

Green Infrastructure

And Brownfields





Green Infrastructure and Brownfields

Workshop Schedule

- Registration
- Welcome
- NJIT TAB Introduction
- Introduction to Green Stormwater Infrastructure
- GSI Implementation – Local Challenges/Opportunities
- Small Group Exercise
- Break
- Small Group Exercise Review
- Lunch
- Operation and Maintenance
- Brownfield Basics
- MS4 Permitting
- Break
- Sustainable Development
- Large Group Exercise
- Q/A & Wrap-Up

What Is NJIT TAB?

- Funded by the United States Environmental Protection Agency
- FREE resource for state, regional, county, tribal and local governments, nonprofits and community organizations for brownfield cleanups.



www.pixabay.com



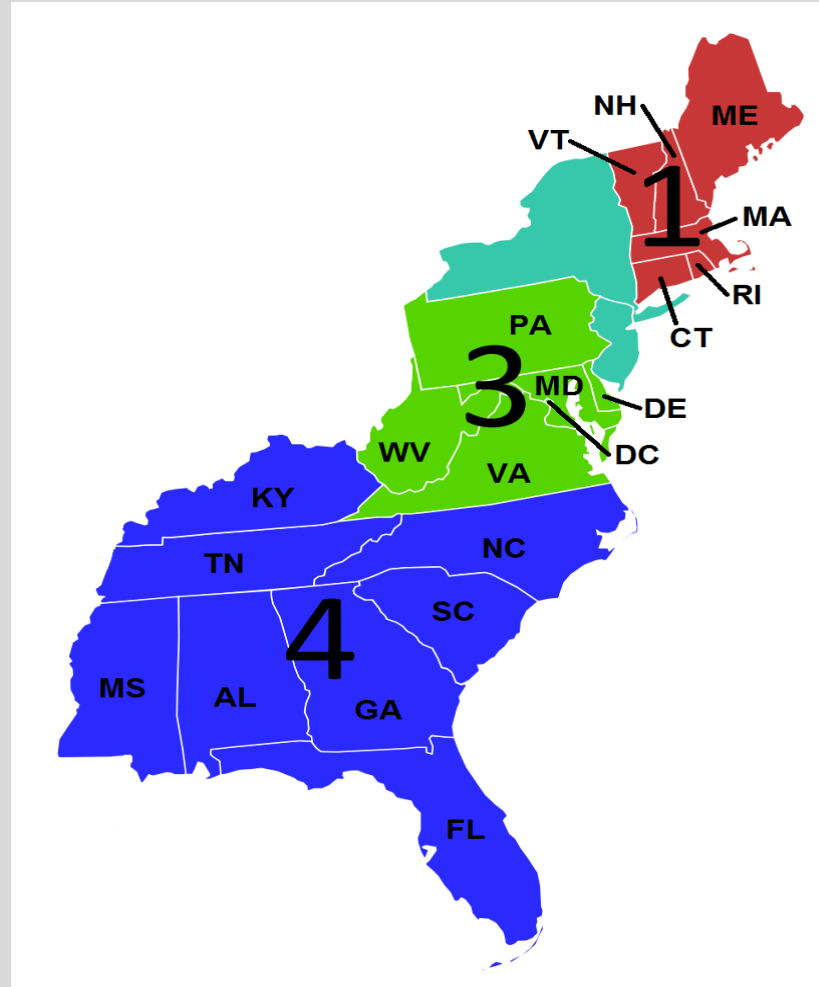
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Who Provides TAB Services?

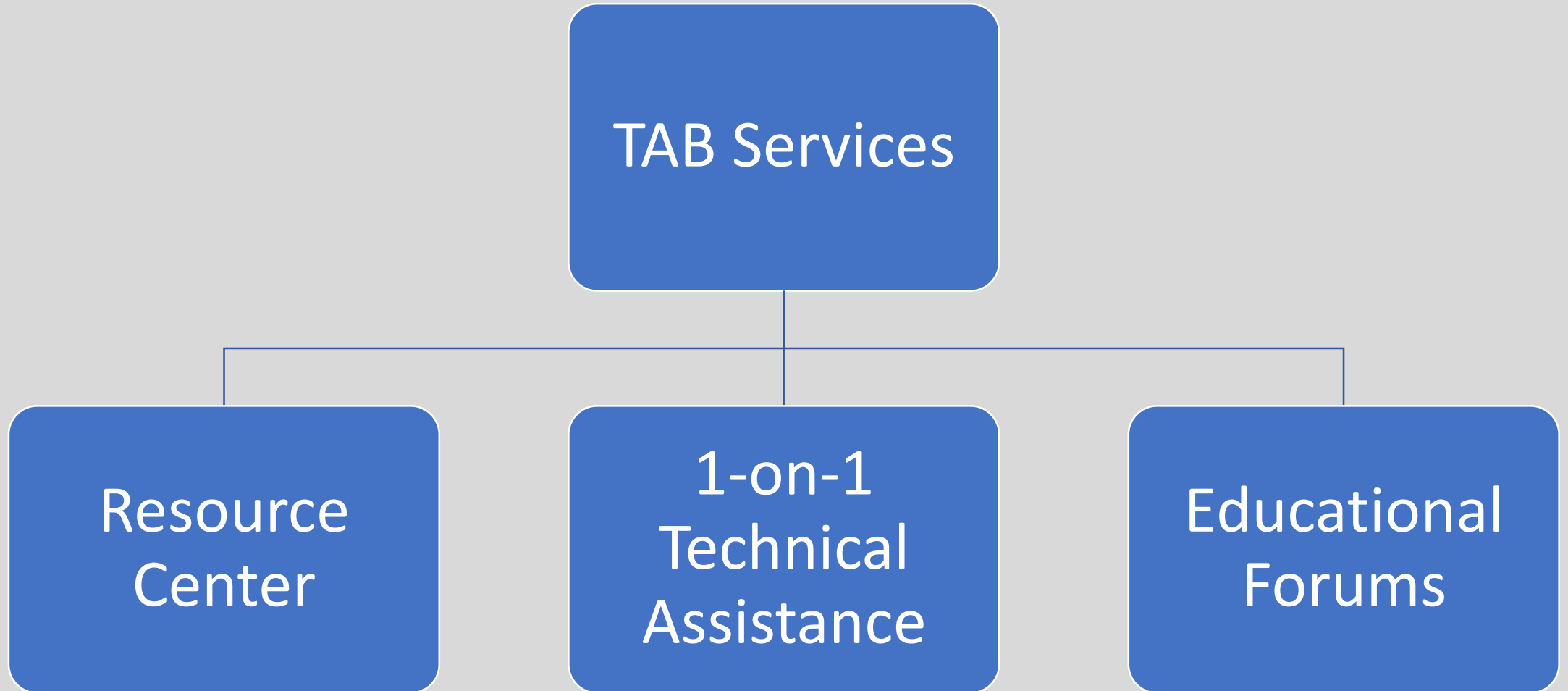


- New Jersey Institute of Technology (NJIT)
- Planners
- Licensed Site Remediation Professionals
- Civil and Environmental Engineers

Who Can Receive TAB Assistance?



What Services Can Tab Provide?



What Services Can Tab Provide?

Resource Center

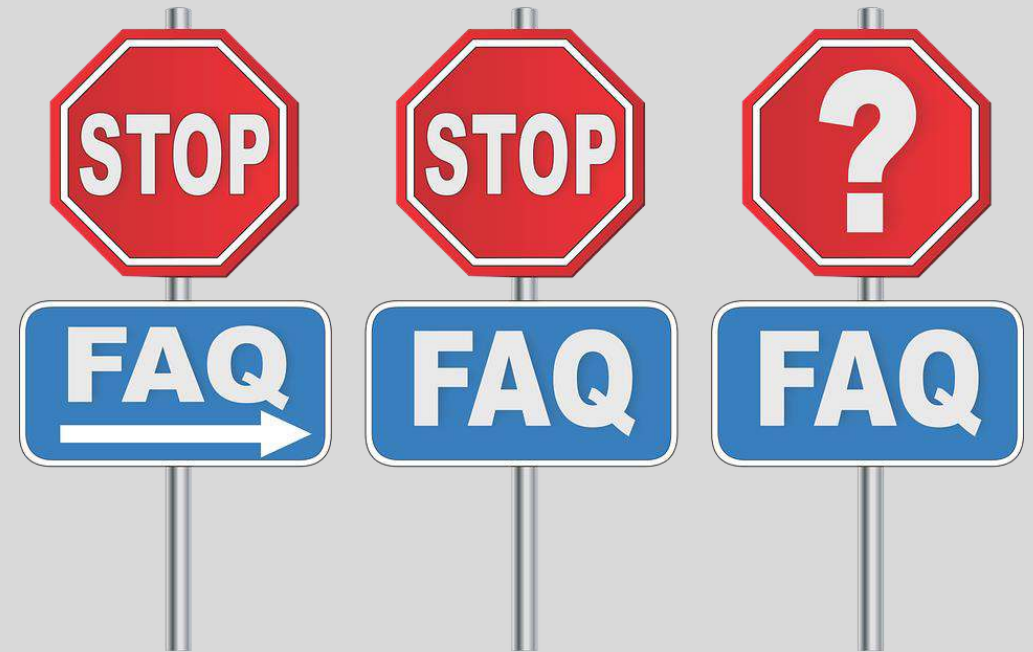
- Contacts for interested organizations
- Brownfield Development Tools
- Identifying Grants for brownfield redevelopment
- Providing professional critiques
- Reviewing Draft Grant Proposals
- NJIT TAB Website



What Services Can Tab Provide?

1-on-1 Technical Assistance

- Grant management techniques
- Leadership visioning for redevelopment
- Site development strategies
- Direct Technical Mentoring



What Services Can Tab Provide?

1-on-1 Technical Assistance

- Explaining Regulations
- Explaining Liability Issues
- Research
- Webinars
- Assets and Needs Studies



What Services Can Tab Provide?

