


Incorporating Green and Natural Assets into Asset Management

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Southwest EFC
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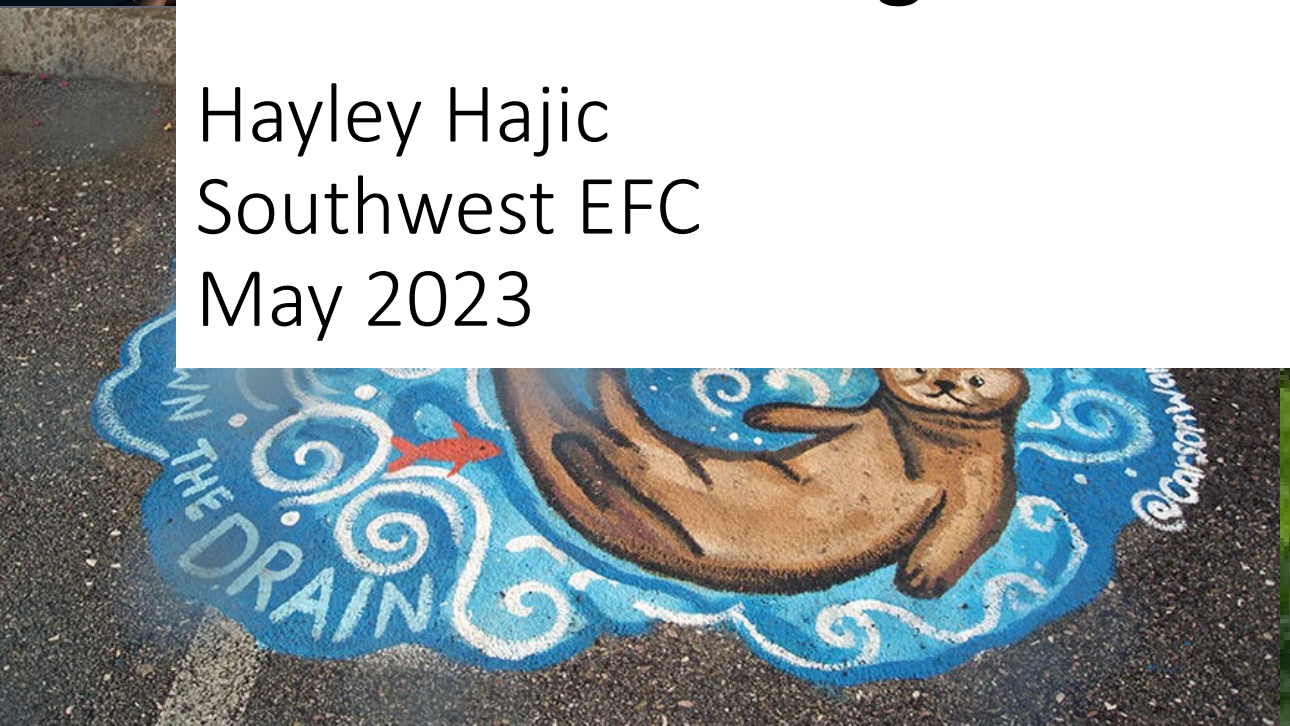
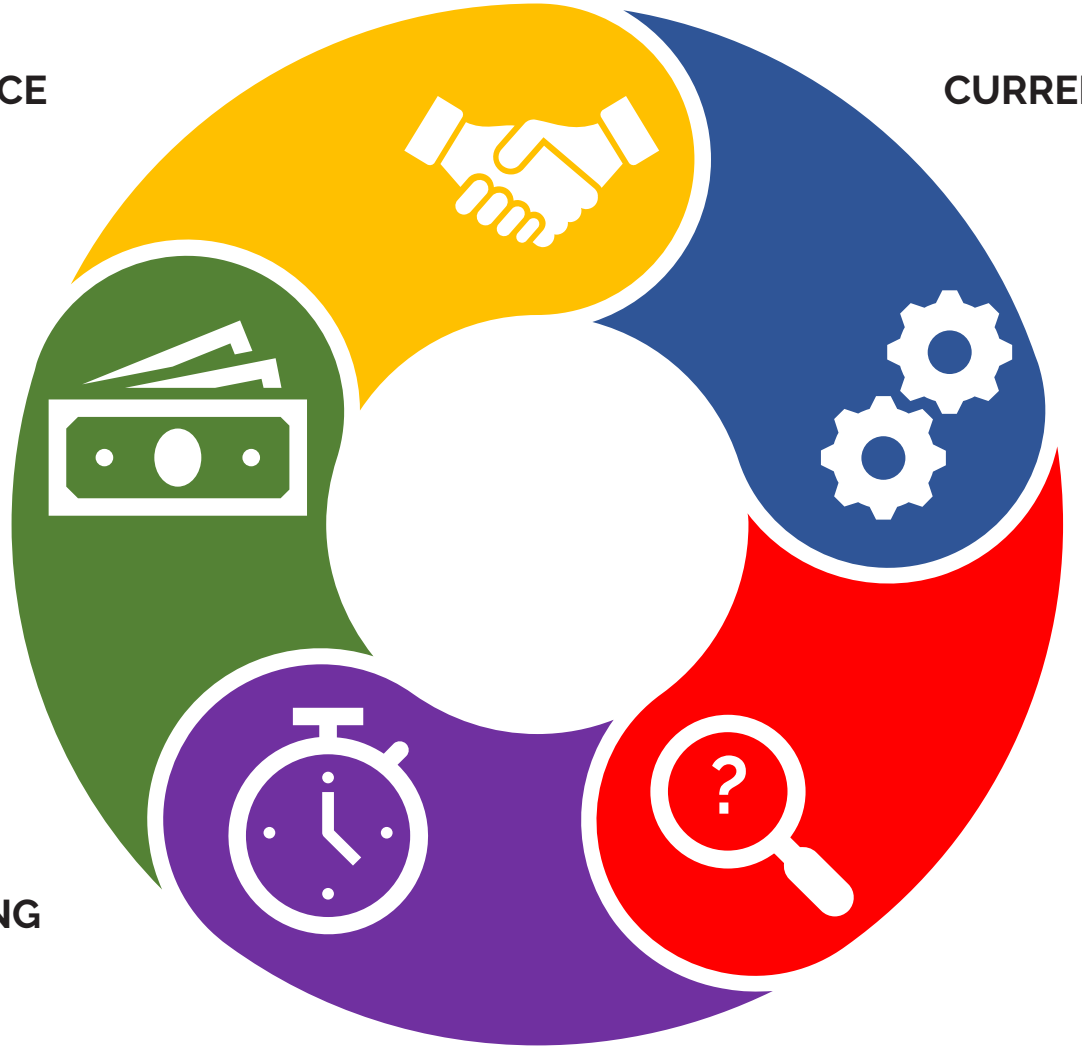
SOUTHWEST ENVIRONMENTAL FINANCE CENTER



General Asset Management Framework

LEVEL OF SERVICE

CURRENT STATE OF THE ASSETS



LONG-TERM FUNDING

CRITICALITY

LIFE CYCLE COSTING

Green Gray Framework

https://swefc.unm.edu/iamf/

CITY OF PALO ALTO

METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

CITY OF VANCOUVER

TORONTO

Green Stormwater Infrastructure Asset Management Resources Toolkit

December 2021

What do we mean by “Green Infrastructure”?

