LANDSCAPE PERFORMANCE SERIES
presented by the Landscape Architecture Foundation

Cortex Commons
Methods

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This investigation was conducted as part of the Landscape Architecture Foundation's 2023 *Case Study Investigation* (CSI) program. CSI matches faculty-student research teams with design practitioners to document the benefits of exemplary high-performing landscape projects. Teams develop methods to quantify environmental, social, and economic benefits and produce Case Study Briefs for LAF's *Landscape Performance Series*.

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The full case study can be found at: https://landscapeperformance.org/case-study-briefs/Cortex-Commons

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The Cortex Commons staff: Colleen Autry and Leslie Heusted

Collogues: Rich Harrison and Cassidy Johnson

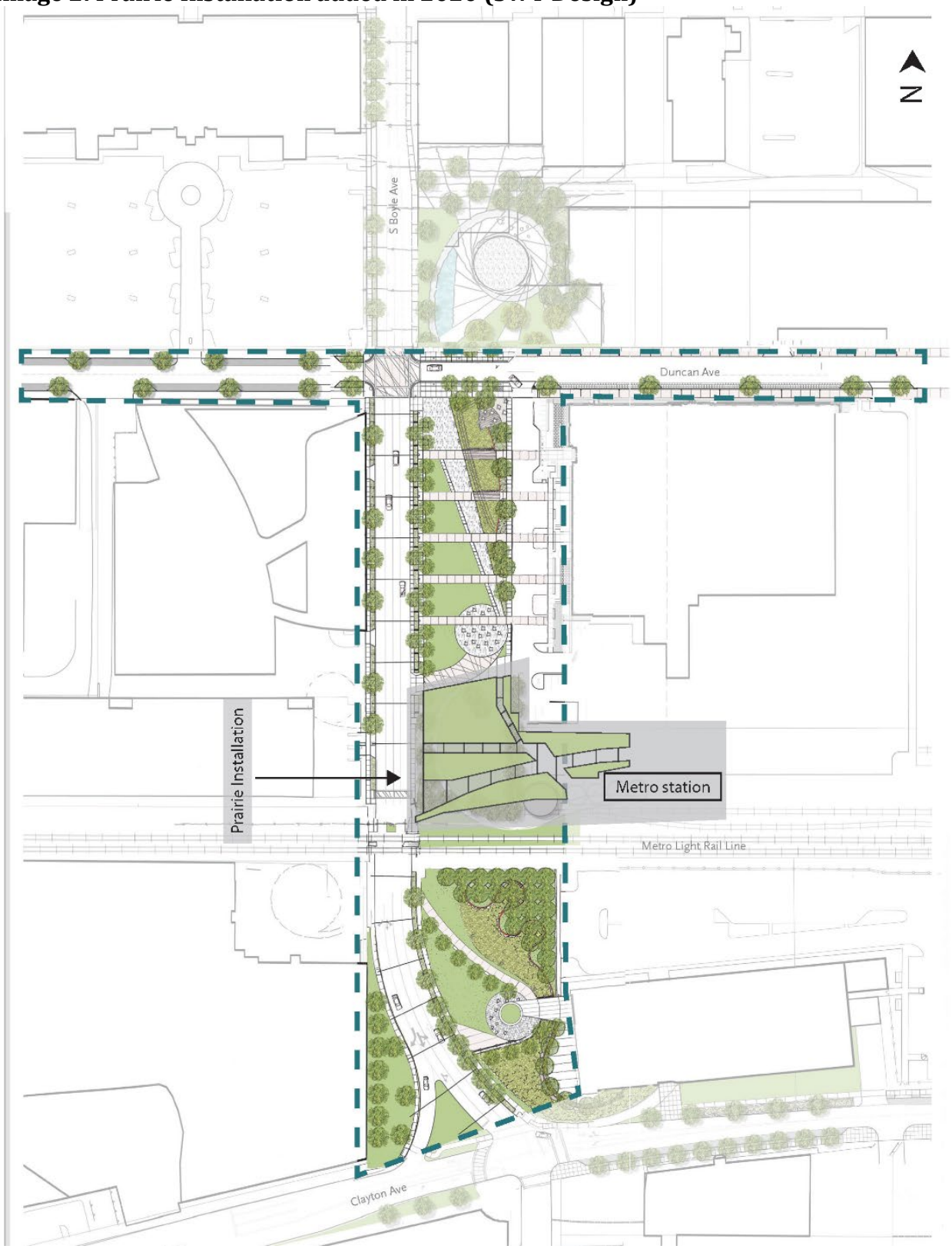
University of Minnesota: Rebecca Krinke, Kristine Miller and Amanda Smoot

Research Strategy

The overall focus of this Case Study Investigation is to compare the benefits of green infrastructure and community space designed at Cortex Commons compared to a previous design that primarily involved a turf basin for collecting stormwater. Environmental, social, and economic benefits chosen for the case study are focused on the added benefits provided by the Cortex Commons design.

Image 1: Original Site Plan (SWT Design)

Image 2: Prairie Installation added in 2020 (SWT Design)



Environmental Benefits

Research and design team members discussing site conditions.

Several environmental benefits were studied at Cortex Commons to gain an understanding of the advantages of a project design that incorporated several green infrastructure practices and a diversity of plant species as compared to a previously planned turf basin. The turf basin was planned as a dry pond intended to capture rainwater from the development. The basin would have been planted with one species of turf grass (tall fescue). The environmental benefits that were studied focused on the added benefits of having biofiltration basins and other planted areas that are providing increased biodiversity. Each of the metrics chosen for the study help provide a greater understanding of the overall environmental health of the site and include plant species richness, insect species richness, and a pollinator habitat and ecological health assessment.

The CSI research team would like to note that the prairie installation was not in the original design. The prairie installation was a collaboration with Native Landscape Solutions and it was approved by the previous operations manager in efforts to reduce mowing, increase pollinator activity, and provide volunteer opportunities. The installation was done in 2020 with the community included to promote project sustainability.

The following information summarizes the three environmental benefits and is followed by a summary of other site characteristics that were studied to better understand site conditions.

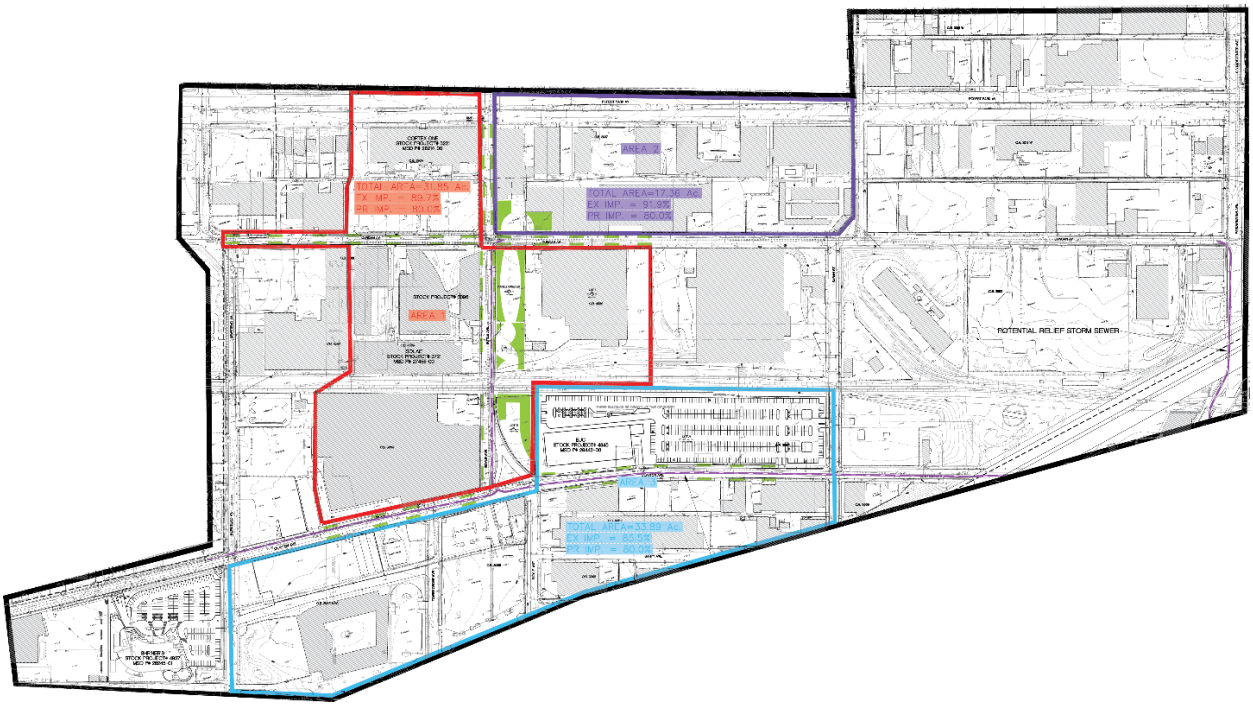
- **Exceeds stormwater storage requirements by 21%, managing 22,049 cu ft as compared to the 18,308 cu ft originally required by the Metropolitan Sewer District.**

Background:

The Cortex Innovation Community was required by MSD to manage all of the stormwater runoff on-site as agreed in their BMP agreement. MSD allocated about $5.1 million to the Cortex district to accomplish the agreement within 15 years. The funding helped the Cortex district by enabling relocation of a combined sewer in Duncan Avenue between Sarah Street and Vandeventer Avenue as well as constructing a stormwater BMP within the Cortex District. The Cortex Commons is one of many projects to help the Cortex District achieve the goal of managing all stormwater on-site.