Educational Forums

- Community Workshops
- Conducting Boot Camps
- Seminars



<https://www.pixabay.com>



<https://www.pixabay.com>

Contact us

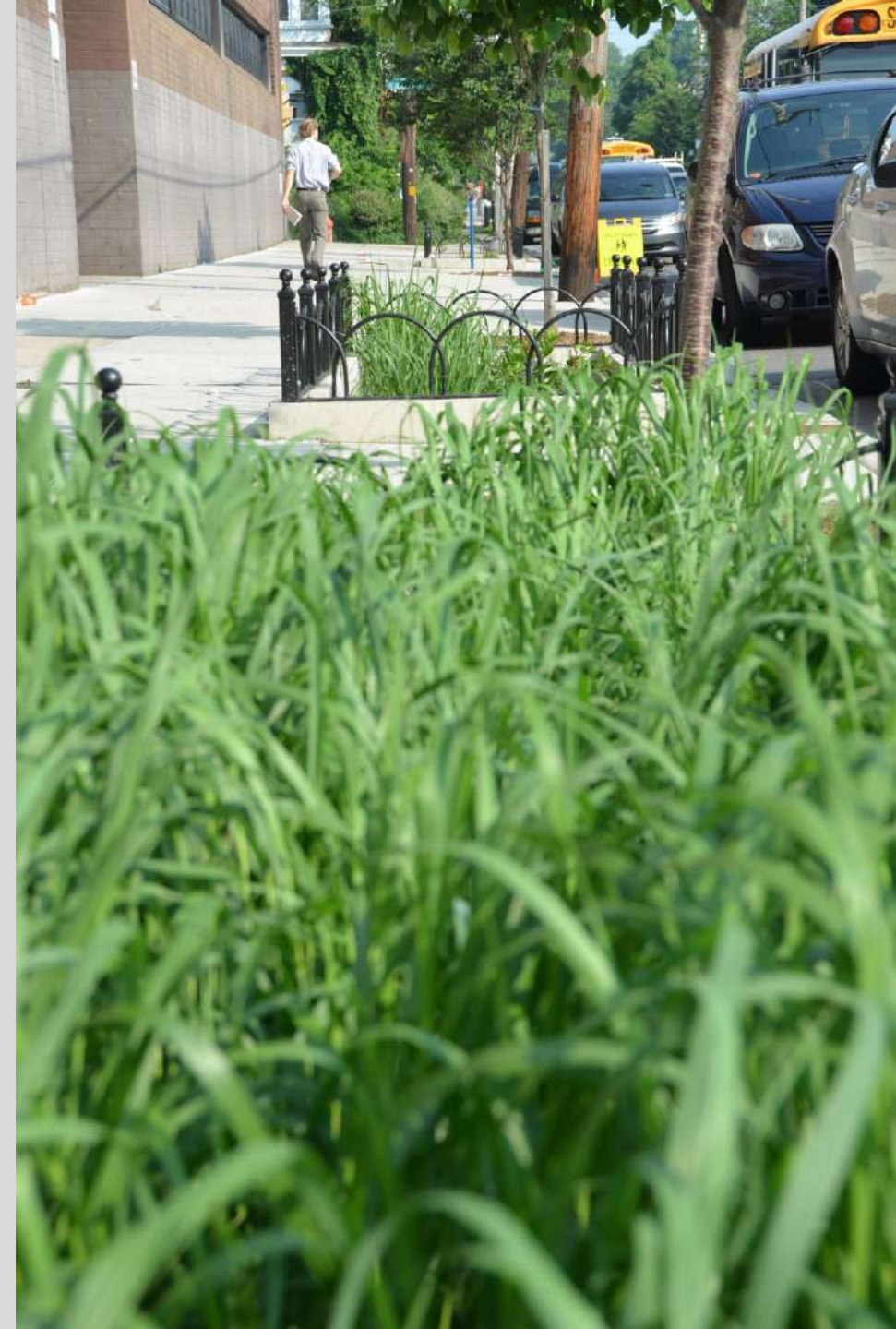
- NJIT TAB HOTLINE 973-642-4165
- EMAIL TAB@NJIT.EDU
- WWW.NJIT.EDU/TAB



Green Infrastructure and Brownfields

Introduction to Green Stormwater Infrastructure

- What is Green Infrastructure?
- Benefits of implementing Green Infrastructure Solutions
- Common Green Infrastructure Techniques
(Benefits and Limitations)
- Which GI Solutions Can Work For My Site?
- Example GI Planning Exercise



Green Infrastructure and Brownfields

What is Green Infrastructure?



.....An approach to the management of water/runoff that works to protect, mimic and/or restore the natural water cycle. Green infrastructure is an effective economical, and enhances community safety and quality of life. www.americanrivers.com

Natural

- Forests
- Wetlands/marshes
- Grasslands/prairies

Restoration Projects

Green Infrastructure Components

- Vegetation
- Soils
- Engineered control elements

Green Infrastructure Solutions

- Engineered Wetlands
- Rain gardens
- Vegetated basins
- Rainwater harvesting
- Permeable Pavement
- Subsurface Storage
- Land Conservation
- Urban Tree Canopy

Green Infrastructure and Brownfields

Benefits of Implementing GI Solutions

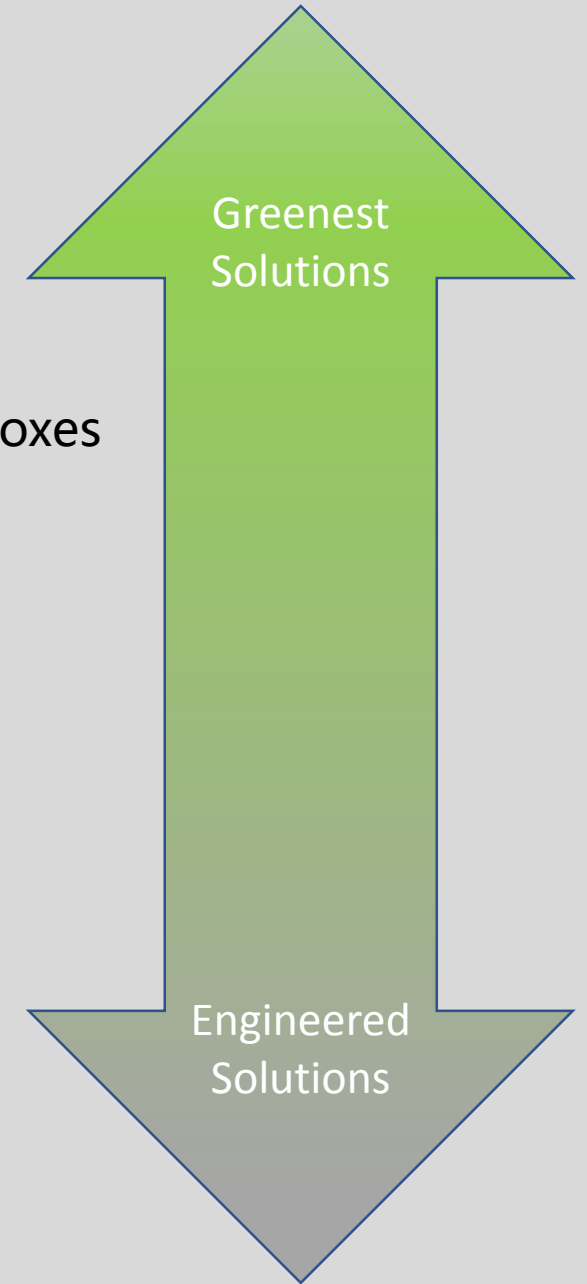


- Improved water quality and reduce runoff volumes
 - Municipal Separate Storm Sewer System (MS4) Requirements
 - Reduction in Combined Sewer Overflow (CSO) incidents
- Reduced ground-level ozone
- Reduced particulate pollution
- Reduced air temperatures in developed areas
- Reduced energy use and associated greenhouse gas emissions.
- Increased or improved wildlife habitat.
- Improved public health from reduced air pollution and increased physical activity
- Increased recreation space
- Improved community aesthetics
- Increased property values
- Educational opportunities

Green Infrastructure and Brownfields

Common GI Solutions

- Rain gardens or bioretention
- Green roof
- Swales and bioswales/planter boxes
- Stormwater bumpouts
- Stormwater tree trenches
- Porous paving
- Subsurface storage



Green Infrastructure and Brownfields

Rain Gardens/Bioretention

Benefits

- Easily adaptable to site conditions
- Natural aesthetics
- Plantings
- Designed to capture first flush (1 – 1.5" rain events)

Limitations

- Require more space than other GI alternatives
- Maintenance (Education, time, maintenance schedule needed)



Green Infrastructure

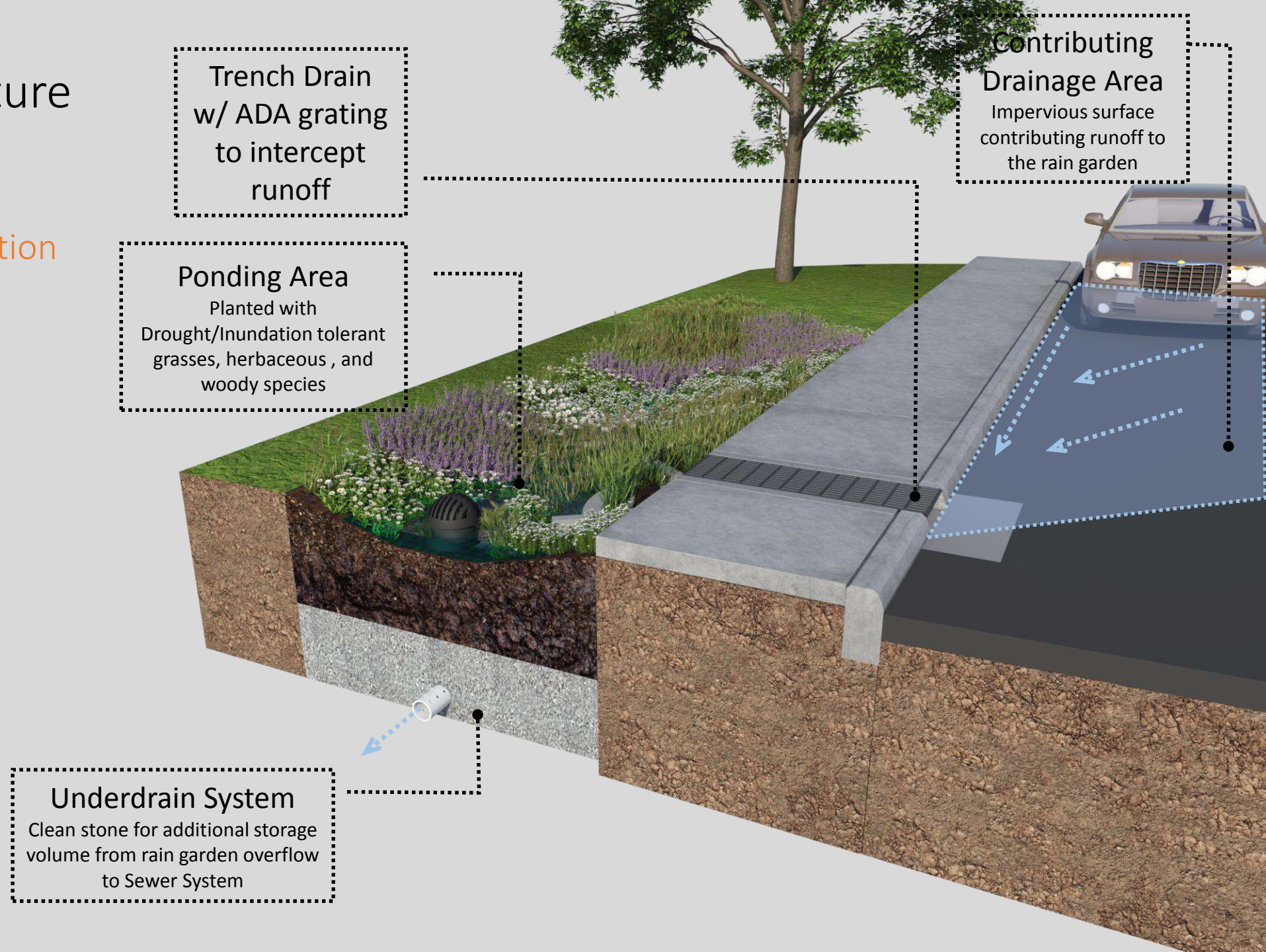
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Rain



Green Infrastructure and Brownfields

Rain Gardens/Bioretention



Green Infrastructure

and Brownfields

Large Scale Rain Gardens/Biore

- Traffic Island and unprogrammed space transformed into rain gardens
- Ability to manage large storm events (2-year)
- Utilize trench drains to direct roadway runoff into garden.
- Maintaining site lines through the use of low growing grasses/shrubs within vehicular site lines



Green Infrastructure and Brownfields

Bioswales, hybrid swale/ditch

Benefits

- Linear infiltration basin captures street and sidewalk runoff for filtering and infiltration of runoff.
- Length and width adjustable to fit the available space (sidewalk width and length).
- Can be planted with street trees and grasses.

