City of Ballwin

Vlasis Park Master Plan

2022

CITY OF Ballwin Est. 1837

This park master plan was completed for:

CITY OF Ballwin Est. 1837

by:

LAWRENCE GROUP

in association with:

April 2022

Acknowledgments

Thank you to everyone who played a part in developing this Master Plan document. Many people contributed and provided their valuable time and input - and for that we are extremely grateful. From City Staff to our stakeholder group and everyone in between, Thank you!

City of Ballwin:
Chris Conway, Director of Parks and Recreation
John Hoffman, Superintendent of Parks & Facilities
Eric Sterman, City Administrator
Kennedy Robinson, Marketing and Communications Specialist
Sean Edghill, Planning Technician
Jim Link, Public Works Director

Vlasis Park Stakeholders:
Megan Gibson
Fred Plese
Dan Aiken
Ross Bullington, Ward 4 Alderman
Krista Elliot
Marie Clark, Historical Commission
Melissa Dippel
Sarah & Mike Flamion

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1 Introduction

Vlasis Park History

Named for former Ballwin Mayor George Vlasis, the land for Vlasis Park was purchased during his term of 1956-1961 in an effort to begin to preserve public open space for the new municipality. At nearly 30 acres, Vlasis Park is Ballwin's largest park and serves as the home of many of the City's facilities including: The Government Center, Police Station, and Public Works Facility. This community park is a central hub for Ballwin activity and serves as the site of the much beloved annual festival: Ballwin Days. Throughout the years Vlasis Park has evolved and improved to become the park that it is today. Aerial photography over the past 65 years shows how the vehicular circulation throughout the park has changed as new amenities such as the ball field, playground, and ponds were developed. For the most part, Vlasis Park has remained in its current configuration since the early 2000's. After the playground was built, cross-site vehicular access was removed entirely and limited to the perimeter roads.

Figure 01: Vlasis Park aerial image from 2021 Created by BAX Engineering.

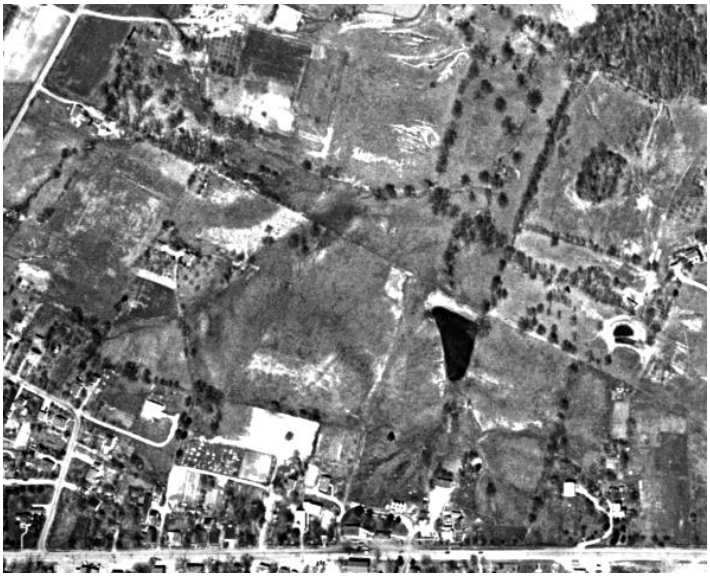


Figure 02: Aerial image from 1955.

Figure 03: Aerial image from 1970-1972.

Figure 04: Aerial image from 1981.

Figure 05: Aerial image from 2000.

Figure 06: Aerial image from 2004.

Figure 07: Aerial image from 2010.

Community Demographics

Community demographics within this section were compiled using data previously gathered for the 2019 City of Ballwin Parks Master Plan along with updated census data from https://worldpopulationreview.com/us-cities/ballwin-mo-population and https://www.census.gov/quickfacts/ballwincitymissouri.

Population

	Ballwin
2010 Census	30,404
2020 Census	31,103

Median Age

	Ballwin	Missouri	Nationally
2010 Census	41.3	37.8	37.1
2020 Census	42.1	39.0	38.1

Households

	Ballwin
2010 Census	11,875
2020 Census	11,934

Median Household Income

	Ballwin	Missouri
2020 Census	97,174	55,461

Age Distribution*

Ages	Population	% of Total	Nat. Population	Difference
0-5	1,677	5.4%	6.0%	-0.6%
5-17	5,376	17.3%	16.3%	+1.0%
18-24	2,300	7.4%	9.7%	-2.3%
25-44	7,267	23.3%	26.4%	-3.1%
45-54	4,307	13.8%	13.0%	+0.8%
55-64	4,488	14.4%	12.9%	+1.5%
65-74	3,196	10.3%	9.2%	+1.1%
75+	2,546	8.2%	6.4%	+1.8%

Race and Median Age*

Race	Total Population	Median Age	% of Population	% of MO Population
White	26,906	44.4	86.4%	81.4%
Black	969	35.0	3.1%	11.7%
American Indian	77	39.6	0.3%	0.5%
Asian	2,184	35.8	7.0%	2.0%
Pacific Islander	10	57.5	0.0%	0.1%
Other	259	25.6	0.8%	1.6%
Multiple	753	16.3	2.4%	2.6%

*Indicates data taken directly from the 2019 City of Ballwin Parks Master Plan.

Figure 08: People at the annual Ballwin Days festival.

City of Ballwin Parks Master Plan Review

Vlasis Specific Take-aways

The 2019 Parks Master Plan by DG2 Design prioritized improvement opportunities for Vlasis Park. The City has already begun to accomplish some of these recommendations, including the addition of a new restroom facility adjacent to the playground in 2020, and additional parking west of the government center. The plan also emphasized the importance of a detailed park master plan specific to Vlasis Park, which is being accomplished with this document.

Ballwin Trails System

Community survey results from this and previous master plans for the City of Ballwin have shown strong support for improving pedestrian and bicycle infrastructure throughout the City. Increasing and improving safe pedestrian connections to Vlasis Park should remain a high priority for the community.

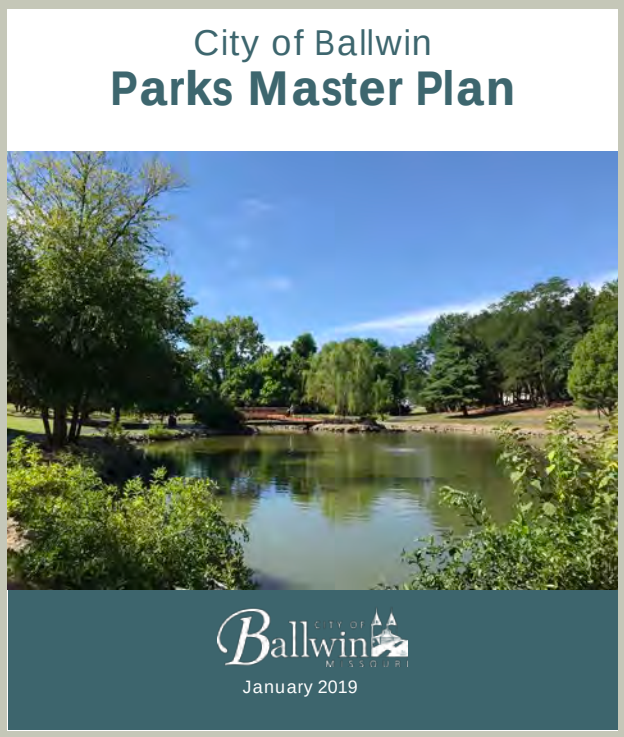


Figure 09: 2019 master plan document cover page.

Improvement Opportunities

High Priority

- Complete a Park Master Plan
- Enhance ballfield
- Add pickleball courts

Medium Priority

- Add large amphitheater for concerts and events
- Dredge ponds and improve edge treatments
- Update and relocate playground
- Add parking

Low Priority

- Provide a restroom closer to playground
- Add trails and neighborhood connections

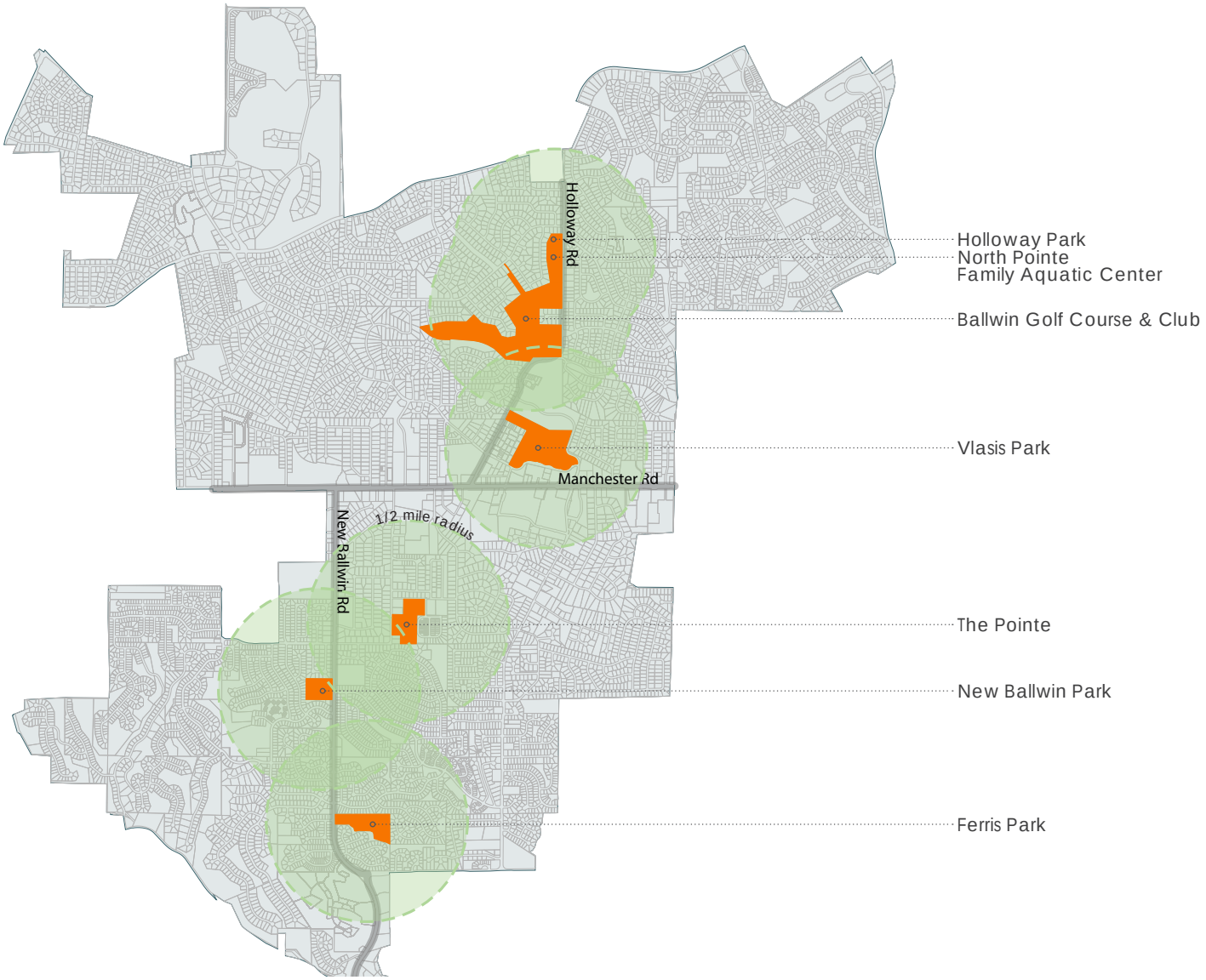


Figure 10: Ballwin's Parks, shown in the City of Ballwin Parks Master Plan document completed in 2019 by DG2. Design

Goals and Objectives

Through a collaboration between the design team, City Staff, and the stakeholder group a set of goals was created to help guide this master plan process. These goals look to tackle some of the physical constraints of the park site such as topography and connectivity. Another massive goal is to update and improve the aging Public Works facility on the western side of the park. These goals will be used to guide the final design for the park and are a paramount tool for Ballwin to re-visit and evaluate over the next 10 years as they begin to implement improvements for Vlasis Park.

Goals

- Improve green space
- Increase community connection
- Update playground
- Decrease separation caused by extreme topography change
- Update and improve Public Works facilities

Figure 11: Understanding goals and objectives for the re-imagined Vlasis Park helps identify opportunity zones for improvement.

Ballwin Days

Vlasis Park has been home to Ballwin Days, the City's annual summertime festival for 42 years. Spanning an entire weekend, the event hosts live music, food, local vendors, carnival rides & games, fireworks, and a car show. It is estimated that Ballwin Days brings approximately 60,000 attendees each year. The park's current layout presents several obstacles for facilitating Ballwin Days. The functionality of this annual event, and the prospect for additional city-wide events are crucial in planning for the future of Vlasis Park.

Figure 12: Views of the annual Ballwin Days celebration.

Master Plan Process

Inventory and Analysis

The park master plan process began with a comprehensive drone-based aerial topographic survey. This survey and orthogrametric photography was used to create a CAD base file which included topography at one foot contour intervals. A full inventory and qualitative analysis of the park's features and structures was completed as well.

Community Engagement

Gaining public feedback and comments throughout this master plan process was vital. A community survey was published in the summer of 2021 to record individual experiences of how visitors interact with Vlasis Park. A small stakeholder group of 9 individuals representing each of Ballwin's 4 wards was created to continue public engagement. This stakeholder group was asked to give specific feedback on amenities and improvements they would like to see implemented in the park. Finally, a public meeting was held to present two master plan concept designs.

Figure 13: Ballwin community members voice their opinions on Vlasis Park improvements.

Design Development

A clear set of goals and objectives were developed based on community input, as well as the site analysis conducted by the design team. Concept designs began in the Fall of 2021 and were guided by these goals. Two different concept designs were presented to the public at an open house event where additional feedback and comments were received. Following the public meeting, the design team refined and combined these concepts into one final master plan concept.

Figure 14: Concept design sketches developed for Vlasis Park.

2 Inventory & Analysis

Overview

Site inventory and analysis is a crucial part of any master plan, especially when the focus is an existing community park like Vlasis. Documenting all of the existing features of the park provides a snapshot in time for this and future planning efforts. Utilizing a drone-based topographic survey provides an accurate base for spatial planning and design. Key items analyzed include the basic topography & stormwater facilities of the park, as well as the aging Public Works facility.

Figure 15: Site inventory and analysis documents existing conditions and informs design.

Topography

The steep grades found in Vlasis Park are some of the most challenging physical features of the site. The park slopes generally from the southwest down to the northeast. Elevations range from 655 ft at the highest point above the Public Works facility, down to 574 ft at the lowest point behind the Government Center. Development on the site throughout the years has leveled out terraces with the playground and tennis courts at an elevation around 600 ft. The baseball field and upper parking lot are both perched up at a higher elevation of 621 ft., and Andrews Parkway borders the southern edge of the park with undulating elevations ranging from 640-655 ft. This creates two large steep slopes bisecting the park with 3:1 grades. From a spatial planning perspective these topographical features provide the greatest challenge for Vlasis Park – limiting circulation and the sizes and arrangements of potential park improvements. Furthermore, the nearly 400' long retaining wall at the middle of the site is showing signs of failure and it is known that the wall was constructed prior to the use of geo-grid horizontal tiebacks.

Figure 16: The large existing retaining wall currently creates an unwanted division within the park.

Figure 17: Slope analysis diagram showing extreme, moderate, and low slopes.

Existing Amenities

Playground

The centrally-located playground at Vlasis Park is a huge draw for visitors. Its large size and variety of play features provide a wealth of play options for children ages 2-12. Constructed in 2003, the playground is starting to show its age and this is most-evident with the degradation seen on the safety surface tiles. Keeping up with repairs to the structures has become a challenge in recent years due to unavailable and discontinued parts. A splash pad was once a beloved feature of the play area, but unfortunately it currently remains non-operational.

The playground area is supplemented nicely with site furnishings and 4 very large umbrellas for additional shade. There is a lack of landscape and trees to soften this space, which would also help to reduce temperatures during hot Ballwin summers. A new restroom was recently added on the northwestern edge of the space. The playground is dominated by a large rambling structure with high-reaching towers and multiple slides, tunnels, walkways, and platforms. One smaller structure is set aside for children in the 2-5 year old range. The current layout of the playground limits sight-lines in some areas.

Figure 18: Safety surface tiles are in disrepair and require replacement.

Figure 19: Existing playground structures are greatly enjoyed by the community but are outdated and require ongoing maintenance.

Location Plan

Community Survey Response:

"My kids love it, but the equipment is way past its prime and the sightings are terrible for keeping an eye on my kids."

Community Survey Response:

"We like this park and appreciate the shade umbrellas at the playground since there would be very little shade otherwise."

Community Survey Response:

"My kids love the playground. It is unique and challenging for them. However, every time I go there I notice how worn down the playground is and wonder when it will get some updates."

Ponds

The two ponds at Vlasis Park are a beautiful focal point for the park. A smaller upper pond spills into the larger lower pond, which features a covered deck that reaches towards the middle of the pond. Additionally, each pond features a fountain for aeration and a small deck at the southern ends of the ponds. The decks and railings are constructed from wood, and are showing signs of deterioration. The half-acre lower pond is also a registered with the Missouri Department of Conservation and is stocked with 100 lbs of fish each month. The shoreline of both ponds is uninviting, and consists of small rip-rap style stone anchored in placed and topped with concrete. From time to time both ponds harbor excessive algae growth with the problem being worse on the upper pond. It is anticipated that both ponds need to be dredged to remove years of sediment input.

Figure 20: The lower pond showing the edge condition and fountain.

Figure 21: The decks on the south end of the lower pond are used by visitors for fishing and other activities but are deteriorating and require improvement or replacement.

Location Plan

Figure 22: The upper pond looking south towards the deck and beyond to Andrews Park Way.

Pavilions

There are two clusters of pavilions at Vlasis Park on the upper half of the site. Each pavilion area features two covered structures measuring roughly 21'x21' for a total of four structures. The pavilions are of wood construction with wood shingle roofs and pergola-like extensions to allow filtered sunlight through. The patio spaces around these pavilions each contain a grill station, picnic tables, and trash/recycling receptacles. The pavilions are lit and have electrical outlets. The pavilions east of the baseball field are easily accessible from the parking lot and larger restroom facility, while the other pavilions west of the baseball field are less accessible. While these custom pavilions are iconic to Vlasis Park and offer a unique aesthetic, their wood construction is aging and will need to be repaired or replaced in the near future.

Figure 23: The pavilions west of the baseball field.

Figure 24: The pavilions east of the baseball field.

Location Plan

Tennis Courts

There are 4 tennis courts in the middle of Vlasis Park. These courts are adequately lit by 6 large light poles and were resurfaced in 2004. A full perimeter fence surrounds the courts, but there are no internal fences dividing the courts. There is visible cracking on the surface of the courts and it is suspected that an inadequate sub-base is allowing hydrostatic pressure to build up beneath the courts as they sit at the bottom of a slope.

Figure 25: The lit tennis courts are a popular amenity at the park.

Figure 26: The tennis courts are located directly south of an expanded parking lot for easy access.

Location Plan

Baseball Field

There is one remaining baseball field at Vlasis Park – on the upper portion of the site. The field is oriented generally southwest to northeast and features a dirt infield and simple chain-link backstop. There are no designated lights to allow for nighttime games or practices. The turf in this area slopes toward the north-northeast with steeper slopes in the left field area of play. This area is also heavily trafficked during Ballwin days, and as such necessitates a continual turf management regimen to repair and overseed damaged areas. This ball field is the last remaining public field in Ballwin Parks.

Figure 27: The centrally located baseball field lacks shade, lighting, and seating.

Location Plan

Paths and Hardscape

Vlasis Park offers a significant amount of sidewalks and paths. Most are concrete with the exception being the long asphalt connection at the northern end of the park. This asphalt trail is worn and weathered and needs to be replaced. Sidewalks along the perimeter roads allow park users to circumnavigate the park, but internal connections are lacking. The main paths connect the playground to the ponds through the center of the park, and continue with a loop around the ponds. There are several areas where paths exceed 5% slope.

Figure 28: Concrete paths maneuver between the playground and non-operational splash pad.

Figure 29: Asphalt parking areas surround the police station. A section of parking is covered.

Figure 30: Concrete paths are mostly consistent throughout the park.

Location Plan

Figure 31: The asphalt path along the north side of the park creates a larger loop in the park but needs resurfacing.

Restrooms

A large restroom building is sited adjacent to the upper parking lot off of Andrews Parkway. This structure was built in 2001 and is roughly 1,500 square feet in area. It served as the only restroom facility in Vlasis Park until 2020 when a pre-fabricated restroom structure was added west of the playground as recommended in the 2019 Parks & Rec. Master Plan. Both restrooms are closed and winterized each year during cold weather.

Figure 32: The new restroom facility provides easier access to park visitors utilizing the playground.

Location Plan

Figure 33: The larger restroom building adjacent to the parking area off Andrews Parkway.

Signage

There are 2 main types of signs in Vlasis Park: double-sided metal monument signs, and post mounted informational signs. Most signs have a light gray or white background, with Ballwin's typical dark blue color for text. The signs feature an out-dated logo but still represent a consistent Ballwin brand. The monument signs located near adjacent streets are slightly undersized and difficult to read from a vehicle. A larger unique monument sign highlighting the arrival to Vlasis Park is needed at the southeast corner for the site.

Figure 34: Entry signage at Holloway Road.

Figure 35: Park rules, hours, and Police Station signage.

Figure 36: Park hours and park pond rules.

Figure 37: Fishing information at Vlasis Park.

Figure 38: Directional signage within Vlasis Park.

Harrison-Schmidt-Dahlke Log House

The Harrison-Schmidt-Dahlke Log House sits at the western edge of the park, at the southeast corner of Holloway Rd. and Park Drive. This unique feature provides Vlasis Park with an opportunity to educate park users and history buffs alike. The Ballwin Historical Commission oversees the structure and it is cared for by volunteers. Besides a handful of guided tours, there are currently no programmed events or activities associated with the house.