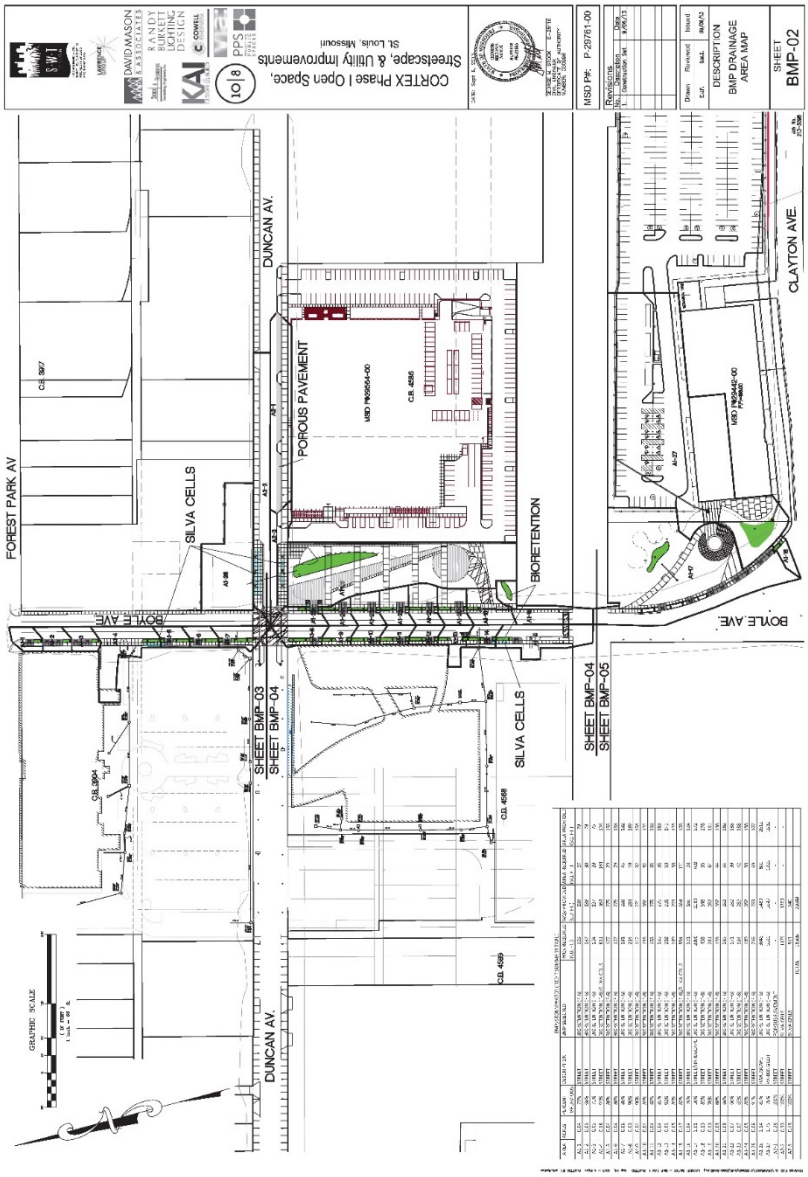
Methods:

BMP Drainage Map of the Cortex District



BMP Drainage Map of the Cortex Commons

BMP Calculations



Calculations:

Original Calculations (requirements) conducted by the Metropolitan Sewer District
Final BMP Calculation conducted by the design firm

$$\frac{\text{(Final BMP Calculation – Original BMP Calculations)}}{\text{Original}} \times 100 = \% \text{ Change}$$

$$\frac{(22{,}049\ ft^3 - 18{,}308\ ft^3)}{18{,}308\ ft^3)} \times 100 = 20.7\%$$

Sources:

Calculations and documents provided by SWT Design and the Cortex Commons Innovation Community

Limitations:

The research team did not have an opportunity to measure and assess the storage capacity on-site.

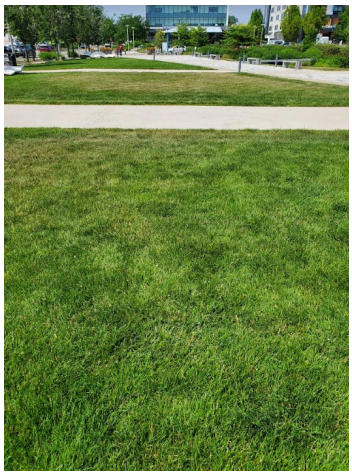
- **Achieves plant species richness of 52 within green infrastructure plantings, as compared to 2 species in lawn areas which are comparable to the initial stormwater management feature planned for the site: a turf basin.**

Background:

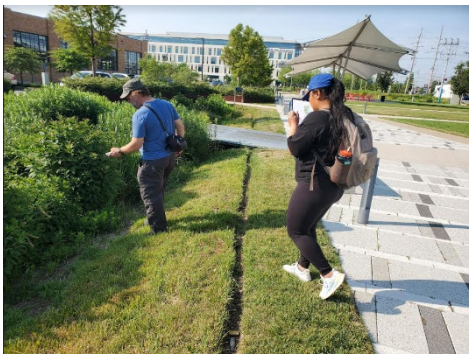
Plant species richness is commonly used as a measure of the overall ecological function of many stormwater and natural wetland systems. Several studies (Tilman 1996, 1997; Piper 1996; Tilman et al. 1997; Knops et al. 1999; Tilman & Dowling 1994; Tilman & Reich 2006; Biondini 2007,) have shown benefits from having high diversity, including resistance to invasive species, improved plant community structure, increased biomass, decreased spread of fungal diseases, and increased richness and structure of insect populations. Research has also shown that plant species richness can add to the resiliency of plantings, making them more resistant to drought and other disturbances associated with climate change. Many of the plant species present at Cortex Commons also play important role in stormwater evapotranspiration, phytoremediation, and carbon sequestration (Shaw & Schmidt 2003; Shaw & Schmidt 2007; USEPA 2000). As part of the study, native plant species richness was compared in green infrastructure plantings and lawn areas for Cortex Commons.

Method:

A thorough meander survey that involved recording all plant species present at the site was conducted for green infrastructure plantings at Cortex Commons which included stormwater plantings and a planted prairie but excluded other landscape plantings such as those along buildings. A meander survey was also conducted for the lawn areas at Cortex Commons, and this information was used as a baseline for the vegetation that would have been found in the turf basin design since the turf basin design was planned to have the same soils and vegetation composition as the current lawn. All species present were recorded during the meander surveys for the two areas being investigated. Percent cover and whether the species present was native or non-native was recorded. The research team



Lawn area that was dominated with tall fescue.



Project team members assessing vegetation in a biofiltration area.

decided to include non-native species in the count of total species, as the non-native species present were providing benefits for soil stabilization and pollinator habitat. Of the 52 species recorded at the project site, 43 were considered native species with an origin within 200 miles of the project prior to European settlement. The following lists were created for two biofiltration areas found at the site, the planted prairie, vegetated vegetated roadside curb inlets, and the lawn areas. A species list is also included for the other landscape areas that were not used as part of this benefits assessment.

Plant Survey Data

Table 1: Biofiltration Area A

Amsonia sp.	Bluestar species 45%
Brizia maxima	Quaking grass 3%
Carex grayi	Gray's sedge 15%
Carex shortiana	Short's sedge 5%
Convolvulus arvensis	Field bindweed 1% (non-native)
Eutrochium purpureum	Joe-pye weed 10%
Festuca sp.	Tall fescue 1% (non-native)
Itea virginica	Virginia sweetspire 5%
Juncus effusus	Soft rush 20%
Lactuca virosa	Wild lettuce <1% (non-native)
Solidago sp.	Goldenrod species 1%

Table 2: Biofiltration Area B

Amsonia sp.	Bluestar species 5%
Apocynum cannabinum	*Dogbane* 18%
Asclepia syriaca	Common milkweed 1%
Baptisia australis	Blue wild indigo 2%
Brizia maxima	Quaking grass 1%
Bromus sp.	Brome species 2%
Carex Praegracilis	Tollway sedge 1%
Carex shortiana	Short's sedge 1%
Convolvulus arvensis	Field bindweed 1% (non-native)
Coreopsis lanceolata	Lanceleaf coreopsis
Cornus sericea	Red osier dogwood 4%

Echinacea purpurea	Purple coneflower 1%
Erigeron sp.	Fleabane species 1%
Festuca sp.	Tall fescue 5% (non-native)
Lactuca virosa	Wild lettuce 1% (non-native)
Rhus glabra	Smooth sumac 1%
Scirpus atrovirens	Green bulrush 1%
Solidagao sp.	Goldenrod species 50%
Teucrium canadense	American germander 1%
Torilis arvensis	Hedge parsley 3% (non-native)
Vicia sp.	Vetch species 1%
Zizia aurea	Golden alexanders 5%

Table 3: Planted Prairie

Achillea millefolium	Common yarrow 10%
Andropogon virginicum	Broom sedge 10%
Asclepias incarnata	Marsh milkweed <1%
Asclepia syriaca	Common milkweed <1%
Aster sp.	Aster species 1%
Bouteloua curtipendula	Side-oats grama 6%
Brassica sp.	Mustard species 1% (non-native)
Dalea purpurea	Purple prairie clover 1%
Erigeron canadensis	Mairstail <1%
Erigeron sp.	Daisy fleabane <1%
Eutrochium purpureum	Joe-pye weed 3%
Festuca sp.	Tall fescue 1% (non-native)
Helianthus helianthoides	Common oxeye <1%
Iris sp.	Iris species 3%
Melliotus albus	White sweetclover <1%
Oenothera biennis	Common evening primrose <1%
Pycnanthemum tenuifolium	Slender mountain mint 1%
Ratibida pinnata	Gray-headed coneflower <1%
Rudbeckia hirta	Black-eyed Susan 15%
Schizachyrium scoparium	Little bluestem 5%
Solidago sp.	Goldenrod species 4%
Tradescantia ohiensis	Ohio spiderwort <1%
Zizia aurea	Golden alexanders 1%

Table 4: Lawn

Festuca sp.	Turf-type tall fescue 97% (non-native)
Trifolium repens	White clover 3% (non-native)

Table 5: Vegetated Roadside Curb Inlets

Amsonia sp.	Bluestar species 15%
Carex muskingumensis	Palm sedge 2%
Carex praegracilis	Tollway sedge 4%
Carex vulpinoidea	Fox sedge 6%
Coreopsis lanceolata	Lanceleaf coreopsis <1%
Festuca sp.	Tall Fescue 1%
Helenium autumnale	Sneezeweed 2%
Juncus effusus	Soft rush 5%
Schizachyrium scoparium	Little bluestem 1%

Table 6: Other Landscape Plantings

Acer rubrum 'October Glory'	'October Glory' Red Maple
Betula nigra "Dura Heat'	'Dura Heat' River Birch
Cladrastis kentukea	American yellowwood
Gleditsia triacanthos 'Skyfire'	'Skyfire Honeylocust
Juniperus virginiana 'Grey Owl'	Grey owl juniper (non-native)
Nyssa sylvatica 'Red Rage'	'Red Rage' Black Gum
Quercus rubur 'Regal Prince'	'Regal Prince' English oak (non-native)
Salvia yangii	Russian sage (non-native)
Taxodium distichum 'Shawnee Brave'	'Shawnee Brave' Bald Cypress
Ulmus carpinfoilia x parvfolia 'Frontier'	'Frontier Elm

Calculations:

Calculations involved summing the total number of plant species currently found in the green infrastructure plantings and doing the same for the lawn areas. These totals which were 52 species for the green infrastructure plantings and 2 species for the lawn areas were then used for the benefits comparison.