Limitations

- Do not capture as much runoff as other GI solutions
- Maintenance (regular removal of debris)



Green Infrastructure and Brownfields

Stormwater Bump

Benefits

- Can capture runoff from roadway/ sidewalk
- Utilize parking lot
- Considered a green space for pedestrian safety

Limitations

- Require coordination with Dept. of Transportation
- Signage



Green Infrastructure

and Brownfield

Green Roof

- Utilize unused roof space
- Intensive: > 6" depth soil media
 - Supports variety of plant material
 - Capture large volume of runoff
 - Loading requirements
- Extensive: 3" to 6" depth soil media
 - Lightweight compared to extensive green roof
 - High maintenance due to limited soil volume, harsher environment.
- Green Roof Limitations
 - Capture area limited to building footprint
 - Challenging to implement as retrofit project, extensive investigations needed on existing structure.



Green Infrastructure and Brownfields

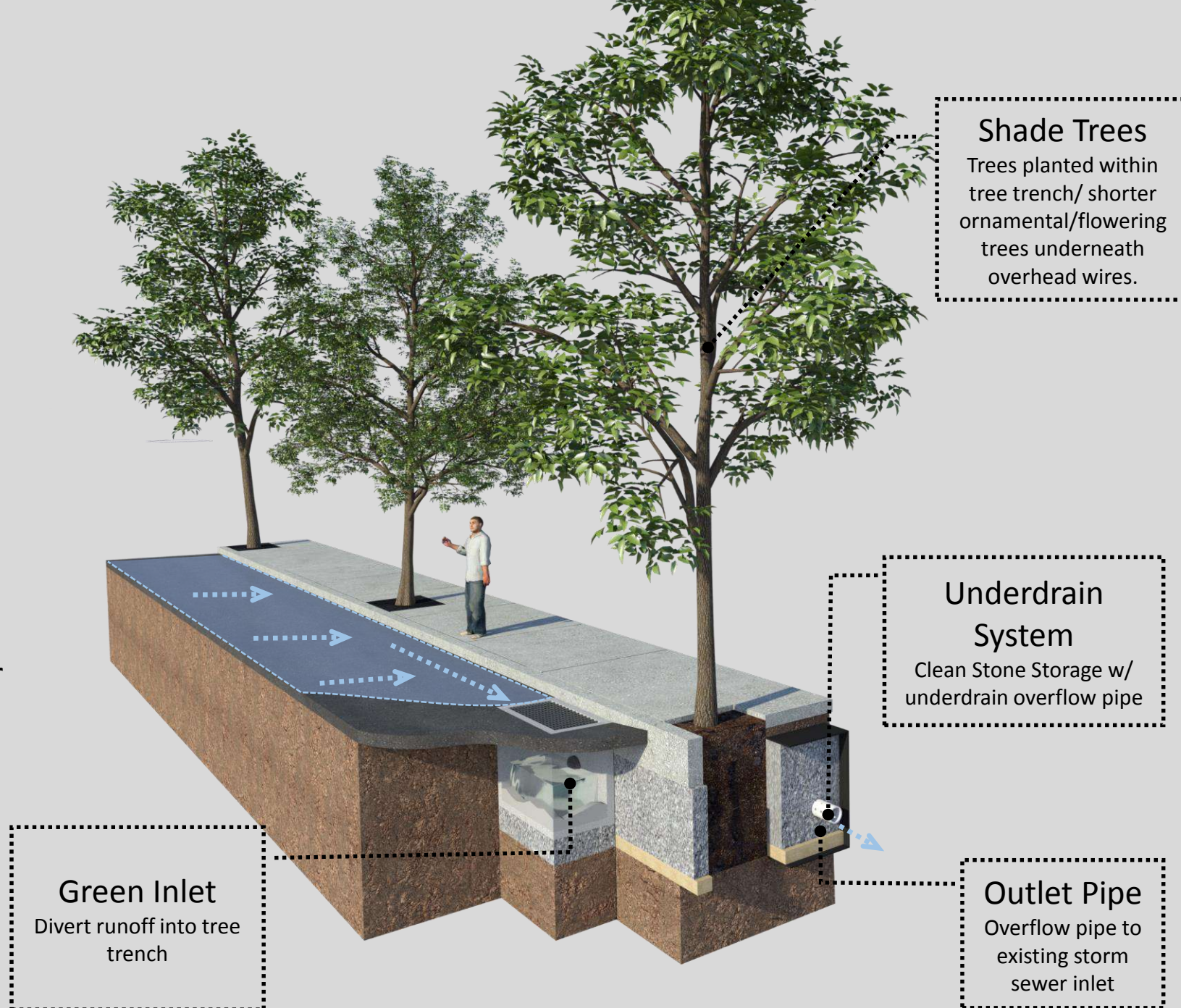
Stormwater Tree Trench

Benefits

- Can capture large volume of runoff for detaining and infiltration.
- Above grade improvements resemble a street tree planting.
- Less ROW impact then other GI Solutions

Limitations

- Plant benefit, pollutant removal very limited
- Minimal Soil
- Large excavations required.



Green Infrastructure and Brownfields

Permeable Pavement

Benefits

- Ideal for parking lots or parking areas in redevelopment
- Open green spaces are efficient
- Promotes

Limitations

- No vegetation from evapotranspiration
- Need to ensure sediment is not permeable pavement
- Maintenance

- Clogged Void Spaces



porous Asphalt
Parking Stalls



Stone
Storage

overflow pipe to
existing storm
sewer inlet

Green Infrastructure and Brownfields

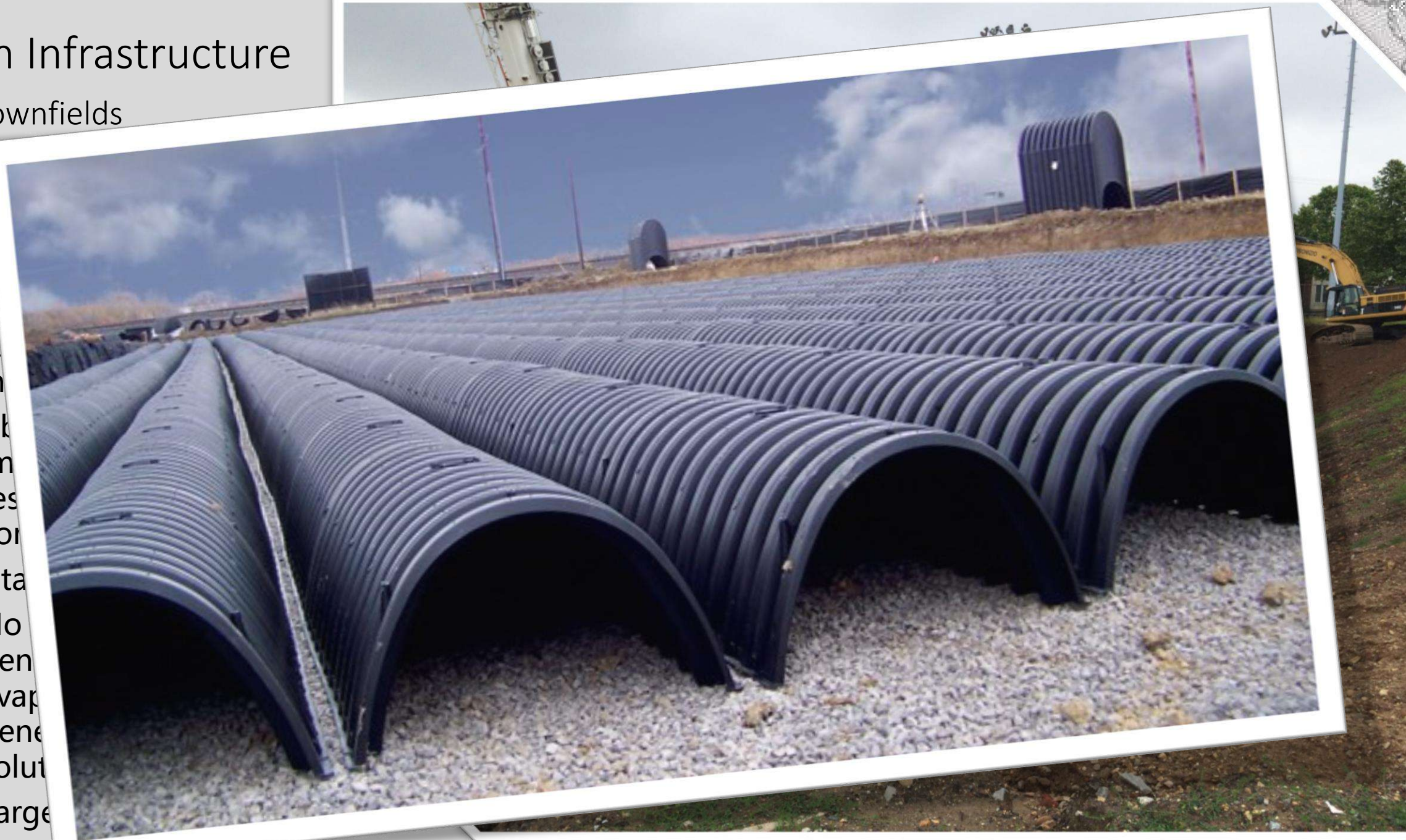
Subsidence

Benefits

- Can
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Limitations

- No
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Green Infras and Brownfields

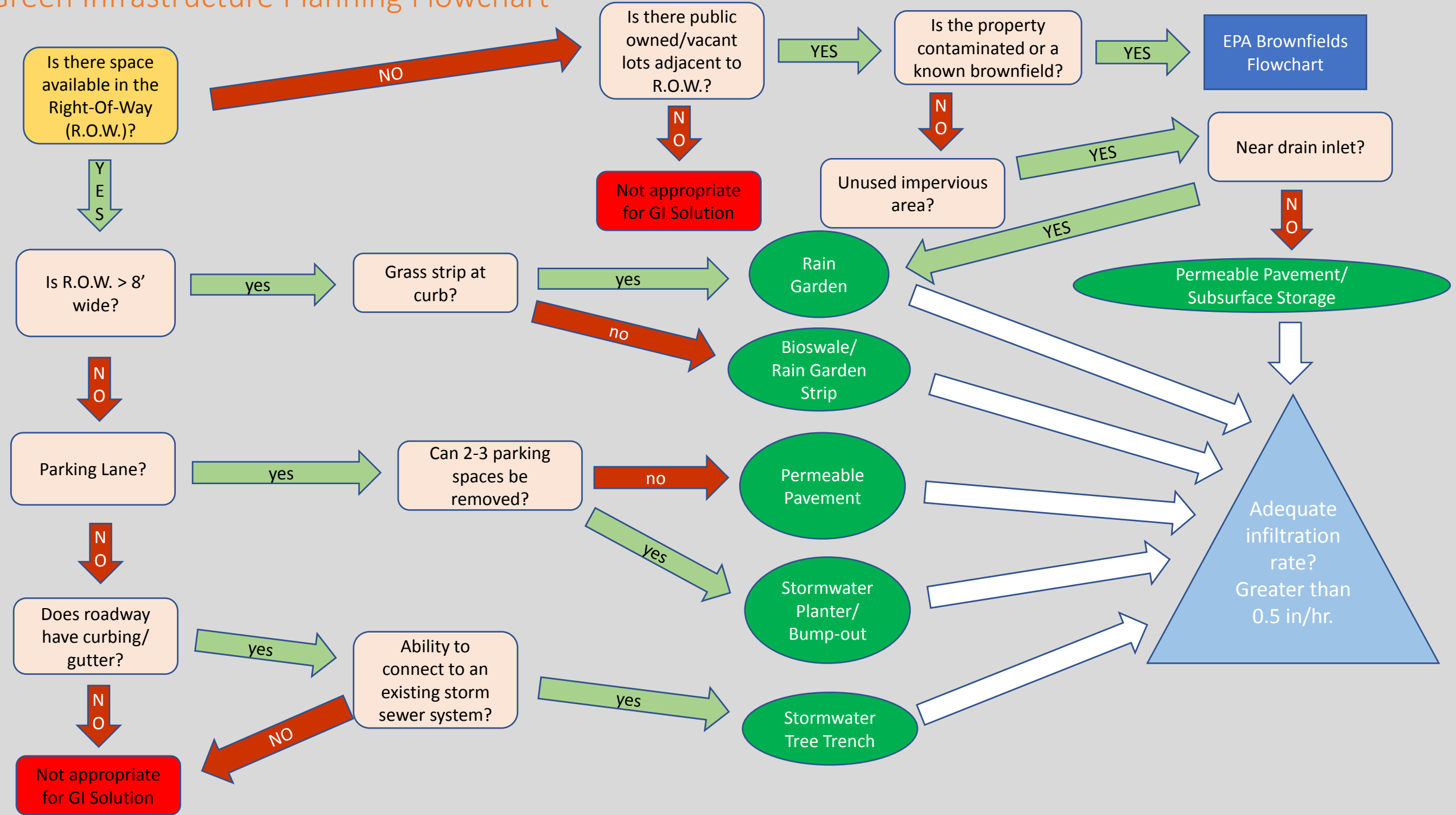
Other Opportun

GI Solutions as community amenities

- Incorporation of rain gardens into playgrounds/schools (Educational opportunities)
- Converting underutilized impervious surface into community amenities
- Converting vacant lots into community green spaces/parks
- Public by in for projects that provide other benefits, ie. Gathering