Our categories:

Natural Asset

Green Asset

Engineered Green Asset

What do we mean by “Green Infrastructure”?

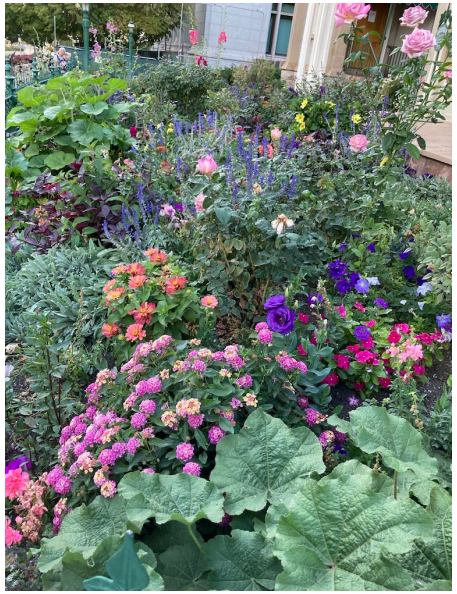
A **Natural Asset** (Already exists, just being used to serve a purpose)



Rivers, lakes, streams, forests, land around well heads

What do we mean by “Green Infrastructure”?

A **Green Asset** (Use of natural materials, engineered to serve a purpose)




Revegetation, constructed wetlands, buffer zones

What do we mean by “Green Infrastructure”?

Engineered Green Asset (Use of gray materials or mixtures of green and gray asset components to mimic natural processes)

Bioretention basins, green roofs, infiltration planters

Level of Service

Goals

What service levels do your customers want?

What service levels can you provide?

How will you measure performance?

Quality

Reliability

Safety

Professionalism

There are extra level of service considerations around social considerations and secondary goals/purposes for green assets

Secondary Functions: Aesthetics, Heat Island Reduction, Health Improvements, Decreased Property Damage, Improved Biodiversity etc.

Customer Service

Fewer than 2 complaints received regarding vegetation overgrowth, trash, and/or flooding of green infrastructure per month

System Maintenance

The system will inspect and perform routine maintenance on all infiltration planters and rain gardens once a month. Routine maintenance includes weeding, mowing, unclogging, litter removal, and pruning.

Response Time

System staff will inspect all green infrastructure installations within two weeks after a large storm event to assess damage.

Drought/Demand Management

The utility will develop a management plan for stormwater runoff entering streams and other source water to minimize pollutants within 3 years.

Current State of the Assets

How to define the "asset"

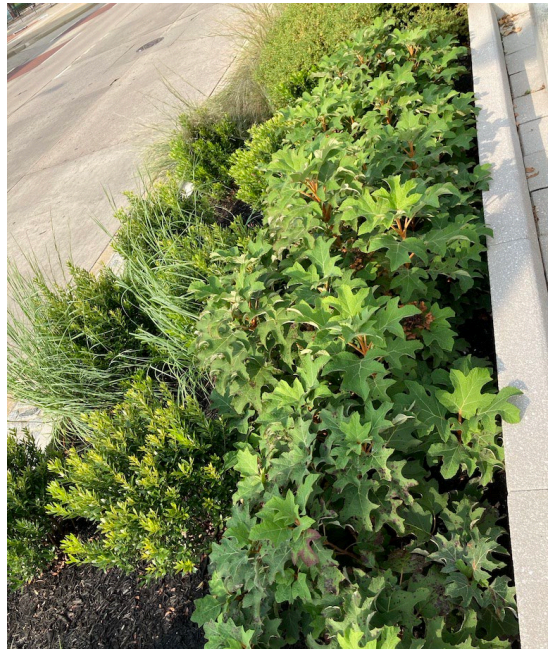
What is the asset?

Is it managed as a whole or by individual component?

Is it replaced as a whole or by components?

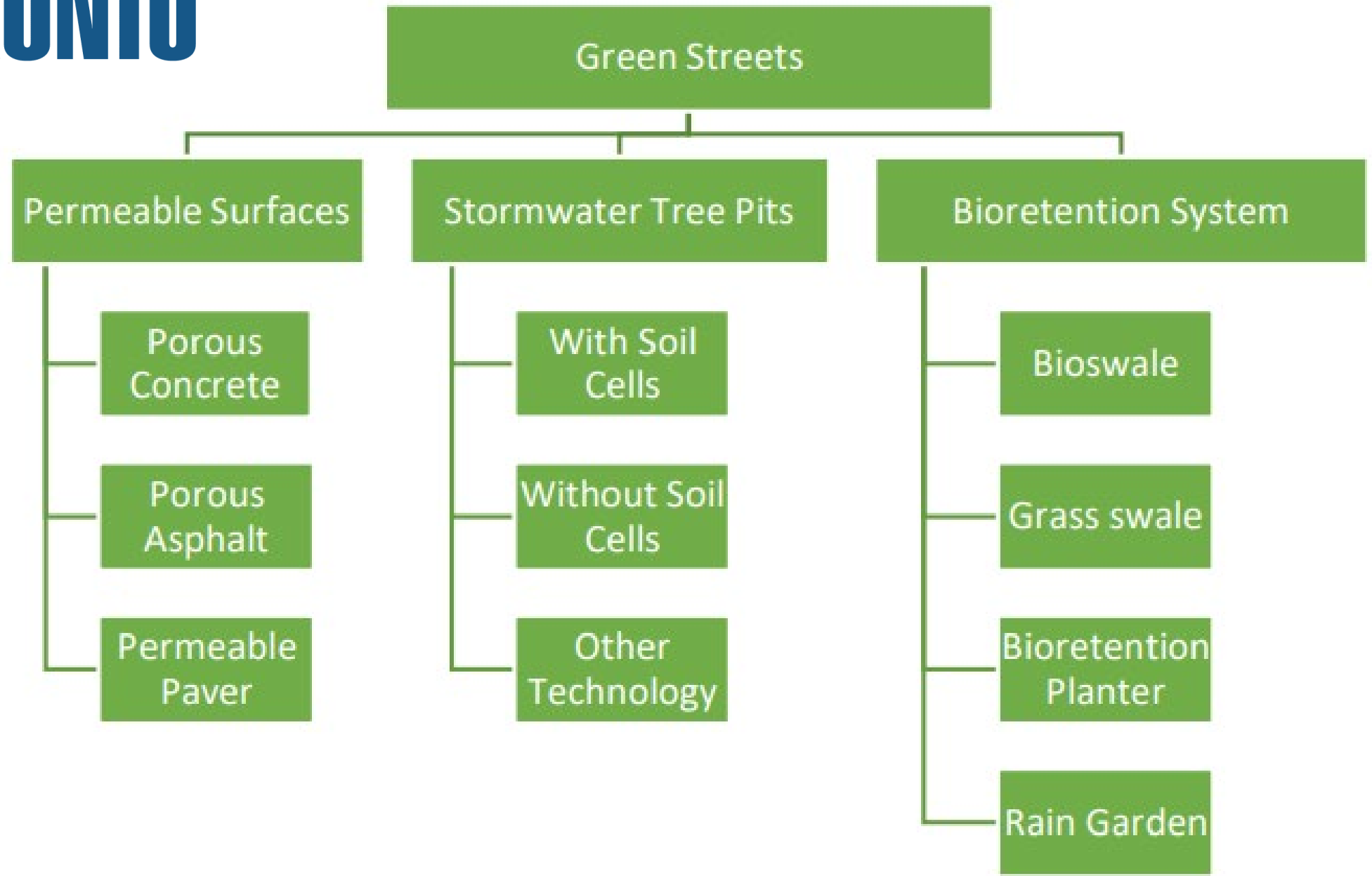
What data do you collect about an asset?