From St. Louis County:

"The city of Ballwin moved the Harrison-Schmidt-Dahlke Log House, to Vlasis Park in 1992, from a site about a quarter of a mile north. It is said to have been built in 1849 by Joshua Harrison (d. 1879), a native of Maryland, and his wife Martha Anne Shotwell. As restored, the two-story house has just one room downstairs and one up. The Harrisons sold a small part of their large farm in 1870 to William Schmidt, a native of Prussia. Charles and Wilhelmina Dahlke, also from Germany, bought the property in 1904. Their son Ted lived in the house from his birth in 1900 to his death in 1987."

Figure 39: The Harrison-Schmidt-Dahlke Log House is a unique historic structure bringing cultural interest to the park.

Figure 40: Located at the farthest west end of the park, the log house is the first amenity visitors see when entering the park from Holloway Rd.

Location Plan

Figure 41: The patio space seen here is the closest seating area to the log house.

Stormwater

Since the year 2000 there have been a number of improvements to the park including additional parking lots, an updated playground, and new buildings. The Metropolitan St. Louis Sewer District (MSD) regulates and manages the sewer systems throughout most of our region, and as such have a set of land development regulations which must be addressed. As part of this master plan the park was analyzed to determine if detention, channel protection, and water quality is required for the entire site. Consideration was given to a previous stormwater report which was completed as part of the improvements and construction of the Government Center in 2018.

Figure 42: Bioretention cells help offset increased stormwater runoff created by impervious surfaces such as concrete or asphalt parking lots.

Figure 43: Understanding existing stormwater runoff patterns helps identify potential problems and inform future intervention.

Detention and Channel Protection

MSD has selected a year 2000 site conditions benchmark for tracking differential runoff. When an additional runoff of 2.0 cubic feet per second (cfs) or more has been generated in relation to the Year 2000 benchmark, stormwater detention and channel protection shall be required. All impervious areas added to the site since the Year 2000 benchmark will need to be addressed for detention and channel protection. The 15 year, 20 minute rain event will be used to determine differential runoff.

The 2018 storm water report completed by Cochran identified an increase of 1.5 cfs to the site from the construction of the new Government Center. A 50-foot wide prairie grass buffer was designed to reduce run off. However, only a portion of the park (10.45 acres) was analyzed. The west side of the park, which was not included in the 2018 report, has seen an increase in the impervious areas, specifically new asphalt around the public works building. The table below considers the overall 28.47 acre parcel.

Due to runoff difference greater than 2.0 cfs, detention and channel protection are both required on site.

	Pervious Area (ac)	PI (cfs/ac)	Pervious Runoff (cfs)	Impervious Area (ac)	PI (cfs/ac)	Impervious Runoff (cfs)	Total Runoff (cfs)
Year 2000 Condition	20.79	1.7	35.34	7.68	3.54	27.19	62.53
Year 2021 Condition	18.03*	1.7	30.65	10.44*	3.54	36.96	67.61

*Per the 2018 report findings, 0.23 acres of building have been counted as pervious area, as directed by staff from MSD, due to runoff reduction from grass buffer.

Runoff Difference (cfs)	**5.08**

Water Quality

For water quality, MSD has established October 1, 2006 as the site conditions benchmark for tracking land disturbance. When total land disturbance exceeds 1 acre compared to the benchmark site conditions, all land disturbed after October 1, 2006 requires treatment for water quality. Water Quality consists of 1.) treatment to reduce pollutants and 2.) volume reduction. The intent of volume reduction is to mimic pre-existing run off conditions by recharging the groundwater. The treatment features may be implemented in areas not disturbed so long as they are equivalent to the disturbed area. Due to a lack of historical design plans for the park, total area disturbed will be estimated using change in condition from pervious to impervious areas. Water quality will be calculated to find the increase in runoff due to change in land condition from pervious to impervious.

The minimum water quality volume to be treated with bioretention for this site is 3,067 ft^3. The 2018 storm water report identifies a bio retention swale that catches run off from the tennis courts. The parking lot improvements project, completed in 2020, included removal and installation of a new bio retention swale which would also treat runoff from the new lot. The retention swale has a tributary area of 0.51 acres (0.40 acres impervious) and a runoff differential of 0.32 cfs. The water quality volume provided by the bio-retention swale is 1202.5 ft^3. The remaining water quality volume to be treated is 1864.5 ft^3.

	Pervious Area (ac)	Impervious Area (ac)
Year 2006 Condition	18.84	9.63
Year 2021 Condition	17.8	10.67

Impervious Area Difference (ac)	**1.04**

Due to an increase in estimated disturbed area greater than 1 acre, water quality is required on site.

Water quality treatment consists of runoff volume reduction and pollutant reduction. MSD allows for 75% of Water Quality Volume to be provided when implementing bioretention.

$WQ_v = PR_vA/12$

Where: $P = 1.14$"
$R_v = 0.05 + 0.009(I)$
I = % Impervious
A = Watershed Area = 28.47 ac
A_I = Impervious Area = 10.67 ac

$I = A_I/A$
$I = 1.04 \text{ ac} / 1.04 \text{ ac} = 1.0 = 100.00\%$
$R_v = 0.05 + 0.009(100.00) = 0.95$
$WQ_v = 1.14(0.95)(1.04)/12 = 0.0939 \text{ ac-ft} = 4088.53 \text{ ft}^3$
$75\% \ WQ_v = 3066.41 \text{ ft}^3$

The minimum water quality volume to be treated with bioretention for this site is 3,067 ft^3.

2000 Park Drainage Areas

2000 PARK DRAINAGE AREAS	
IMPERVIOUS AREAS	7.68 AC
PERVIOUS AREAS	20.79 AC
TOTAL AREA	28.47 AC

2006 Park Drainage Areas

2006 PARK DRAINAGE AREAS	
IMPERVIOUS AREAS	9.63 AC
PERVIOUS AREAS	18.84 AC
TOTAL AREA	28.47 AC

2021 Park Drainage Areas

2021 PARK DRAINAGE AREAS	
IMPERVIOUS AREAS	10.67 AC
PERVIOUS AREAS	17.80 AC
TOTAL AREA	28.47 AC

Current Erosion and Stormwater Issues

Minor erosion and drainage problems exist at various parts of the park. The swale along the left-field foul line of the baseball field shows signs of erosion and stays wet for longer periods. Likewise, the swale at the northern side of the park, which receives a large amount of sheet flow over the grassy area, shows signs of erosion and minor scouring. Finally, visible cracking on the surface of the tennis courts leads to an assumption that an inadequate sub-base is allowing hydrostatic pressure to build up beneath the courts as they sit at the bottom of the slope. One stormwater inlet sits adjacent to the southern side of the courts.

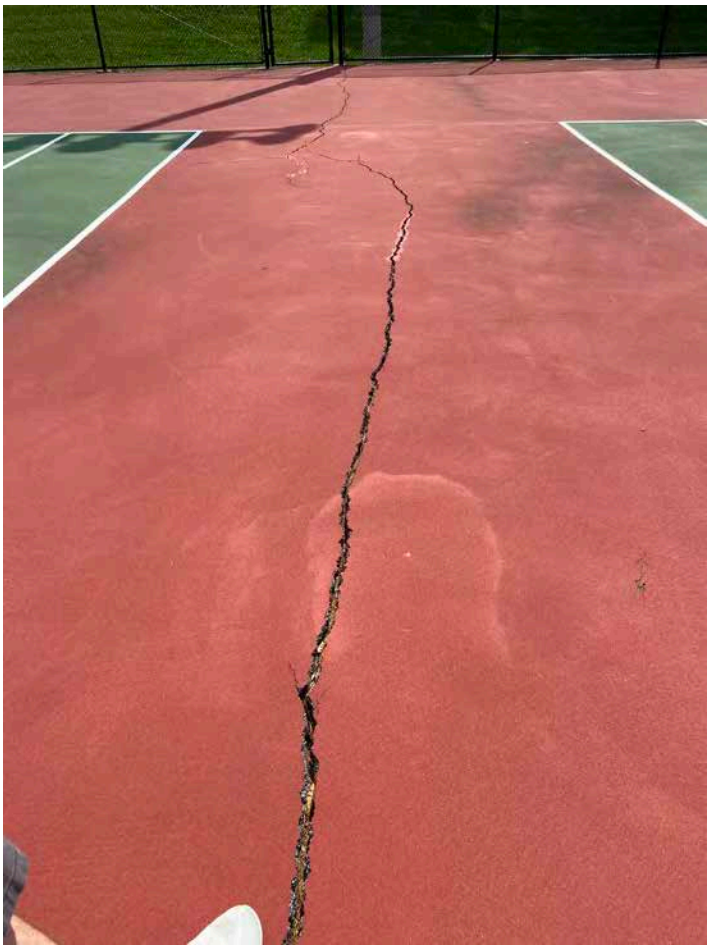


Figure 44: Large cracking is occurring on the tennis courts likely due to inadequate drainage south of the courts.

Figure 45: Drainage is channeled to the swale along the left-field foul line creating erosion issues.

Public Works Facility

Mission Statement:

"The Public Works Department's mission is to maintain the City's infrastructure in order to provide safe roadways for all motorists and pedestrians to travel on. This requires routine maintenance of streets including snow and ice control, sidewalks, signage, traffic signals, and the city's fleet. The department provides a fall leaf collection program, street maintenance and pot hole repair, site inspections, street tree removal and trimming services, mosquito control, and snow removal."

The department utilizes the western portion of the park and includes 2 buildings, a nearly 7,000 square foot salt dome, and hundreds of pieces of equipment and vehicles that are used to support the City.

The main building at the public works facility was constructed in the 1960's, while the 2,200 square foot parks & facilities building was built in 1984. The public works building is 10,500 square feet in size and is the center of operations for the department and its 33 employees. 5 Building Systems employees also use the northern portion of the building as their workshop. Between the 2 buildings there is a total of 8 work bays for maintaining and repairing equipment. Many of the vehicles are too large or tall to fit in these covered bays, and as such sit unprotected and exposed to the elements year-round. In total, the public works department has at 46 vehicles, 18 truck attachments, and 44 pieces of small equipment and trailers. The parks and recreation department has 8 vehicles, 3 trailers, and a sound stage/ bandwagon. The public works building also has limited storage space and lacks a central meeting space for its employees. Currently the department meets in one of their vehicle maintenance bays.

Legend

1. Main Public Works Building
2. Parks & Facilities Building
3. Salt Dome
4. Raw Materials Storage
5. Gated Access
6. Employee Parking
7. Yard Storage / Parking

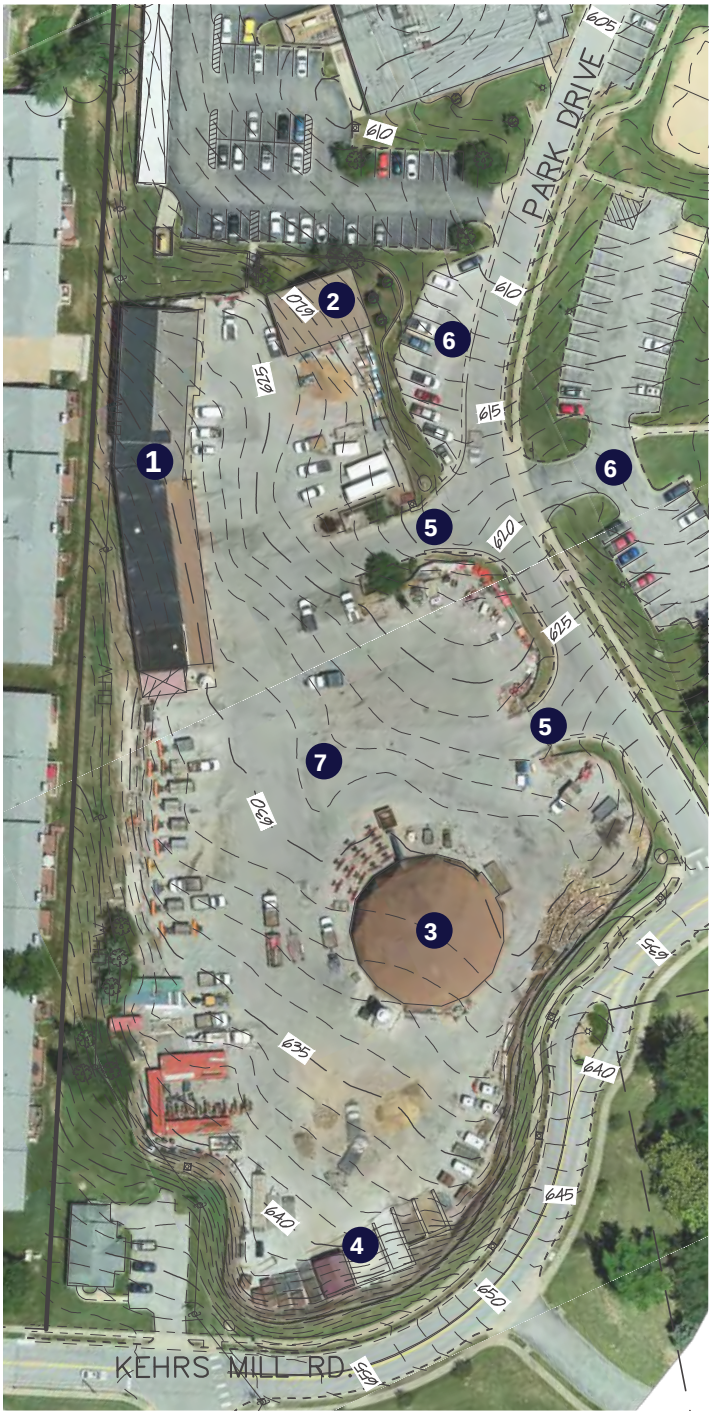


Figure 46: Public Works existing conditions.

The main building is in poor condition, with a roof and back wall that both actively leak water into the spaces. The current setup for the salt brine operations does not have adequate water pressure and needs a new water pump that could also support their wash bay. Although there is no history of security issues on the site, outdoor lighting is extremely limited and leaves many dark spots at night.

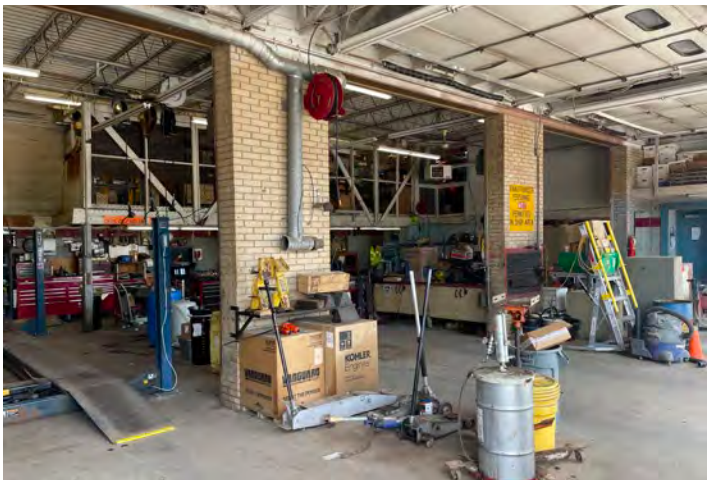


Figure 47: With a limited amount of space available, Public Works employees use these bays for storage, work, and meeting spaces.

Figure 48: Three of eight work bays used to maintain and repair City equipment and vehicles.

Figure 49: Due to a lack of covered space within the buildings, many machines and equipment is stored outside or in separate storage containers.

Figure 50: Additional space dedicated to storage would relieve some of the clutter and provide a better working area.

Figure 51: Much of the equipment and vehicles are too large to fit in the covered bays and are forced to be stored and serviced outside.

Police Station

Immediately north of the Public Works facility on the western edge of the park sits the current police station. The 15,000 square foot police department building was originally built in 1969, with renovations occurring in 1998. The building also served as the municipal court until the new Government Center was built in 2019 on the opposite side of the park. A new police station has been planned off of park property but adjacent to the south with access from Andrews Parkway. It is anticipated that the current police station will be occupied and used through 2022.

Figure 52: View of the current police station from the sand volleyball courts

Figure 53: A portion of covered parking along the west property line

Figure 54: Police station main entrance

Figure 55: View of the current one story police station

Figure 56: Perspective rendering of the new proposed police station. Design and rendering by JEMA.

Figure 57: View from Ballpark Dr. of the new proposed police station. Design and rendering by JEMA.

Trees and Landscape

As an established park, Vlasis Park is beautified by mature trees, shrubs, and perennials. Most of the park's ornamental landscape plantings are concentrated on the eastern portion of the park around the ponds. The plants in this area are relatively low-maintenance and feature traditional species like Horizontal Junipers, Burning Bush, Crabapples, Fountain grasses, and Day Lilies.

The existing trees in the park consist mostly of Eastern Redbuds, Sweet Gums, Ash, Pines, Oaks, and a few Elms. Many of the larger canopy trees are mature and in good condition, however there are not many younger trees established to provide a succession of canopy coverage and shade as the older trees die out.

Recent plantings around the Government Center and parking lot extension have begun to update the plant palette of the park. Native species such as Coneflowers, Sedges, Dogwoods, and Hydrangea offer seasonal interest with low-maintenance.

Figure 58: Dead and dying mature trees are present at a few locations throughout the park.

Figure 59: Mature planting areas around the ponds help define spaces and create visual interest.

Figure 60: Planting areas near the new Government Center establish an entry sequence into the eastern side of the park.

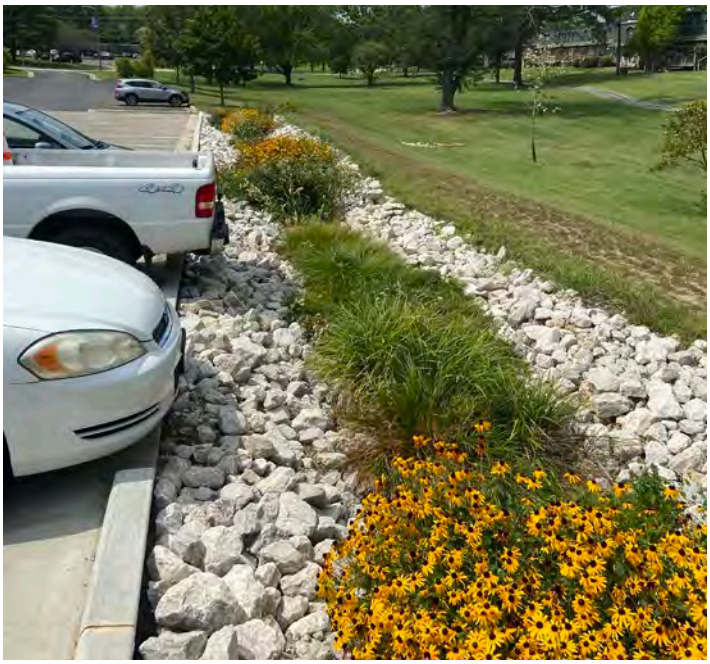


Figure 61: Planting with bioswales provide aesthetic value as well as functional purposes.

Figure 62: Large mature trees provide shade and aesthetic value that can be accented with additional plant material.

Figure 63: Planting accents the ponds and constructed stream that connects the 2 ponds.

Site Furnishings

The site furnishings at Vlasis Park are dated, but reliable. Trash receptacles are either an exposed aggregate concrete or a web-coated expanded metal in green or black. Both options have a simple domed lid with removable liners. Picnic shelters have recycling receptacles made from a composite plastic material, as well as stationary charcoal grill stations. The picnic tables at the pavilions are a simple stained wood top over galvanized steel legs. Drinking fountains are modern and accessible in a black powdercoat. Park benches are steel framed with wooden slats on the seating surfaces and backs, matching the picnic tables. Light bollards around the ponds are an exposed aggregate finish matching the plaza and some of the trash receptacles. Overall the site furnishings are not very attractive, nor do they help define a sense of place for Vlasis Park.

Figure 64: A web-coated expanded metal trash receptacle in black.

Figure 65: An exposed aggregate trash receptacle.

Figure 66: Black powdercoated water fountain.

Figure 67: Recycling receptacle located at the pavilions.

Figure 68: Grill station at a pavilion.

Figure 69: Light bollard with exposed aggregate finish.

Figure 70: Typical bench with wood slats and metal base.

3 Community Engagement

Overview

The public engagement process for the Vlasis Park Master Plan was formulated at the initial kickoff meeting with Ballwin staff on July 8th, 2021. It was agreed that an extensive community survey would be developed and shared online to allow for maximum exposure. A small stakeholder group of 9 individuals was also formed to help serve as an additional conduit for direct feedback and input to the park planning effort. By the fall, design concepts were advanced and presented to the public in an open forum. Comments, notes, and responses from all of these methods were recorded and used to guide the final design of the park.

Public Engagement Process

- Kickoff Meeting (07/08/2021)
- Community Survey (08/2021)
- Stakeholder Meeting (10/20/2021)
- Design Review Meeting (11/16/2021)

Figure 71: Jordan Wilkinson discusses the constraints and opportunities of Vlasis Park with stakeholders.

