobility, and community development. Credits might focus on improving public health, increasing accessibility, and fostering community cohesion.

1. https://www.ada.gov/law-and-regs/design-standards/2010-stds/
2. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/23405_domi_bike_guide.pdf
3. https://pittsburgh.legistar.com/LegislationDetail.aspx?ID=2876655&GUID=58D1D58A-BAA3-4C2A-B9A1-E040B0F44D64&Options=ID|Text|&Search=2016-0935
4. https://www.pittsburghpa.gov/files/assets/city/v/1/domi/documents/policies-and-standards/18958_ev_row_charging_guidelines_final.pdf
5. https://www.access-board.gov/aba/guides/chapter-10-outdoor/