Or it can be just one asset



The asset can be broken into components

TORONTO


Green Streets
Permeable Surfaces
Stormwater Tree Pits
Bioretention System
Porous Concrete
Porous Asphalt
Permeable Paver
With Soil Cells
Without Soil Cells
Other Technology
Bioswale
Grass swale
Bioretention Planter
Rain Garden

Streams/rivers/forests hardest assets to define as assets

Useful Remaining Life

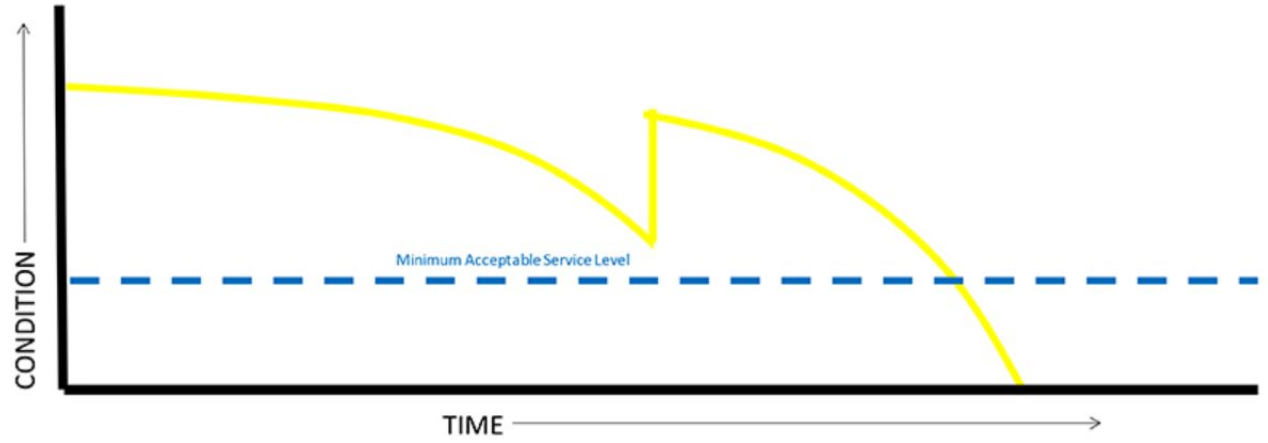
Useful life - a big difference between green and gray

Natural assets lifetime can be indefinite

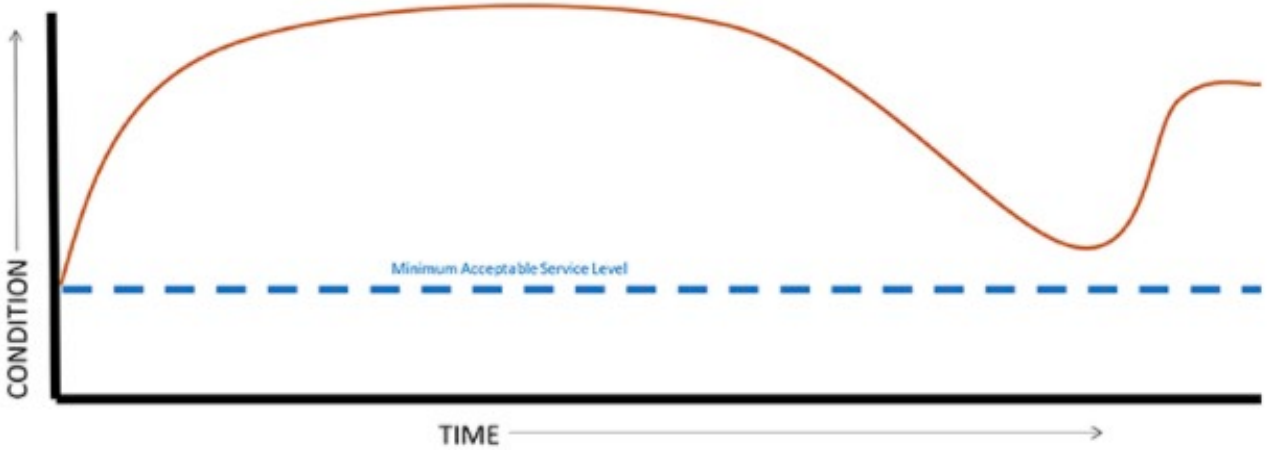
Green Assets – may need to replace soils/plants after a period of time

Engineered Green - Green and gray components can have very different lives

Condition Curve – Typical *Gray Asset*



Condition Curve – Typical *Green Asset*



Source: SW EFC Green Gray Framework

Example Condition Scale for Bioretention Swales and Planters (Vegetation Components):

1. **Vegetation and trees are in very good condition:** excellent vigor in trees with no pests/disease/damage, symmetrical tree growth; desirable vegetation makes up >90% of soil area; excellent vigor in vegetation; weeds cover <25% of soil area.

2. **Vegetation and trees can wait for routine maintenance and/or pruning**: average vigor in trees with no pests/disease/damage, minor asymmetry in tree form; desirable vegetation covers 75%-89% of soil area; average vigor in vegetation; weeds cover 25%-49% of soil area.

3. **Vegetation and trees require priority maintenance, pruning, irrigation and/or weeding**: fair vigor in trees with minor pests/disease/damage, minor defects in tree form; desirable vegetation covers 50%-74% of soil area; fair vigor in vegetation; weeds cover 50%-74% of soil area.

4. **Vegetation and trees require high priority weeding, irrigation and lower priority replanting**: poor vigor in trees with significant pests/disease/damage and significant growth defects; desirable vegetation covers 25%-49% of soil area; poor vigor in vegetation; weeds cover 75%-89% of soil area.

5. **Vegetation and/or tree require replacement with high priority**: Trees are dead or nearly dead and not able to be saved; desirable vegetation covers <25% of soil area; vegetation is dead or nearly dead and not able to be saved; weeds cover >90% of soil area.