Sources:

Biondini, M. 2007. Plant Diversity, Production, Stability, and Susceptibility to Invasion in Restored Northern Tall Grass Prairies (United States). Restoration Ecology 15: 77-87.

Knops, J. M. H.; Tilman, D.; Haddad, N. M.; Naeem, S.; Mitchell, C. E.; Haarstad, J.; Ritchie, M. E.; Howe, K. M. Piper, J.K. 1996. Composition of prairie plant communities on productive versus unproductive sites in wet and dry years. Can. J. Bot. 73: 1635-1644.

Pollock, M., Naima, R., Hanley, T. 1998. Plant species richness in riparian wetlands – A test of biodiversity theory. *Ecology* 79: 94-105.

Shaw, D., R. Schmidt. 2003. Plants for Stormwater Design: Species Selection for the Upper Midwest. Saint Paul, MN: Minnesota Pollution Control Agency.

Shaw, D., R. Schmidt 2007. Plants for Stormwater Design: Species Selection for the Upper Midwest Volume II, Saint Paul, MN: Great River Greening.

Tilman, D. 1996. Biodiversity: Population versus ecosystem stability. Ecology 77(3):350-363.

Tilman, D. 1997. Community invasibility, recruitment limitation, and grassland biodiversity. Ecology 78:81-92.

Tilman, D., J. Downing. 1994. Biodiversity and stability in grasslands. Nature 367:363-365.

Tilman, D., J. Knops, D. Wedin, P. Reich, M. Ritchie, E. Siemann. 1997. The influence of functional diversity and composition on ecosystem processes. Science 277:1300-1302.

Tilman D., P.B. Reich, J. M. H. Knops. 2006. Biodiversity and ecosystem stability in a decade-long grassland experiment. Nature: 441: 629-632.

United States Environmental Protection Agency. 2000. Introduction to Phytoremediation. Cincinnati: U.S Environmental Protection Agency.

Limitations:

Plant species richness is just one measure of the environmental benefits of a project and do not provide a full understanding of the environmental quality of a site. To compensate for this limitation of the measure of plant species richness other complementary benefits are being measured including insect abundance and pollinator habitat/ecological health. A Floristic Quality Assessment was also considered for this project, but based on experience of the research team was not considered an effective measure of the integrity of the stormwater plantings as it is most effective for assessing natural plant communities.

The research team recognizes that the presence of plant species in the lawn areas at Cortex Commons may not fully replicate the conditions of the planned turf basin due to differences in size and other site conditions.

- **Provides habitat for at least 24 observed insect species in green infrastructure and prairie plantings, 23 of which are pollinators, as compared to 4 insect species observed in lawn areas comparable to the planned turf basin.**

Background:

Black swallowtail butterfly on purple coneflower

The presence of insect species is an important component of the ecological health of a landscape and act as bioindicators, as they support food webs and provide a wide range of ecological services (Kevan 1999; Chowdhury et al. 2023). Pollinator species are particularly important due to their role in the seed production of native plants. An insect survey was conducted to compare the number of insects in stormwater planting and a planted prairie at Cortex Commons to the number of insects in the current lawns areas which are comparable to the planned turf basin for the project.

Method:

The number of unique insect species were counted during a through meander survey in each of the assessment areas between 12:00PM and 3:00PM on June 9th, 2023 when they were likely to be active. Images of the pollinators were taken to the extent possible in order to document each species and verify that the species were unique. The number of unique insect species was documented in green infrastructure plantings (biofiltration areas, vegetated roadside curb inlets, and the prairie planting) as well as turf areas of Cortex Commons in the same time period. The turf areas of Cortex Commons were used as the comparison to document species that would have been present in the planned turf basin design. The following lists include species in green infrastructure plantings and lawn areas.

Insect Survey

Table 7: Green Infrastructure Plantings

Milkweed beetle (*Tetraopes tetrophthalmus*) - 1
Lady bug beetle A (Family *Coccinellidae*)
Lady bug beetle B (Family *Coccinellidae*)
Beetle species (Order *Coleoptera*) - 1
Soldier beetle (*Chauliognatha pennsylvanicus*) – 48
Stinkbug (Family *Pentatomidae*) – 1 non-native
Honey bee (*Apias mellifera*) – 25 non-native
Digger bee species A (Genus *Anthophora*) – 1
Digger bee species B (Genus Anthophora) - 1

Sweat bee (Genus Lasioglossum) – 1
Wasp species A (Order *Hymenoptera*) – 1
Wasp species B (Order *Hymenoptera*) – 1
Wasp species C (Order *Hymenoptera*) - 1
Cabbage white butterfly (*Pieris rapae*) – 7 non-native
Orange sulphur butterfly (*Colias eurytheme*) - 1
Eastern blue butterfly (*Cupido comyntas*) – 1
Black swallowtail butterfly (*Papilio polyxenes*) - 1
Moth species A (Order *Lepidoptera*) – 2
Moth species B (Order *Lepidoptera*) – 1
Moth species C (Order *Lepidoptera*) - 1
Dragonfly (Order *Odonata*) – 3
Fly species A (Order *Diptera*) – 1
Fly species B (Order *Diptera*) – 1
Fly species C (Order *Diptera*) – 1
Fly species D (Order *Diptera*) - 1

Table 8: Lawn area

Digger bee species A (Genus *Anthophora*) – 1
Lady bug beetle A (Family *Coccinellidae*)
Eastern blue butterfly (*Cupido comyntas*) – 1
Moth species A (Order *Lepidoptera*) – 2

Calculations:

Calculations involved summing the total number of insect species currently found in the green infrastructure planting and doing the same for the lawn areas. Insects that were considered pollinators were also summed separately. These totals which were 24 insect species (23 pollinator species) for the green infrastructure plantings and 4 insect species (4 pollinator species) for the lawn areas were then used for the benefits comparison.

Sources:

Bees of Missouri | Missouri's Natural Heritage | Washington University in St. Louis (wustl.edu)
37 Types of Bees With Identification Guide and Pictures (leafyplace.com)

Kevan, P., 1999. Pollinators as bioindicators of the state of the environment: species activity and diversity. Agriculture, Ecosystems & Environment. Volume 74, Issues 103.

Chowdhury, S., V. Dubey, S. Choudhury, A. Das, D. Jeengar, B. Sujatha, A. Kumar, N. Kumar, A. Semwal, V. Kumar. 2023. A hidden gem for environmental monitoring. Frontiers in Environmental Science. Volume 11.

Limitations:

The research team recognizes that the presence of insects in the lawn areas at Cortex Commons may not fully replicate the conditions of the planned turf basin due to differences in size and other site conditions.

Due to the large number of unique insect species, challenges with viewing living insect species and subtle differences between males and females of the same species there is potential for inaccuracies with the total number of insects documented.

- ***Attains a "high" urban pollinator score of 85 for green infrastructure and prairie plantings as compared to a "low" score of 42 for the lawn areas that are comparable to the planned turf basin, based on the Urban Pollinator Habitat and Ecological Health Assessment.***

Background:

Prairie planting with a diversity of native grasses and forbs

An Urban Pollinator and Ecological Health Assessment document was developed by the Minnesota Board of Water and Soil Resources (by this study's Principal Investigator) in 2016. The document was developed through a combination of available research and review by many pollinator experts and ecologists. This assessment method was refined for this study in May of 2023 to increase its emphasis and effectiveness for assessing urban stormwater projects. It was determined that this assessment document would be a good complement to the plant and insect species richness information being collected at the site and would provide an effective assessment of the project's overall benefits for pollinators and ecological health. The assessment was conducted for green infrastructure plantings at the project site and within the lawn areas that are similar to the previously planned turf basin.

Method:

Eastern blue butterfly

A wide range of environmental conditions that are part of green infrastructure projects contribute pollinator and overall ecological health (Donkersley et al. 2023, USFWS 2003; Xerces Society 2023a, Xerces Society 2023b). The urban pollinator and ecological health assessment used at the site has specific categories that identify important environmental conditions. These categories include:

-Size of planted area providing habitat (maximizing habitat benefits)

-Habitat types present (supporting a wide range of insects and wildlife)

-Native plant cover diversity (supporting a wide range of insects and other wildlife)

-Seasons with three blooming species present (maximizing flower resources for pollinators)

-Habitat components (enhancing habitat for target species)

-Pesticide risk (protecting the health of insects and other wildlife)

-Percent cover of native vegetation in planted areas (supporting a wide range of insects and other wildlife)