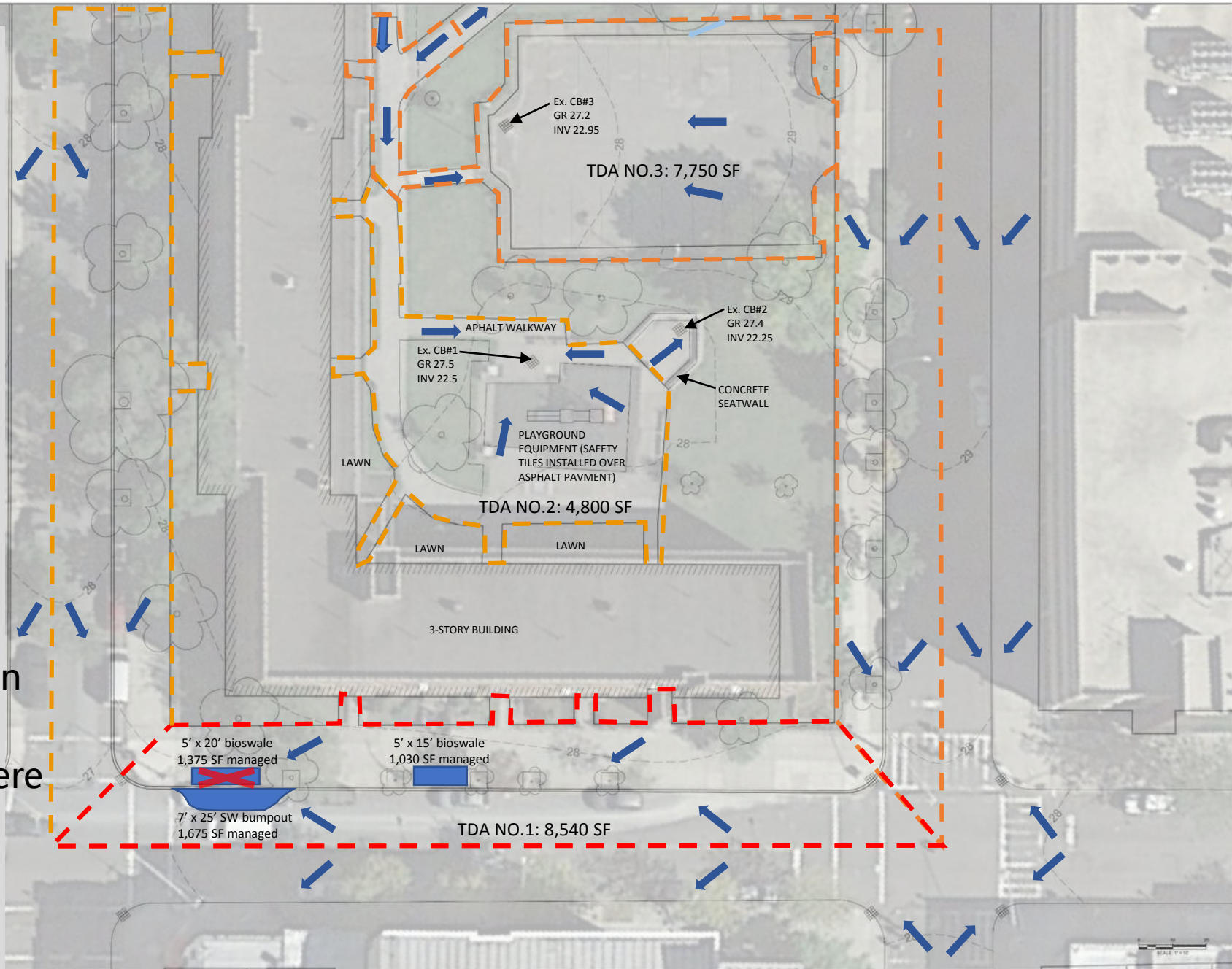
Green Infrastructure Planning Flowchart



Green Infrastructure and Brownfields

Design Process

- Gather Information (surveys, record drawings, etc.)
- Determine direction of rain flow using contours, spot elevations, site inspections
- Delineate tributary drainage areas (TDA)
- Layout potential GI Solutions
 - Begin at lowest point within drainage area
 - Add systems upstream where feasible (adequate runoff)
 - Utilize other methods if necessary



Green Infrastructure and Brownfields

SMALL GROUP EXERCISE

Green Infrastructure and Brownfields

SMALL GROUP EXERCISE

RAIN GARDEN (15' X 30')
3,900 SF MANAGED
370 V-CR / \$13,000

Stormwater Bump Out (25' X 7')
2,600 SF MANAGED
130 V-CR / \$8,000

SUBSURFACE
STORAGE (15' X 15')
9,000 SF MANAGED
0 V-CR, \$24,000

SUBSURFACE
STORAGE (8' X 15')
4,500 SF MANAGED
0 V-CR, \$15,000

RAIN GARDEN (10' X 20')
2,300 SF MANAGED
190 V-CR / \$9,000

BIOSWALE (20' X 5')
2,100 SF MANAGED
100 V-CR, \$8,000

BIOSWALE (15' X 5')
1,600 SF MANAGED
80 V-CR / \$7,000

Stormwater Bump Out (30' X 7')
3,500 SF MANAGED
180 V-CR / \$17,000

RAIN GARDEN
(8' X 15')
1,500 SF MANAGED
120 V-CR / \$8,000

PERMEABLE
PAVEMENT
(18' X 18')
2,900 SF MANAGED
0 V-CR / \$12,000

Stormwater Bump Out (30' X 7')
3,500 SF MANAGED
180 V-CR / \$17,000

Stormwater Tree Trench (55' X 8')
8,000 SF MANAGED
40 V-CR / \$26,000

Tree
Pit

Tree
Pit

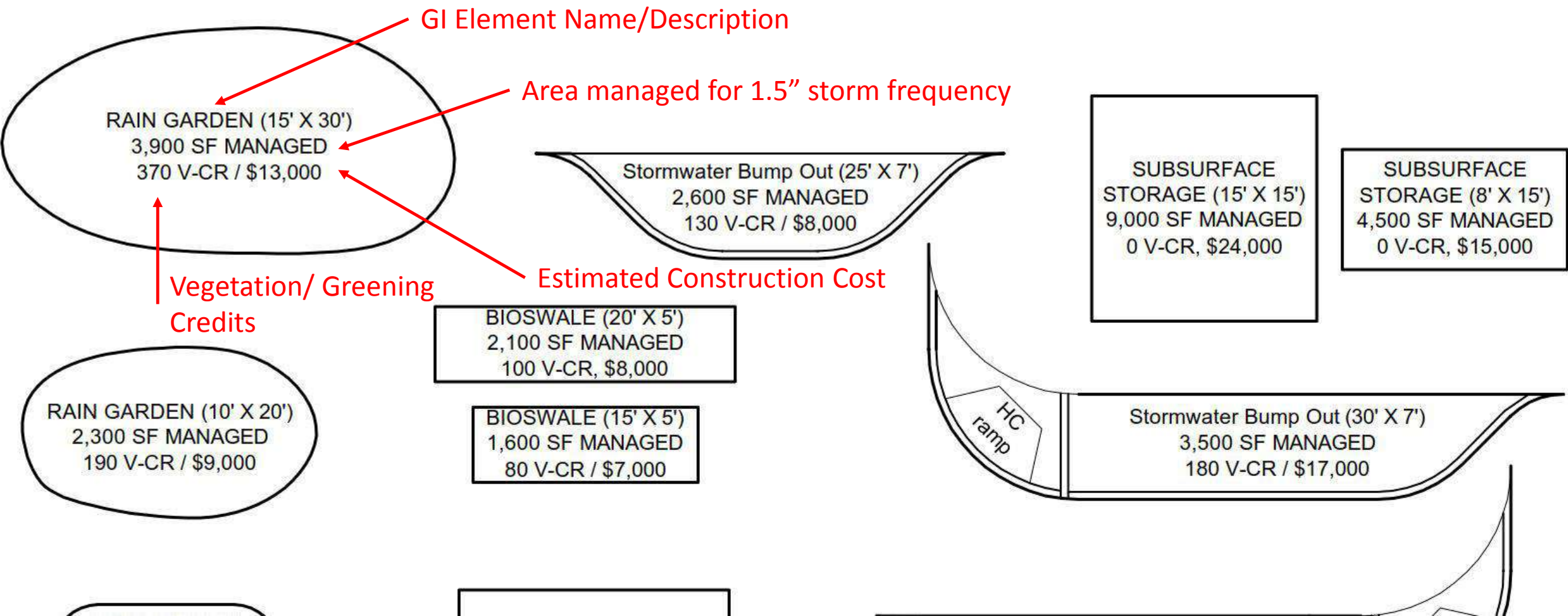
Stormwater Tree Trench (35' X 8')
5,300 SF MANAGED
20 V-CR / \$18,000

Tree
Pit

PERMEABLE PAVEMENT (45' X 18')
6,800 SF MANAGED
0 V-CR, \$22,000

Green Infrastructure and Brownfields

SMALL GROUP EXERCISE



Green Infrastructure and Brownfields

SMALL GROUP EXERCISE

Group 1 & 4:

SITE 1, TDA No. 2

Goal: 4,800 SF managed
No less than 100 V-Cr *
Budget: \$25,000

Site 1, TDA No. 4

Goal: 8,050 SF managed
No less than 100 V-Cr *
Budget: \$35,000

Group 2 & 5:

SITE 2, TDA No. 1

Goal: 10,800 SF managed
No less than 100 V-Cr *
Budget: \$40,000

SITE 2, TDA NO. 2

Goal: 9,400 SF managed
No less than 100 V-Cr *
Budget: \$40,000

Group 3 & 6:

SITE 1, TDA No. 5

Goal: 6,340 SF managed
No less than 100 V-Cr *
Budget: \$35,000

Site 1, TDA No. 3

Goal: 8,000 SF managed
No less than 50 V-Cr *
Budget: \$35,000

* V-Cr = Vegetative/ Green Credits

Green Infrastructure

and Brownfields

SMALL GROUP EXERCISE

Guidelines

- Rain Gardens are typically located at a low point/inlet.
- Tree Trenches cannot require the removal of existing trees.
- Multiple areas of permeable pavement can be added within one parking lot.
- No practice should be located over an existing utility line.
- No practices to be located within the drip line of existing trees.