Beginning Software Options

Excel

Database

GIS

Workorder

Advanced Software Options

CMMS is used for

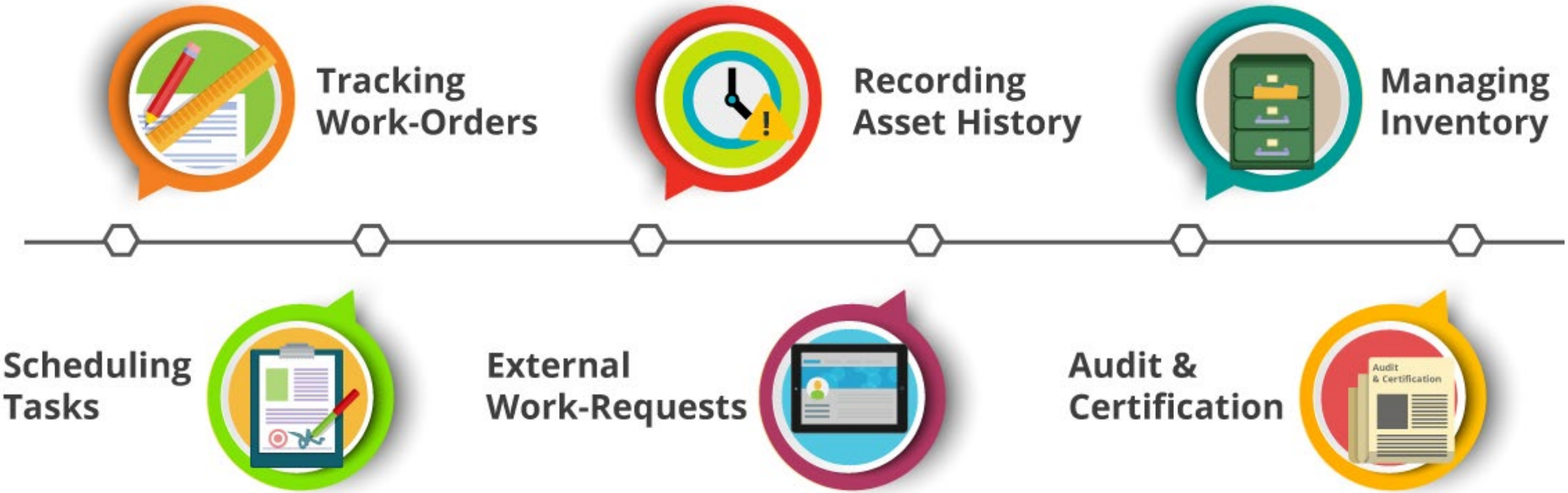


Image source: https://www.manufacturing.net/article/2018/03/beyond-proactive-advanced-maintenance-cmms

Capabilities/Functionalities

- Monitor work orders
- Quickly generate accurate reports
- Schedule repairs
- Create inventory forecasts
- Determine which assets require maintenance and when
- Quick reporting
- Equipment records
- Preventative maintenance
- Safety plans
- Improve work completion rate
- Increase visibility and transparency
- Create paperless work environment

Create Lists

Essential:

- Asset Management Tracking
  - Asset Inventory
  - Cost Data
  - Maintenance Records
- Generates Work Orders
- Spare parts inventory tracking
- Communicates with tablets or smart phones for in-field updating and accessing (mobile option)

Optional:

- Clean user interface
- Easy to use
- Connects horizontal assets (GIS based inventory) and vertical assets
- Communication with (future) SCADA systems

AM/CMMS Software Criteria

Item	Must Have	Highly Desirable	Desirable	Only if Standard with the Software
Cloud-based platform				
Ability for local data backup				
Asset inventory				
Ability to add new assets in the future in a user-friendly way				
Ability to change/modify asset inventory information in a user-friendly way				
Ability to search for assets in a variety of ways (e.g., by asset ID, by asset names, by asset type, etc.)				
Ability to tie assets to asset ID numbers				
Ability to assign user-created asset ID numbers (i.e., a deliberate numbering system, not just randomly generated ID numbers)				
Use existing asset hierarchy structure (e.g., facility, group, parent, child, etc.)				
Asset criticality and rick assessment				
Ability to integrate existing asset risk data				
Asset risk analysis tools				
Mechanism to use asset risk to facilitate decision-making (e.g., prioritize work orders and repairs, inform capital improvement planning)				
Ability to integrate asset useful life estimates				
Standalone capital improvement planning feature				
Ability to use asset data (inventory, risk, etc.) to generate a capital improvement plan or suggested list of capital improvements				
Spare parts inventory				
Work order system				
Easy to create work orders (preventive and corrective)				
Work order status tracking				
Ability to schedule preventative maintenance work orders based on operational parameters (e.g., by pump run time) or frequency				
Ability to track total cost of work order (at least in a simplified way)				
Ability to use mandatory entry fields for work orders (i.e., to ensure critical data capture)				
Ability to integrate safety (e.g., lockout/tagout, confined space)				
Coordination or integration with ESRI-based GIS				
Ability to track progress towards key performance indicators (KPIs) and level of service goals				
Ability to create and display KPI dashboards				
Mobile applications				
Compatibility with Android, Apple, or Windows devices				
Compatibility with smart phones and tablet devices (tablet will most likely be used)				

https://swefc.unm.edu/home/resource/cmms-criteria-checklist/

Item	Must Have	Highly Desirable	Desirable	Only if Standard with the Software
Ability to collect data and use applications in on-line or off-line modes (highly likely that parts of the system will not have connectivity at all times)				
Documentation of asset inspections				
Ability to store photos, videos, and audio recordings				
Report generation				
Ability to create and edit data collection and/or productivity-type reports				
Report customization and guidance included by vendor during installation and configuration				
Platform for entering/cataloguing business workflow processes (e.g., SOPs, org charts, chain-of-command, QA processes, etc.)				
Process control data/regulatory data capture				
Elimination of data input redundancy (i.e., each data point is entered only once in the system for use by any person or process)				
Ability to add this type of data through mobile devices				
Customer inquiry/complaint tracking				
Ability to create standard "form letter" responses to customers				
Ability to track resource usage				
Employee time tracking				
Vehicle inventory and tracking				
Tracking both personnel and equipment, including vehicles				
Integration with closed-circuit television (CCTV) system				
Ability to store CCTV inspection data				
Ability to store or link to CCTV videos				
Ability to tie videos to assets (pieces of pipe)				
Ability to store CCTV inspection reports/results/ratings				
Ability to have different levels of user access – read, write, full access, no access				
Ability to link to/communicate with a supervisory control and data acquisition (SCADA) system				
Compatibility with other software (*mapping and* financial software)				
Ability to facilitate fixed asset inventory audits/updates				
Ability to easily integrate other departments now or in the future				
Advanced Options				
Automatic email alerts				
Budget Management				
Document Management				
Warranty Management				
Monitoring				
Condition				
Calibration				
Energy				

Image source: http://www.huenei.com/index.php/en/2017/08/28/benefits-of-cloud-vs-on-premise/

A cloud-based system requires fewer upfront costs because you don't have to set up and manage the server

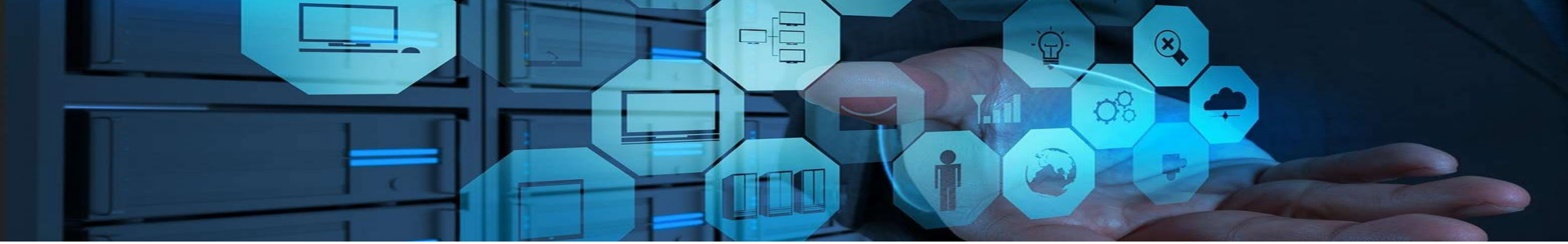
Updates can be quickly implemented
Issues with the software can be solved remotely

An on-premise solution has better security

If your utility has data or regulatory requirements that force the data to stay on-site then it will be the best option for you

What type of hardware is needed?

