

# Green Infrastructure in Phoenix

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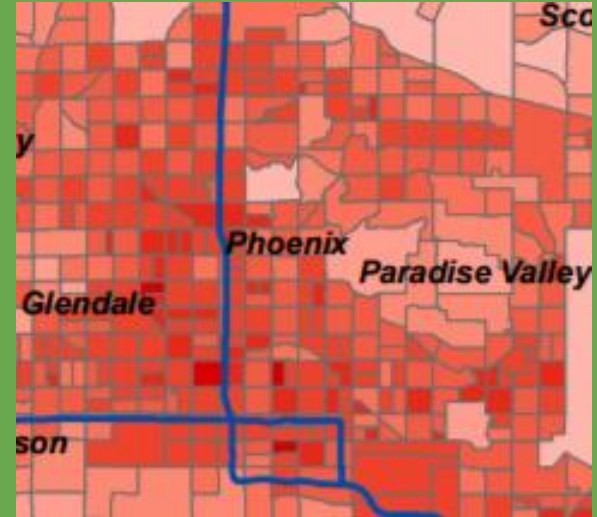
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# Problem: Stormwater in Phoenix

- High amount of impervious surfaces
- High stormwater accumulation
- Water and soil pollution
- Grey infrastructure systems fail

## Objectives

- Identify functionality of specific GI over lifetime
- Initial and Operating costs for GI over lifetime
- Find direct and indirect benefits of GI



# Reduced/Disconnected Impervious Surfaces

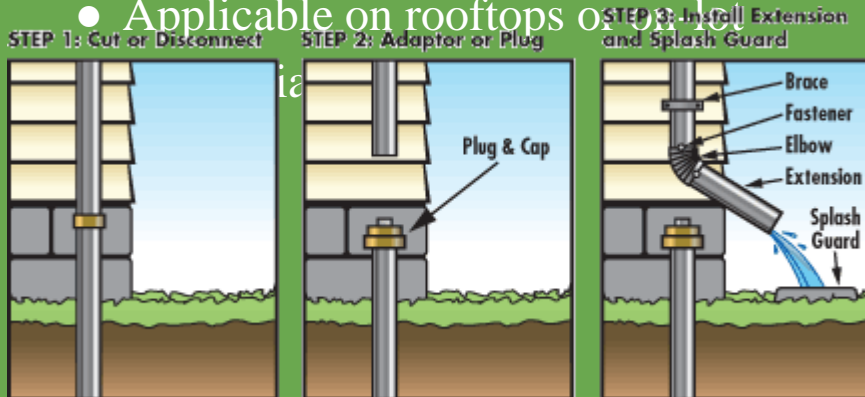
- practice used to minimize impervious surface area, or direct stormwater to reduce the volume of runoff
- Implements multiple GI features
- Applicable on rooftops or on lot



Impervious 'hard' surfaces (roofs, roads, large areas of pavement, and asphalt parking lots) increase the volume and speed of stormwater runoff. This swift surge of water erodes streambeds, reduces groundwater infiltration, and delivers many pollutants and sediment to downstream waters.

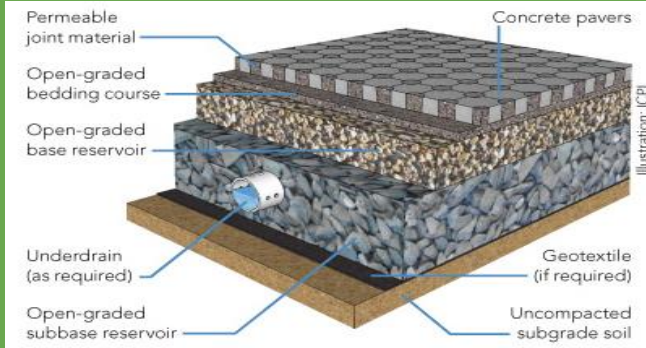
Pervious 'soft' surfaces (green roofs, rain gardens, grass paver parking lots, and infiltration trenches) decrease volume and speed of stormwater runoff. The slowed water seeps into the ground, recharges the water table, and filters out many pollutants and sediment before they arrive in downstream waters.