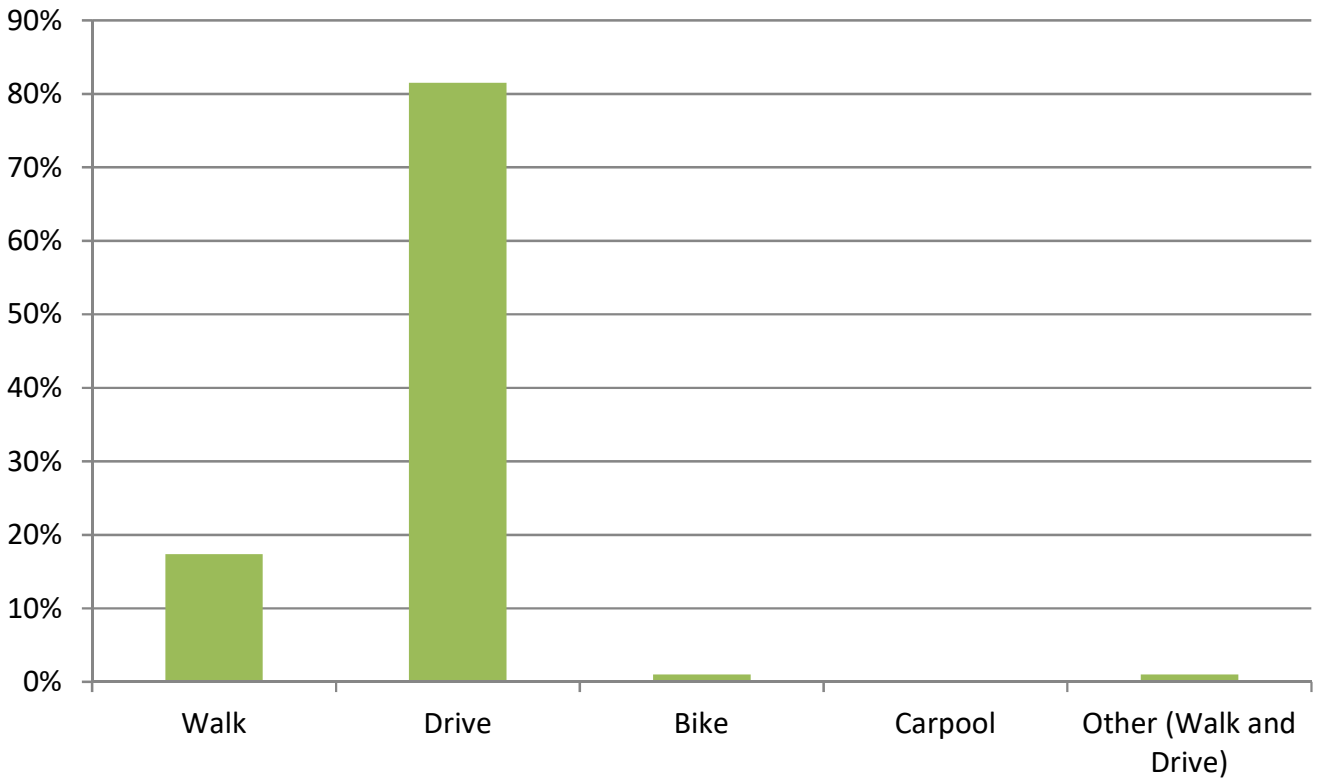
Community Survey

Methodology

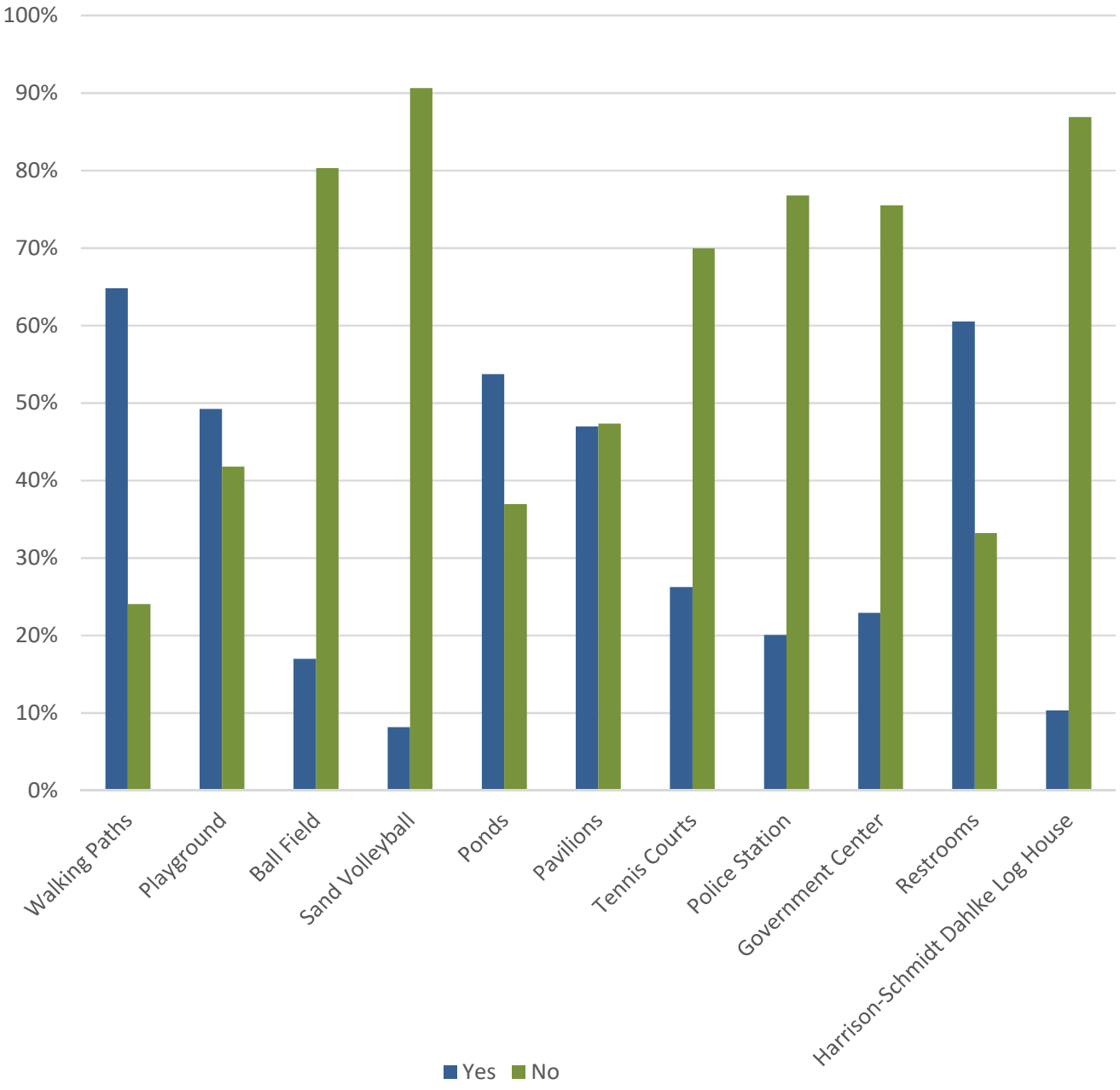
The community survey was launched online in August 2021 prior to the annual Ballwin Days celebration. The online survey was kept open for 2 months. Printed copies of the survey were also distributed at Ballwin Days and The Pointe. The survey consisted of 10 multiple-part questions aimed at getting a thorough record of how the park is used, as well as how respondents favor proposed park enhancements. The design team received 210 responses in all, with over 80% of them coming from Ballwin residents. A graphic summary of the essential data is displayed below.

Questions and Responses

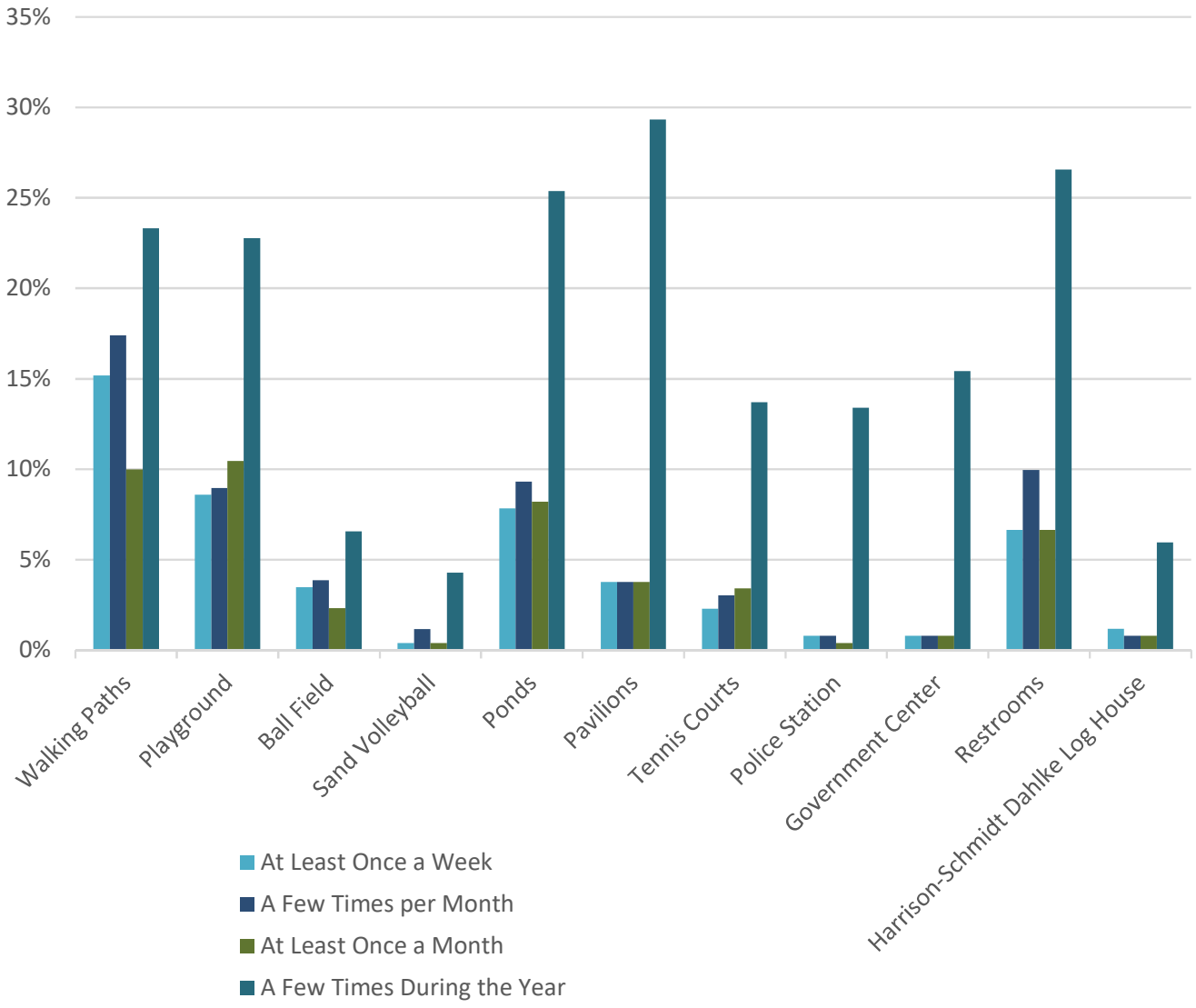
How do you typically travel to Vlasis Park?



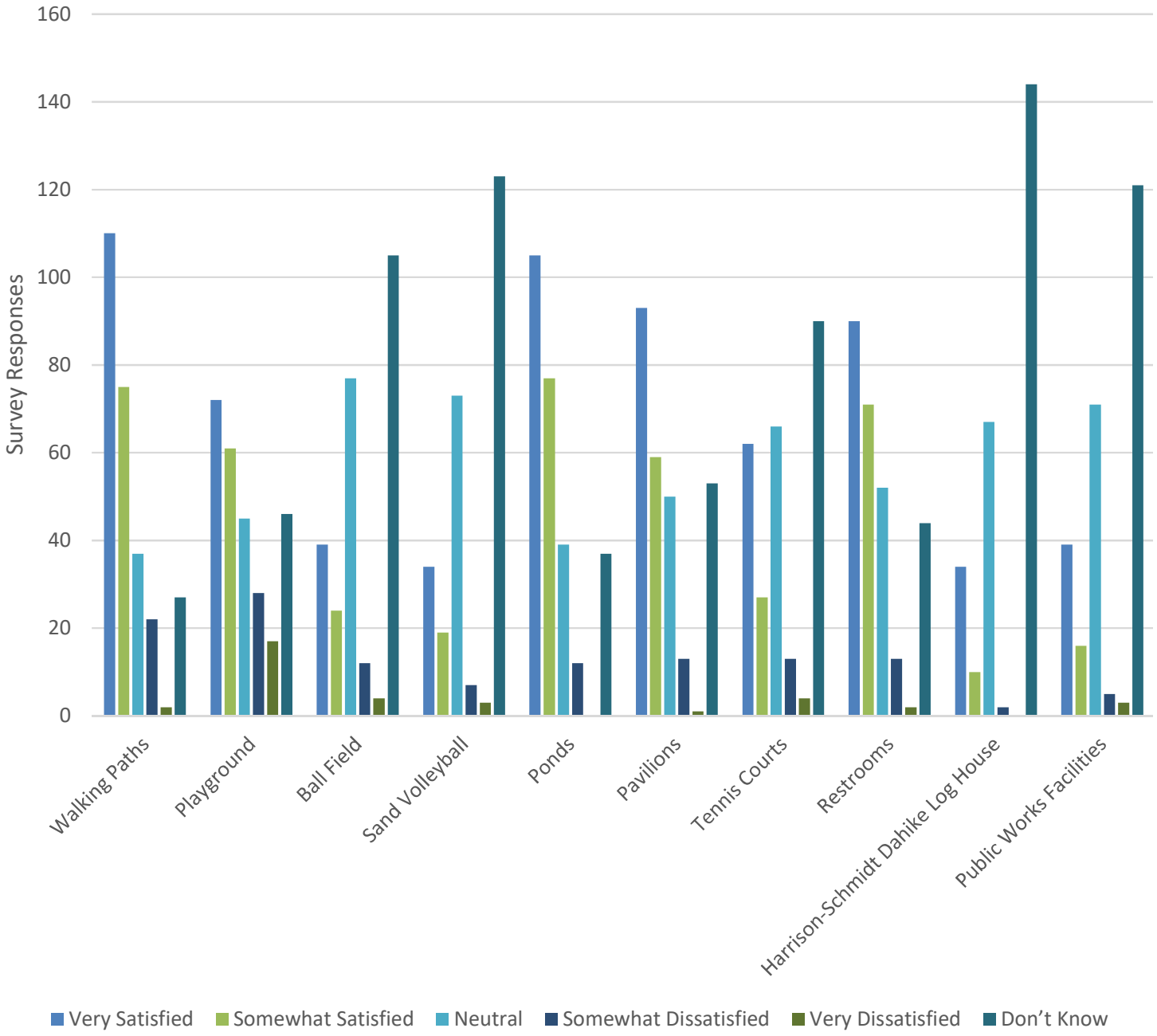
Have you or members of your household visited Vlasis Park, and used its amenities during the past year?



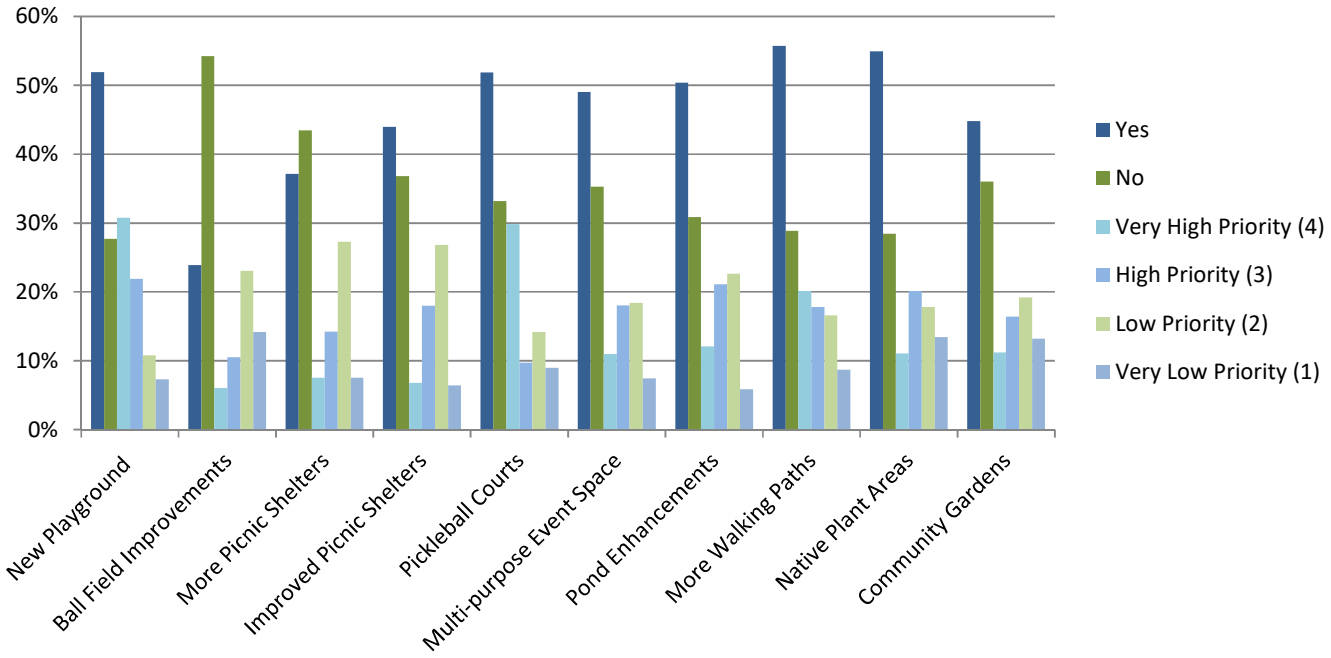
For each yes: How often did you or members of your household use each amenity during the past 12 months?



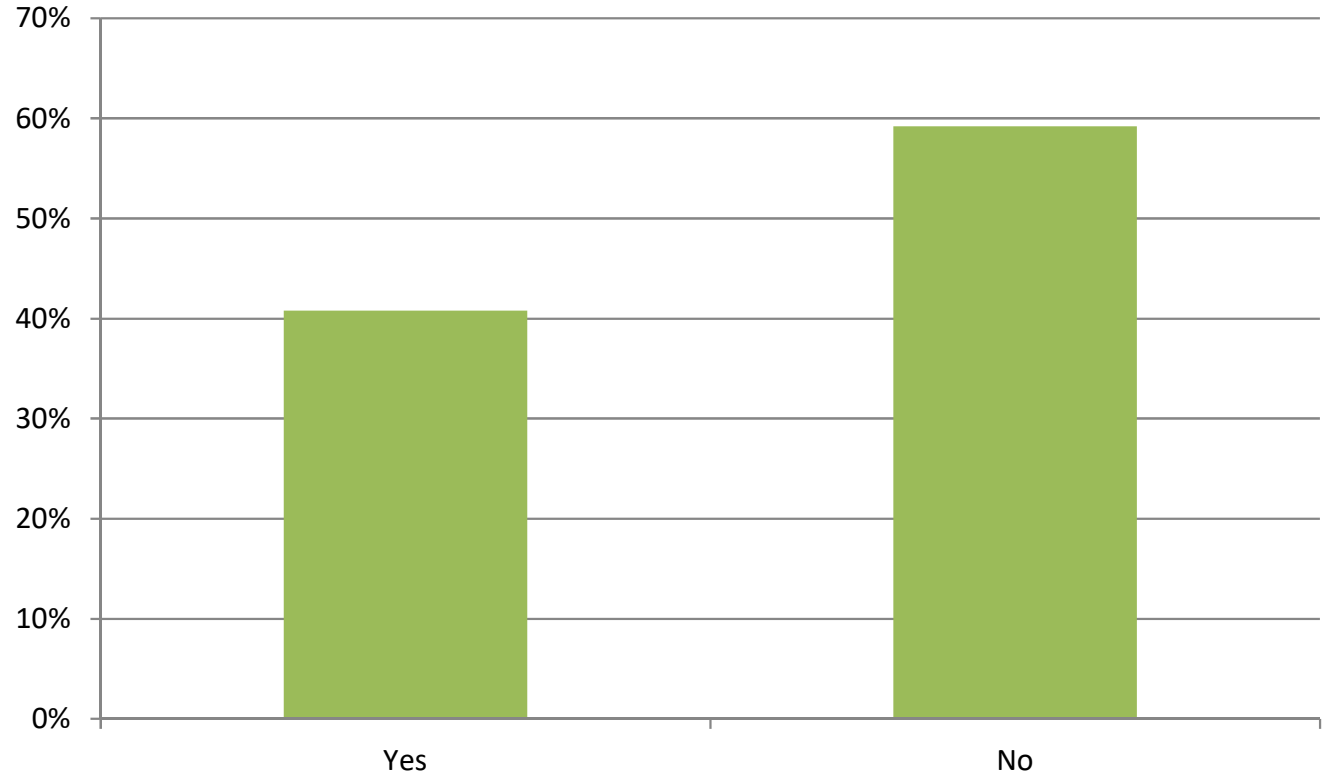
How satisfied are you with the physical conditions of each of the following at Vlasis Park?



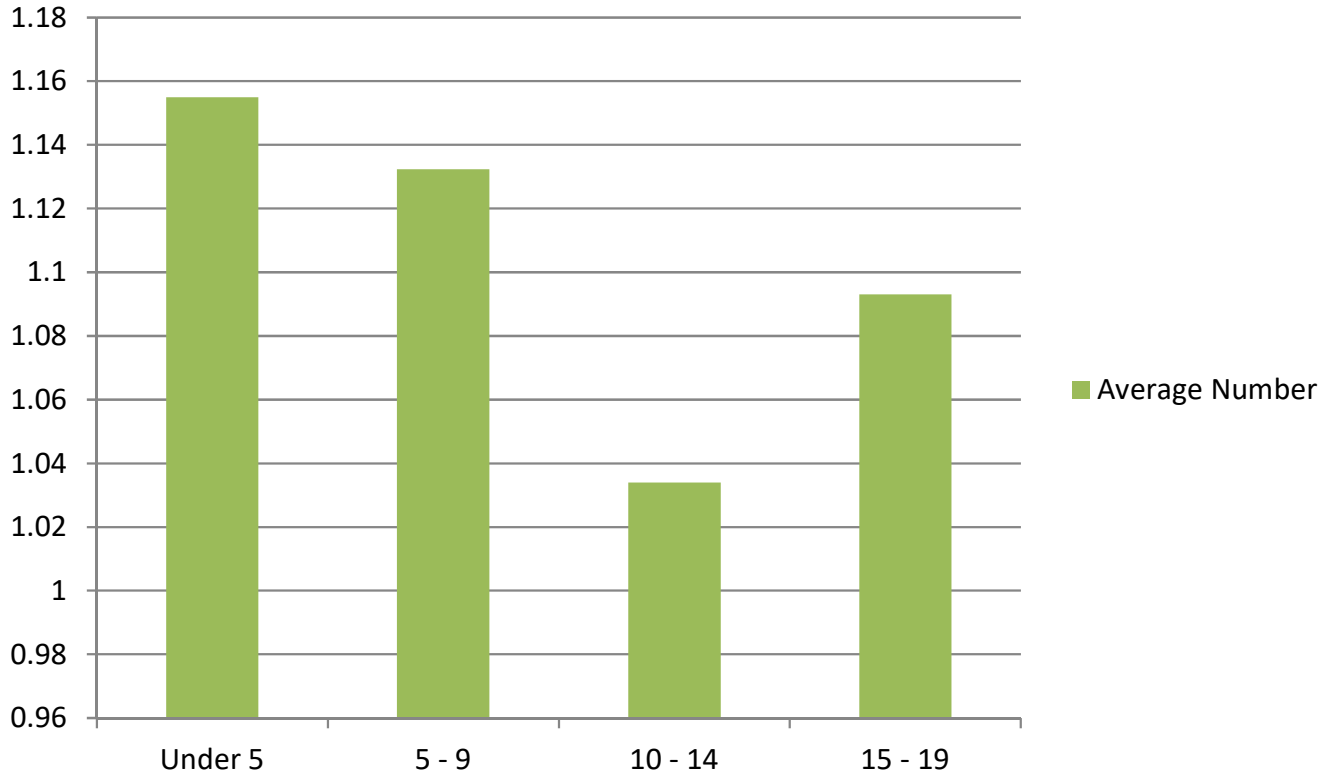
Please indicate if you or any member of your household has a need for each of the parks amenities. How would you rate the priority of each amenity for Vlasis Park?