Will you want some type of portable devices?



Demo (Plan on at least 2 hours)

Specifically ask to see some of the items on your essential features list
Think about functionality and ease of use as the demo is going on.
Do the features seem user friendly?

Invite a wide array of people to watch the demo

Ask questions!

The more prepared you come to the demo, the more you will get out of it and the easier it will be to pick the right CMMS for your system

Criticality

Risk

Probability of Failure

- Need to define how assets can “fail”

Failure modes:

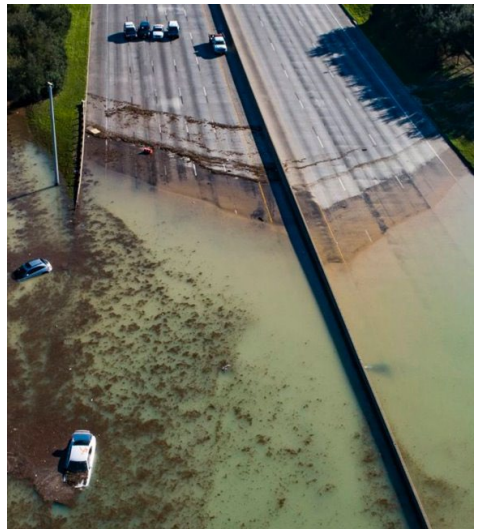
- Mortality
- Level of Service
- Capacity
- Financial Inefficiency

Consequence of Failure

Infiltration Trench: vegetation death, invasive species infiltration, inlet blocked, debris clogging drain, broken curbs, compacted soils

Permeable Pavement: clogged joints or pores, ponding, underdrain deteriorated, vegetation growing through cracks

Gray Asset Failures



Green Asset Failures

Consequence of Failure

Generally, not very high for individual green assets

Types of consequences:

- Loss of habitat
- Overland flow
- Financial cost of repair
- Property damage
- Water ponding leading to mosquitos
- Residential complaints of trash or poor aesthetics

Considerations:

Very few entities who have performed criticality assessments for their green assets

Asset, or portions of asset, can fail but the asset can still function

Comparing different risks can be difficult (function, aesthetics, biodiversity, heat island, quality of life)

Multi-asset vs. single asset failures

Ways Permeable Pavement can fail

- ❑ Pavement joints or pores are clogged (sediment accumulation)
- ❑ Ponding
- ❑ Underdrain has deteriorated and is damaged or collapsing (end of life)
- ❑ Damage to surface makes it unusable for walking/biking/parking/etc.
- ❑ Heaving or settlement that becomes a safety hazard
- ❑ Construction, falling tree, or other external force destroys the pavement
- ❑ Improper material installation (unravelling of the stones)
- ❑ Lack of winter maintenance
- ❑ Vegetation growing through cracks

Factors influencing the probability of failure of Permeable Pavement

- ❑ Low levels of preventative maintenance
- ❑ Construction
- ❑ Weather (rain/freeze-thaw cycle)
- ❑ Traffic load/type
- ❑ Location

Consequence of failure for Permeable Pavement

- ❑ Clogged pavements (without overflow) causing overland flow into private property, potentially causing damages
- ❑ Financial impacts for required repairs
- ❑ Closing/restricting roadways or parking lots
- ❑ Tripping hazards for users, potentially causing injuries
- ❑ Loss of public support or confidence

Life Cycle Costing

Costs the asset will incur over its lifespan

Costs include: planning, design, acquisition, installation, maintenance, rehabilitation, replacement, retirement/disposal

Natural assets don’t have some of the costs (won’t be replaced)

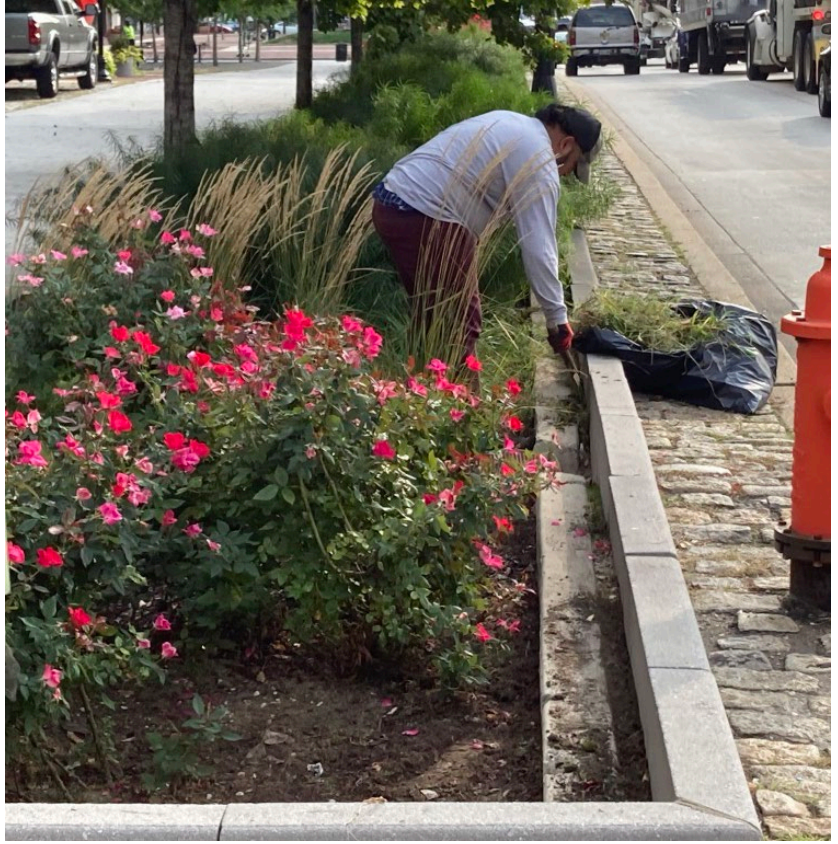
Green assets can be owned by different entities than manage them

Early Stages – Design, Construction Extraordinarily Important!!!