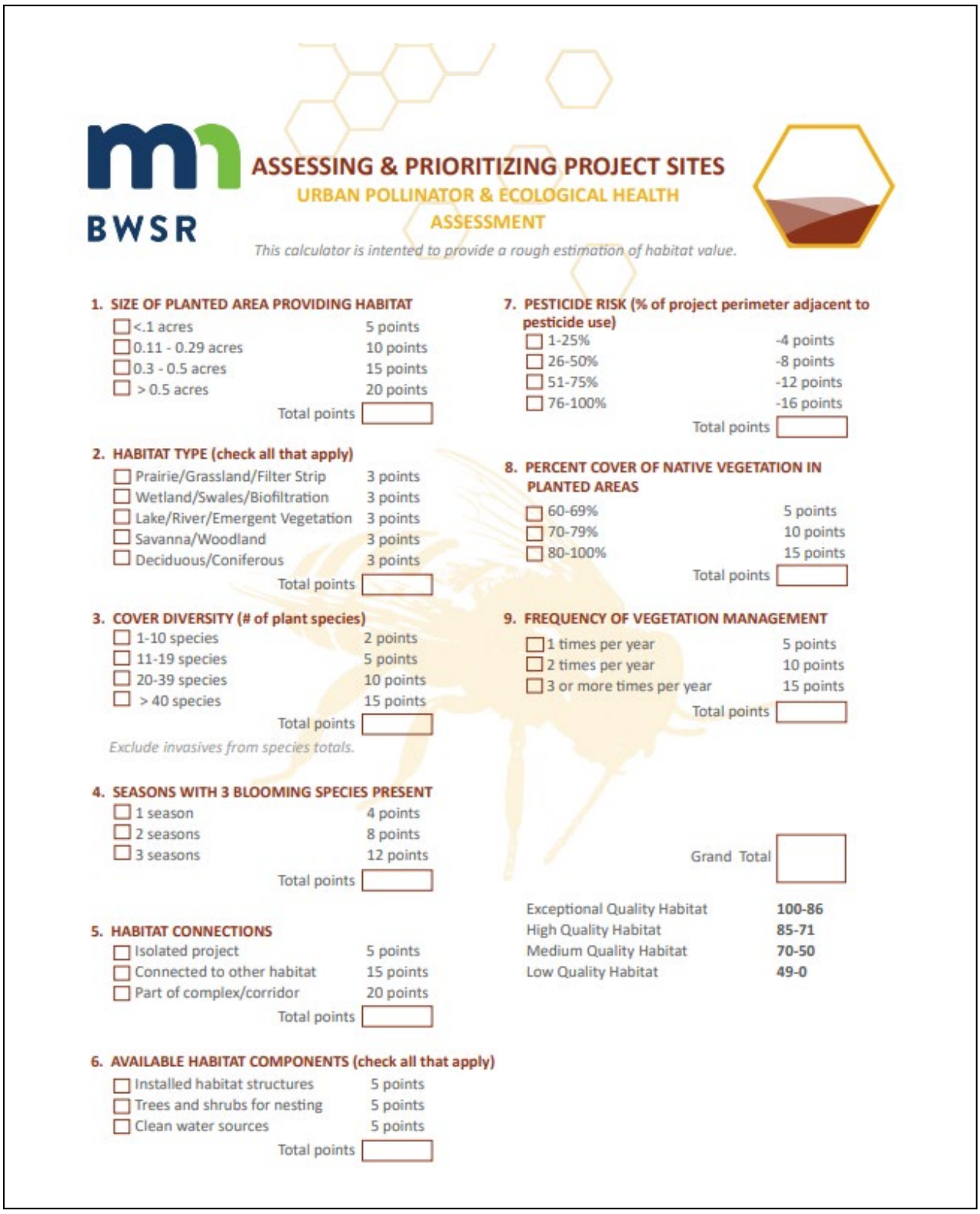
-Frequency of vegetation management (ensuring the quality of habitat and long-term benefits)

Each category that is part of the assessment has a range of potential scores based on site conditions. Using the assessment form, points were awarded for green infrastructure areas and the lawn areas separately.

Calculations:

On the Pollinator and Ecological Health Assessment Form, 49 or fewer points ranks as low-quality habitat; 50-70 points ranks as medium-quality habitat; 71-86 points ranks as high-quality habitat; and 86-100 points ranks as exceptional-quality habitat. The lawn areas at the site scored a 42 which is at the upper end of the low-quality habitat category, while the non-lawn areas scored 85 which is the high end of the high-quality habitat score.

Image 3: Example habitat assessment form used for the study



BWSR

ASSESSING & PRIORITIZING PROJECT SITES

URBAN POLLINATOR & ECOLOGICAL HEALTH ASSESSMENT

This calculator is intented to provide a rough estimation of habitat value.

1. SIZE OF PLANTED AREA PROVIDING HABITAT

☐ <.1 acres	5 points
☐ 0.11 - 0.29 acres	10 points
☐ 0.3 - 0.5 acres	15 points
☐ > 0.5 acres	20 points

Total points ☐

2. HABITAT TYPE (check all that apply)

☐ Prairie/Grassland/Filter Strip	3 points
☐ Wetland/Swales/Biofiltration	3 points
☐ Lake/River/Emergent Vegetation	3 points
☐ Savanna/Woodland	3 points
☐ Deciduous/Coniferous	3 points

Total points ☐

3. COVER DIVERSITY (# of plant species)

☐ 1-10 species	2 points
☐ 11-19 species	5 points
☐ 20-39 species	10 points
☐ > 40 species	15 points

Total points ☐

Exclude invasives from species totals.

4. SEASONS WITH 3 BLOOMING SPECIES PRESENT

☐ 1 season	4 points
☐ 2 seasons	8 points
☐ 3 seasons	12 points

Total points ☐

5. HABITAT CONNECTIONS

☐ Isolated project	5 points
☐ Connected to other habitat	15 points
☐ Part of complex/corridor	20 points

Total points ☐

6. AVAILABLE HABITAT COMPONENTS (check all that apply)

☐ Installed habitat structures	5 points
☐ Trees and shrubs for nesting	5 points
☐ Clean water sources	5 points

Total points ☐

7. PESTICIDE RISK (% of project perimeter adjacent to pesticide use)

☐ 1-25%	-4 points
☐ 26-50%	-8 points
☐ 51-75%	-12 points
☐ 76-100%	-16 points

Total points ☐

8. PERCENT COVER OF NATIVE VEGETATION IN PLANTED AREAS

☐ 60-69%	5 points
☐ 70-79%	10 points
☐ 80-100%	15 points

Total points ☐

9. FREQUENCY OF VEGETATION MANAGEMENT

☐ 1 times per year	5 points
☐ 2 times per year	10 points
☐ 3 or more times per year	15 points

Total points ☐

Grand Total ☐

Exceptional Quality Habitat	**100-86**
High Quality Habitat	**85-71**
Medium Quality Habitat	**70-50**
Low Quality Habitat	**49-0**

Sources:

BWSR Urban Pollinator Habitat Assessment: Urban and Rural Assessment Forms_0.pdf (state.mn.us)

Donkersley, P., S. Witchalls, E. Bloom, D. Crowder. 2023. A little does a lot: Can small-scale plnating for pollinators make a difference?. Agriculture, Ecosystems & Environment. Volume 343, 108254.

Xerces Society. 2023. Maintaining Diverse Stands of Wildflowers Planted for Pollinators, *Ongoing Management of Pollinator Habitat.* https://xerces.org/publications/guidelines/maintaining-diverse-stands-of-wildflowers-planted-pollinators

Xerces Society. 2023. Guidance to Protect Habitat from Pesticide Contamination, *Creating and Maintaining Healthy Pollinator Habitat.* https://xerces.org/publications/fact-sheets/guidance-to-protect-habitat-from-pesticide-contamination

United Sates Fish and Wildlife Service, 2023. Threats to Pollinator. https://www.fws.gov/initiative/pollinators

Limitations:

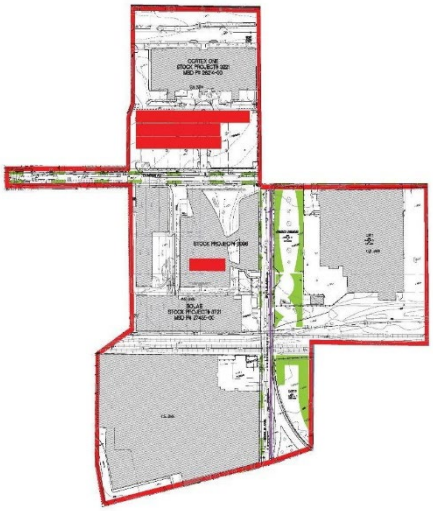
The habitat assessment form used for the study provides a general understanding of the habitat value for pollinators and the overall ecological health of an urban landscapes. Many factors can influence the ecological health of an urban site including some that are difficult to detect such as pesticide impacts, contaminated soils, and water pollution. As the form was recently updated it may need additional adjustments in the future to ensure that it is working for a wide range of potential urban conditions.

Other + Inconclusive Environmental Benefits

In addition to the three primary benefits studied the CSI research team investigated other site parameters including stormwater treatment, soils, and surface temperatures.

Stormwater Treatment:

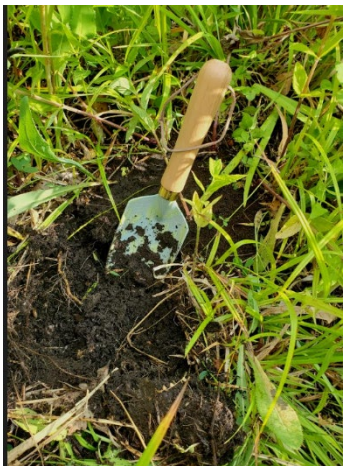
As part of agreements with the Metropolitan Sewer District, the Cortex district is required to treat stormwater on-site. The district is divided into three drainage areas that manage stormwater within the treatment area boundary. The total area to be managed within Cortex Commons and adjacent streets is 31.85 acres. Water holding capacity was required to meet the annual rainfall event of 1.14 inches. It was determined that the stormwater holding capacity and water treatment ability of the stormwater practices installed at Cortex Commons would have a comparable benefit to the turf basin that was planned, as both would capture an annual rain event of 1.14 inches and both would be effective at treating total suspended solids, total phosphorus, total nitrogen, nitrate, and heavy metals. As a result, these site parameters were not selected as a project benefit and instead benefits focus on the additional value of habitat and species diversity provided by the green infrastructure.



Drainage area map showing the 31.85-acre area that drains into the green shaded Cortex Commons stormwater treatment infrastructure.