Green Infrastructure and Brownfields

COFFEE BREAK

Green Infrastructure and Brownfields

Group Exercise No. 1

Group Presentations

Green

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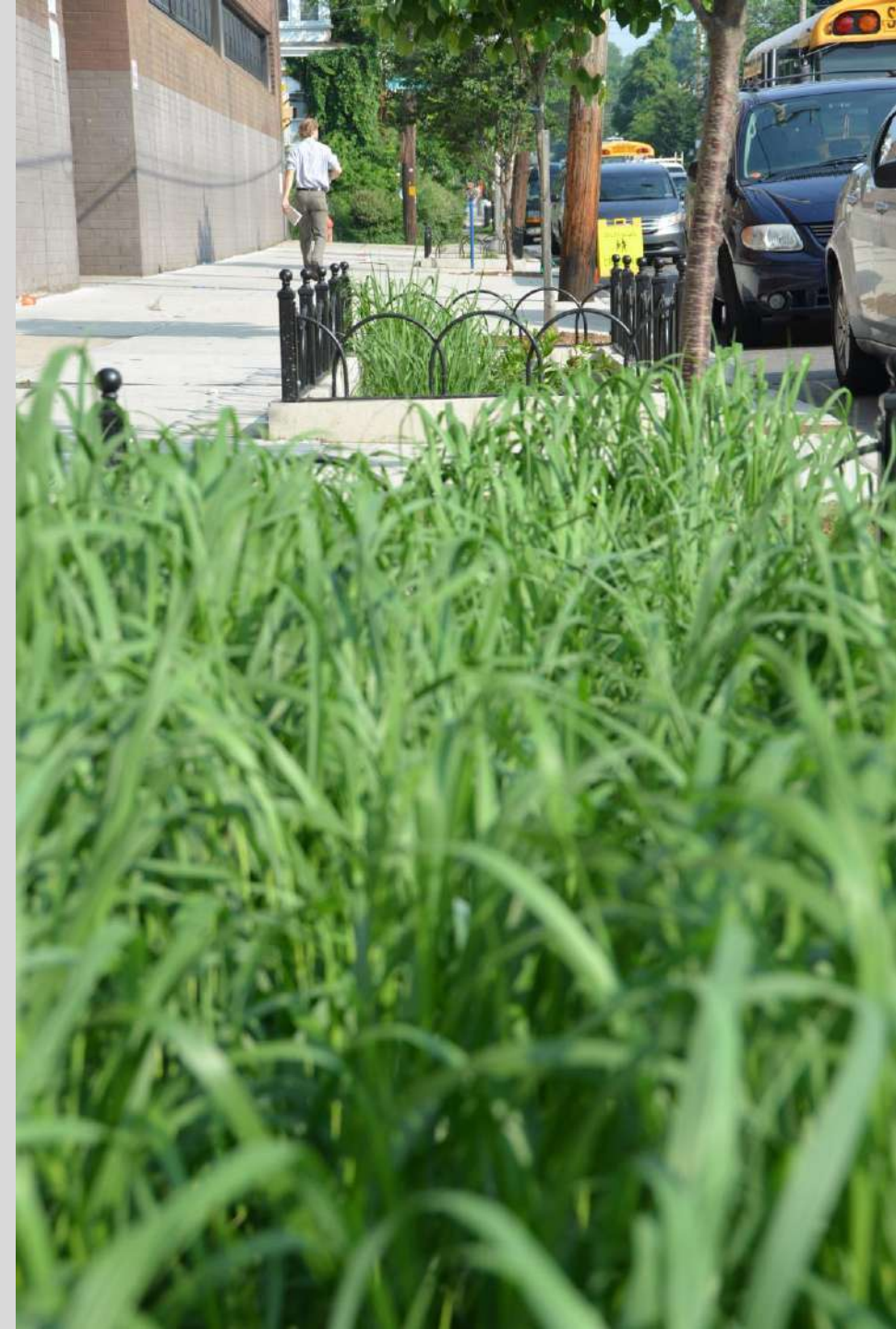
Green Infrastructure and Brownfields

LUNCH BREAK

Green Infrastructure and Brownfields

Costs of Green Infrastructure

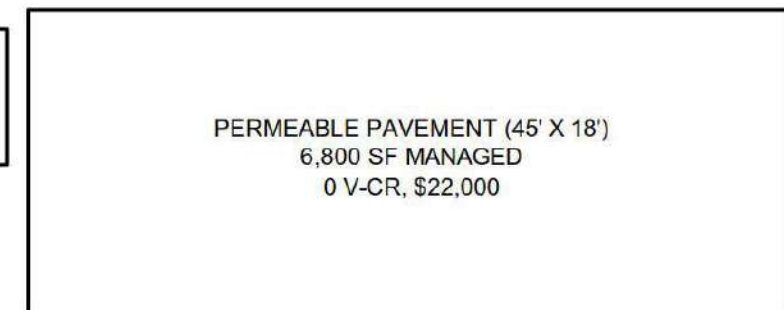
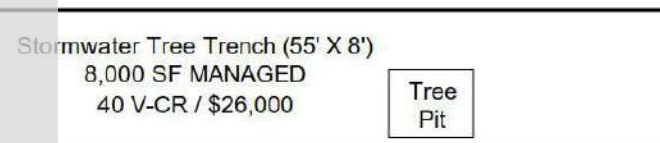
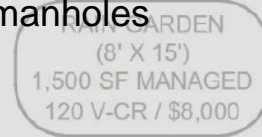
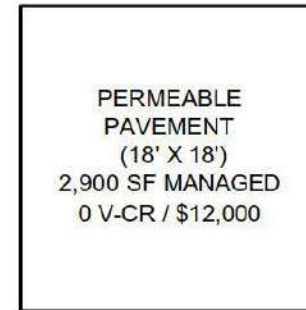
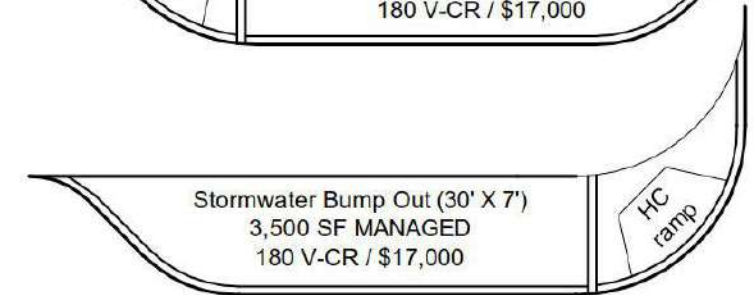
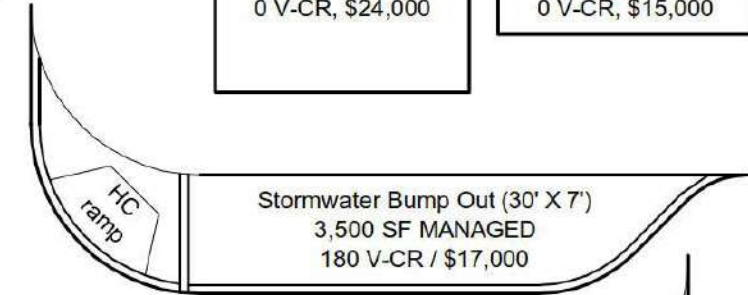
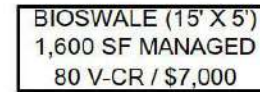
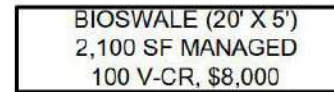
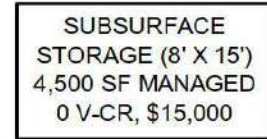
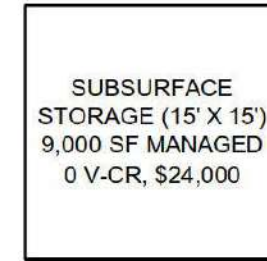
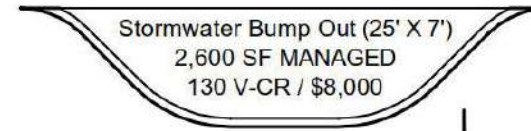
- Construction Costs
- Operations and Maintenance Costs



Green Infrastructure and Brownfields

Green Infrastructure Construction Cost Considerations

- Removal of existing pavements/curbing
- Stormwater Management System
 - Connections to existing inlets/manholes
 - Relocations
 - New Inlets/Structures
- Removal of existing soils
- New Curbing
- Pavement Repair (Roads/Sidewalks)
- Proposed Drainaged (Structures, overflow, trench drains, etc.)
- Porous Pavements
- Plantings (Trees/Shrubs/Perennials, mulch, etc)



	RG (10x20)				RG (5x18)		RG (15x30)		Tr Trench (55x8)		Tr Trench (85x8)		Subsurface 15x15		Subsurface 8x15		Bump-out (25x7)		Bun
	Size								55		85		15		8				
	Depth												10		10				
	Area (SF)				181		120		368		440		680		225		120		122
	Perimeter				51		46		74		126		186		60		46		57
Prop. Curb Area +2 ft	19				19		19		37		37		0		0		36		57
	294												76		361		62		254
Item	Unit	Unit Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost	Quantity
General Conditions (Permits, Mobilization, Soil Erosion and Sediment Control), 10% Construction Cost	LS	N/A	N/A	\$705	N/A	\$586	N/A	\$1,073	N/A	\$2,112	N/A	\$3,061	N/A	\$1,945	N/A	\$1,232	N/A	\$613	N/A
Concrete Curb	LF	\$45	0	\$0	0	\$0	0	\$0	55	\$2,475	85	\$3,825		\$0		\$0	36	\$1,620	
Engineered Soil	CY	\$97	13.4	\$1,294	8.9	\$858	27.3	\$2,631		\$0		\$0		\$0		\$0	9.0	\$872	
Soil Excavation Unclassified	CY	\$45	20	\$905	13	\$600	41	\$1,840	65	\$2,933	101	\$4,533	81	\$3,626.25	43	\$1,934.00	18	\$813	
Saw Cutting Pavement	LF	\$8	0	\$0	0	\$0	0	\$0	71	\$568	101	\$808	76	\$608.00	62	\$496.00	57	\$456	
Pavement Removal	CY	\$50	0	\$0	0	\$0	0	\$0	5	\$272	8	\$420	3	\$138.89	1	\$74.07	2	\$75	
Storm Chamber	LF	\$48		\$0		\$0		\$0		\$0		\$0	60	\$2,880.00	30	\$1,440.00		\$0	
12" Wide Trench Drain	LF	\$550		\$0		\$0		\$0		\$0		\$0		\$0		\$0		\$0	
6" Solid Dual Wall HDPE Pipe	LF	\$27		\$0		\$0		\$0		\$0		\$0		\$0		\$0		\$0	
Open Graded Stone Base	CY	\$89	0	\$25	0	\$16	1	\$50	65	\$5,775	101	\$8,926	74	\$6,532.77	40	\$3,512.50	9	\$801	
Inlet Reconstruction (As Overflow)	Ea	\$3,500	1	\$3,500	1	\$3,500	1	\$3,500	1	\$3,500	1	\$3,500	1	\$3,500	1	\$3,500	0	\$0	
15"x15" concrete catch basin with weir plate (Diversion Structure)	Ea	\$2,200		\$0		\$0		\$0		\$0		\$0						\$0	
Asphalt Pavement	SF	\$6		\$0		\$0		\$0		\$0		\$0	361	\$2,166	228	\$1,368	72	\$432	
Porous Asphalt Pavement	SF	\$9		\$0		\$0		\$0		\$0		\$0		\$0		\$0	0	\$0	
Porous Concrete Pavement	SF	\$13		\$0		\$0		\$0		\$0		\$0		\$0		\$0		\$0	
Concrete Pavement	SY	\$90							48.9	\$4,400	75.6	\$6,800							5,777
Detectable Warning Surface	SY	\$400																	0.888
Mulch	SY	\$12		\$0		\$0		\$0		\$0		\$0		\$0		\$0	13.5555556	\$163	19.44
Trees (2.5" - 3" cal.)	Ea	\$600		\$0		\$0		\$0	2	\$1,200	3	\$1,800		\$0		\$0		\$0	
Shrubs - Large (4 ft spacing - 10% of plantings)	Ea	\$90												\$0		\$0			
Shrubs - Medium (3ft spacing) - 10% of plantings)	Ea	\$47												\$0		\$0			
Perennials/Grasses(2 ft spacing) - 80% of plantings	Ea	\$25	53.2	\$1,331	35.3	\$882	108.2	\$2,706		\$0		\$0		\$0		\$0	36.0	\$900	
				\$7,760		\$6,442		\$11,799		\$23,236		\$33,673		\$21,397		\$13,557		\$6,745	
		10.00%		\$780		\$650		\$1,180		\$2,330		\$3,370		\$2,140		\$1,360		\$680	
TOTAL		\$184,059		\$8,540		\$7,092		\$12,979		\$25,566		\$37,043		\$23,537		\$14,917		\$7,425	