Many failures of green assets can be tied to poor design or poor construction

Community needs to be engaged – Green has to fit the community

Equity concerns



Operation & Maintenance

The operation part of green infrastructure tends to be relatively simple. Almost all of the assets are passive operation

Maintenance may take a different type of skill set, may need different staff for green vs gray

Less knowledge regarding the maintenance needs of the green assets

Example:

Landing Page | Capital Projects | Constructed Projects | GI_AssetTypes | GI_Components_n_LOS

Category	Component Type	Regular Maintenan	Inspection Points	Task	Frequency/Schedule
Inlet	Concrete Curb Cut	☑	Sedimentation	Clear Debris	6mo or as required
Inlet	Catchbasin	☑	Sedimentation	Hydrovac	12mo or as required.
Inlet	Trench Drain (Narrow)	☑	Sedimentation, struct	Power wash or manual cleanc	6mo or as required
Inlet	Trench Drain (Wide)	☑	Sedimentation, struct	Power wash	12mo or as required.
Inlet	Sheet Flow	☐	Sedimentation, erosio	Clear debris	12mo or as required.
Inlet	-none-	☐			
Pretreatment	Concrete Forebay	☑			
Pretreatment	River Rock/Rift Raft	☑			
Pretreatment	Wood Disperser	☑			
Pretreatment	Catchbasin - Jellyfish	☑			
Pretreatment	Catchbasin - CB Shield	☑			
Pretreatment	Oil Grid Separator (OGS)	☑			
Pretreatment	-none-	☐			
Surface Treatment	Trees	☑			
Surface Treatment	Shrubs	☑			
Surface Treatment	Horticulture	☑			
Surface Treatment	Sod/Grass	☑			
Surface Treatment	Mulch	☑			
Surface Treatment	Base Soil	☑	Erosion	Inspect for erosion	

Life Cycle Costing – Repair/Rehabilitation/Replacement

Green - Natural assets - generally need some repair/rehabilitation but not “replacements”

Green Assets – Typically need periodic rehabilitation

Green – Engineered Green – need replacement of gray components and rehabilitation of green ones

Long-Term Funding

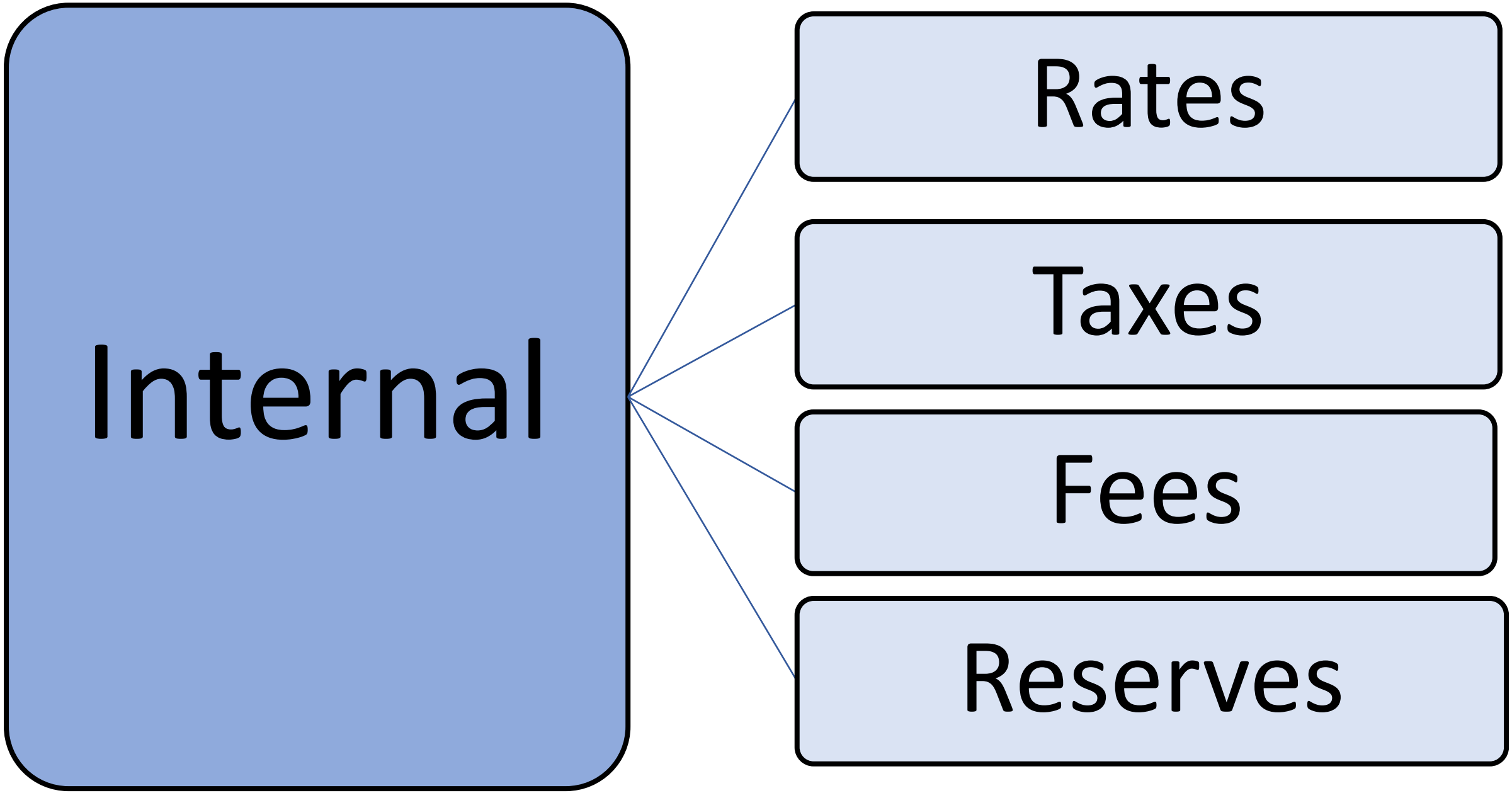
Funding is in its infancy with green assets