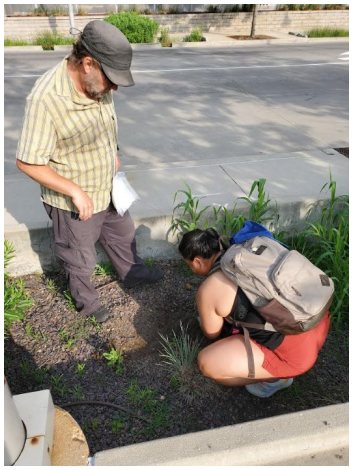
Soil Conditions:

Soil samples were taken at the site to better understand how soil soluble salt content was influencing the health of vegetation and if organic content was increasing in areas of dense vegetation which could increase carbon sequestration and retain stormwater for use by plant species. Two soil samples were collected in biofiltration basin A, biofiltration basin B, vegetated roadside curb inlets, the prairie planting, and the lawn areas. The samples were collected by removing the upper 1.5 inches of soil and thatch and digging down another 3 inches to collect the samples. The two samples collected from each defined area were combined, bagged, and labelled. The samples were then stored in a cooler with ice to keep them at a consistent temperature. The samples were brought to the University of Minnesota Soil Testing Lab to run basic soil tests and a test for soluble salt content. The basic tests analyze samples for organic content, pH, phosphorus, and potassium. The soluble salt test was also conducted to see if low plant establishment success in vegetated roadside curb inlets was partly due to soluble salt content.



Organic-rich soils in the base of a biofiltration basin

Based on soil samples taken at the site, the research team determined that the organic content of the biofiltration areas, vegetated roadside curb inlets, turf areas, and planted prairie varied significantly due to a variety of soils that were incorporated as part of site construction. This made it difficult to determine if root systems were contributing to increased organic content accumulation. Based on the soil samples, soluble salt content was similar in the vegetated roadside curb inlets, indicating that soluble salt was probably was not a significant factor for plant growth. The roadside areas did have less organic content which may result in lower water retention, as well as slightly lower phosphorous content, both of which could influence plant growth.

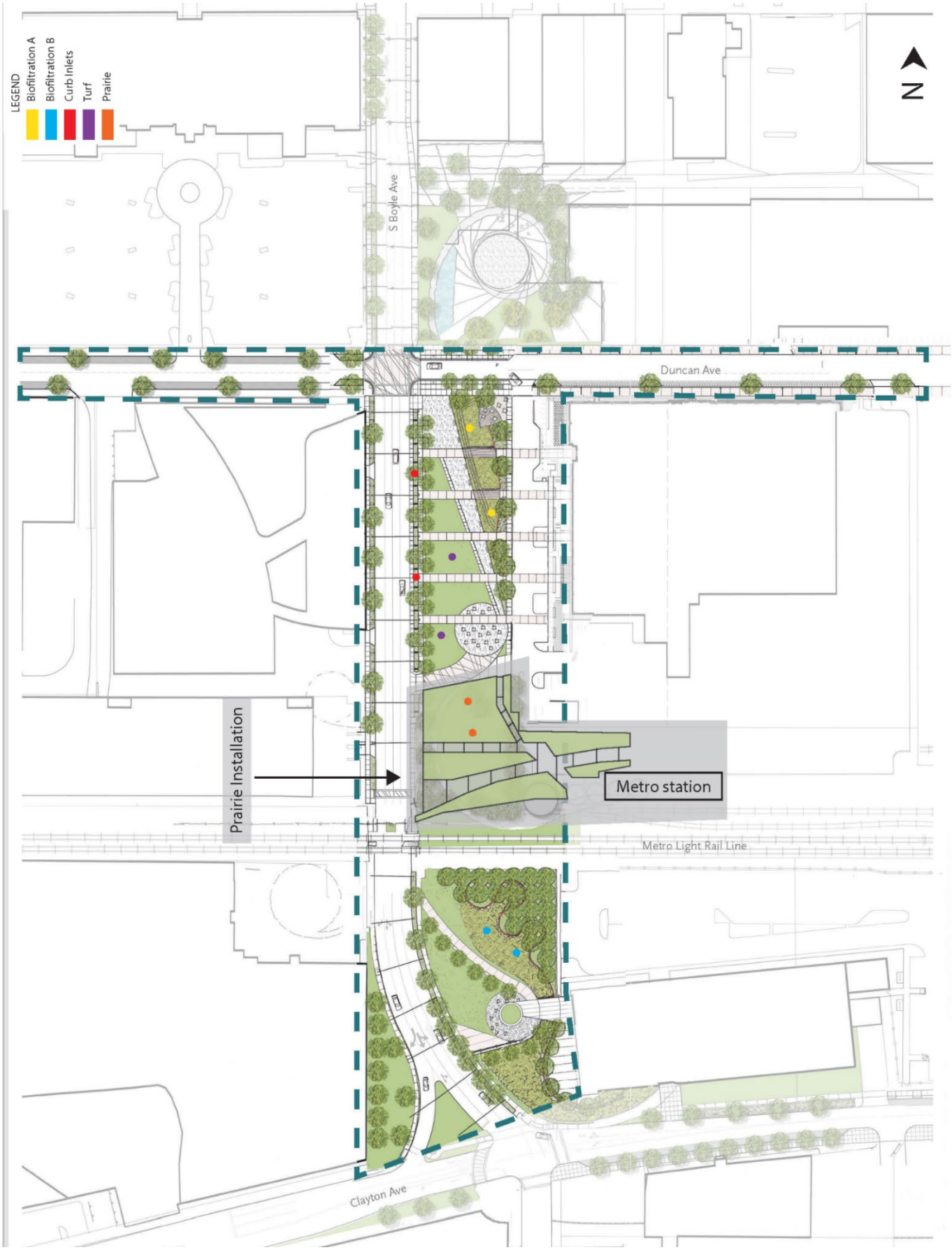


Soil collection in a vegetated roadside curb inlet

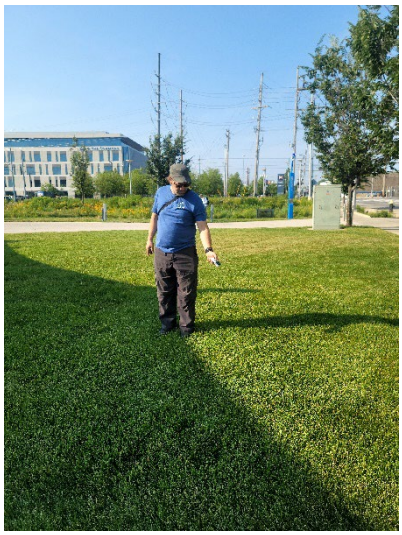
Table 9: Summary of Soluble Salts, Organic Content and Phosphorus Content for Project areas

Project Area	% Organic Content	mmhos/cm salt	P in ppm
Prairie	8.9	.3	41
Biofiltration Area A	1.9	.1	13
Biofiltration Area B	2.1	.2	13
Vegetated roadside curb inlets	1.8	.1	8
Turf	2.9	.3	10

Image 4: Map of soil sample collection points



Surface Temperatures:



Morning temperature readings

The CSI research team investigated temperatures at the site to understand how different surfaces contribute to heating of air temperatures and how temperatures may contribute to urban heat island effect and influence the experience of park visitors and the health of plants and wildlife species. Surface temperatures were taken on benches, lawn areas, biofiltration basins, and paving.

The team wanted to understand if having a biodiverse space like a rain garden decreases temperatures as compared to turf. The morning and afternoon surface temperature readings from the turf and biofiltration areas went up about 20° F, but overall there was not a significant difference between the two types of plantings. One of the most surprising differences was a temperature difference on brown, dormant sod, which was 69.9° F in the morning and spiked up by about 30°F in the afternoon to a reading of 102.45°F. Although this was an interesting find, the research team decided the surface temperature readings were inconclusive because it was difficult to get an accurate reading in the biofiltration areas due to the areas having pockets of empty spaces that exposed large aggregate which covered the topsoil of the biofiltration areas. The variability in the biofiltration areas caused readings to fluctuate about 10°F to 15°F depending on whether the temperature was read at the aggregate surface or at the base of plants.

Wooden benches and a charging outlet – Jim Diaz and SWT Design

The site also features wooden benches and pavers that replicate the pattern of a DNA sequence. The pavers consisted of light and dark pavers which didn't have a significant temperature differences. However, the wooden bench did have a reading of 104.5°F in the afternoon. The high reading was surprising because wooden benches are often significalntly cooler than metal benches. One hypothesis is that the metal frame supporting the wood heated up during the day causing a consistent heat transfer through conduction. Overall, the research team decided the temperature readings for the different surfaces were inconclusive due to varying conditions across the site and a lack of baseline information.

Table 10: Morning Surface Temperature Readings for Turf and Biofiltration Areas

Taken 8:30AM to 9:15AM	Reading 1	Reading 2	Average	Notes
A	60.9°	62°	61.45°	
B	62.4°	61°	61.7°	
C	65.6°	65.4°	65.5°	
D	58.6°	60.8°	59.7°	
E	64.4°	63.9°	64.15°	
F	69.9°	69.9°	69.9°	Taken on a patch of turf that was dry and browning.
G	65.3°	64.2°	64.75°	

H Shade	56.6°	56.4°	56.5°	The turf space under the shadow of the large pavilion.
H Sun	62.7°	62.9°	62.8°	The turf reading was taken outside the shadow of the shade structure.
I	73.4°	71.6°	72.5°	
J	67.6°	67.7°	67.65°	Taken under the first 2 or 3 trees in the grove.
K	65.3°	64.4°	64.85°	Dark soil color and a lack of large aggregate compared to other areas of the biofiltration.
L	75.2°	76.1°	75.65°	

Table 11: Afternoon Surface Temperature Readings for Turf and Biofiltration Areas

Taken 3:00PM - 4:00PM	Reading 1	Reading 2	Average	Notes
A	91.4°	85.6°	88.5°	
B	87.8°	91.4°	89.6°	
C	80.4°	82.4°	81.4°	Taken in partial shade from the shadow of a tree
D	93.2°	80.6°	86.9°	
E	85.4°	84.2°	84.8°	
F	102.5°	102.4°	102.45°	Taken on a patch of turf that was dry and browning.
G	86.1°	87.8°	86.95°	
H	83.3°	83.4°	83.35°	
I	80.6°	74.3°	77.45°	Reading 2 was taken in the shade standing in the same spot where reading 1 was taken.
J	83.6°	89.2°	86.4°	
K	77°	87.2°	82.1°	
L	92.9°	87.8°	90.35°	

Table 12: Surfaces Temperature Readings for Benches and Paving

Area	Time of day	Readings	Notes
Under Pavilion	3:15PM	77.5°	
Wooden bench	4:00PM	104.5°	Reading could be high possibly because the metal frame supporting the benches heated the wood.
Pavement (Sun)	2:45PM	113°	average temperature of 112.1 and 113.9
Pavement (Shade)	2:45PM	92.3°	Average temperature of 87.8 and 96.8
DNA Sequence Paver (Dark)	8:45AM	70.1°	
DNA Sequence Paver (Light)	8:45AM	69.9°	

Image 5: Map of Temperature Data Collection Points

Social Benefits

Pre-COVID food truck event – Jim Diaz and SWT

The Cortex Commons Innovation Community strived to have a campus-like space that supports a variety of uses. One of the main goals for the Cortex Commons design is to inspire innovation and collaboration. To enhance creativity and movement the site features charging outlets and a pavilion with ample seating, a MetroLink station, and events that are held throughout the year. Before the COVID-19 pandemic, Cortex Commons was a busy space with people socializing or grabbing a bite to eat at food truck events. The space was inviting for workers and visitors alike to enjoy the green space that is surrounded by businesses. Post-COVID, the park has had fewer visitors but based on site surveys Cortex Commons maintains social and recreational value as well as inspiring visitors who pass through.