Green Infrastructure and Brownfields

Green Infrastructure Maintenance

- Trash and debris removal
- Sediment removal (Control structures, trench drains, etc.)
- Weeding and pruning
- Product testing
- Structural repairs (inlets, cleanouts)
- Reseeding and watering
- CCTV underground pipe and vector cleaning
- Public Perception
(*"Looks like weeds", "not manicured landscape"*)



Green Infrastructure and Brownfields

Green Infrastructure Maintenance

- Master Specifications Development
 - Various Technical Sections – Geosynthetics, Planting, Inlets, Energy Dissipators, Etc.
 - GSI Soils
 - Soils Handling
 - Quality of Life
- Annual Landscaping Services Contract
- Drawing standardization
 - Efficiency in design
 - Ease of review
 - Used for As-Builts
 - Compatible with GIS and Asset Management



Brownfield Basics

New jersey institute of technology
Technical assistance to brownfield communities program
(njit tab)



“

What is a Brownfield

Real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant

”

Brownfields

Energy Exploration (1800 - present)

+

Steel production (1870 - 1980)

+

Manufacturing (1800 -present)

=

Brownfields of Today



Disadvantages of Having a Brownfield Site

- Potential harm to human health
- Degradation of the environment – soils, water, air
- **Lowers surrounding property values**
- **Contributes to neighborhood deterioration**
- **Contributes to negative perception of the neighborhood**



https://en.wikipedia.org/wiki/Brownfield_land



http://fieldsenvironmentalinc.com/brownfield_redevelopment

- Reduces local employment opportunities
- Reduces or loss of tax revenue
- Limits economic growth



<http://www.bnd.com/news/local/community/highland-news-leader/article33406179.html>

- Attracts vandals, open dumping, or other illegal or unwanted activity
- Contributes to sprawl – as activities locate on greenfields

Advantages of Having a Brownfield Site

location efficiency and existing infrastructure



<http://www.pvpc.org/projects/brownfields>



<http://www.rochestersubway.com>



<http://www.newsworks.org/index.php>

Advantages of Having a Brownfield Site

holds the potential of becoming a community asset



<http://finance-commerce.com/2013/12/minnesota-brownfields-group-eases-cleanup-process/>



<https://www.talgov.com/eper/eper-brownfields.aspx>



<https://www.talgov.com/eper/eper-brownfields.aspx>

Environmental, Societal, and Economic Benefits of Brownfield Cleanup and Redevelopment

- Removes health and safety hazards
- Improves environmental quality
- Removes eye sore; improves community appearances
- Reduces area crime



http://blog.cleveland.com/metro/2008/11/pittsburghs_renaissance_holds.html



<http://www.smartgrowthamerica.org>

Environmental, Societal, and Economic Benefits of Brownfield Cleanup and Redevelopment



<http://www.deedworks.org/>

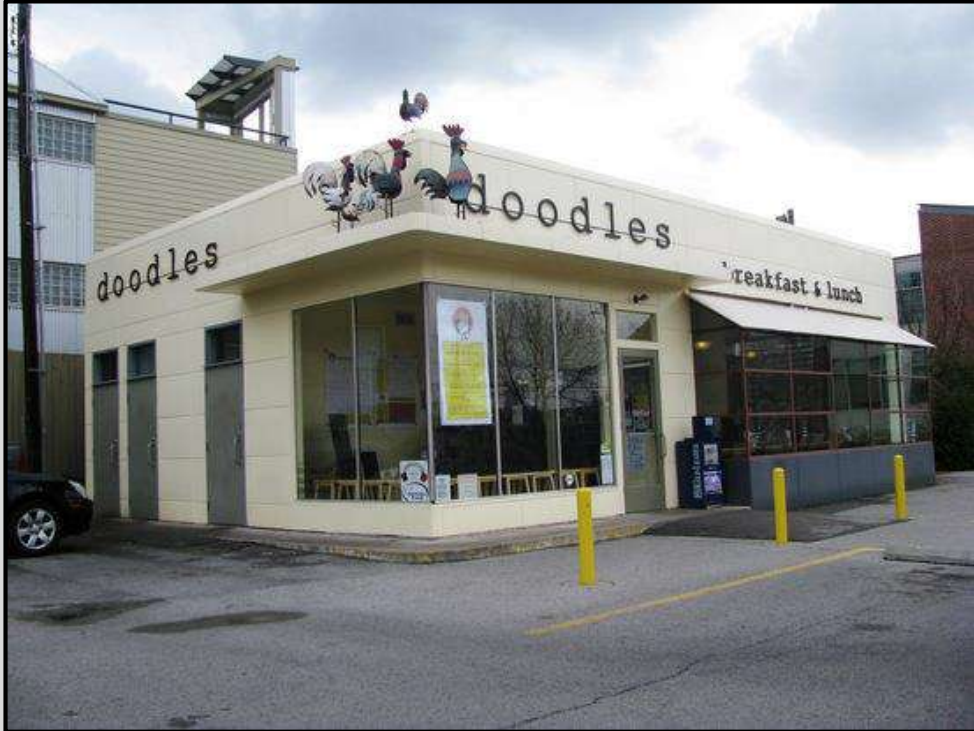
- Alleviates community fears and worries



<http://www.njfuture.org/2013/03/07/brownfields-bill/>

- Increases property values
- Promotes infill development; reduces sprawl; reduces infrastructure costs

Environmental, Societal, and Economic Benefits of Brownfield Cleanup and Redevelopment



<https://www.brownfieldrenewal.com>

- Creates housing, open space, commercial, retail, and entertainment uses

- Potential increases local tax base
- Creates jobs



<http://equalmotion.com/news/new-york-city-high-line-photos/>

Brownfield Redevelopment Options

Parks, Recreation, and Open Space



Lardner's Park Point / East Coast Greenway, PA

The HighLine, NYC



Before



After

Brownfield Redevelopment Process

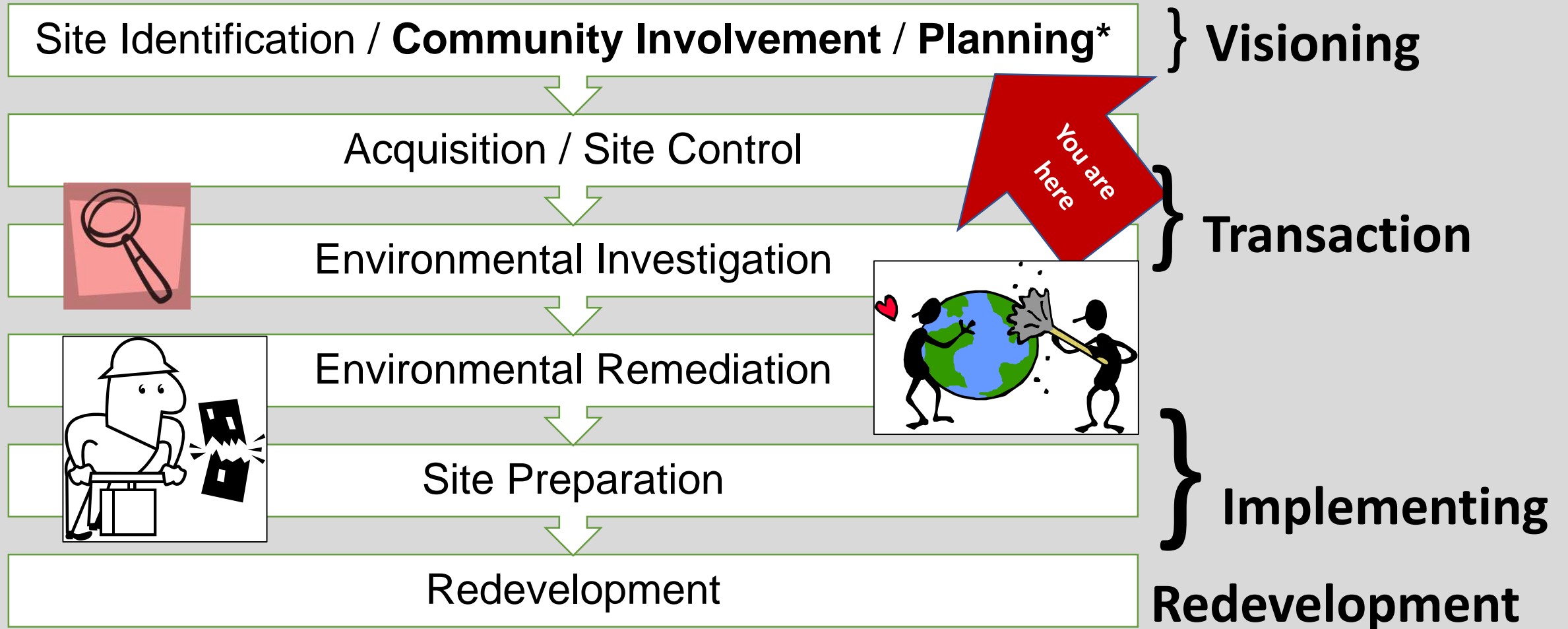
Steps in the Brownfield Redevelopment Process

I have brownfield site...
Now What?



<http://wisconsinwatch.org>

What is typically involved with redeveloping a Brownfield?



Steps in the Brownfield Redevelopment Process

Phase I Preliminary Assessment

What environmental issues could we have?



Phase II Site Investigation

Qualify: Do we have contamination/environmental issues?

Yes or No?

Phase III Remedial Investigation

Quantify: What is the nature and extent of our contamination?

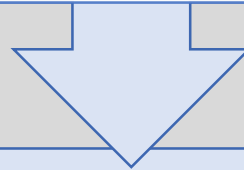
How much?

What is Typically Involved With Redeveloping a Brownfield?