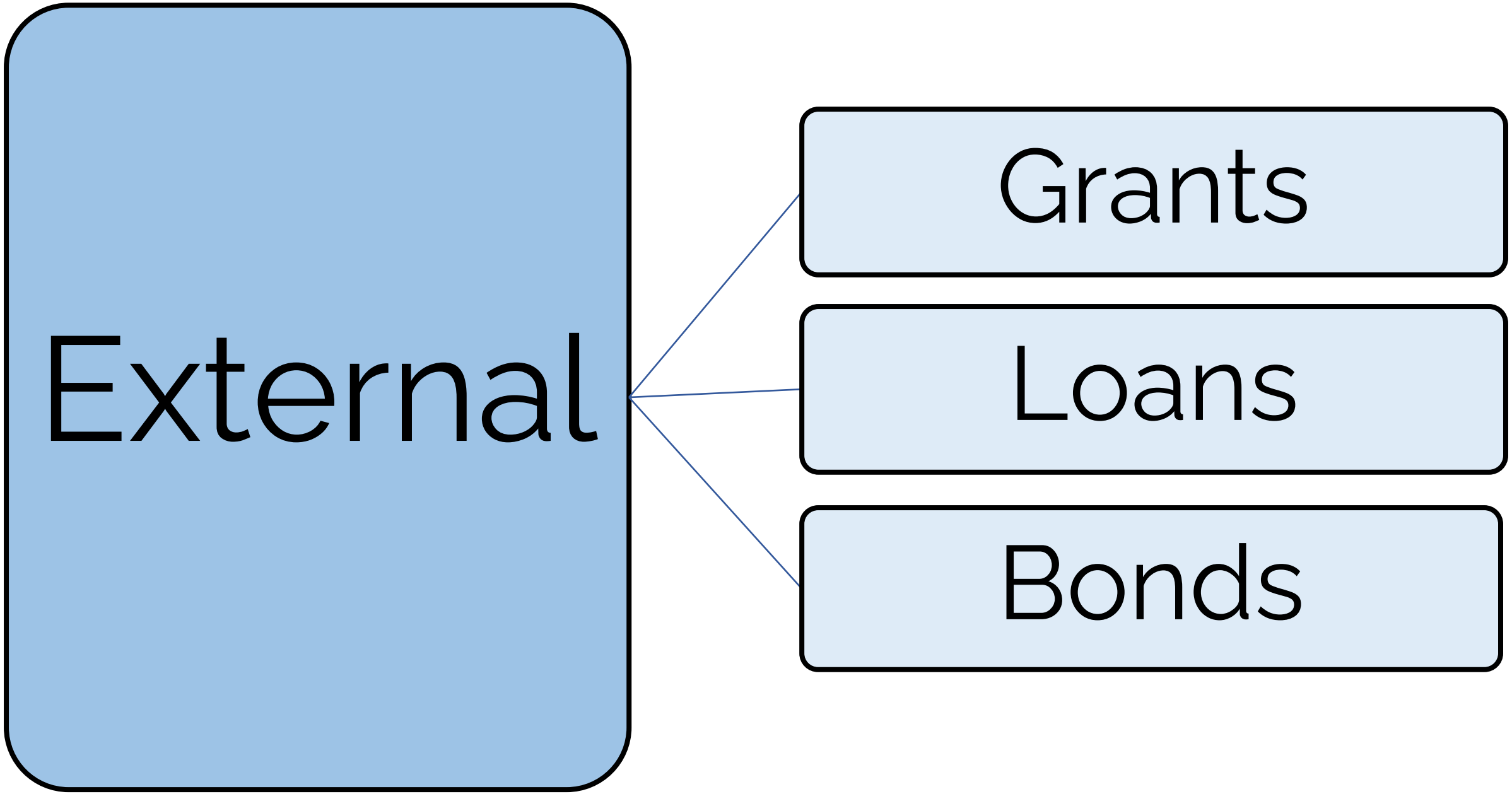
Green infrastructure options may be removed from consideration because of a belief that it “costs more” without actual proof that over time it does

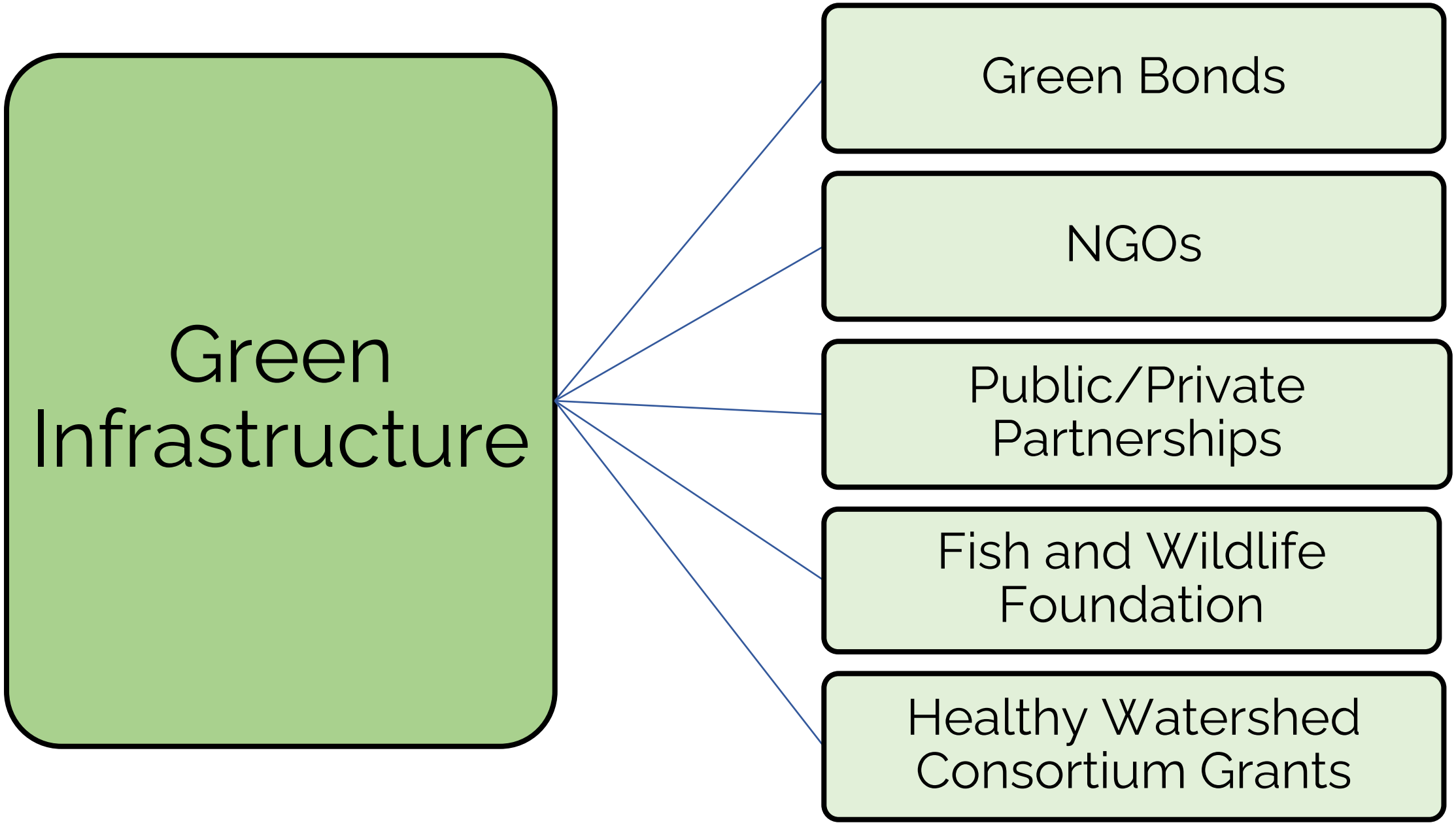
Long-Term Funding

One problem with limited knowledge of funding, Green infrastructure is not being used to the extent it should be

Green infrastructure options may be removed from consideration because of a belief that it “costs more” without actual proof that over time it does


Internal
Rates
Taxes
Fees
Reserves


External
Grants
Loans
Bonds


Green Infrastructure
Green Bonds
NGOs
Public/Private Partnerships
Fish and Wildlife Foundation
Healthy Watershed Consortium Grants

Free, available as an on-line resource to enable easy updates, additions, etc.

Working with utilities/municipalities to add additional information

SPRING POINT PARTNERS

Interviews

Knowledge Transfer – Larry Covington, President, Picacho Mutual Domestic Water Association, Las Cruces, NM

The benefits of a proper map and inventory – Shawn McLean, General Foreman, Public Works Dept., City of Somersworth, NH

The benefits of a proper inventory for future collaboration/partnerships – Doug Powers, Community Development Director, City of Tucumcari, NM

Using Asset Management to provide a clear picture of where the system is at – Gilbert Miera, Board President, Arenas Valley Water Development Association, Silver City, NM

Examples

What Constitutes an Asset?