There may be several reasons that park use has decreased visitation after the pandemic including:

- Many workers choosing to work from home, leaving office spaces empty.
- Most events held at the Cortex Commons stopped during the pandemic and the reestablishment of events has been slow.
- During the pandemic it is likely that most people opted to go to larger green spaces. The largest green space closest to Cortex Commons is Forest Park, which is a mile away from the site and has about 1,300 acres of green space.
- The campus-like feel of the Innovation district may create confusion for people who are new to the space about whether the park is public or private.
- Housing that was planned to be built near the site has not begun construction.

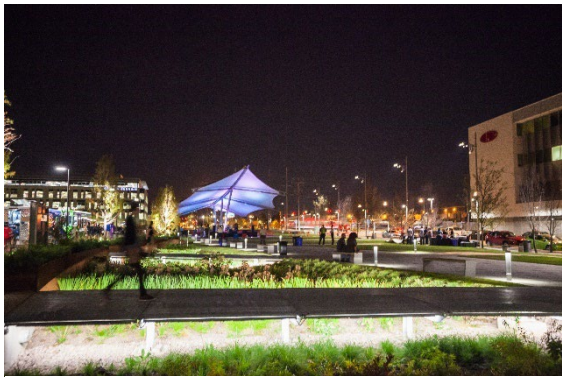
Venture 8 cafe tabling event

The social benefits of Cortex Commons that were studied focused on understanding how visitors and/or workers used the space and if people knew the role of green infrastructure for treating stormwater on-site. Surveys were distributed in-person at an event held by the Venture 8 Café, online through the Cortex Commons Innovation Community newsletter, and through QR codes that were left on the tables under the pavilion and security check-in for the building on-site. The survey was left open for one month.

- ***Provides outdoor space for recreation and relaxation, with 75% of 51 surveyed site users reporting relaxing or recreating in the space from once or twice per month to multiple times per week.***

Background:

One of the goals of the site was to create a space that was welcoming for professionals and visitors alike to use for relaxation purposes whether it was having a break from being inside the office or finding a peaceful place to read a book. Cortex Commons offers outdoor seating, charging outlets, well-lit paths in the evening and soon, free Wi-Fi to offer the maximum usage of the space.



Lit walking paths throughout the site during an evening event – Jim Diaz and SWT Design

Method:

Online and in-person surveys were used to collect information about the use of Cortex Commons for work and/or recreation or relaxation. The question for this data is as follows:

- *How often do you use the Cortex Commons for recreation or relaxation?*
- *Why do you visit the Cortex Commons?*

Calculation:

Figure 1: Survey Results for Question 6

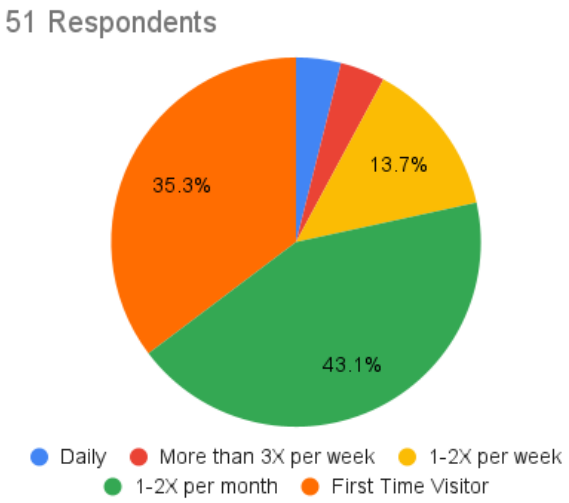


Figure 2: Survey Results for Question 7

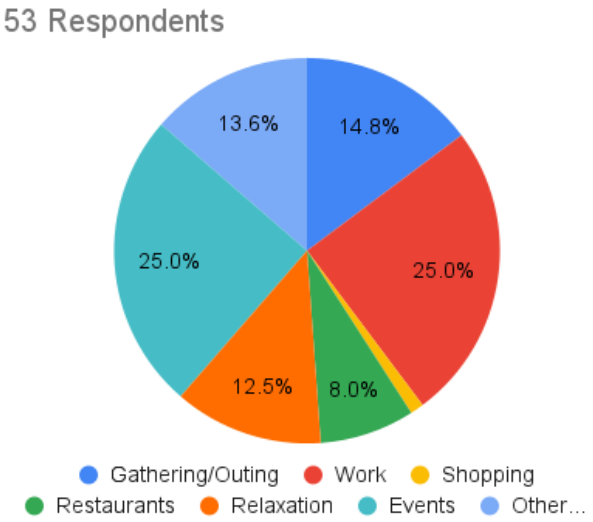


Table 13: Survey Results for 32 respondents who answered "other" on Question 7

Other. . .
Team meetings on a sunny day
My toddler likes to watch the metro link trains
Washington University Patient
Study
Volunteer
To wait for the train
I do not use the commons. They are merely a passthrough
School trip
To sit and make a phone call
Venture Café
Community Development
Research

Sources:

Survey responses solicited by CSI research team.

Limitations:

An option on the survey that states "N/A" or "do not use" should have been included because one person taking the in-person survey responded "never" to question 6.

When handing out hard copies of the in-person surveys, the CSI research team could not require survey-takers to answer all the questions. One person on the in-person survey left question 6 blank.

- ***Provides educational value, with 50% of 26 people surveyed who work in Cortex Innovation Community and 56% of 27 outside visitors knowing what green infrastructure is and naming at least one element on-site. Of 52 total site users, 27% reported interacting with a feature that increased their knowledge of green infrastructure.***

Background:

Cortex Commons is a unique urban space that plays a significant role in managing and treating stormwater in addition to providing a gathering space for the public and professionals that use the park for work or leisure. A survey question was used to determine if visitors were aware of the green infrastructure on-site, which directly manages and treats water for 31.85 acres.

The Cortex Commons rain garden

SWT Design collaborated with the clients at the Cortex Innovation Community to design a space that supports learning. Educational signs of rain gardens (biofiltration areas) were placed throughout the site, so visitors understood the benefits of having rain gardens and stormwater management designs.

Rain garden signage – Jim Diaz and SWT

Method:

Online and in-person surveys were used to collect information about the survey-taker's knowledge of green infrastructure. The questions for these benefits are as follows:

- *Do you generally know what green infrastructure is?*
- *If you answered YES, can you name at least 1 green infrastructure element within the Cortex Common?*
- *Have you interacted with any feature within the Cortex Commons that has increased your knowledge of green infrastructure?*

Calculations:

Figure 3: Survey Results for Question 10 With A Total of 53 Respondents.

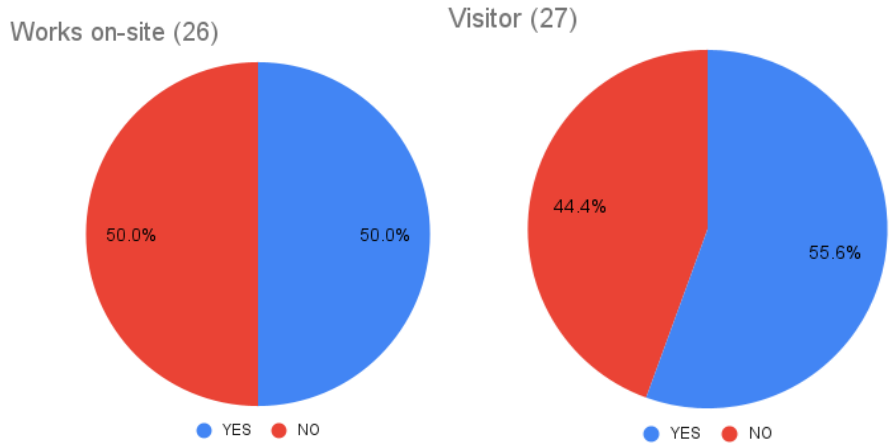
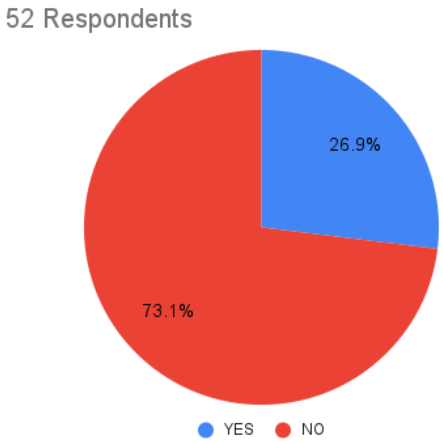


Table 14: Survey Results for Question 11

If you answered YES, can you name at least 1 green infrastructure element within the Cortex Common?
Rain Gardens
Rain Scape
BMP
Rain gardens, cistern and heat capture shrubs
Outdoor
MSD rain water collection
Nothing comes to mind from memory for this question. I don't know the green space that well by memory
Rainscaping
Streetscape/tree area
The grass
Bio Retention
Porous pavement
prairie garden near metrolink
Grass
N/A
The Cortex
Rain Gardens
Grass, Trees
Wildflower garden
Stormwater management

Microsoft
Open space supports walkability
Metrolink, bike parking
Rain garden
Front lawn
Native plant runoff things

Figure 4: Survey Results for Question 12



Sources:

Survey responses solicited by CSI research team.