Conceptual diagram illustrating impervious and pervious surfaces. Impervious surfaces are hard and increase stormwater runoff, causing pollutant and sediment delivery in downstream waters. Pervious surfaces are soft and decrease stormwater runoff, which filters out pollutants and sediments before they arrive in downstream waters. Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Chesapeake and Atlantic Coastal Bays Trust Fund, 2013. Stormwater Management: Reducing Water Quantity and Improving Water Quality. IWpress, newsletter publication.



# Permeable Pavements

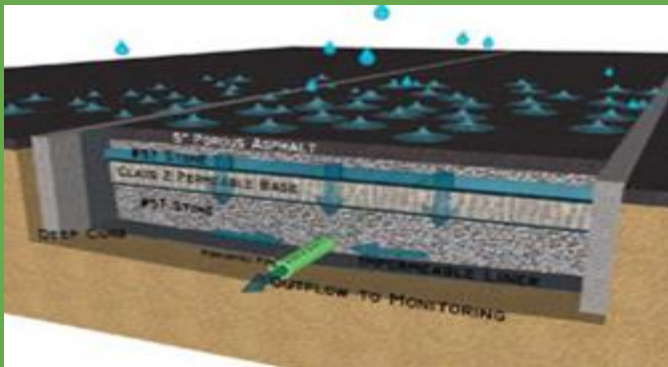
## Permeable Pavers



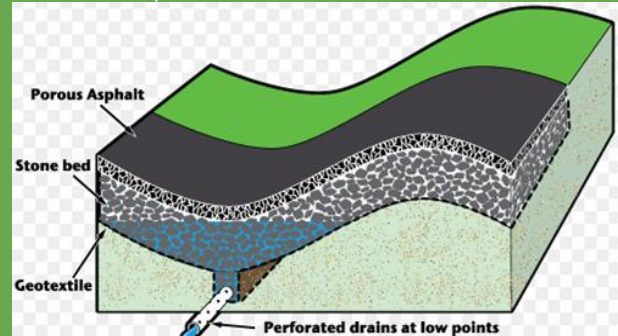
## Stabilized aggregate



## Porous Concrete



## Porous Asphalt



# Challenges of Permeable Pavement

City Code 32-33 E.3. All sidewalks are required to be surfaced with Portland Cement material.

Amend Subdivision ordinance to allow use of permeable pavement for sidewalks.

It is more expensive to install as compared to traditional pavements.

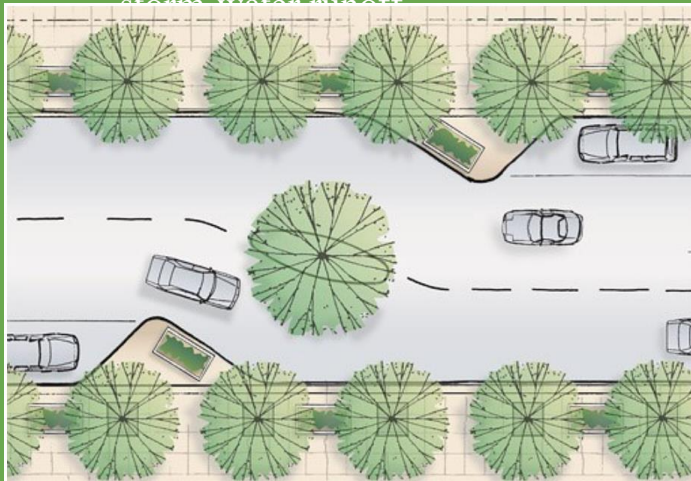
The maintenance requirements of permeable pavement are quite different.

They aren't as strong as traditional or asphalt pavements.



# Traffic Chicanes

- Traffic calming feature designed to slow traffic while enabling GI benefits.
- “Bump outs” or curb extensions along side streets
- includes a bioretention area with vegetation that captures



- substitute for traditional speed bumps
- multiple positive externalities
- encourages alternative transportation

# Challenges and Benefits of Traffic Chicanes

## Benefits:

- reduced impervious pavement, creates new areas for landscaping increased pedestrian safety, improves street aesthetics, creates shade and cooling effects for pedestrians, encourages alternative methods of transportation

## Challenges:

- price - average \$6,690, may require removal of on street parking
- when compared to the price of a traditional speed bump, traffic chicanes offer a better alternative with additional benefits
- City coding