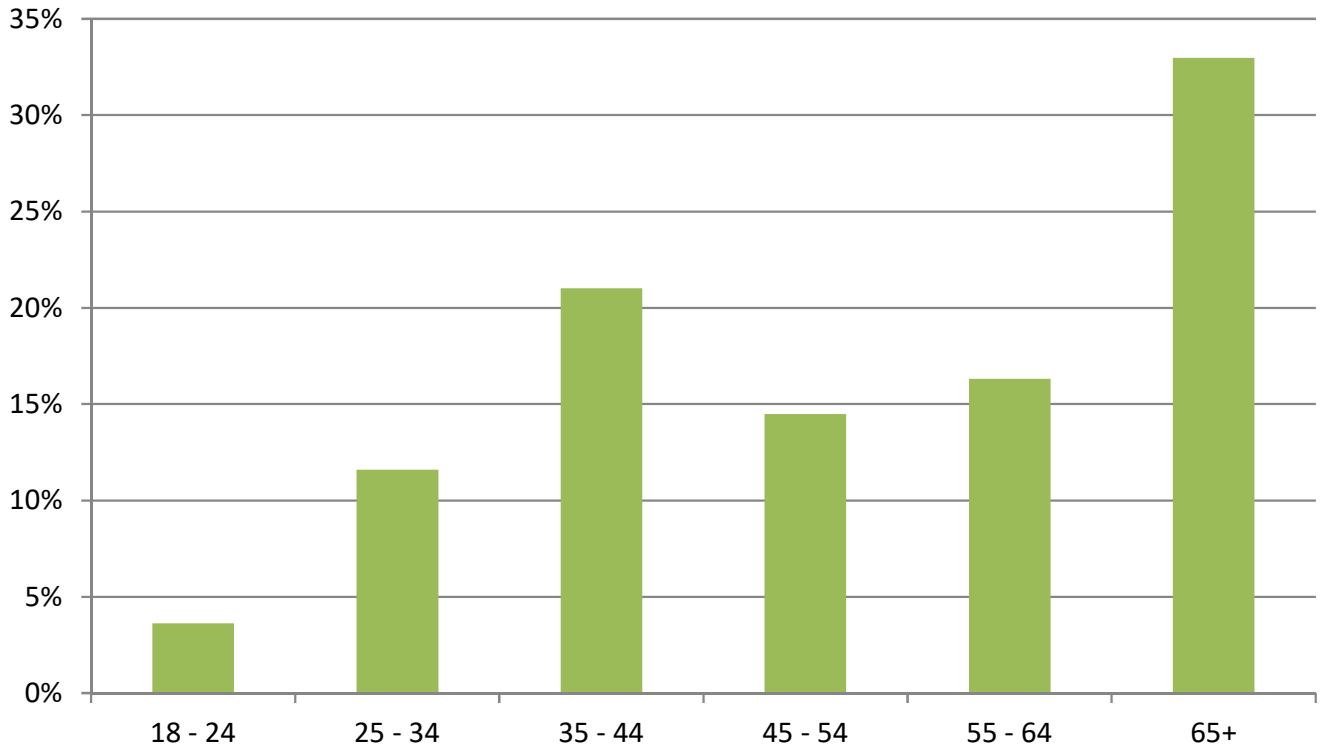
Does your household include children under the age of 18 years old?



How many children in your household are:



What is your age?



What comes to mind when you hear Vlasis Park? (Include any other comments)

"It is a big park with room for improvement. It should remain and grow as a center of the city by being a community gathering space."

"Vlasis park has a lot of potential, but needs some love. The ball fields are in awful condition, the playground needs some attention and there needs to be more community space."

"It would be nice if they had more trees to shade the walking paths. Too hot in the summer to walk."

"It's a very hodgepodge park. A lot of green space sort of, but in weird ways, and not always a very friendly park (and a 7 story apartment will only make it worse). The log cabin is so interesting, but the park is disjointed in how the log cabin area doesn't meet the rest of the park. The city of Ballwin has no dog park, no outdoor auditorium, no community garden, no dedicated basketball facilities (e.g. parking lots), too much concrete. There are no walking/biking paths, no water features, and way too much goose poop. There are some lovely benches that are near the pond, but you wouldn't know it as the shrubs are overgrown. The public works department uses pavilion 2 as a second parking lot. There used to be a splash area, but it disappeared. The playground area is worn and old, and it shows. We could use the park to expand. Remove the unused horseshoe toss, tear down the old government building, add some value to the biggest park in our city. We need more green space, not less. And, yes, I'll gladly pay more in taxes."

"Ballwin Days, Craft Beer Festival, playground, tennis courts, the log cabin, the pond., Memorial Day ceremony. Adding pickleball courts and community gardens are very good ideas."

"I would love to see a nature playscape similar to the recent installment in Forest Park"

"My kids love the playground. It is unique and challenging for them. However, every time I go there I notice how worn down the playground is and wonder when it will get some updates."

Stakeholder Input

Stakeholder Meeting (10/20/2021)

A stakeholder meeting was held on October 20, 2021 with 9 Ballwin residents. These residents were selected by City staff, and represent a diverse group of park users with varying experiences and interests. An inventory and analysis of Vlasis Park was reviewed with the group and a dialogue was held regarding some of the successes and shortcomings of the park. There was a general consensus that Vlasis Park is an enjoyable space and the primary destination among Ballwin's parks. The stakeholders all generally visited the park at least weekly, and emphasized their use of the park's walking paths and playground. Image boards were presented to the group showing the potential enhancements and improvements that are being proposed for Vlasis Park. Stakeholders were asked to 'vote' with stickers for their highest priority changes to the park. The playground itself was a major topic, as many of the stakeholders recognized that it is a huge draw bringing in visitors to the park. Playground improvements were a top choice for future enhancements.

The group also recognized the challenges with Vlasis Park's topography and grade issues – especially the large retaining walls that cut across the site causing separation in the core of the site. There was a fair amount of interest in exploring ways to link the current playground area with the upper portion of the park. The stakeholder group was also in favor of updating the pond areas and improving the landscape aesthetic across the park. Most stakeholders were also supportive of the creation of a multi-purpose event space that would support Ballwin Days and other programmed events such as concerts and movie nights.

Figure 72: Stakeholder meeting held 10/20/21

Figure 73: Site analysis was presented to stakeholders

Figure 74: Results of stakeholder voting for potential improvement prioritization

Design Concepts: Public Review Meeting (11/16/2021)

After analyzing input from the stakeholder group and the community survey, a public review of 2 design concepts was scheduled. The open-house meeting took place on November 16, 2021 and allowed attendees a chance to see 2 different conceptual designs for the future of Vlasis Park.

Citizen Comment:

"Concept 2 is more of a good use than a baseball field in the middle. The trail idea is good. Would a lighted area displaying colors be an additional attraction for the park to bring people out for a evening event?"

Key Take-aways

- Great Lawn allows for flexibility in uses (multi-sport field, event space, etc.)
- Slope play is an appropriate use of the extreme grade changes
- Nature play is a positive addition to the playground
- Pickleball courts should be considered
- Support Ballwin Days festival
- Improved Site Signage is needed

Figure 75: Community members provide feedback as to what improvements they would like to see at the park.

Figure 76: Precedent images help paint the picture for community members.

Figure 77: The design team presents 2 concept plans to gain public opinion.

4 Master Plan

Overview

2 Concept designs were developed to illustrate different master plans for Vlasis Park. Both designs feature a strong emphasis on playground and pond improvements. The concepts vary in how they would manage the steep slopes that traverse the core of the site, but offer a variety of amenities and improvements to the site – ranging from pickleball courts to a prairie walk. These concepts also show 2 differing options for the future of the current police station and public works facility on the western side of the park.

Legend	
1	New Playground / Splash Pad
2	Slope Play Area
3	Dog Run
4	Bocce Courts
5	Trail Additions
6	Trail Resurfacing
7	Pickleball Courts
8	New Pond Deck
9	Retaining Wall Pond Edge
10	Duck Habitat Zones
11	Pavilion
12	Shade Structure, Seat Walls
13	Street Parking
14	Native Planting / BMP Areas
15	Public Works Admin. (4,500 sqft)
16	Heated Bays (12,000 sqft)
17	Public Works Covered Storage
18	Renovated Plaza

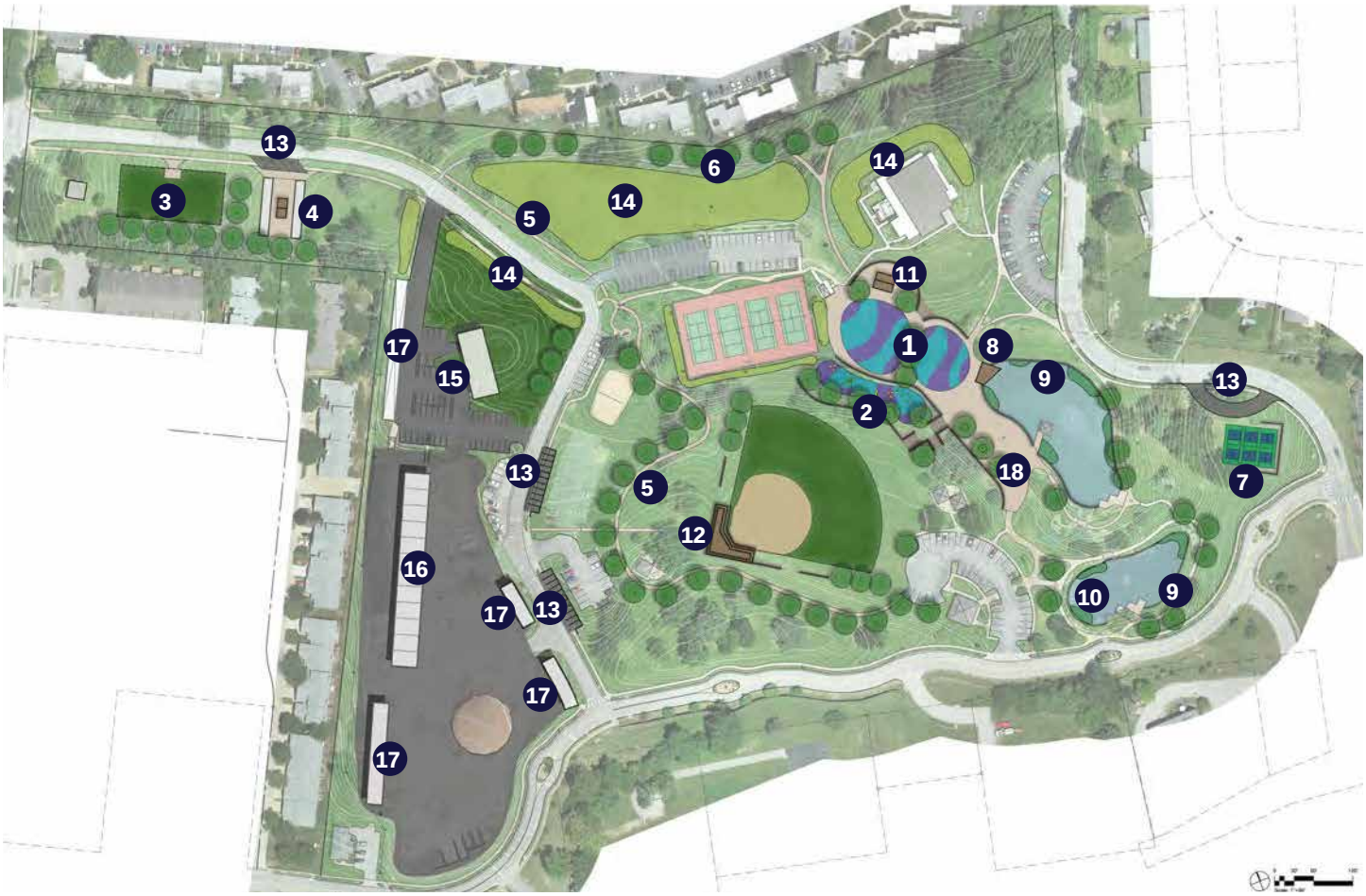
Initial Concepts

Concept 1:

Concept 1 features an enlarged playground area with a new splash pad and pavilion at the center of the site. A new cross-site connection is formed with terraced retaining walls and a large stair. Between these terraced retaining walls is another extension of the playground that utilizes the sloping land as a feature. On axis with the playground is a new deck for the lower pond, allowing increased access to the fishing pond. The ponds would be dredged and restructured to include several aquatic benches supporting emergent plant species and a new retaining wall edge around both pond perimeters. Renovations are included for the central hardscape plaza to the west of the lower pond. This option includes 3 pickleball courts in the area that was previously used for horseshoe pits. Additional recreational amenities include 2 bocce courts adjacent to a dog run just east of the Harrison-Schmidt-Dahlke house, and an improved baseball field at the center of the park. Baseball field improvements would include structured seating and shade structures.

In the area of the current police station the design includes a new 4,500 sq. ft. office building for the public works department. This increases the department's footprint, which would also include an additional 12,000 sq. ft. of pull-through heated bays and multiple covered storage structures. Concept 1 also includes trail additions and resurfacing throughout the park. A variety of native plant areas are planned to function as required BMP areas to help clean and slow stormwater runoff in the park.

Figure 78: (Over) A series of precedent images to better inform stakeholders and community members of possible improvements proposed in Concept 1.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Concept 2:

Like concept 1, concept 2 also includes a large updated playground area at the center of the park. This playground concept features 4 different play zones with one central pavilion. 2 long arcing retaining walls open to provide a wide link to a new multi-purpose field referred to as the 'Great Lawn'. The Great Lawn sits where the baseball field does today and provides a spot for recreation, as well as events and concerts. A combination stage and pavilion sits at the western edge of the great lawn providing a backdrop for concerts and shows. Pond improvements are similar to what is shown in concept 1, with a different deck access point at the middle of the lower pond. Rather than aquatic benches, these dredged ponds would feature a native butterfly garden buffer on the slopes surrounding them. Like concept 1, this design also includes a renovated hardscape plaza on the western shore of the lower pond.

On the west side of the park, a new nature play area occupies the space vacated by the current police station. This play area would feature natural play elements made from materials such as stone, wood, and plants. Extending west from this new play area is a meandering trail that travels through a native prairie landscape and terminates at the Harrison-Schmidt-Dahlke house.

The public works facility design is similar to concept 1, but includes additional heated bays. The administration building is sited in place of the existing Parks & Facilities structure, and would be constructed as a split-level structure with frontage to the road serving as a public entrance. New covered storage circles the perimeter of the space. Additional park improvements include a new patio at the log home, and walking path improvements and additions, a native shade garden at the park's high point, and new signage throughout.

Legend	
1	New Playground
2	Prairie Walk
3	New Patio at Log Cabin
4	Nature Play Area
5	Trail Additions
6	Trail Resurfacing
7	Stage / Pavilion
8	New Pond Deck
9	Butterfly Gardens
10	Native Planting / BMP Areas
11	Native Shade Garden
12	Pavilion
13	Great Lawn Multi-purpose Field
14	Street Parking
15	Entry Signage
16	Public Works Admin. (5,000 sqft)
17	Heated Bays (13,600 sqft)
18	Public Works Covered Storage
19	Renovated Plaza

Figure 79: (Over) A series of precedent images to better inform stakeholders and community members of possible improvements proposed in Concept 2.


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Clover Park
Technical College

Final Concept Design

The final concept design for Vlasis Park is a hybrid of the 2 concepts developed for public feedback. Many of the features from concept 2 have been retained in the final design, with a few additional improvements from concept 1.

The Great Lawn remains as the centerpiece of the new park plan and will continue to serve the community as a space for unstructured play, a 12u baseball field, and a staging area for large events such as Ballwin Days. The lawn will be renovated with improved drainage and irrigation allowing the field to recover more quickly after large events and heavy use. Major transformations to the central playground are occurring as well. A central staircase and retaining walls will provide the critical link across the site. As with concept 2, a new natural playground area will take the place of the existing police station building. Likewise, the slope play features from concept 1 and splash pad renovations with a sanitary connection are also included to expand the footprint of the playground area and really create a play destination for Vlasis Park. A total of 3 pickleball courts are included by replacing 1 of the tennis courts. A stage fronted by an existing hillside will be located near the western parking lot. This location allows for easy loading and unloading for concerts and events while providing natural amphitheater-like seating on the hillside.

Natural landscape-oriented improvements including the prairie walk, shade garden, pollinator garden, and pond rehabilitation are vital components of this final design. A bioretention area will be needed in the central northern area of the site, and should be optimized to become another educational and interactive element to the park. Signage highlighting the stormwater functions, native plants, and hydrology should be incorporated.

Lastly, the plan for the public works facility is a combination of 2 concepts, with a split-level administration / office building fronting the street.

Figure 80: Final concept plan developed for Vlasis Park.


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Amenity Improvements & Additions

Playground - Traditional

An updated playground will be the centerpiece of the park, attracting both local and regional visitors and creating a destination at Vlasis Park. Play equipment will include custom-designed and standard play structures with various subareas including a tot lot (2-5 years), splash pad, pavilions for shade, play stages, and elevated play. The playground will also be designed with accessibility in mind, providing ADA accessible play equipment, multi-sensory engaging elements, and imaginative spaces for exploration and refuge alike.

Figure 81: Playground example from Landscape Structures.

Playground - Nature Play

Within this playground will be informal play elements that encourage nature play. Elements in this zone will be constructed from tree logs, tree stumps, boulders, native plants, drainage paths, etc. Safety surfacing will be provided in the form of engineered wood fiber, sand, or pea gravel.

Figure 82: Example of natural play elements.

Playground - Slope Play

This play area will be adjacent to the destination playground and utilize the existing sloped topography as an integral play feature. Additional features include: slides integrated into the hillside, rope climbs, boulder steps, tree stumps, and an obstacle course.

Figure 83: Example of a slope play environment.

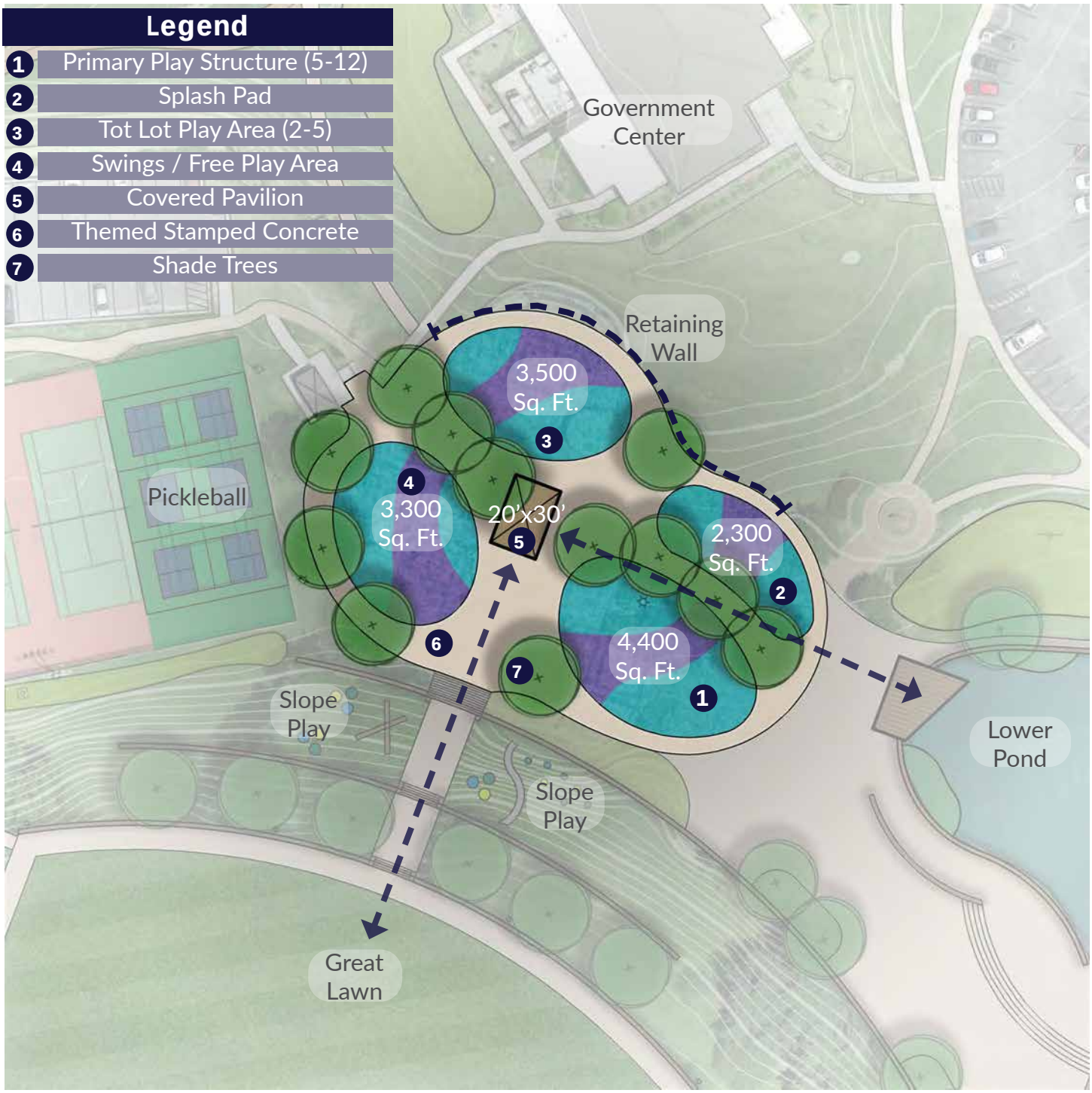

Figure 84: Sizing and framework layout for a new traditional playground space

Entry Signage

New signage and way-finding should be developed at the main access points to create a sense of arrival and direct users to park amenities. Environmental graphic signage can be added as well to educate the users on native prairies, stormwater management techniques, and native trees within the park. A consistent material palette of stone, metal, and three-dimensional lettering will bring visual interest and prominence to the park.