While it might seem straightforward, it can be complicated to answer the question, what constitutes an asset? An asset is defined as something that has potential or actual value to an organization. The system must decide how granular to go with the definition of an asset. Should a unit (a collection of parts into a whole) be the asset or should the individual components each be assets?

Examples of How to Define an Asset

Pump

- Entire pump is the asset
- Pump is an asset, motor is an asset, controls are an asset

Infiltration planter

- Entire structure including plants is an asset
- Each plant is an asset (or each type of plant is an asset), underdrain is an asset, walls are an asset, soil is an asset

Stream

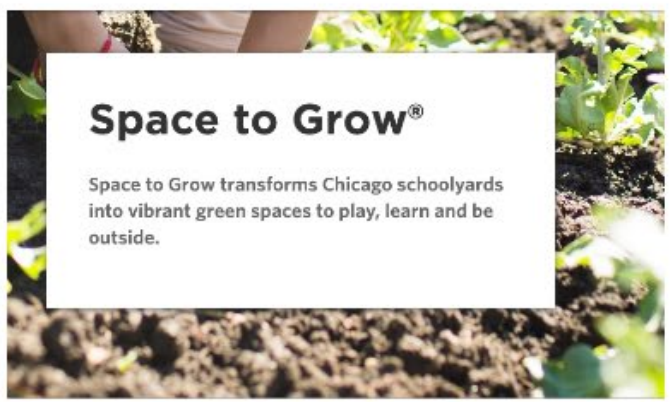
- Entire stream is an asset
- Stream is divided into one mile segments, each mile is an asset
- Stream is divided into segments within GIS system, each segment is an asset

Examples of Green Infrastructure

Integrating Land Use and Water Planning for a Sustainable Future

Castle Rock, CO

Located on the southern fringes of the Denver metro area, Castle Rock is one of the fastest growing communities in the country. Its population has skyrocketed from 20,224 in 2000 to nearly 72,000 today. Seventy percent of Castle Rock's water supply comes from nonrenewable groundwater, so as the town grew, officials had to figure out how to stretch that supply. In 2006, the water utility and the planning department started collaborating to address that issue.

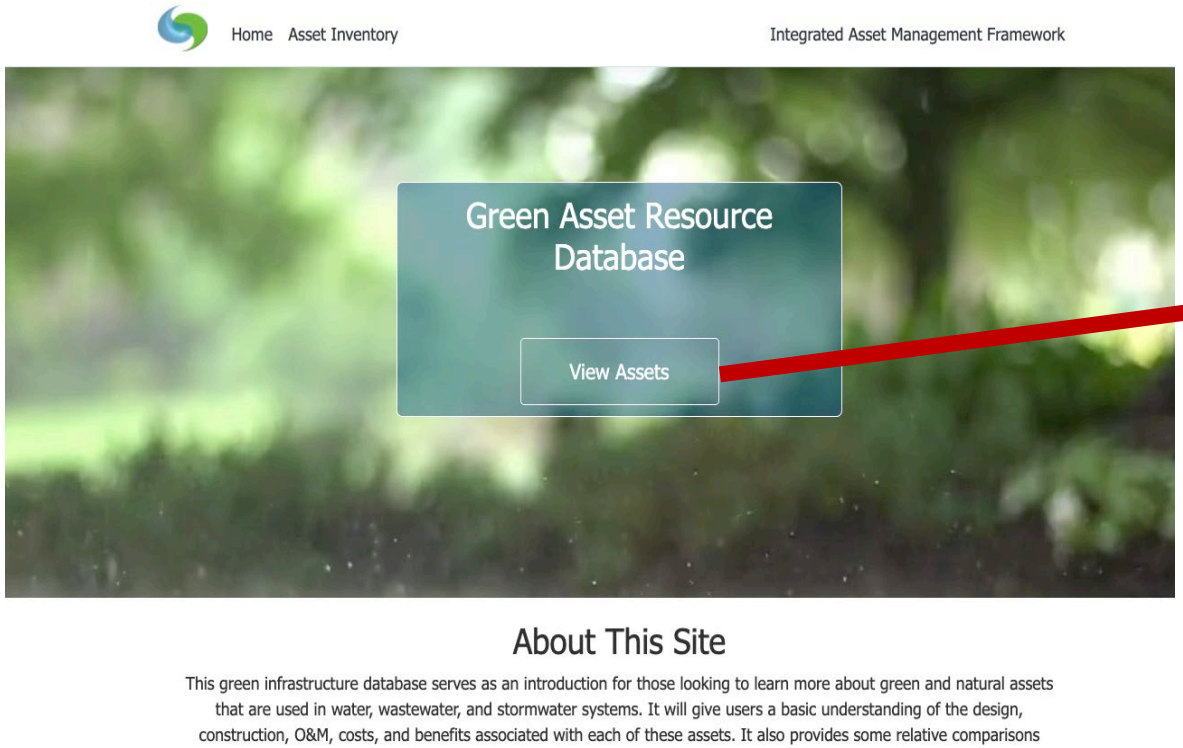


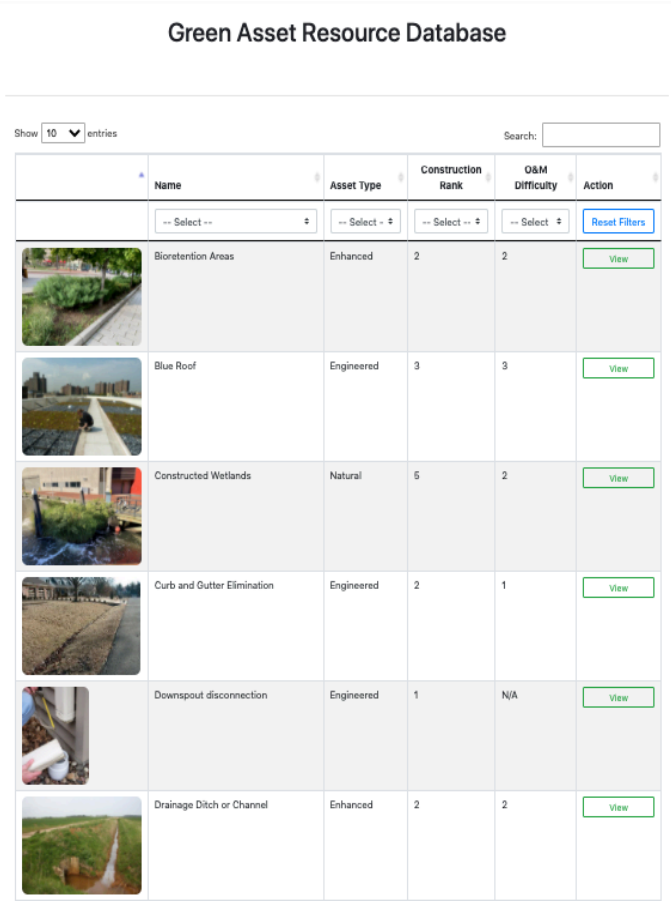
Space to Grow

Chicago, IL

Space to Grow transforms Chicago schoolyards into beautiful and functional spaces to play, learn, garden and enjoy being outside.

A list of green assets can be found in our database (free to anyone)





https://swefcapps.unm.edu/gardb

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