Limitations:

Using a survey to collect information about the knowledge of green infrastructure at the site introduces some uncertainty about whether people understand the terminology of green infrastructure and are answering based on their knowledge of the terminology.

During the site visit the CSI research team had limited opportunities to speak with visitors due to the lack of visitors on that day. There were many factors that led to the limited number of in-person surveys, which are as follows:

- The COVID-19 pandemic allowed workers to work from home, which led to the decrease in use of the space.
- Many events were cancelled during the pandemic, and the Cortex Innovation Community staff are currently working to attract people back to the site.

4 people left question 11 unanswered on the in-person survey. "*If you answered YES, can you name at least 1 green infrastructure element within the Cortex Commons?*"

For the final question, the CSI research team did not provide a follow-up question to understand what feature the survey respondent interacted with.

Faded rain garden sign

1 person left question 12 unanswered in the in-person survey. *Have you interacted with any feature within the Cortex Commons that has increased your knowledge of green infrastructure?*

The CSI research team cannot confidently say that the survey-takers learned about some of the green infrastructure on-site due to signs being overlooked or because the signage has faded over time.

- ***Promotes innovation, with 45% of 53 surveyed site users reporting satisfaction with how Cortex Commons enhances innovation.***

Background:

Cortex Commons designed key features throughout the site to enhance and spark innovation for people who use the space for work, relaxation, or a through space to get to their next destination. Key features at Cortex Commons to help enhance innovation include:

- Charging outlets at every bench along the walking path
- Outdoor seating for relaxation and collaboration
- Rain garden signs for education
- Quotes etched on metal plates along the walking path from inspirational people like Albert Einstein


CSI research team reading an etched quote along the walkway.

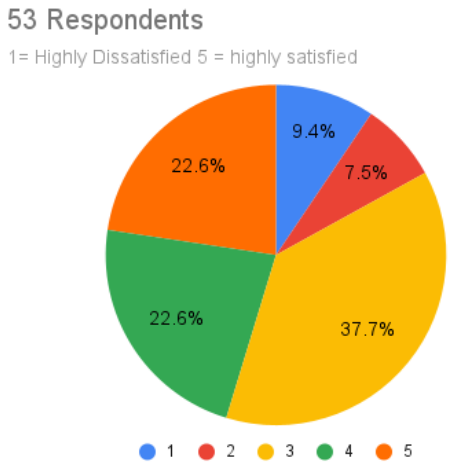
Method:

Using the Likert scale method, online and in-person surveys were used to collect information about the survey-takers and if they were very satisfied (5) or very dissatisfied (1) with Cortex Commons enhancing their innovation. The question for this data is as follows:

- *On a scale of 1 - 5, how does the Cortex Commons enhance your innovation?*

Calculations:

Figure 5: Survey Results for Question 9



Sources:

Survey responses solicited by CSI research team.

Limitations:

Using a survey to collect data about "enhancing innovation" is difficult given that people perceive innovation differently and will respond to the site in different ways related to how it "enhances innovation" for them individually.

37.7% of the people surveyed were neutral (3) with the Cortex Commons enhancing innovation.

The CSI research team did not provide a follow-up question to understand what about Cortex Commons enhanced their innovation.

- ***Promotes use of outdoor workspaces, with 55% of 53 surveyed site users reporting working in Cortex Commons from once or twice per month to multiple times per week.***

Background:

One of the goals for the Cortex Commons Community was to design a space that promoted collaboration and innovation both inside and outside of the building. The Cortex office building includes a variety of businesses and provides an outdoor space with ample outdoor seating, charging outlets, well-lit paths in the evening and soon, free Wi-Fi. Cortex Commons was made to engage people to spend some of their workday outside collaborating and engaging with people from different backgrounds or having a team meeting outside on a nice day.

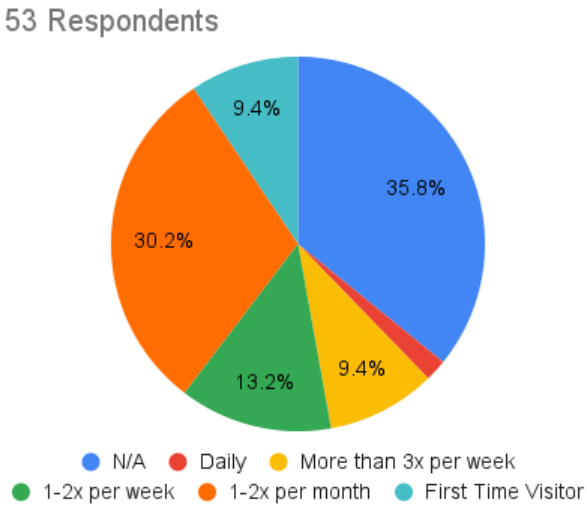
Method:

Online and in-person surveys were used to collect information about the usage of the Cortex Commons for work and/or recreation or relaxation. The question for this data is as follows:

- *How often do you use the Cortex Commons for work?*

Calculation:

Figure 6: Survey Results for Question 5



30.2 (1-2x per month) + 13.2 (1-2x per week) + 9.4 (more than 3x per week) + 1.5 (daily) = 54.8%

Sources:

Survey responses solicited by CSI research team.

Limitations:

Question 5 did not apply to all respondents since this question was focused on people who work at the Cortex Innovation Community. This question left out 5 of the respondents.

Parking for people who work in the building on-site is located on the north side of the building which has a crosswalk that leads them to the building's East side entrance. This path does not cross into the Cortex Commons green space which is located on the West side of the building. Some respondents communicated at the in-person tabling event at Venture 8 Café that they did not know there was a green space because they do not pass through it from the parking lot.

Reference of parking lot and site, with an arrow indicated the path preferred by workers.

The COVID-19 pandemic has influenced the use of the site since most people are choosing to work from home post-pandemic.

Image 6: In-person Survey

The Cortex Commons Survey

What Are We Doing?

We are researching how the Cortex Commons is being used and measuring its success.

1. What means of transportation did you use today?

☐ Vehicle ☐ Light Rail ☐ Bus ☐ Ride Share ☐ Biking
☐ Other: _____

2. If you live within the Cortex Innovation Community, what is your mode of transportation out of the district?

☐ N/A ☐ Vehicle ☐ Light Rail ☐ Bus ☐ Ride Share

☐ Biking ☐ Walking ☐ Other:_____

3. Do you work within the Cortex Innovation Community?

☐ YES | ☐ NO

If you answered YES:

☐ Full Time | ☐ Part Time

4. How often do you use the Cortex Commons for work?

☐ N/A ☐ Daily ☐ More than 3x per week
☐ 1-2x per week ☐ 1-2x per month ☐ first time visitor

5. How often do you use the Cortex Commons for recreation or relaxation?

☐ Daily ☐ More than 3x per week ☐ 1-2x per week
☐ 1-2X per month ☐ first time visitor

6. Why do you visit the Cortex Commons? (You can check more than 1)

☐ Gathering/Outing ☐ Work ☐Shopping
☐ Restaurants ☐ Relaxation ☐Events
☐ Other:_____

7. Over the past year, how many events have you attended at the Cortex Commons?

_____

8. On a scale of 1 – 5 how does the Cortex Commons enhance your innovation?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Highly Dissatisfied Highly Satisfied

9. Do you generally know what green infrastructure is?

☐ YES | ☐ NO

Flip To back

10. If you answered YES, can you name at least 1 green infrastructure element within the Cortex Commons?

_____
_____

11. Have you interacted with any features in the Cortex Commons that have increased your knowledge of green infrastructure?

☐ YES | ☐ NO

12. What is your favorite aspect of the Cortex Commons?

_____
_____

13. What can be improved?

_____
_____
_____

Thank you for taking the time to take this survey!

Economic Benefits

In 2002 Cortex, which is a 501(C)(3) nonprofit, managed the development of the Cortex Commons Innovation Community that was founded by Washington University (in St. Louis, Saint Louis University), University of Missouri – St. Louis, BJC Healthcare, and the Missouri Botanical Garden. As stated on their website, the overall mission of Cortex is to serve "as an inclusive economic engine for the St. Louis region. We create equitable economic impacts by leveraging high quality facilities, developing a portfolio of programmatic offering that build knowledge and networks, and convening a collection of strategic partnership that attract and support emerging and established companies." The Cortex Innovation Community wanted Cortex Commons to reflect the values of the community by working with SWT Design to create a space that showcased innovation and collaboration.

The focus of the economic benefits assessment was to look at the operations and maintenance of Cortex Commons. The CSI research team's goal was to further understand the cost of maintaining the site and what job opportunities it created.

- ***Creates 19 subcontracted maintenance jobs along with 1 groundskeeper position that supports a person with a long-term disability in reentering the workforce.***

Background:

The Cortex Commons Innovation Community outsources the maintenance for Cortex Commons green spaces, as well as the inspection and reporting on the condition of BMPs. The Innovation Community also employs someone from in-house as a Cortex grounds maintenance person. One highlight that is valuable to note is that the Cortex Innovation Community hired a Cortex groundskeeper in a transitional working arrangement with the Independence center. This allows a person with a long-term disability to reenter into the workforce by providing part-time employment opportunities. The groundskeeper is in charge of removing trash and debris on a weekly basis.

Method:

An estimate of employment funded to maintain Cortex Commons was provided to the CSI research team from the VP of District Operations of the Cortex Innovation Community. Contracts made with each company varied in cost and maintenance expectations. The cost of the contract will determine how many employees each company can use to maintain Cortex Commons. The data breaks down as follows:

- Company
- # of employees

Calculations:

Table 15: # of People Employed Through Subcontractors to Work at Cortex Commons

Company	***# of employees***
Delgado Brothers	3
Clean Air Lawn Care	4
TRC Outdoor	11
Stock & Associates	1
Cortex	1

Sources:

Provided by the VP of District Operations at the Cortex Innovation Community

Limitations:

The research team did not speak with every company directly about the maintenance operation at the Cortex Commons.