Figure 85: An example of a modern monument sign.

Walks and Trails

New ADA accessible asphalt pathways and trails will circumscribe Vlasis Park with entry points at the four corners of the park. The paths will include a connected loop system meandering through different natural and built features such as, prairie, native shade garden, and individual picnic areas. New walking surfaces should be a minimum of six foot wide.

Figure 86: A concrete trail through a prairie with mowed borders.

Figure 87: Path improvements include combining new, existing, and resurfaced walkways.

Pavilions and Structures

New pavilions will provide areas for picnics, gathering, education, and shade. The structures will also create opportunities for hosting small gatherings and events throughout the year. A new structure between the Great Lawn and western parking lot will include a stage and be large enough to support performances and larger gatherings. This stage is at the base of a large hillside allowing for lawn and boulder outcropping seating for many spectators, ideal for Ballwin Days.

Figure 88: Example for the pavilion on the great lawn.

Figure 89: Example of a park shade structure.

Figure 90: Example of a large pavilion for the playground area.

Pond Rehabilitation

The existing ponds are a beloved amenity within the park and the plan is to preserve them for future generations. The existing pond edges are deteriorating and unsightly. Improvements include a new clean edge with aquatic benches to be planted with emergent wetland plants. A new dock relocated closer to the main entry walk will allow visitors more space and easier access for fishing in the lower pond.

Figure 91: Urban and naturalized pond edge precedent images.

Stormwater Mitigation Strategies

Multiple stormwater mitigation strategies should be employed across the site. These best management practices, or BMP's will aid in resolving existing and future erosion and water quality issues on site.

A bioswale or French drain should be installed at the bottom of the existing slope to intercept stormwater before it hits the tennis courts. This will allow the tennis court sub-base to freely drain and reduce surface cracking.

As part of any new construction moving forward, MSD will require both water quality and quantity measures in the park. These will include removing turf lawn areas and replacing them with amended soil and native prairie to improve drainage and reduce runoff by capturing more stormwater. A bioretention basin leading into a bioswale has been proposed on the north side of the park. This will serve to treat the water quality and water quantity requirements of the site, while also serving as a beautiful and educational feature for the site.

Figure 92: Newly planted bioretention basin used to mitigate stormwater runoff.

Figure 93: Native and naturalized planting helps prevent soil erosion.

Detention and Channel Protection

MSD has selected a year 2000 site conditions benchmark for tracking differential runoff. When an additional runoff of 2.0 cubic feet per second (cfs) or more has been generated in relation to the Year 2000 benchmark, stormwater detention and channel protection shall be required. All impervious areas added to the site since the Year 2000 benchmark will need to be addressed for detention and channel protection. The 15-year, 20-minute rain event will be used to determine differential runoff.

The most recently completed project on the site is MSD Project #19-MSD-00571 (parking lot extension project), completed in May 2020. Per the approved site plan, the total differential runoff, including the parking lot extension project, totals 1.79 cfs. This total will be added to the improvements proposed by the master plan to find the total differential runoff since 2000.

The previous stormwater report, completed by Cochran in 2018, references 0.23 acres of building that has been counted as pervious area, as directed by staff from MSD. This is due to runoff reduction from a 50-foot grass buffer. It will be assumed that this 0.23-acre credit is already accounted for and will not be included in this analysis.

The Master Plan improvements include several new impervious areas and removal of existing impervious areas. Proposed improvements to the park include a new playground, public works administration building, covered storage, additional parking, pickleball courts, and several new trails throughout the park. Existing improvements to be removed include the Ballwin police department building, the playground area, horseshoe pits, and trails near the ponds. The proposed improvements to the park will increase the total area of impervious surfaces, thereby increasing runoff. The changes to total runoff are shown in the table below.

	Pervious Area (ac)	PI (cfs/ac)	Pervious Runoff (cfs)	Impervious Area (ac)	PI (cfs/ac)	Impervious Runoff (cfs)	Total Runoff (cfs)
Year 2022 Condition	18.03	1.7	30.65	10.44	3.54	36.96	67.61
Master Plan Improvements	16.93	1.7	28.78	11.54	3.54	40.85	69.63

Total Runoff Differential (cfs)	**Since 2000**	**Master Plan Improvements**	**Total**
	1.79	**2.02**	**3.81**

Due to runoff difference greater than 2.0 cfs, detention and channel protection will be required on site.

Water Quality

For water quality, MSD has established October 1, 2006 as the site conditions benchmark for tracking land disturbance. When total land disturbance exceeds 1 acre compared to the benchmark site conditions, all land disturbed after October 1, 2006 requires treatment for water quality. Water Quality consist of 1.) treatment to reduce pollutants and 2.) volume reduction. The intent of volume reduction is to mimic pre-existing run off conditions by recharging the groundwater. The treatment features may be implemented in areas not disturbed so long as they are equivalent to the disturbed area. Water quality will be calculated to find the increase in runoff due to change in land condition from pervious to impervious.

From the as-built plan set for MSD Project #19MSD-00517 (parking lot extension project), it is referenced that a total disturbed area since 2006 totals 2.0 acres (1.62 + 0.38 acres from the above referenced project). From aerial imagery it is estimated that a total of 0.57 acres of impervious area has been added to the park since 2006 (Ballwin City Hall and parking lot extension projects). It will be assumed that other areas of disturbance remained pervious. This total will be added to the improvements proposed by the master plan to find the total disturbed area since 2006.

The Master Plan improvements include several areas that will be disturbed. This includes the multi-purpose field, the shade garden, butterfly gardens, and nature play area, in addition to those amenities identified as increasing the impervious areas. The proposed disturbed areas and total disturbed areas are shown in the tables below.

The 2018 storm water report identifies a bio retention swale that catches run off from the tennis courts. The parking lot improvements project, completed in 2020, included removal and installation of a new bio retention swale which would also treat runoff from the new lot. The retention swale has a tributary area of 0.51 acres (0.40 acres impervious) and a runoff differential of 0.32 cfs. The water quality volume provided by the bio-retention swale is 1,202.5 ft^3.

	Pervious (ac)	Impervious (ac)	Total (ac)
Disturbed Area Since 2006	1.43	0.57	2.00
Master Plan Improvements Disturbed Area	3.31	2.35	5.66
Total Disturbed Area	**4.74**	**2.92**	**7.66**

	Pervious Area (ac)	Impervious Area (ac)
Year 2006 Condition	18.60	9.87
Year 2022 Condition	18.03	10.44

Due to an increase in disturbed area greater than 1 acre, water quality will be required on site.

Nested Bioretention

Several areas were considered for conceptual improvements to satisfy detention, channel protection, and water quality requirements. The existing (lower) pond was considered for detention, however there is concern for the resulting highwater elevation relative to the existing perimeter improvements. A berm would be necessary to provide the required detention capacity and freeboard. Based on review of site analysis, a new basin would be most practical. An onsite nested bioretention basin with forebay, located at the north end of the park, will allow for requirements for detention, channel protection, water quality and flood protection to be satisfied within a single basin. The elevation of the bioretention floor will be 590.00 ft. See Exhibit A for conceptual layout plan of the nested bioretention basin.

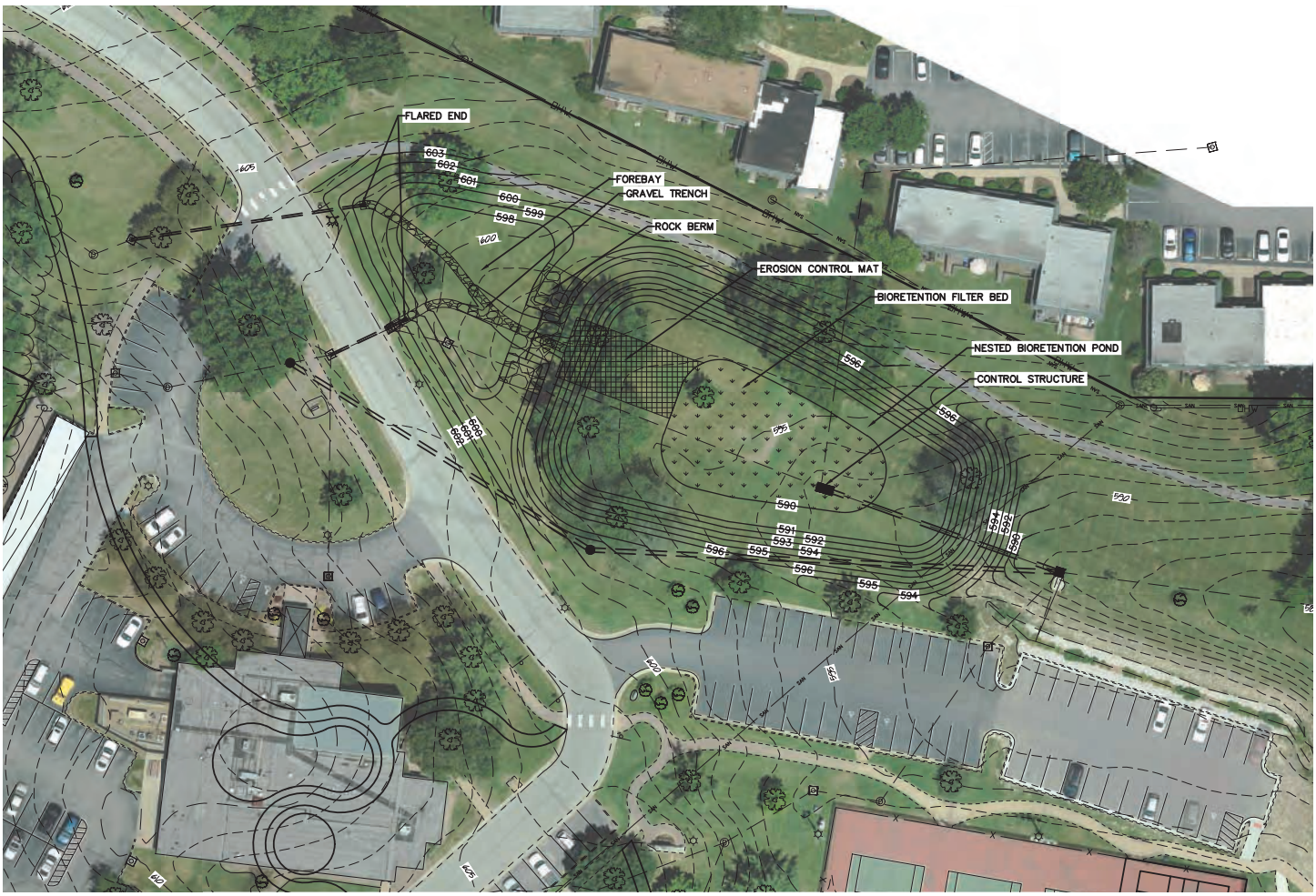

Figure 94: Proposed bioretention basin at the north end of the park.

Pickleball Additions

There was great support for pickleball additions demonstrated in community engagement events and survey responses alike. The proposed site plan groups 3 pickleball courts within the existing tennis courts which still receive a great deal of usage. Utilizing the footprint of the western most tennis court, the added pickleball courts will use the existing court with an overlay and re-striped surface. This is a temporary solution with the intent to fully reconstruct and resurface both the tennis courts and pickleball courts in the future.

Locating the new pickleball courts at this site will ensure close proximity to existing parking and restroom facilities. While the E-W orientation of the courts is not ideal, it maximizes the space and provides for a third court. If the courts were rotated to a N-S orientation, 1 whole court would be sacrificed in the design.

Additional sites for pickle ball courts were explored in concept 1 at the previous location of the old horseshoe pits. A number of factors impeded the use of this space for courts, such as tree removal and the grade changes to create off-street parking. This option also would have increased impervious surface and required additional stormwater treatment.

Figure 95: Pickleball is one of the fastest growing recreational sports today.

Figure 96: The proposed pickleball layout utilizes the area of the eastern most existing tennis ball court, and maximizes space.

Figure 97: Alternative layout 1 creates an ideal orientation of the courts, but removes 1 of the pickleball courts.

Site Furnishings

New site furnishings including trash receptacles, benches, picnic tables, drinking fountains, and light bollards will give an updated aesthetic to Vlasis Park. Products should be selected with a good warranty and a strong finish. A consistent material and color palette will help reinforce the local identity of Vlasis Park and unify the different spaces and uses throughout.

Figure 98: Park bench by Anova Furnishings.

Figure 99: Trash and recycling receptacles by Anova Furnishings.

Figure 100: Picnic table by Anova Furnishings.

Sport Courts

New pickleball courts are proposed for a portion of the existing tennis courts. These new courts will be specifically striped for pickleball, and have permanent nets. These courts should maintain adequate circulation space around the perimeter. Where adjacent to the existing tennis courts, a new partition fence and gate should be installed to separate the courts.

Figure 101: Pickleball courts being enjoyed by players.

Public Works Facility

This new layout for the Public Works Facility aims at making the most out of the existing site in Vlasis Park. With the future vacation of the adjacent Police station, a new cross-site access point can be developed allowing use of that parking lot and covered parking. A new office building is proposed to be constructed on the eastern portion of the site, allowing for a split-level building with 2 attached bays on the high side accessible from the interior of the site. This building will serve both the Public Works Department as well as the Parks Department.

12 heated bays in one long building are pulled back from the property line - allowing for pull through traffic and additional perimeter screening for the adjacent residential properties. 3 additional covered storage structures are proposed at the perimeter of the yard, allowing for trucks and equipment to be under cover year-round. A full needs assessment and design will need to be completed in the future.

Legend	
1	PW Admin./Parks Dept. (8,000 Sq. Ft.)
2	12 Heated Pull-through Bays (12,000 Sq. Ft.)
3	2 Heated Bays Parks & Facilities (2,000 Sq. Ft.)
4	New Covered Storage
5	Existing Covered Storage
6	Existing Salt Dome
7	Raw Materials Storage
8	Entrance Only
9	Exit Only
10	New Cross-site Connection
11	11 Parking Spaces
12	Landscape Perimeter Screening

Building Programming

- 5 offices (750 Sq. Ft. total)
- Men's and Women's locker rooms / showers (1,200 Sq. Ft. total)
- Cafeteria for 33 people (500 Sq. Ft.)
- Conference Room for 40 people (900 Sq. Ft.)
- Heated bays are 25'x40' at 16' height
- Includes 1 wash bay

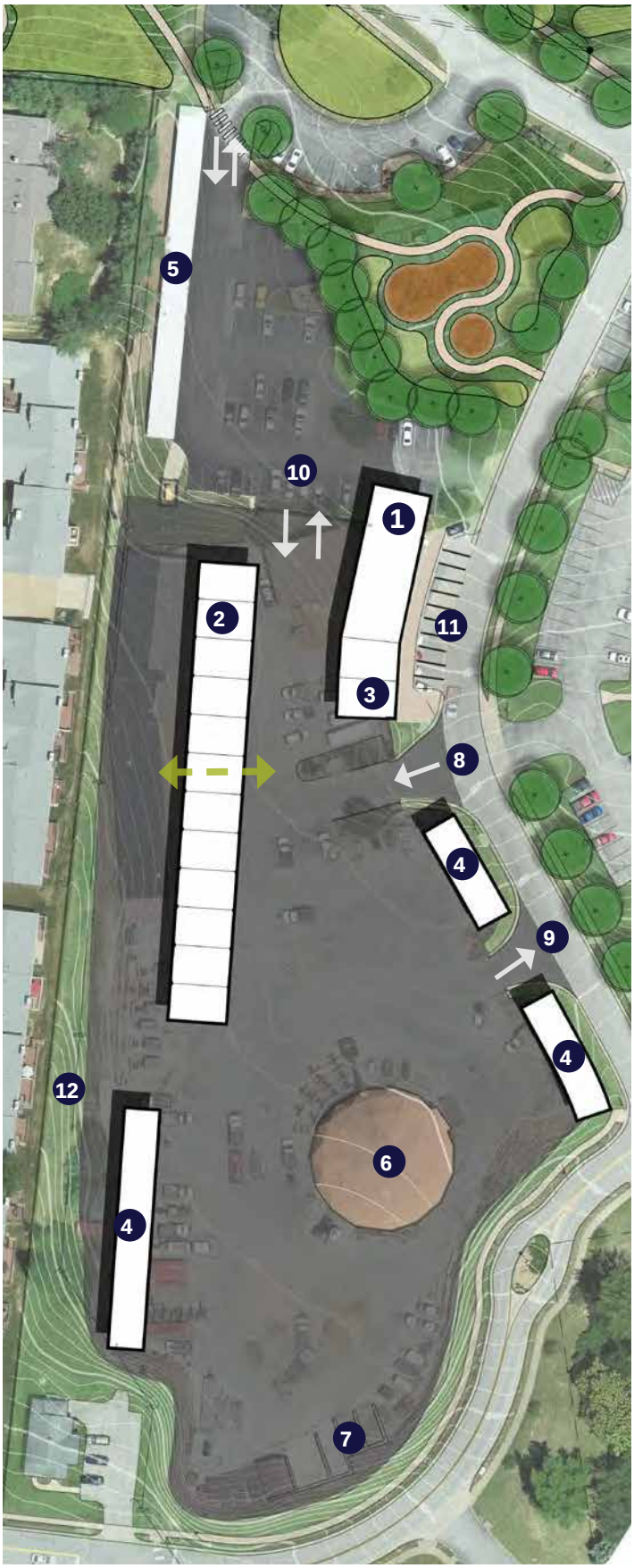

Figure 102: Proposed Public Works Facility upgrades

Figure 103: San Marcos, TX Public Services Center - Designed by The Lawrence Group

Tree Succession Plan

As noted in the site analysis, most of existing trees in the park are species such as Eastern Redbuds, Sweet Gums, Ash, Pines, Oaks, and Elms. Some of these species - especially Ash and Elm are disease prone and generally are not planted anymore unless using a particular disease-resistant variety.

Vlasis Park also has several mature trees in good condition, however there are not many younger trees established to provide a succession of canopy coverage and shade as the older trees die out. In effort to maintain a healthy and desirable tree canopy for Vlasis Park, a detailed tree succession plan should be followed outlining a timeline for removal of trees in poor condition and establishment of trees from a recommended species list. Planting different species of trees also helps to increase biodiversity and reduce the risk of a monoculture susceptible to widespread disease or pests such as the Emerald Ash Borer.

The key to a successful tree succession plan is to start with an accurate inventory, and continue to update the plan on a regular basis as removals and new plantings occur. The plan should coincide with the phased improvements outlined in this plan.

Recommended Species

Botanical Name:	Common Name:
Quercus bicolor	Swamp White Oak
Platanus occidentalis	American Sycamore
Gleditsia triacanthos var. inermis	Thornless Honeylocust
Ulmus sp.	Frontier Elm
Acer (multiple)	Maple sp.
Taxodium distichum	Bald Cypress
Nyssa sylvatica	Black Gum
Quercus muhlenbergii	Chinkapin Oak
Quercus phellos	Willow Oak
Liriodendron tulipifera	Tulip Tree
Cercis canadensis	Eastern Redbud
Cornus florida	Flowering Dogwood
Amelanchier x 'Autumn Brilliance'	Serviceberry
Betula nigra	River Birch
Ginkgo biloba	Ginkgo
Gymnocladus dioica	Kentucky Coffee Tree
Magnolia 'Butterflies'	Magnolia

5 Phasing & Cost Opinion

Overview

A cost opinion was developed to reflect the proposed changes and additions to the park as shown in the final concept plan. The scope of improvements was broken down into 7 logical categories:

Cost Opinion Categories

- Play
- Great Lawn
- Site Improvements
- Pond Rehabilitation
- Recreation
- Public Works Facility
- Landscape

While breaking down the plan into these groups makes it easier to provide a cost opinion, it does not always give a direct correlation to how future construction and development should be phased. Further information on how these improvements could be phased is addressed in a phasing plan that takes budgets, logistics, and prioritization into account.

Cost opinions are provided based on the scale and type of improvements shown in the master plan, and reflect 2021-2022 construction environment. Cost opinions provided here do not include any additional anticipated costs such as general conditions, professional fees, or permitting. Typical percentages for these costs are noted but will vary based on many factors - including how many phases of development will occur.