Clean Up (Remediation)

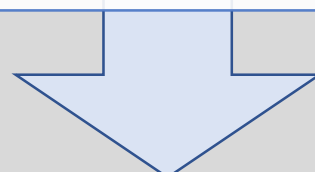
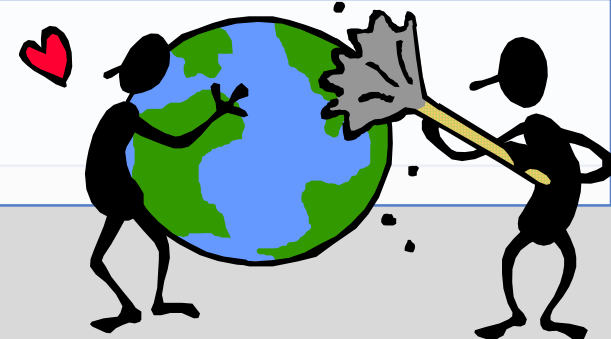
Remedial Action Work Plan (RAWP)

Actions that will be taken to address identified contamination

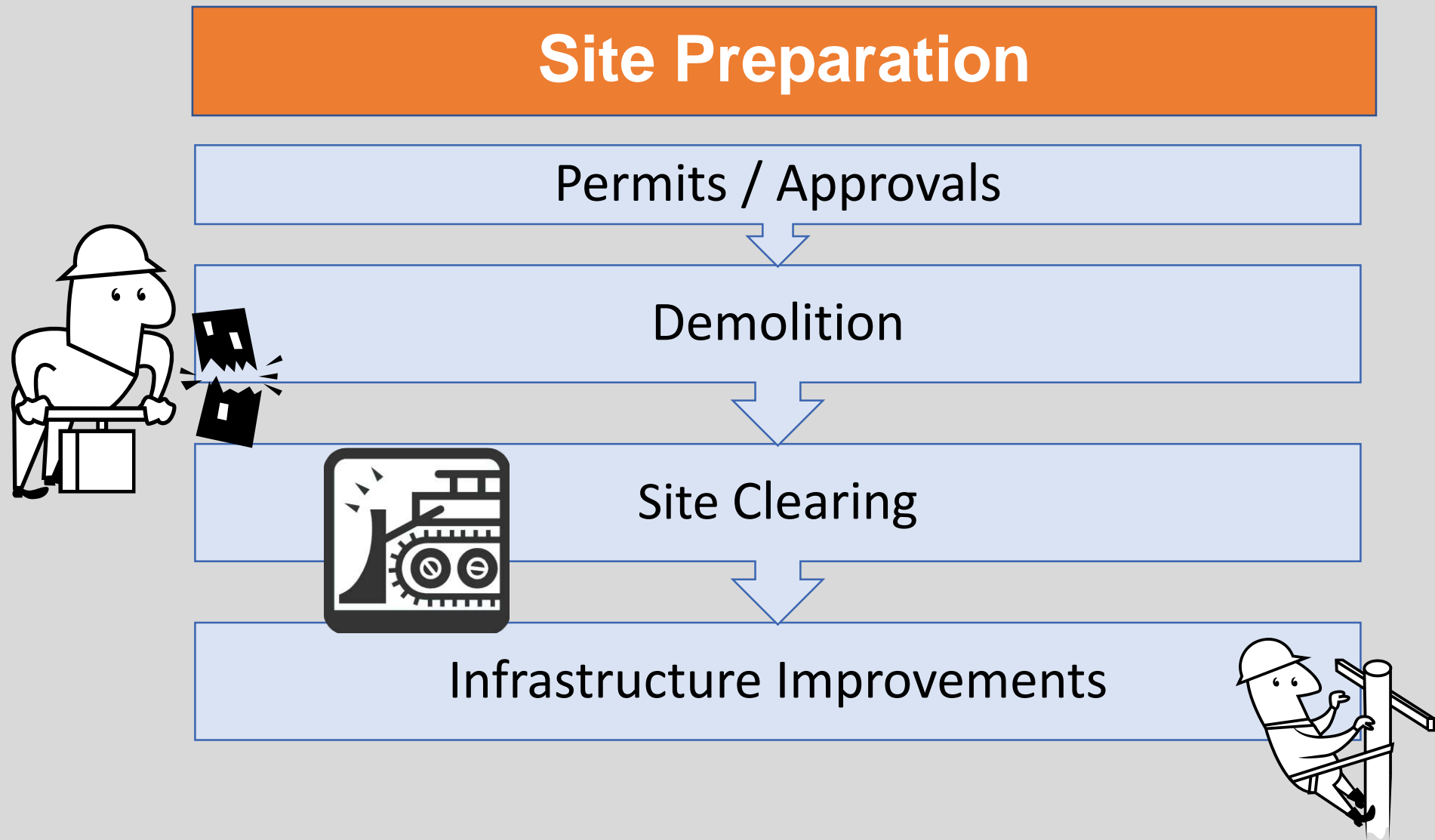


Implement Remedial Action Work Plan . . .

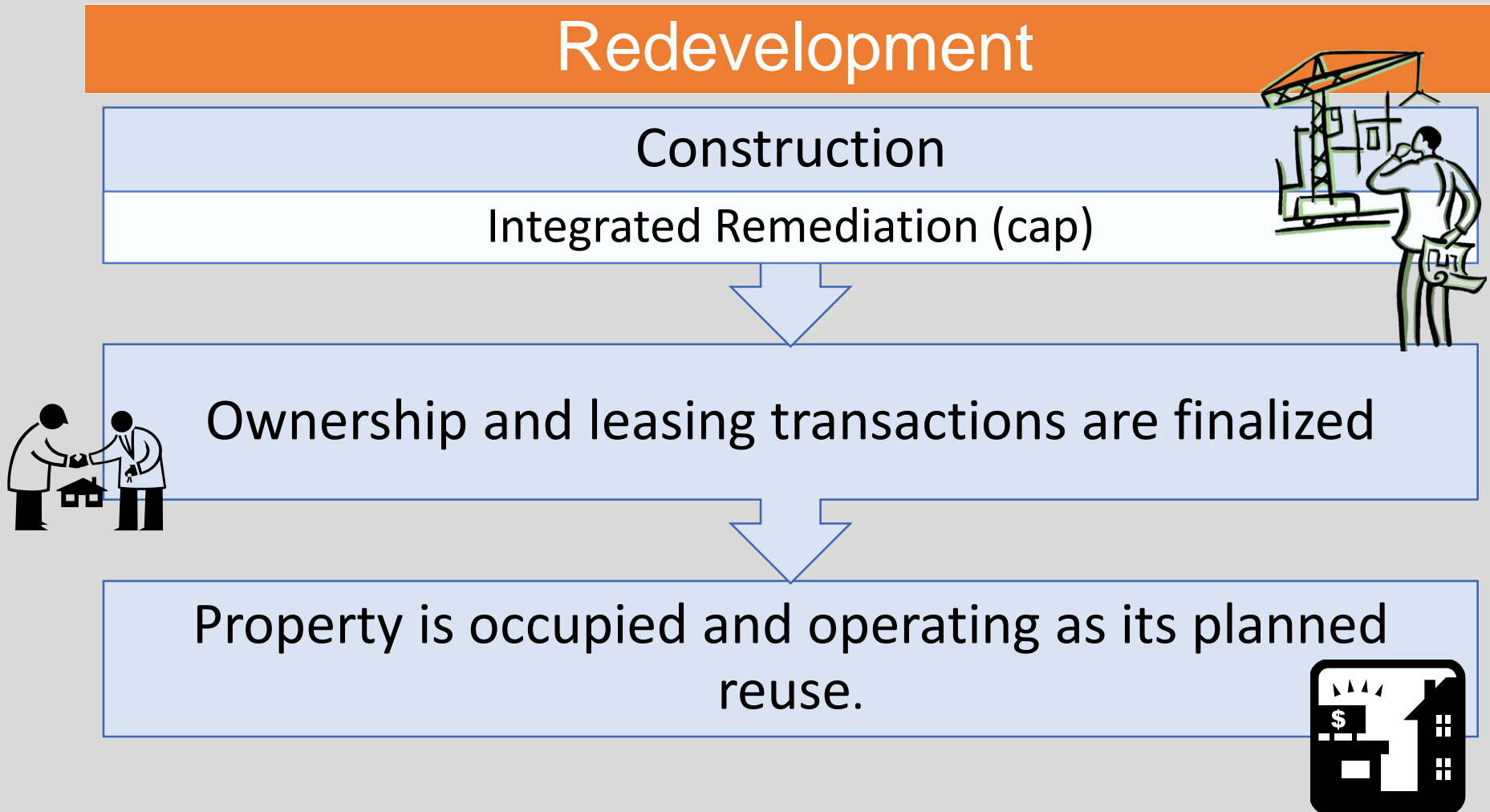
- Conduct Clean Up
- Ensure Clean Up Was Effective



What is typically involved with Redeveloping a Brownfield?



What is Typically Involved with Redeveloping a Brownfield?



Steps in the Brownfield Redevelopment Process

How much will it cost?

How long will the cleanup take?

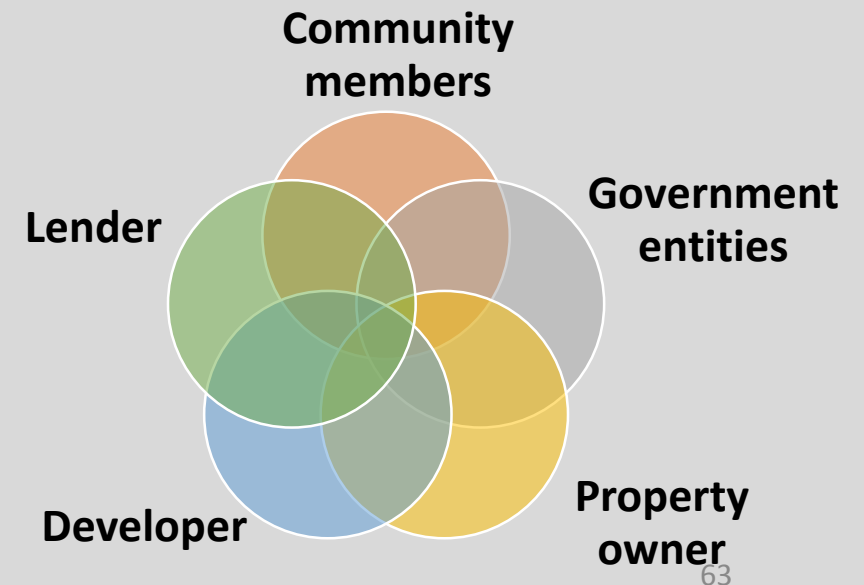
It depends:

- level, type, amount, and extent of contamination
- cleanup standards
- availability of funding



What Makes a Brownfield Redevelopment Successful?

1. YOU!
2. Partnerships
3. Community Involvement / Champion
 - Remember: Whose Project is it? The Community's
4. Agreement among stakeholders



What Makes a Brownfield Redevelopment Successful?

5. Evaluating and Mitigating Environmental Risks

- How “clean” does it need to be?

6. Is the Project Viable?

- Evaluate finances and funding sources.
 - Do the numbers work?
 - Can this area support the future use?



What Makes a Brownfield Success?