Cost Comparison

- ***A full-time Cortex Landscape Maintenance Manager was being considered to manage the grounds at the Cortex Commons. This dedicated position would initially cost the Cortex Innovation Community $87,057, as compared to the current overall maintenance costs of subcontractors at $106,680. The initial cost to hire a full-time employee would cost the Cortex Innovation Community 18% less than continuing the current subcontracting system and would provide improved care and ongoing planning for the site.***

Background:

The VP of District Operation wrote a proposal to the Cortex Innovation Community board about the feasibility of having a full-time worker that would also have paid benefits and a 401k plan. The cost to hire a Cortex Landscape Maintenance Manger would cost the Innovation Community an initial $87,057 to start the position. This includes the annual salary of $62,080. The initial start-up of the position includes the budgeting for all the supplies needed for the job.

Having a full-time employee on-site would offer many benefits over contract workers including:

- Knowledge of design intent
- Consistent inspection of the site to identify issues (diseases, pests, trash, accident, clogged drains, etc.)
- Ability to take care of small projects that can improve aesthetics
- Better management of vendors for seasonal timelines
- Ability to conduct repairs (small irrigation leaks, signage, etc.)
- Another person with horticultural knowledge and grounds management that can inform the team of new projects that could be implemented
- The ability to lead tours of green spaces
- Plan and maintain annual displays

Although the Innovation Community denied the full-time position, it led to a part-time position of the Cortex groundskeeper, which has an agreement with the Independence Center allowing someone with a long-term disability to re-enter the workforce.

Method:

The VP of District Operation for the Cortex Innovation Community provided information about the hiring of a full-time landscape manager as well as the cost breakdown of the maintenance done by various companies and their contracts.

Calculations:

Table 16: Cost Breakdown for A Full-Time Maintenance Manager

Cortex Landscape Maintenance Manager Budget **$87,057.00**

Salary	$52,000.00	$25.00
Benefits	$4,200.00	?
401K	$5,200.00	
Uniform (see breakout)	$680.00	
Other		
TOTAL SALARY	$62,080.00	

UNIFORM ALLOWANCE	$		$680.00
T-Shirts/Polos	5	$35.00	$175.00
PFG long sleeve	5	$50.00	$250.00
Pants	3	$60.00	$180.00
Boots/Annually	1	$75.00	$75.00

PPE	#	$	$346.00
Safety Glasses	10	$10.00	$100.00
Gloves (12)	1	$45.00	$45.00
Ears	2	$20.00	$40.00
chemical gloves (12)	1	$21.00	$21.00
Chaps	1	$110.00	$110.00
Face Shield	1	$30.00	$30.00

TOTAL EQUIPMENT $24,977.00

EQUIPMENT NEEDED	QTY	PRICE	TOTAL	STORE	NOTES
Electric Trimmer	2	$300.00	$600.00	Husqvarna	
Trimmer Battery	1	$300.00	$300.00	Husqvarna	
Battery Charger	1	$180.00	$180.00	Husqvarna	
Trimmer Line	5	$13.00	$65.00	Husqvarna	
PPE (see breakout)	1	$346.00	$346.00	Uline/Home depot	
Tarps	3	$5.00	$15.00	Harbor freight	
Gator/Utility	1	$14,650.00	$14,650.00	John Deere	
Gator Service (annually)	1	$5,000.00	$5,000.00	John Deere	
Hand tools (see breakou	1	$1,668.00	$1,668.00	Various	
Backpack Sprayer	1	$85.00	$85.00	Lowes	
Backpack Blower	1	$479.00	$479.00	Husqvarna	
Chainsaw	1	$490.00	$490.00	Husqvarna	
Chemicals	1	$300.00	$300.00	Site One?	
Irrigation Tools	1	$37.00	$37.00	Amazon	
Quick coupler	1	$12.00	$12.00	Amazon	
Storage locker/cage	1	$250.00	$250.00		
Laptop	1	$500.00	$500.00		

HAND TOOLS		$	$1,668.00
Soil Knife/Hand Prur	1	$120.00	$120.00
Hard Rake	2	$15.00	$30.00
Leaf Rake	2	$32.00	$64.00
Transfer Shovel	1	$38.00	$38.00
Sharp Shooter Shove	1	$131.00	$131.00
Mulch Fork	1	$45.00	$45.00
Wheelbarrow/Cart	1	$240.00	$240.00
Breakage/Other	1	$1,000.00	$1,000.00
			$0.00
			$0.00

Table 17: Annual Cost Analysis

Company	***Purpose***	***Annual Cost***	***Recurrence***
TRC Outdoor	Stormwater basins and rain gardens	$45,590	Monthly
Clean Air Lawn Care	Turf	$36, 490	Weekly
Native Landscape Solutions, Inc.	Prairie	$1,600	As needed
Delgado Brothers	Irrigation	<$10,000	As needed
Cortex	Grounds keeper	$13,000	PT (15hrs)

Calc 1: % Difference FT Landscape Manager Annual Cost Vs. Subcontractor Annual Cost

Subcontractor Total Annual Cost = $106,680
1% of Annual Cost = $1,066.80

Subcontractor Total Annual Cost – FT Landscape Manager Annual Cost = Cost Difference
$106,680 - $87,057 = $19,623 Cost Difference

Cost Difference ÷ 1% Annual Cost = % Difference
$19,623 ÷ $1,066.88 = 18.39 % Difference

Sources:

Provided by the VP of District Operations at the Cortex Innovation Community

Limitations:

The full-time position proposal was denied by the Cortex Innovation community board, so the CSI research team cannot say with confidence that having a full-time employee on-site is more cost effective because it is based on an estimate.

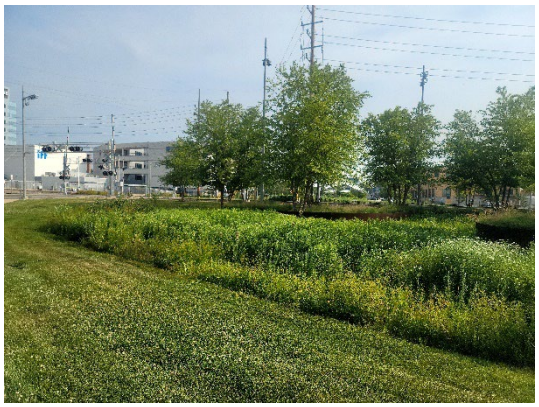
Additional Economic Information

- ***Requires $106,680 annually to maintain 2 large biofiltration basins, 34 street basins, prairie planting, irrigation, and turf lawns.***

Background:

Detailed maintenance data has been maintained by the Cortex Commons Community staff and provides a valuable assessment of costs over time. The turf, stormwater and street basins, and newly planted prairie are maintained by different contractors who come in weekly, monthly or as needed.

The picture to the right is a biofiltration basin installed in 2014 that has fully established native vegetation. The basin was not well maintained for a few years during the COVID-19 pandemic according to the new Vice President of District Operations. Although the basin is dominated with about 98% native vegetation, large monotypic stands of Canadian Goldenrod have slowly overtaken some areas, leaving less room for other native species to compete. The expansion of Canadian Goldenrod is due to the aggressive tendency of the species that can spread by seed or rhizomes. Maintenance of Canadian Goldenrod is required to ensure plant diversity. All green spaces on site require maintenance, but this basin requires both the removal of invasive and native species.



Stormwater basin

Common strategies for removing unwanted species are to mulch mow with a weedwhacker or to use herbicide, followed by reseeding. In the case of the stormwater basin, the VP of District Operation decided to take a different approach involving hand weeding and then letting native species reseed naturally over time after more competitive species are decreased in abundance.

Method:

A cost breakdown of maintenance for the Cortex Commons was provided to the CSI research team from the VP of District Operations of the Cortex Innovation Community. There are three different companies that maintain the green spaces within the site, each one cares for a different type of space (turf, stormwater basins, street inlets, and prairie). The data breaks down the following:

- Company
- Purpose
- Annual cost
- Recurrence of maintenance
- Responsibilities

Calculations:

Table 17: Annual Cost Analysis

Company	***Purpose***	***Annual Cost***	***Recurrence***
TRC Outdoor	Stormwater basins and rain gardens	$45,590	Monthly
Clean Air Lawn Care	Turf	$36, 490	Weekly
Native Landscape Solutions, Inc.	Prairie	$1,600	As needed
Delgado Brothers	Irrigation	<$10,000	As needed
Cortex	Grounds keeper	$13,000	PT (15hrs)
	TOTAL	$106,680	

TRC Outdoor Responsibilities:

- Monthly Visits March - October

- Trash, debris, and weeds removed from sites
- Annual cutbacks of plant materials as needed, winter months
- MSD reporting

Clean air Lawn Care:
- Turf and bed maintenance April – October
- Monthly tree maintenance March – July
- Spring bed cleanup completed by March (weather permitting)
- Shrub shaping with 2 visits from May – July
- Planter installation
- Mulch delivery and spreading in garden beds and around trees in spring

Native Landscape Solutions, Inc.
- Invasive weed control by hand pulling or spot spraying
- Trash removal
- Spring/Summer cut back

Delgado Brothers:
- Help blow out the irrigation system in the winter and start it up in the summer
- Repair leaks
- Updating irrigation system
- Installing WIFI controller

Cortex Grounds Position:
- Pick-up litter from the district

Sources:

Provided by the VP of District Operations at the Cortex Innovation Community.

Cortex Innovation Community.
https://www.cortexstl.org/.

Limitations:

The estimated costs for the original design before the prairie installation was conducted were not available and the original turf basin design costs were also not available.

The Prairie installation is 2 years old, and the annual maintenance needs and costs have been changing as the project matures. Mature prairie plantings tend to need less maintenance after the first few years of establishment.

Cortex Grounds position is budgeted for the entire district and not just for Cortex Commons

Only the 2023 contract data was used for this assessment.