Overall Cost Opinion:

Proposed Improvments	Quantity	Unit	Cost Opinion	Notes
Play				
Traditional Playground	27,000	SF	$550,000	PIP Safety surfacing, concrete walks, trees, play structures
Nature Play Area	17,000	SF	$155,000	EWF Safety surfacing, wood play structures, boulders, stump climbers
Hillside Slope Play Area	5,000	SF	$100,000	PIP Safety surfacing, synthetic turf, climbing featues, concrete slide
New Pavilion at Playground	600	SF	$55,000	prefab steel
Splash Pad	1	LS	$35,000	Santary sewer connection, utilize existing water service, no equipment

Proposed Improvments	Quantity	Unit	Cost Opinion	Notes
Great Lawn				
Multi-Purpose Field	56,000	SF	$330,000	Fully irrigated, re-graded, 12" topsoil replacement, sod,sub-surface drainage
Boulder Outcroppings	100	LF	$30,000	Ledgerock boulders integrated into exiting slope
Stage	1,500	SF	$160,000	New electrical service, open-air steel framed structure on raised concrete pad
Cedar Pavilion (pre-fabricated)	800	SF	$90,000	New electrical service with fans and lighting, covered
Seatwalls	1,150	LF	$75,000	CMU with stone veneer, cast stone caps
Lighting	8	EA	$30,000	LED, decorative pole
Mobile Backstop for Ballfield	1	EA	$3,000	
Retaining Walls & Central Stair Connection	410	LF	$120,000	large block wall, cast in place concrete steps, regrading
Site Improvements				
Central Plaza Renovation	19,000	SF	$190,000	
Electrical Infrastructure Upgrades	1	LS	$200,000	
Entry Signage	1	LS	$60,000	(2) Masonry base, Metal Lettering, uplit
Concrete Sidewalks	19,800	SF	$150,000	6' width, 4" thick with WWM
Asphalt Paths	4,400	SF	$27,000	4' width existing replacement
Site Furnishings	1	LS	$50,000	(8) Trash receptacles, (12) Benches, (16) Picnic Tables
New Patio at Log Home	400	SF	$6,000	colored and stamped concrete 4" thick with WWM
Street Parking at Prairie Walk	1,300	SF	$11,000	asphalt with concrete curb, gutter, and striping

Proposed Improvments	Quantity	Unit	Cost Opinion	Notes
Pond Rehabilitation				
Retaining Wall Perimeter	650	LF	$175,000	poured concrete, assumed 2' height
Dredging	41,000	SF	$95,000	both ponds, draining and demolition of riprap edges, fish relocation
Deck Platform	750	SF	$48,000	composite decking, plus demolition of existing
Aquatic Benches & Emergent Plantings	5,000	SF	$45,000	regrading, plants at 24" O.C. spacing
Butterfly Gardens	14,000	SF	$10,000	seeded prairie
Recreation				
Pickleball Courts at Tennis Courts	1	LS	$120,000	(3) pickle ball courts, complete removal of 1 tennis court and new post-tension concrete slab
Pickleball striping, nets, court repair	1	EA	$5,000	
Drainage Improvements at Tennis Court	1	LS	$25,000	
Public Works Facility				
Covered Storage	8,000	SF	$240,000	coated steel structures
Heated Bays	14,000	SF	$1,200,000	12 pull-through bays, 2 regular bays, storage closet, maintenance shop, bathroom
Administration Building	5,000	SF	$2,400,000	1-story, slab on grade, fiber cement siding, TPO roof
Police Department Demolition	1	LS	$100,000	
New north-south connection	1	LS	$75,000	
Demolition of existing Parks & Facilities Build	1	LS	$25,000	
Perimeter Screenwall & Planting	1,400	LF	$80,000	100 lf of repaired wall, 200 lf extension, with 1 tree and 6 shrubs every 30' O.C.

Proposed Improvments	Quantity	Unit	Cost Opinion	Notes
Landscape				
Tree Removal	1	LS	$25,000	15 mature trees
Successional Tree Planting	1	LS	$25,000	60 trees
Supplemental Landscape Improvements	1	LS	$75,000	
Prairie Walk & Dry Creek Bed	1	LS	$80,000	
Stormwater BMP's	1	LS	$150,000	Bioretention with native plants, includes re-routing storm sewers
Native Shade Garden	17,000	SF	$40,000	

Subtotal	$7,465,000
Contingency (10%)	$746,500
Cost Opinion Total	**$8,211,500**

General				
General Conditions (8%)	8	%		management, mobilization,
Professional Fees (12%)	12	%		architectural and engineering services
Permitting				
Surveying (completed)				

Phasing Plan

Phasing Overview

The master plan can be broken down into 5 separate phases. These phases were developed in an effort to balance anticipated costs, while also considering constructibility logistics, and prioritization. For example, items that came up in high demand in survey responses and public comments are included in earlier phases. Related improvements are grouped together as well as amenities that are in the same area of the park.

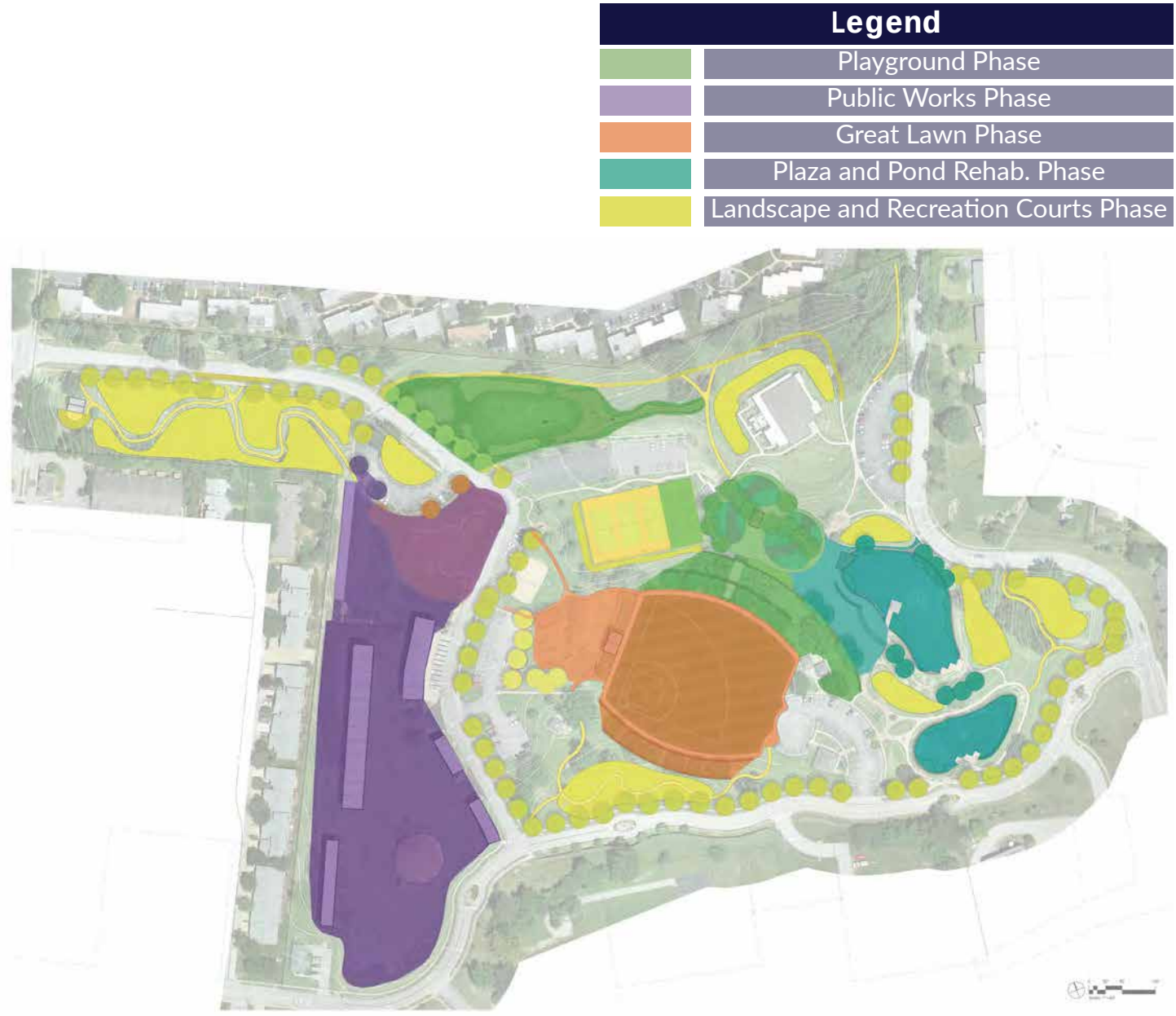

Figure 104: Overall phasing plan.

Playground Phase Improvements:

The playground phase improvements include most amenities that are related to the play elements of the master plan. These include the main playground area, splash pad, pavilion, and new hillside play area. Also included in this phase are all of the retaining walls and central stair connection that will eventually link the Great Lawn with the centrally located playground, as well as temporary pickleball improvements. A major stormwater BMP is also included in this phase to aid in constructibility and reduce overall costs.

Playground Phase Cost Breakdown

	Proposed Improvments	Quantity	Unit	Cost Opinion
Playground Phase	Pickleball striping, nets, court repair	1	EA	$5,000
	Traditional Playground	27,000	SF	$550,000
	Hillside Slope Play Area	5,000	SF	$100,000
	New Pavilion at Playground	600	SF	$55,000
	Splash Pad	1	LS	$35,000
	Stormwater BMP's	1	LS	$150,000
	Retaining Walls & Central Stair Connection	410	LF	$120,000
				$1,015,000

Figure 105: Playground phase plan.

Public Works Phase Improvements:

Improvements related to updating the aging public works facilities are included in the public works phase. This phase carries the largest anticipated cost and should be approached as its own stand-alone project. A full needs assessment and design will need to be completed in the future prior to completing this phase.

Public Works Phase Cost Opinion:

	Proposed Improvments	Quantity	Unit	Cost Opinion
Public Works Phase	Police Department Demolition	1	LS	$100,000
	Covered Storage	8,000	SF	$240,000
	Heated Bays	14,000	SF	$1,200,000
	Administration Building	8,000	SF	$2,400,000
	New north-south connection	1	LS	$75,000
	Demolition of existing Parks & Facilities Building	1	LS	$25,000
	Perimeter Screenwall & Planting	1,400	LF	$80,000
				$4,120,000

Figure 106: Public works phase plan.

Great Lawn Phase Improvements:

The great lawn phase includes construction of the Great Lawn, the addition of the retaining and seat walls on the southern side of the lawn, as well as the nature play area. Any electrical infrastructure upgrades to support events such as Ballwin Days should be planned for when these improvements take place. Hardscape improvements associated with the great lawn such as updated and new concrete and asphalt paths are also included in this phase. The stage, hillside boulder seating, and pavilion are also integrated into this phase. The stage and pavilion in this improvement package are intended to be rentable and create revenue for the city, as well as becoming a new centerpeice for Ballwin Days

Great Lawn Phase Cost Opinion:

	Proposed Improvments	Quantity	Unit	Cost Opinion
Great Lawn Phase	Nature Play Area	17,000	SF	$155,000
	Multi-Purpose Field	56,000	SF	$330,000
	Cedar Pavilion (pre-fabricated)	800	SF	$90,000
	Stage	1,500	SF	$160,000
	Boulder Outcroppings	100	LF	$30,000
	Seatwalls	1,150	LF	$75,000
	Mobile backstop for ball field	1	EA	$3,000
	Lighting	8	EA	$30,000
				$873,000

Figure 107: Great lawn phase plan.

Plaza & Pond Rehabilitation Phase Improvements:

The plaza and pond rehabilitation phase improvements includes the central plaza renovation, electrical infrastructure updates, paths associated with this area, and all pond improvements. Retaining wall perimeter, dredging, aquatic benches and emergent planting, as well as the deck platform are all included in this phase.

Plaza & Pond Rehabilitation Phase Cost Opinion:

	Proposed Improvments	Quantity	Unit	Cost Opinion
Plaza & Pond Rehab. Phase	Central Plaza Renovation	19,000	SF	$190,000
	Electrical Infrastructure Upgrades	1	LS	$200,000
	Concrete Sidewalks	9,900	SF	$75,000
	Asphalt Paths	4,400	SF	$27,000
	Retaining Wall Perimeter	650	LF	$175,000
	Dredging	41,000	SF	$95,000
	Deck Platform	750	SF	$48,000
	Aquatic Benches & Emergent Plantings	5,000	SF	$45,000
				$855,000

Figure 108: Plaza and pond rehabilitation phase plan.

Landscape & Recreation Courts Phase Improvements:

The landscape and recreation courts phase includes permanent tennis and pickleball court improvements, remaining landscape and site improvements, log home patio, remaining walks and paths, entry signage, and site furnishings. Most of the items included in this phase could be completed by a piece-meal method as budgets and timing allow.

Landscape & Recreation Courts Phase Cost Opinion:

	Proposed Improvments	Quantity	Unit	Cost Opinion
Landscape & Recreation Courts Phase	Tennis & Pickleball Courts Demolition & Reconstruction	1	LS	$120,000
	Drainage Improvements at Tennis Court	1	LS	$25,000
	Tree Removal	1	LS	$25,000
	Successional Tree Planting	1	LS	$25,000
	Supplemental Landscape Improvements	1	LS	$75,000
	Prairie Walk & Dry Creek Bed	1	LS	$80,000
	Native Shade Garden	17,000	SF	$40,000
	Butterfly Gardens at pond	14,000	SF	$10,000
	New Patio at Log Home	400	SF	$6,000
	Street Parking at Prairie Walk	1,300	SF	$11,000
	Concrete Sidewalks	9,900	SF	$75,000
	Entry Signage	1	LS	$60,000
	Site Furnishings	1	LS	$50,000
				$602,000

Figure 109: Landscape and recreation courts phase plan.

List of Figures:

Figure 86: Photo from City of Columbia. https://www.como.gov/parks/bonnie-view-nature-sanctuary/
Figure 87: Image by Lawrence Group.
Figure 88: Photo of Centennial Park. https://www.google.com/maps/v?pb=!1s0x874139209e22777%3A0x390352f839ca8abe!3m1!7e115!4shttps%3A%2F%2Flh5.googleusercontent.com%2Fp%2FAF1QipO_hDvyhGeTP-bdeWwR-5j3s-ZH-DYxFp__vHFS%3Dw213-h160-k-no!5scentennial%20park%20Rifle%2C%20Colorado%20-%20Google%20Search!15zQ2dJZ0FRPT0&imagekey=!1e10!2sAF1QipOaQP2AwAXcSMzkpP4jO5kTo6roq9-4_LY CkmH&hl=en&sa=X&ved=2ahUKEwjpn_2i7Zr0AhUYV80KHQBoC7cQoip6BAhfEAM#
Figure 89: Photo by of Pioneer Park. https://southsoundsmallfries.wordpress.com/2013/06/02/pioneer-park-downtown-puyallup/
Figure 90: Photo from Campspot. https://www.campspot.com/park/glampers-inn-rv-resort?location=Mesquite,%20Nevada&latitude=36.804&longitude=-114.0681&guests=2,0,0
Figure 91: Photo from Pinterest. https://www.pinterest.com/pin/324188873163802906/
Figure 92: Photo from New Jersey Developers Green Infrastructure Guide 2.0. https://developersguide.njfuture.org/bmp/bioretention-system/
Figure 93: Photo from Cornell Chronicle. https://news.cornell.edu/essentials/2014/10/foundation-studies-plantations-bioswale-garden
Figure 94: Image from BAX Engineering.
Figure 95: Photo from Salem, VA. https://salemva.gov/Departments/Parks-and-Recreation/Pickleball-Courts
Figure 96: Image by Lawrence Group.
Figure 97: Image by Lawrence Group.
Figure 98: Photo from Anova. https://www.anovafurnishings.com/collection/exposition?type=benches
Figure 99: Photo from Anova. https://www.anovafurnishings.com/collection/exposition?type=benches
Figure 100: Photo from Anova. https://www.anovafurnishings.com/collection/exposition?type=benches
Figure 101: Photo from Salem, VA. https://salemva.gov/Departments/Parks-and-Recreation/Pickleball-Courts
Figure 102: Image by Lawrence Group.
Figure 103: Photos from Lawrence Group.

Phasing and Cost Opinion
Figure 104-109: Images by Lawrence Group.

6 Appendices

CONCEPTUAL STORMWATER REPORT

OF

VLASIS PARK

IN

CITY OF BALLWIN, MISSOURI

BAX PROJECT NO. 21-18319

January 27, 2022

Scott O. Kolkmeyer
Engineer
MO 024744

Bax Engineering Co, Inc.
Missouri State
Certificate of Authority
Engineering Authority No. 000655

Prepared by:
Bax Engineering co., INC.
221 Point West Blvd.
Saint Charles, MO 63301
(636)928-5552

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INTRODUCTION:

Vlasis Park is a 28.47-acre community park located in Ballwin, Missouri. Since the year 2000 there have been a number of improvements to the park including additional parking lots, an updated playground, and new buildings. The City of Ballwin is in the process of completing a Master Plan for the park. The Master Plan includes proposed improvements and removal of existing improvements that will increase impervious areas within the park, as well as increase land disturbance. This report shall address detention, channel protection and water quality requirements as part of the Master Plan. The park shall be analyzed to determine if detention, channel protection, water quality, and flood protection is required for the entire site. Consideration shall be given to a previous storm water report which was completed as part of the improvements in 2018, as well as stormwater management future runoff and disturbance tracking from previously approved site plans.

DETENTION AND CHANNEL PROTECTION:

MSD has selected a year 2000 site conditions benchmark for tracking differential runoff. When an additional runoff of 2.0 cubic feet per second (cfs) or more has been generated in relation to the Year 2000 benchmark, stormwater detention and channel protection shall be required. All impervious areas added to the site since the Year 2000 benchmark will need to be addressed for detention and channel protection. The 15-year, 20-minute rain event will be used to determine differential runoff.

The most recently completed project on the site is MSD Project #19-MSD-00571 (parking lot extension project), completed in May 2020. Per the approved site plan, the total differential runoff, including the parking lot extension project, totals 1.79 cfs. This total will be added to the improvements proposed by the master plan to find the total differential runoff since 2000.

The previous stormwater report, completed by Cochran in 2018, references 0.23 acres of building that has been counted as pervious area, as directed by staff from MSD. This is due to runoff reduction from a 50-foot grass buffer. It will be assumed that this 0.23-acre credit is already accounted for and will not be included in this analysis.

The Master Plan improvements include several new impervious areas and removal of existing impervious areas. Proposed improvements to the park include a new playground, public works administration building, covered storage, additional parking, pickleball courts, and several new trails throughout the park. Existing improvements to be removed include the Ballwin police department building, the playground area, horseshoe pits, and trails near the ponds. The proposed improvements to the park will increase the total area of impervious surfaces, thereby increasing runoff. The changes to total runoff are shown in the table below.

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	Pervious Area (ac)	PI (cfs/ac)	Pervious Runoff (cfs)	Impervious Area (ac)	PI (cfs/ac)	Impervious Runoff (cfs)	Total Runoff (cfs)
Year 2022 Condition	18.03	1.7	30.65	10.44	3.54	36.96	67.61
Master Plan Improvements	16.93	1.7	28.78	11.54	3.54	40.85	69.63

Total Runoff Differential (cfs)	**Since 2000**	**Master Plan Improvements**	**Total**
	1.79	**2.02**	**3.81**

Due to runoff difference greater than 2.0 cfs, detention and channel protection will be required on site.

WATER QUALITY

For water quality, MSD has established October 1, 2006 as the site conditions benchmark for tracking land disturbance. When total land disturbance exceeds 1 acre compared to the benchmark site conditions, all land disturbed after October 1, 2006 requires treatment for water quality. Water Quality consist of 1.) treatment to reduce pollutants and 2.) volume reduction. The intent of volume reduction is to mimic pre-existing run off conditions by recharging the groundwater. The treatment features may be implemented in areas not disturbed so long as they are equivalent to the disturbed area. Water quality will be calculated to find the increase in runoff due to change in land condition from pervious to impervious.

From the as-built plan set for MSD Project #19MSD-00517 (parking lot extension project), it is referenced that a total disturbed area since 2006 totals 2.0 acres (1.62 + 0.38 acres from the above referenced project). From aerial imagery it is estimated that a total of 0.57 acres of impervious area has been added to the park since 2006 (Ballwin City Hall and parking lot extension projects). It will be assumed that other areas of disturbance remained pervious. This total will be added to the improvements proposed by the master plan to find the total disturbed area since 2006.

	Pervious Area (ac)	Impervious Area (ac)
Year 2006 Condition	18.60	9.87
Year 2022 Condition	18.03	10.44

The Master Plan improvements include several areas that will be disturbed. This includes the multi-purpose field, the shade garden, butterfly gardens, and nature play area, in addition to those

amenities identified as increasing the impervious areas. The proposed disturbed areas and total disturbed areas are shown in the tables below.

	Pervious (ac)	Impervious (ac)	Total (ac)
Disturbed Area Since 2006	1.43	0.57	2.00
Master Plan Improvements Disturbed Area	3.31	2.35	5.66
Total Disturbed Area	**4.74**	**2.92**	**7.66**

Due to an increase in disturbed area greater than 1 acre, water quality will be required on site.

Water quality treatment consists of runoff volume reduction and pollutant reduction.

$WQ_v = PR_vA/12$ Where: P = 1.14”
$R_v = 0.05 + 0.009(I)$
I = % Impervious
A = Watershed Area = 7.66 ac
A_I = Impervious Area = 2.92 ac

$I = A_I/A$
I = 2.92 ac / 7.66 ac = 0.3812 = 38.12%
$R_v = 0.05 + 0.009(38.12) = 0.3931$
$WQ_v = 1.14(0.3931)(7.66)/12 = 0.286$ ac-ft = 12,560.1 ft^3

The 2018 storm water report identifies a bio retention swale that catches run off from the tennis courts. The parking lot improvements project, completed in 2020, included removal and installation of a new bio retention swale which would also treat runoff from the new lot. The retention swale has a tributary area of 0.51 acres (0.40 acres impervious) and a runoff differential of 0.32 cfs. The water quality volume provided by the bio-retention swale is 1,202.5 ft^3.

The minimum water quality volume to be treated with bioretention for this site is 12,560.1 - 1,202.5 = 11,357.6 ft^3.

NESTED BIORETENTION

Several areas were considered for conceptual improvements to satisfy detention, channel protection, and water quality requirements. The existing (lower) pond was considered for detention, however there is concern for the resulting highwater elevation relative to the existing perimeter improvements. A berm would be necessary to provide the required detention capacity

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and freeboard. Based on review of site analysis, a new basin would be most practical. An onsite nested bioretention basin with forebay, located at the north end of the park, will allow for requirements for detention, channel protection, water quality and flood protection to be satisfied within a single basin. The elevation of the bioretention floor will be 590.00 ft. See Exhibit A for conceptual layout plan of the nested bioretention basin.