# Curb Cuts

Enables stormwater to enter a landscaped area

Reduces peak/total runoff into stormwater systems

Less expensive than traditional raised curbs

Less material used in making of curb

Maintenance: clear debris/sediment accumulation in curb cut (1-2 times/year)

Repair/reinforce erosion damage (annual inspection/after major storms)

Functions best in lower areas; implemented with bioretention basins, vegetated swales, etc.  
Barriers: City Code Zoning 507 Tab A

Indirect Benefits: heat-island reduction, aesthetics, wildlife habitat

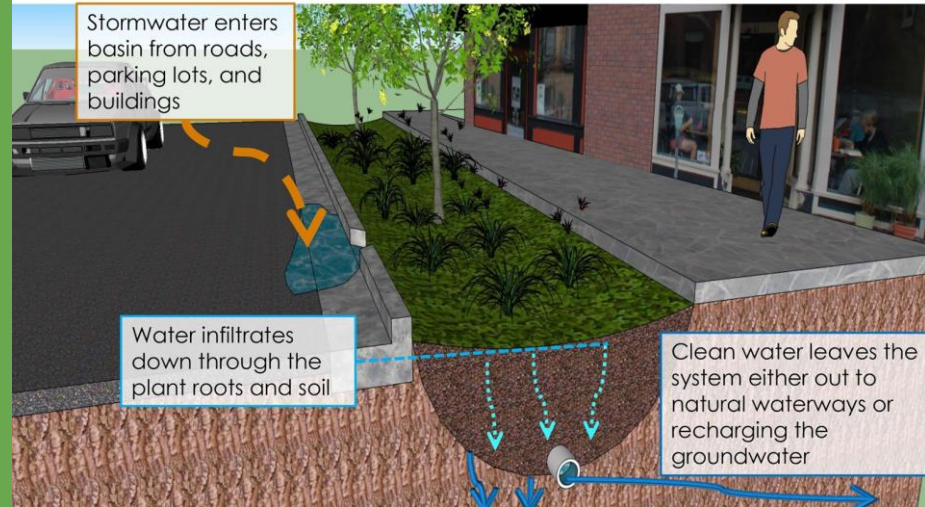




# Bioretention Basins



Bioretention basins capture pollutants from impervious surfaces.



## Costs

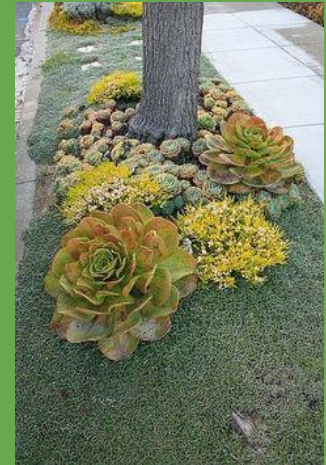
- Capital Costs:  
\$53,000/hectare
- (less than \$1 per sq. foot)
- Maintenance per year:  
\$5000

## Challenges

- Reduces runoff
- Can size to almost any scale
- Infiltrates pollutants
- Aesthetic value
- Fits most landscapes
- Relatively low maintenance costs

## Benefits

- City building codes and ordinances



# Vegetative Swales

- Process
- Design
- Scale
- Relevance



San Diego, CA



## Costs

- Capital Costs:  
\$30,000/hectare
- Maintenance per year: \$200  
per 900 sq. foot area
- Higher estimated costs if  
improperly implemented/



## Challenges

- Requires a lot of space
- Maintenance costs
- Dangerous to use in  
industrial areas
- Thick vegetative cover is  
needed for highest  
effectiveness
- No current template for  
Phoenix
- Manning's equation

## Benefits

- Diverts stormwater  
runoff
- City Code Zoning 507  
Tab A Guidelines for  
Design Review
- Reduce Urban heat  
island effect
- Raise property value

# Our Recommendation for the City of Phoenix:

It is possible to utilize the natural ecology of the Phoenix area to improve stormwater diversion efforts. By implementing green infrastructure as well as incentivizing the implementation of green infrastructure to private contractors, business owners, and residential communities, it is very possible to raise the functionality of the stormwater system. While it would be costly to transform much of the existing infrastructure in Phoenix, there would be a trade-off in the money saved in maintaining these forms of storm water diversion.

Proposal: Sky Harbor Airport pitch

Questions?



# References

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