7. Financing / Funding

- Obtain the funds / financing



8. Timing



Green Infrastructure and Brownfields

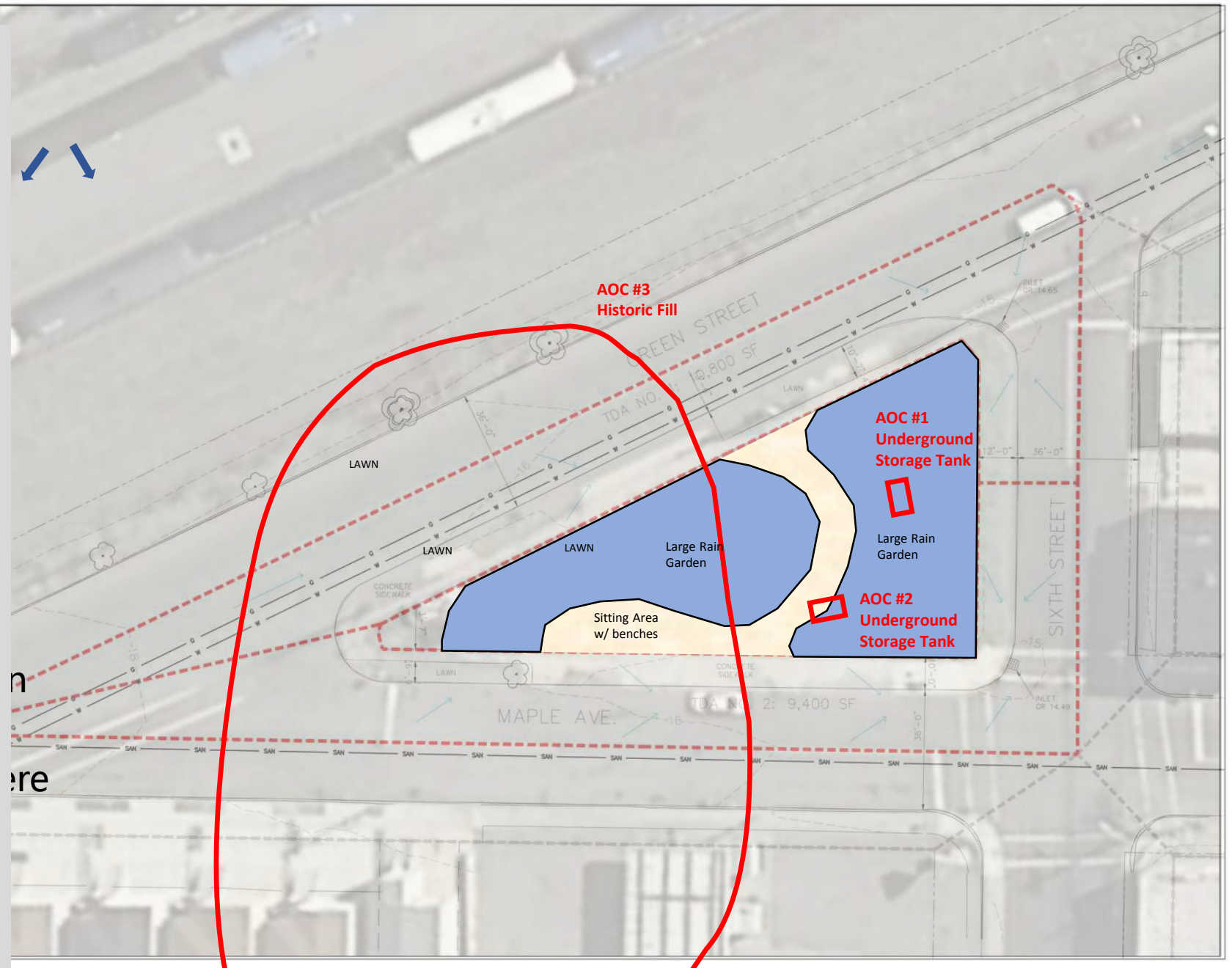
LARGE GROUP EXERCISE

Green Infrastructure and Brownfields

Design Process

- Gather Information (surveys, record drawings, etc.)
- **Environmental Investigations find several areas of concern (AOC)**
 - **Historic Fill**
 - **Underground Storage Tanks**

SUGGESTIONS?

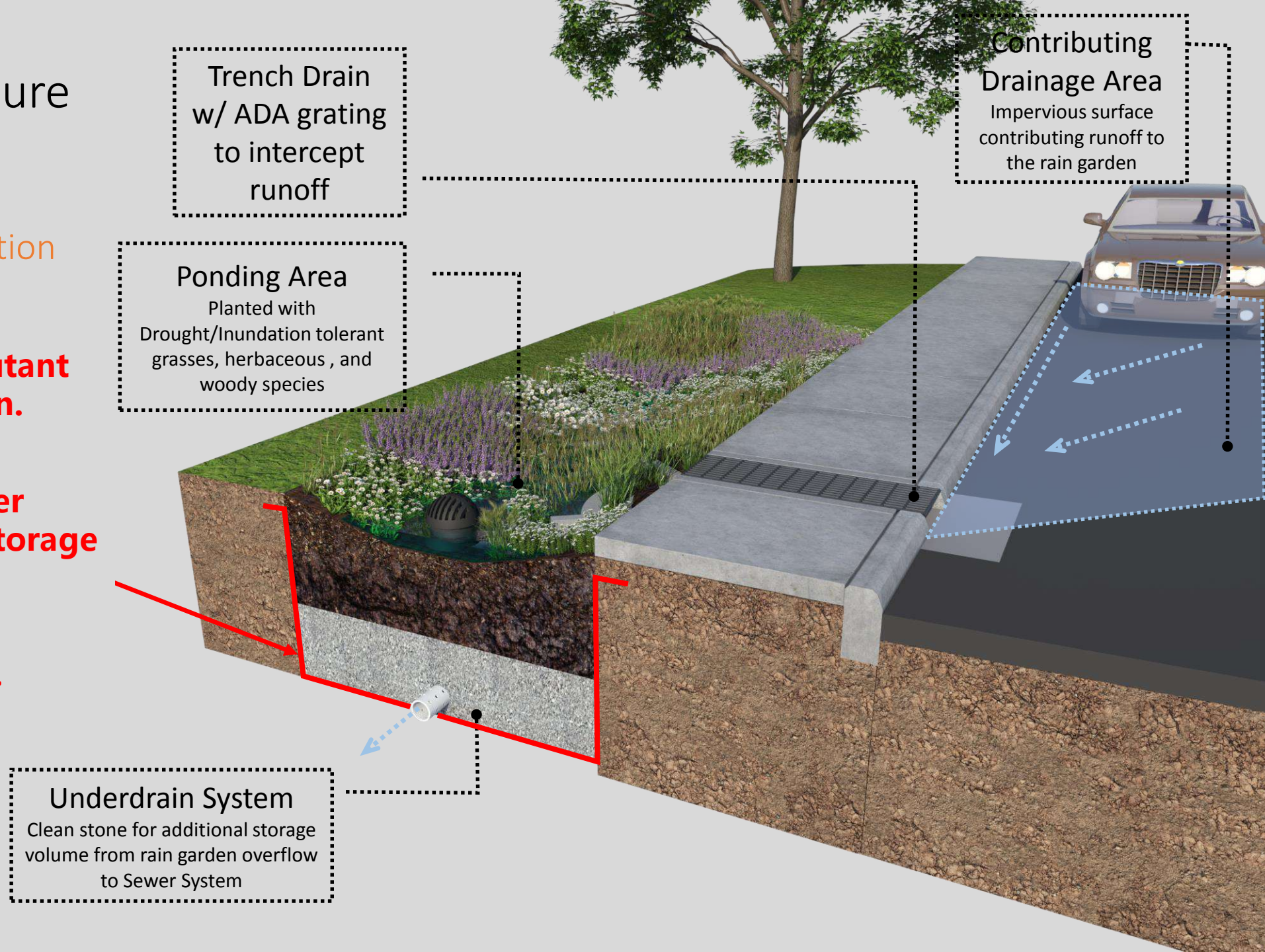


Green Infrastructure and Brownfields

Rain Gardens/Bioretention

Benefits

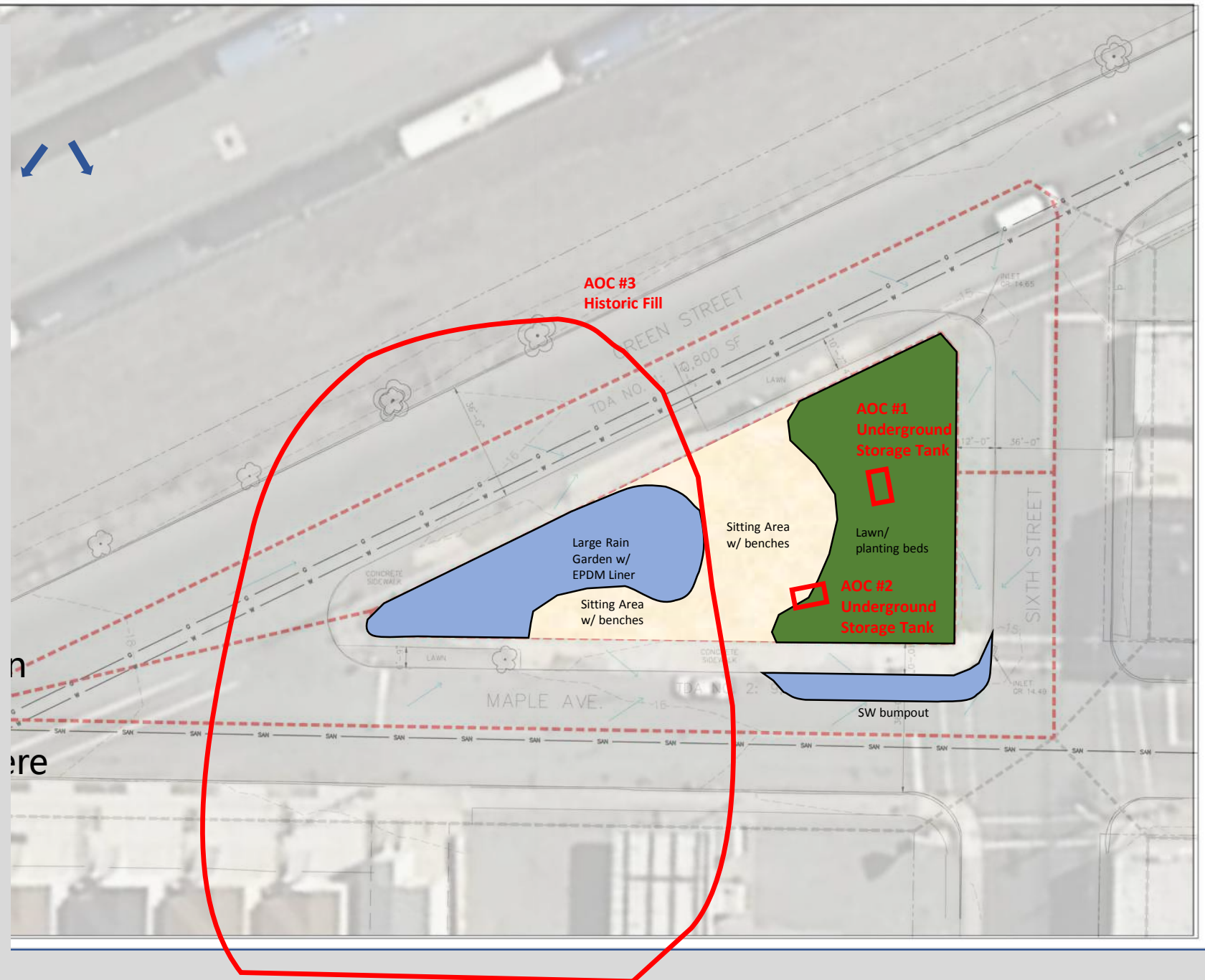
- **Stormwater and pollutant filtering by vegetation.**
- **Temporary stormwater storage within soil/ storage layer.**
- **Visual Enhancements.**



Green Infrastructure and Brownfields

Design Process

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Green Infrastructure and Brownfields

QUESTIONS?