Detention Calculations

The contributing watersheds to the dry detention basin are composed of greenspace and impervious areas. Stormwater is first routed through stormwater pipe, and then discharges into the proposed forebay. From the forebay, the stormwater will enter the detention basin. Stormwater will be detained in the detention basin after the water quality volume is achieved.

Conditions	Area (ac)	Soil Group	Curve Number
Onsite Greenspace	4.19	D	80
Onsite Impervious	1.49	D	98
Offsite Greenspace	0.48	D	80
Offsite Impervious	3.27	D	98

The postdeveloped watershed contributing to the bioretention basin was modeled to analyze the peak runoff under the developed conditions. The total runoff for the watershed was calculated using the TR-55 method to determine the postdeveloped runoff rates leaving the watershed.

	Existing Condition	**Master Plan Improvements**		
Storm Event	**Peak Inflow (cfs)**	**Peak Inflow (cfs)**	**Peak Outflow (cfs)**	**Highwater Elevation**
2-Year 24-Hour	**25.53**	**27.16**	**0.46**	**593.36**
100-Year 24-Hour	**77.61**	**79.26**	**63.64**	**594.50**

[1]limits of water quality volume ponding
[2] limits of channel protection ponding
[3] limits of flood protection ponding

Basin Storage Volume

Contour Elevation (ft)	Contour Area (ft^2)	Incremental Volume (ft^3)	Total Volume (ft^3)
590.00	5,572	0	0
591.00	14,081	9,827	9,827
591.50[1]	14,824	7,226	17,053
592.00	15,581	7,544	24,915
593.00[2]	17,138	16,234	41,150

(Continued)

Contour Elevation (ft)	Contour Area (ft^2)	Incremental Volume (ft^3)	Total Volume (ft^3)
594.00	18,751	17,808	58,957
595.00	20,421	19,439	78,396
595.50[3]	21,277	10,347	88,743
596.00	22,148	10,776	99,519
594.00	18,751	17,808	58,957

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1 Year Extended Detention

The bioretention basin was designed to provide a minimum of 24 hours of extended detention for the 1 year 24 hour design storm. To achieve extended detention, a control structure with a 3-inch diameter orifice holds back the stormwater runoff and provides a lag time of 24.16 hours between the centroid of the inflow hydrograph and centroid of the outflow hydrograph. The ponding height for the 1-year 24-hour storm is 2.55 ft, which is below the maximum 3.0 ft allowable within nested bioretention basins. See Exhibit B for control structure details.

1 Year 24 Hour Design Storm	Peak Flow (cfs)	Detention Time (hr)	Maximum Water Surface
	0.34	24.16	592.55

Detention Maximum Ponding

The detention basin was also routed to determine the maximum ponding elevation if the low flow orifice were to become 100% blocked. The starting water elevation will be assumed to be equal to the sill elevation for the structure. The ponding height of the 100-year 24-hour low flow blocked storm is 4.52 ft. For nested bioretention basins, the limits of ponding in the low flow blocked scenario is 5.5 ft.

100 Year 24 Hour Design Storm with Low Flow Blocked	Peak Flow (cfs)	Starting Water Elevation	Maximum Water Surface	Freeboard To Top Of Basin (596.00)
	64.05	593.36	594.55	1.45

Water Quality Volume

The total area contributing to the nested bioretention basin is 9.43 acres. The postdeveloped impervious area contributing to the basin is 4.76 acres.

	Pervious (ac)	Impervious (ac)	Total (ac)
Disturbed Area Required	4.74	2.92	7.66
Bioretention Basin Watershed Areas	4.67	4.76	9.43

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$WQ_v = PR_vA/12$ Where: P = 1.14”
$R_v = 0.05 + 0.009(I)$
I = % Impervious
A = Watershed Area = 9.43 ac
A_I = Impervious Area = 4.76 ac

$I = A_I/A$
I = 4.76 ac / 9.43 ac = 0.5048 = 50.48%
$R_v = 0.05 + 0.009(50.48) = 0.5043$
$WQ_v = 1.14(0.5043)(9.43)/12 = 0.455$ ac-ft = 19,679 ft^3

The water quality volume of the bioretention basin will be a minimum of 19,679 ft^3.

As part of the bioretention treatment, a bioretention filter bed will be implemented.

Required Filter Bed Area (A_f) = (WQ_v) (d_f) / (k*(h_f+d_f)*t_f)

WQ_v,	=	19,666 ft^3	=	Total Water Quality Volume (ft^3)
d_f	=	3.0 ft	=	Filter bed depth (ft) (0.5’ pea gravel mulch + 2.5’ planting soil)
k	=	2 ft/day	=	Coefficient of Permeability ft/day
h_f	=	1.5 ft	=	Average height of water above filter bed (ft)
t_f	=	2 days	=	Filter bed drain time (days)

(A_f) required = (19,666)(3.0)/(2(1.5+3.0)2)= 3,277.7 ft^2

Filter Bed Area	Area (sf)
Required	3,278
Provided	5,572

Filter Bed Storage Volume = (v)(A_f)(d_f)

A_f	=	3,278 ft^2	=	Filter Bed Area (ft^2)
d_f	=	3.0 ft	=	Filter bed depth (ft)) (0.5’ pea gravel mulch +2.50’ planting soil)
h	=	1.50 ft	=	Depth of ponding (ft)
v	=	0.40	=	Porosity of the bioretention media

= (0.40)(3278)(3)
Filter Bed Storage Volume Required = 3,933.2 ft^3

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SURVEYING

Filter Bed Storage Volume Provided

A_f	=	5,572ft^2	=	Filter Bed Area (ft^2)
d_f	=	3.0 ft	=	Filter bed depth (ft)) (0.5' pea gravel mulch +2.50' planting soil)
h	=	1.50 ft	=	Depth of ponding (ft)
v	=	0.40	=	Porosity of the bioretention media

= (0.40)(5572)(3)

Filter Bed Storage Volume Provided = 6,686.4 ft^3

Filter Bed Volume	Volume (cf)
Required	3,934
Provided	6,686

Water quality volume provided is the water quality ponding depth and filter bed volume.

WQ_v = 17,053 ft^3 + 6,686.4 ft^3 = 23,739.4 ft^3

Water Quality Volume	Volume (ft^3)
Required	11,358
Provided	23,739

Pretreatment Forebay

Stormwater treatment prior to entering the dry detention basin will be provided by a forebay. The forebay is required to provide a minimum of 25% of the water quality volume storage when using nested bioretention.

Forebay Volume Required = 25% WQ_v = (0.25) (19,679) = 4,920 ft^3

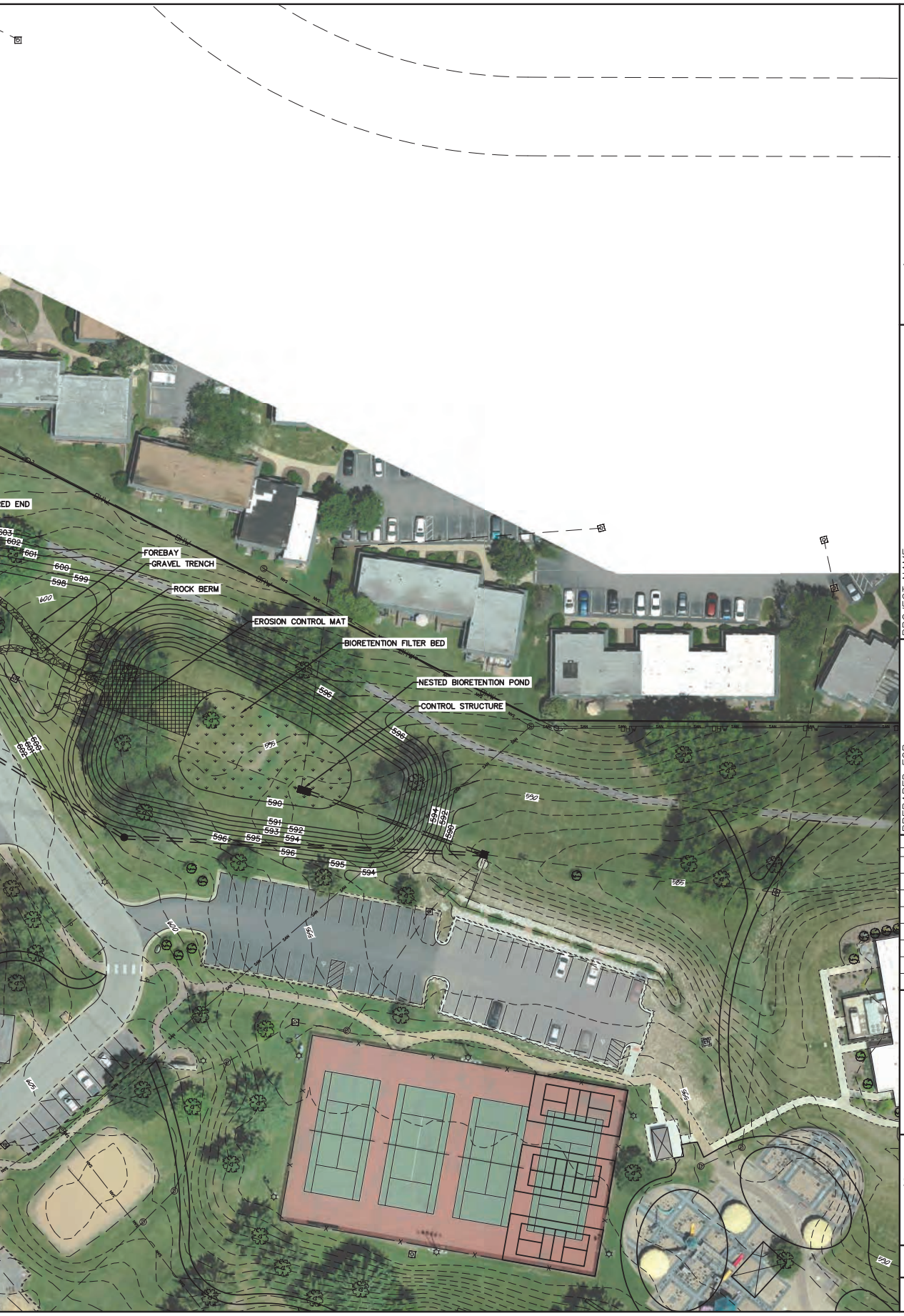
Contour Elevation (ft)	Contour Area (ft^2)	Incremental Volume (ft^3)	Total Volume (ft^3)
597.00	265	0	0
598.00	4,090	2,178	2,178
599.00	5,415	4,753	6,931

Forebay Volume	Volume (cf)
Required	4,920
Provided	6,931

Appendix A

-Exhibit A : Conceptual Plan
-Exhibit B : Concept Control Structure
-Exhibit C : Drainage Area Map
-Exhibit D : Master Plan Improvements
-Exhibit E : 2022 Park Conditions


GRAPHIC SCALE
40'
20'
0
40'



BAX ENGINEERING CO., INC.
221 Point West Blvd.
St. Charles, MO 63301
Phone: 636-928-5552
Fax: 636-928-1718
Missouri State Certificate of Authority: Engineering #000655
Missouri State Certificate of Authority: Surveying #000144

PROJECT NAME:
VLASIS PARK MASTER PLAN
300 PARK DRIVE
BALLWIN, MO 63011

DATE: 01/27/2022
PROJECT NO.: 21-18319

PREPARED FOR:
LAWRENCE GROUP
319 N. 4TH STREET, SUITE 1000
ST. LOUIS, MO 63102
&
CITY OF BALLWIN
200 PARK DRIVE
BALLWIN, MO 63011

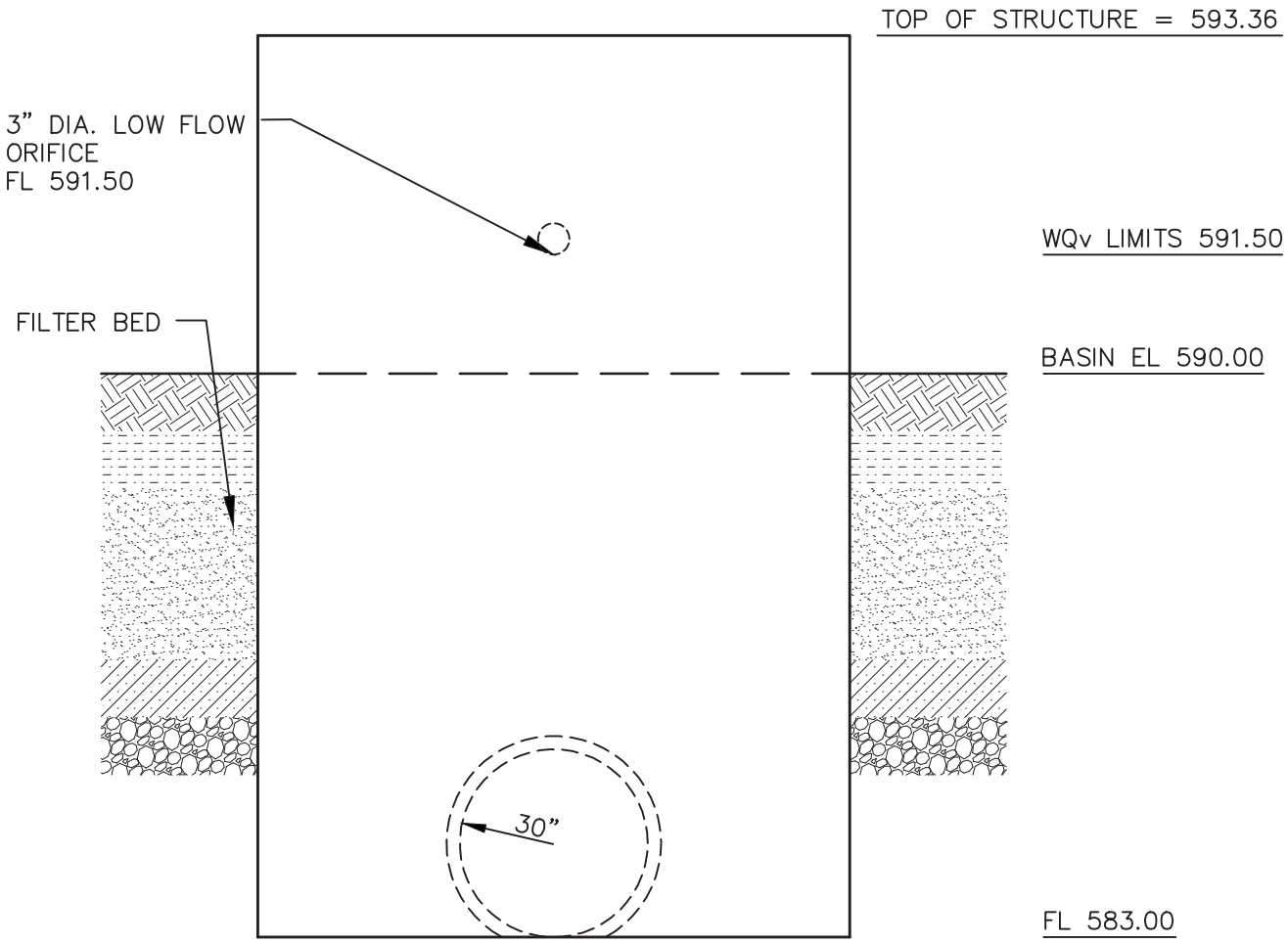
REVISIONS

DATE	DESCRIPTION

CONCEPTUAL PLAN FOR STORM WATER DETENTION AND WATER QUALITY

EXHIBIT A

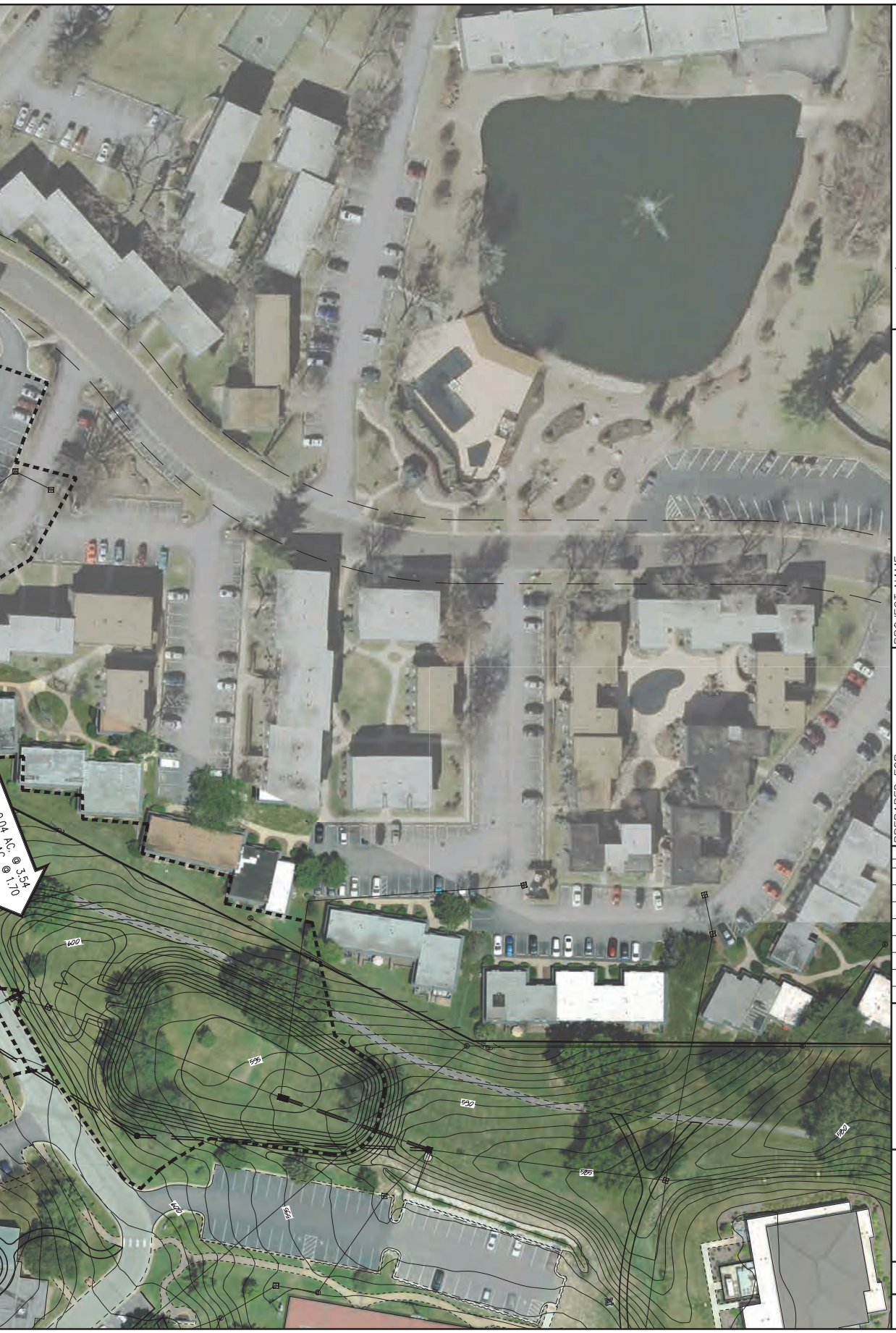
SHEET 1 OF 1



CONCEPT CONTROL STRUCTURE
N.T.S.

EXHIBIT B	PREPARED FOR:	PROJECT NAME:	
DATE: 01/27/2022	LAWRENCE GROUP 319 N. 4TH STREET, SUITE 1000 ST. LOUIS, MO 63102 & CITY OF BALLWIN 200 PARK DRIVE BALLWIN, MO 63011	VLASIS PARK MASTER PLAN 300 PARK DRIVE BALLWIN, MO 63011	BAX ENGINEERING CO. 221 POINT WEST BLVD. ST. CHARLES, MO 63301 636-928-5552
SCALE: NTS			
PROJECT: 21-18319			
SHEET: 1 OF 1			MISSOURI STATE CERTIFICATE OF AUTHORITY ENGINEERING: #000655


GRAPHIC SCALE
50' 0 25' 50'
HOLLOWAY RD.
IMPERVIOUS 2.26 AC. @ 3.54
GREENSPACE 0.30 AC. @ 1.70
Q=8.51 CFS
IMPERVIOUS 0.35 AC. @ 3.54
GREENSPACE 0.66 AC. @ 1.70
Q=2.36 CFS
IMPERVIOUS
GREENSPACE 1.55 AC.
Q=2.77 CFS
IMPERVIOUS 0.92 AC. @ 3.54
GREENSPACE 0.23 AC. @ 1.70
Q=3.65 CFS
IMPERVIOUS 0.29 AC. @ 3.54
GREENSPACE 1.88 AC. @ 1.70
Q=4.22 CFS
IMPERVIOUS 0.36 AC. @ 3.54
GREENSPACE 0.12 AC. @ 1.70
Q=1.48 CFS
IMPERVIOUS 0.18 AC. @ 3.54
GREENSPACE 0.30 AC. @ 1.70
Q=1.15 CFS



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221 Point West Blvd.
St. Charles, MO 63301
Phone: 636-928-5552
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ST. LOUIS, MO 63102
&
CITY OF BALLWIN
200 PARK DRIVE
BALLWIN, MO 63011

REVISIONS

DATE	DESCRIPTION

DRAINAGE AREA MAP

EXHIBIT C

SHEET 1 OF 1


GRAPHIC SCALE
100'
0
50'
100'

MASTER PLAN IMPROVEMENTS	
IMPERVIOUS AREAS	11.54 AC
PERVIOUS AREAS	16.93 AC
TOTAL AREA	28.47 AC

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221 Point West Blvd.
St. Charles, MO 63301
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Fax: 636-928-1718
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LAWRENCE GROUP
319 N. 4TH STREET, SUITE 1000
ST. LOUIS, MO 63102
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DATE	DESCRIPTION

MASTER PLAN IMPROVEMENTS

EXHIBIT D

SHEET
1 OF 1


GRAPHIC SCALE
100'
0
50'
100'

2022 PARK DRAINAGE AREAS	
IMPERVIOUS AREAS	10.44 AC
PERVIOUS AREAS	18.03 AC
TOTAL AREA	28.47 AC

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221 Point West Blvd.
St. Charles, MO 63301
Phone: 636-928-5552
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LAWRENCE GROUP
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ST. LOUIS, MO 63102
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CITY OF BALLWIN
200 PARK DRIVE
BALLWIN, MO 63011

REVISIONS

DATE	DESCRIPTION

2022 PARK CONDITIONS

EXHIBIT E

SHEET 1 OF 1

Appendix B

-1 Year 24 Hour Design Storm Pond Pack Report
-2 Year 24 Hour Design Storm Pond Pack Report
-100 Year 24 Hour Design Storm Pond Pack Report
-100 Year 24 Hour Design Storm with Low Flow Blocked Pond Pack Report

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
Existing Inflow	1 yrs	1	43,818.000	714.0	18.194
Master Plan Improvements Inflow	1 yrs	1	47,266.000	714.0	19.691

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
Existing Outfall	1 yrs	1	43,818.000	714.0	18.194
Master Plan Improvements Outfall	1 yrs	1	47,268.000	1,102.0	0.343

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
Nested Bioretention Basin (IN)	1 yrs	1	47,266.000	714.0	19.691	(N/A)	(N/A)
Nested Bioretention Basin (OUT)	1 yrs	1	47,268.000	1,102.0	0.343	592.55	33,062.000

Subsection: Time-Depth Curve
Label: Design Storm
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Time-Depth Curve: SCS	
Label	SCS
Start Time	0.0 min
Increment	6.0 min
End Time	1,440.0 min
Return Event	1 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 6.0 min
Time on left represents time for first value in each row.

Time (min)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.0	0.0	0.0	0.0	0.0	0.0
30.0	0.0	0.0	0.0	0.0	0.0
60.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.1
120.0	0.1	0.1	0.1	0.1	0.1
150.0	0.1	0.1	0.1	0.1	0.1
180.0	0.1	0.1	0.1	0.1	0.1
210.0	0.1	0.1	0.1	0.1	0.1
240.0	0.1	0.1	0.1	0.1	0.1
270.0	0.1	0.1	0.1	0.1	0.2
300.0	0.2	0.2	0.2	0.2	0.2
330.0	0.2	0.2	0.2	0.2	0.2
360.0	0.2	0.2	0.2	0.2	0.2
390.0	0.2	0.2	0.2	0.2	0.2
420.0	0.2	0.3	0.3	0.3	0.3
450.0	0.3	0.3	0.3	0.3	0.3
480.0	0.3	0.3	0.3	0.3	0.3
510.0	0.3	0.3	0.3	0.4	0.4
540.0	0.4	0.4	0.4	0.4	0.4
570.0	0.4	0.4	0.4	0.4	0.4
600.0	0.5	0.5	0.5	0.5	0.5
630.0	0.5	0.5	0.5	0.6	0.6
660.0	0.6	0.6	0.6	0.7	0.7
690.0	0.7	0.8	0.9	1.1	1.4
720.0	1.7	1.7	1.7	1.8	1.8
750.0	1.8	1.9	1.9	1.9	1.9
780.0	1.9	1.9	2.0	2.0	2.0
810.0	2.0	2.0	2.0	2.0	2.0
840.0	2.0	2.1	2.1	2.1	2.1
870.0	2.1	2.1	2.1	2.1	2.1
900.0	2.1	2.1	2.1	2.2	2.2
930.0	2.2	2.2	2.2	2.2	2.2
960.0	2.2	2.2	2.2	2.2	2.2
990.0	2.2	2.2	2.2	2.2	2.2
1,020.0	2.3	2.3	2.3	2.3	2.3
1,050.0	2.3	2.3	2.3	2.3	2.3
1,080.0	2.3	2.3	2.3	2.3	2.3
1,110.0	2.3	2.3	2.3	2.3	2.3
1,140.0	2.3	2.3	2.4	2.4	2.4
1,170.0	2.4	2.4	2.4	2.4	2.4

Subsection: Time-Depth Curve
Label: Design Storm
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

CUMULATIVE RAINFALL (in)
Output Time Increment = 6.0 min
Time on left represents time for first value in each row.

Time (min)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
1,200.0	2.4	2.4	2.4	2.4	2.4
1,230.0	2.4	2.4	2.4	2.4	2.4
1,260.0	2.4	2.4	2.4	2.4	2.4
1,290.0	2.4	2.4	2.4	2.4	2.4
1,320.0	2.4	2.4	2.4	2.5	2.5
1,350.0	2.5	2.5	2.5	2.5	2.5
1,380.0	2.5	2.5	2.5	2.5	2.5
1,410.0	2.5	2.5	2.5	2.5	2.5
1,440.0	2.5	(N/A)	(N/A)	(N/A)	(N/A)

Subsection: Time of Concentration Calculations
Label: Existing Inflow
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Time of Concentration Results

Segment #1: TR-55 Shallow Concentrated Flow	
Hydraulic Length	380.00 ft
Is Paved?	True
Slope	0.028 ft/ft
Average Velocity	3.40 ft/s
Segment Time of Concentration	1.9 min

Segment #2: TR-55 Channel Flow	
Flow Area	1.23 ft²
Hydraulic Length	855.00 ft
Manning's n	0.013
Slope	0.040 ft/ft
Wetted Perimeter	3.93 ft
Average Velocity	10.57 ft/s
Segment Time of Concentration	1.3 min

Time of Concentration (Composite)	
Time of Concentration (Composite)	3.2 min

Subsection: Time of Concentration Calculations
Label: Existing Inflow
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

= = = = SCS TR-55 Shallow Concentration Flow

Tc =	Unpaved surface: V = 16.1345 * (Sf**0.5) Paved Surface: V = 20.3282 * (Sf**0.5) (Lf / V) / 3600
Where:	V= Velocity, ft/sec Sf= Slope, ft/ft Tc= Time of concentration, hours Lf= Flow length, feet

= = = = SCS TR-55 Sheet Flow

Tc =	(0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))
Where:	Tc= Time of concentration, hours n= Manning's n Lf= Flow length, feet P= 2yr, 24hr Rain depth, inches Sf= Slope, %

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method (Computational Notes)

Definition of Terms

At	Total area (acres): At = Ai+Ap
Ai	Impervious area (acres)
Ap	Pervious area (acres)
CNi	Runoff curve number for impervious area
CNp	Runoff curve number for pervious area
fLoss	f loss constant infiltration (depth/time)
gKs	Saturated Hydraulic Conductivity (depth/time)
Md	Volumetric Moisture Deficit
Psi	Capillary Suction (length)
hK	Horton Infiltration Decay Rate (time^-1)
fo	Initial Infiltration Rate (depth/time)
fc	Ultimate(capacity)Infiltration Rate (depth/time)
Ia	Initial Abstraction (length)
dt	Computational increment (duration of unit excess rainfall) Default dt is smallest value of 0.1333Tc, rtm, and th (Smallest dt is then adjusted to match up with Tp)
UDdt	User specified override computational main time increment (only used if UDdt is => .1333Tc)
D(t)	Point on distribution curve (fraction of P) for time step t
K	2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks	Hydrograph shape factor = Unit Conversions * K: = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K Default Ks = 645.333 * 0.75 = 484
Lag	Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P	Total precipitation depth, inches
Pa(t)	Accumulated rainfall at time step t
Pi(t)	Incremental rainfall at time step t
qp	Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi. = (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t)	Unit hydrograph ordinate (cfs) at time step t
Q(t)	Final hydrograph ordinate (cfs) at time step t
Rai(t)	Accumulated runoff (inches) at time step t for impervious area
Rap(t)	Accumulated runoff (inches) at time step t for pervious area
Rii(t)	Incremental runoff (inches) at time step t for impervious area
Rip(t)	Incremental runoff (inches) at time step t for pervious area
R(t)	Incremental weighted total runoff (inches)
Rtm	Time increment for rainfall table
Si	S for impervious area: Si = (1000/CNi) - 10
Sp	S for pervious area: Sp = (1000/CNp) - 10
t	Time step (row) number
Tc	Time of concentration
Tb	Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp	Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr	Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method
Computational Notes
Precipitation

Column (1)	Time for time step t
Column (2)	D(t) = Point on distribution curve for time step t
Column (3)	Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4)	Pa(t) = D(t) x P: Col.(2) x P

Pervious Area Runoff (using SCS Runoff CN Method)

Column (5)	Rap(t) = Accumulated pervious runoff for time step t
	If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
	If (Pa(t) is > 0.2Sp) then use:
	
	Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

Column (6)	Rip(t) = Incremental pervious runoff for time step t Rip(t) = Rap(t) - Rap(t-1) Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

Impervious Area Runoff

Column (7 & 8)...	Did not specify to use impervious areas.

Incremental Weighted Runoff

Column (9)	R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t) R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS Unit Hydrograph Method

Column (10)	Q(t) is computed with the SCS unit hydrograph method using R(t) and Qu(t).

Subsection: Unit Hydrograph Summary
Label: Existing Inflow
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Storm Event	SCS
Return Event	1 years
Duration	6,000.0 min
Depth	2.5 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	18.194 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	18.194 ft³/s

Drainage Area	
SCS CN (Composite)	86.665
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.5 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.3 in
Runoff Volume (Pervious)	43,818.054 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	43,818.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Unit Hydrograph Summary
Label: Master Plan Improvements Inflow
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Storm Event	SCS
Return Event	1 years
Duration	6,000.0 min
Depth	2.5 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	19.691 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	19.691 ft³/s

Drainage Area	
SCS CN (Composite)	88.112
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.3 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.4 in
Runoff Volume (Pervious)	47,266.210 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	47,266.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Elevation-Area Volume Curve
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Elevation (ft)	Planimeter (ft²)	Area (ft²)	A1+A2+sqr (A1*A2) (ft²)	Volume (ft³)	Volume (Total) (ft³)
590.00	0.00	5,500.000	0.000	0.000	0.000
591.00	0.00	14,080.000	28,380.000	9,460.000	9,460.000
597.00	0.00	23,930.000	56,365.773	112,732.000	122,192.000

Subsection: Volume Equations
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Pond Volume Equations
*** Incremental volume computed by the Conic Method for Reservoir Volumes.**

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

where:	EL1, EL2	Lower and upper elevations of the increment
	Area1, Area2	Areas computed for EL1, EL2, respectively
	Volume	Incremental volume between EL1 and EL2

Subsection: Outlet Input Data
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Requested Pond Water Surface Elevations	
Minimum (Headwater)	590.00 ft
Increment (Headwater)	0.05 ft
Maximum (Headwater)	597.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Low Flow Orifice	Forward	Outfall Pipe	591.50	597.00
Inlet Box	Overflow Pipe	Forward	Outfall Pipe	593.36	597.00
User Defined Table	Bioretentio n Filter	Forward	Outfall Pipe	590.00	597.00
Culvert-Circular	Outfall Pipe	Forward	TW	587.50	597.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Structure ID: Outfall Pipe Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	30.00 in
Length	125.00 ft
Length (Computed Barrel)	125.20 ft
Slope (Computed)	0.057 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.009
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	0.000
T2 ratio (HW/D)	1.169
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	587.50 ft	T1 Flow	27.165 ft³/s
T2 Elevation	590.42 ft	T2 Flow	31.046 ft³/s

Subsection: Outlet Input Data
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Structure ID: Overflow Pipe
Structure Type: Inlet Box

Number of Openings	1
Elevation	593.36 ft
Orifice Area	16.00 ft²
Orifice Coefficient	0.600
Weir Length	18.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Low Flow Orifice
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	591.50 ft
Orifice Diameter	3.00 in
Orifice Coefficient	0.600

Structure ID: Bioretention Filter
Structure Type: User Defined Table

Elevation (ft)	Flow (ft³/s)
0.00	0.116
1.50	0.116
7.00	0.116

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
590.00	0.117	583.41	0.00
590.05	0.117	583.41	0.00
590.10	0.117	583.41	0.00
590.15	0.117	583.41	0.00
590.20	0.117	583.41	0.00
590.25	0.117	583.41	0.00
590.30	0.117	583.41	0.00
590.35	0.117	583.41	0.00
590.40	0.117	583.41	0.00
590.45	0.117	583.41	0.00
590.50	0.117	583.41	0.00
590.55	0.117	583.41	0.00
590.60	0.117	583.41	0.00
590.65	0.117	583.41	0.00
590.70	0.117	583.41	0.00
590.75	0.117	583.41	0.00
590.80	0.117	583.41	0.00
590.85	0.117	583.41	0.00
590.90	0.117	583.41	0.00
590.95	0.117	583.41	0.00
591.00	0.117	583.41	0.00
591.05	0.117	583.41	0.00
591.10	0.117	583.41	0.00
591.15	0.117	583.41	0.00
591.20	0.117	583.41	0.00
591.25	0.117	583.41	0.00
591.30	0.117	583.41	0.00
591.35	0.117	583.41	0.00
591.40	0.117	583.41	0.00
591.45	0.117	583.41	0.00
591.50	0.117	583.41	0.00
591.55	0.120	583.41	0.00
591.60	0.131	583.41	0.00
591.65	0.149	583.41	0.00
591.70	0.171	583.41	0.00
591.75	0.200	583.41	0.00
591.80	0.215	583.41	0.00
591.85	0.227	583.41	0.00
591.90	0.240	583.41	0.00
591.95	0.250	583.41	0.00
592.00	0.260	583.41	0.00
592.05	0.270	583.41	0.00
592.10	0.279	583.41	0.00
592.15	0.287	583.41	0.00
592.20	0.294	583.41	0.00
592.25	0.303	583.41	0.00
592.30	0.310	583.41	0.00
592.35	0.317	583.41	0.00

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
592.40	0.324	583.41	0.00
592.45	0.330	583.41	0.00
592.50	0.336	583.41	0.00
592.55	0.343	583.41	0.00
592.60	0.349	583.41	0.00
592.65	0.354	583.41	0.00
592.70	0.362	583.41	0.00
592.75	0.366	583.41	0.00
592.80	0.372	583.41	0.00
592.85	0.377	583.41	0.00
592.90	0.381	583.41	0.00
592.95	0.388	583.41	0.00
593.00	0.393	583.41	0.00
593.05	0.398	583.41	0.00
593.10	0.402	583.41	0.00
593.15	0.408	583.41	0.00
593.20	0.413	583.41	0.00
593.25	0.418	583.41	0.00
593.30	0.422	583.41	0.00
593.35	0.425	583.41	0.00
593.36	0.427	583.41	0.00
593.40	0.863	583.41	0.00
593.45	1.893	583.41	0.00
593.50	3.268	583.41	0.00
593.55	4.920	583.41	0.00
593.60	6.800	583.41	0.00
593.65	8.893	583.41	0.00
593.70	11.169	583.41	0.00
593.75	13.606	583.41	0.00
593.80	16.229	583.41	0.00
593.85	18.982	583.41	0.00
593.90	21.899	583.41	0.00
593.95	24.957	583.41	0.00
594.00	28.128	583.41	0.00
594.05	31.432	583.41	0.00
594.10	34.857	583.41	0.00
594.15	38.397	583.41	0.00
594.20	42.033	583.41	0.00
594.25	45.776	583.41	0.00
594.30	49.627	583.41	0.00
594.35	53.537	583.41	0.00
594.40	57.590	583.41	0.00
594.45	61.679	583.41	0.00
594.50	63.741	583.41	0.00
594.55	64.039	583.41	0.00
594.60	64.337	583.41	0.00
594.65	64.635	583.41	0.00
594.70	64.921	583.41	0.00

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
594.75	65.219	583.41	0.00
594.80	65.506	583.41	0.00
594.85	65.804	583.41	0.00
594.90	66.090	583.41	0.00
594.95	66.376	583.41	0.00
595.00	66.662	583.41	0.00
595.05	66.948	583.41	0.00
595.10	67.228	583.41	0.00
595.15	67.508	583.41	0.00
595.20	67.794	583.41	0.00
595.25	68.069	583.41	0.00
595.30	68.355	583.41	0.00
595.35	68.629	583.41	0.00
595.40	68.903	583.41	0.00
595.45	69.177	583.41	0.00
595.50	69.451	583.41	0.00
595.55	69.726	583.41	0.00
595.60	70.000	583.41	0.00
595.65	70.268	583.41	0.00
595.70	70.536	583.41	0.00
595.75	70.810	583.41	0.00
595.80	71.073	583.41	0.00
595.85	71.347	583.41	0.00
595.90	71.609	583.41	0.00
595.95	71.871	583.41	0.00
596.00	72.134	583.41	0.00
596.05	72.396	583.41	0.00
596.10	72.658	583.41	0.00
596.15	72.920	583.41	0.00
596.20	73.183	583.41	0.00
596.25	73.445	583.41	0.00
596.30	73.695	583.41	0.00
596.35	73.957	583.41	0.00
596.40	74.214	583.41	0.00
596.45	74.470	583.41	0.00
596.50	74.720	583.41	0.00
596.55	74.983	583.41	0.00
596.60	75.233	583.41	0.00
596.65	75.483	583.41	0.00
596.70	75.734	583.41	0.00
596.75	75.984	583.41	0.00
596.80	76.234	583.41	0.00
596.85	76.485	583.41	0.00
596.90	76.735	583.41	0.00
596.95	76.979	583.41	0.00
597.00	77.224	583.41	0.00

Contributing Structures

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice,Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Low Flow Orifice,Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)

Subsection: Composite Rating Curve
Label: Nested Bioretention Structure
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)
Overflow Pipe,Bioretention Filter,Outfall Pipe (no Q: Low Flow Orifice)

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
590.00	0.117	0.000	5,500.000	0.000	0.117	0.117
590.05	0.117	283.332	5,834.950	0.000	0.117	9.561
590.10	0.117	583.660	6,179.800	0.000	0.117	19.572
590.15	0.117	901.477	6,534.550	0.000	0.117	30.166
590.20	0.117	1,237.280	6,899.200	0.000	0.117	41.359
590.25	0.117	1,591.563	7,273.750	0.000	0.117	53.169
590.30	0.117	1,964.820	7,658.200	0.000	0.117	65.611
590.35	0.117	2,357.548	8,052.550	0.000	0.117	78.701
590.40	0.117	2,770.240	8,456.800	0.000	0.117	92.458
590.45	0.117	3,203.393	8,870.950	0.000	0.117	106.896
590.50	0.117	3,657.500	9,295.000	0.000	0.117	122.033
590.55	0.117	4,133.057	9,728.950	0.000	0.117	137.885
590.60	0.117	4,630.560	10,172.800	0.000	0.117	154.469
590.65	0.117	5,150.502	10,626.550	0.000	0.117	171.800
590.70	0.117	5,693.380	11,090.200	0.000	0.117	189.896
590.75	0.117	6,259.688	11,563.750	0.000	0.117	208.773
590.80	0.117	6,849.920	12,047.200	0.000	0.117	228.447
590.85	0.117	7,464.573	12,540.550	0.000	0.117	248.936
590.90	0.117	8,104.140	13,043.800	0.000	0.117	270.255
590.95	0.117	8,769.118	13,556.950	0.000	0.117	292.420
591.00	0.117	9,460.000	14,080.000	0.000	0.117	315.450
591.05	0.117	10,165.783	14,151.353	0.000	0.117	338.976
591.10	0.117	10,875.138	14,222.886	0.000	0.117	362.621
591.15	0.117	11,588.075	14,294.600	0.000	0.117	386.386
591.20	0.117	12,304.601	14,366.494	0.000	0.117	410.270
591.25	0.117	13,024.727	14,438.569	0.000	0.117	434.274
591.30	0.117	13,748.461	14,510.823	0.000	0.117	458.399
591.35	0.117	14,475.813	14,583.259	0.000	0.117	482.644
591.40	0.117	15,206.790	14,655.874	0.000	0.117	507.010
591.45	0.117	15,941.403	14,728.670	0.000	0.117	531.497
591.50	0.117	16,679.660	14,801.646	0.000	0.117	556.105
591.55	0.120	17,421.570	14,874.802	0.000	0.120	580.839
591.60	0.131	18,167.143	14,948.139	0.000	0.131	605.702
591.65	0.149	18,916.387	15,021.656	0.000	0.149	630.696
591.70	0.171	19,669.312	15,095.354	0.000	0.171	655.815

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
591.75	0.200	20,425.926	15,169.232	0.000	0.200	681.064
591.80	0.215	21,186.238	15,243.290	0.000	0.215	706.423
591.85	0.227	21,950.258	15,317.528	0.000	0.227	731.903
591.90	0.240	22,717.994	15,391.947	0.000	0.240	757.507
591.95	0.250	23,489.455	15,466.546	0.000	0.250	783.232
592.00	0.260	24,264.652	15,541.326	0.000	0.260	809.082
592.05	0.270	25,043.591	15,616.286	0.000	0.270	835.056
592.10	0.279	25,826.283	15,691.426	0.000	0.279	861.155
592.15	0.287	26,612.737	15,766.746	0.000	0.287	887.378
592.20	0.294	27,402.961	15,842.247	0.000	0.294	913.726
592.25	0.303	28,196.964	15,917.929	0.000	0.303	940.202
592.30	0.310	28,994.757	15,993.790	0.000	0.310	966.802
592.35	0.317	29,796.346	16,069.832	0.000	0.317	993.529
592.40	0.324	30,601.743	16,146.054	0.000	0.324	1,020.382
592.45	0.330	31,410.955	16,222.457	0.000	0.330	1,047.361
592.50	0.336	32,223.992	16,299.040	0.000	0.336	1,074.469
592.55	0.343	33,040.862	16,375.803	0.000	0.343	1,101.705
592.60	0.349	33,861.575	16,452.747	0.000	0.349	1,129.068
592.65	0.354	34,686.140	16,529.871	0.000	0.354	1,156.559
592.70	0.362	35,514.565	16,607.175	0.000	0.362	1,184.181
592.75	0.366	36,346.860	16,684.660	0.000	0.366	1,211.928
592.80	0.372	37,183.034	16,762.325	0.000	0.372	1,239.807
592.85	0.377	38,023.096	16,840.170	0.000	0.377	1,267.813
592.90	0.381	38,867.054	16,918.196	0.000	0.381	1,295.949
592.95	0.388	39,714.918	16,996.402	0.000	0.388	1,324.218
593.00	0.393	40,566.697	17,074.788	0.000	0.393	1,352.616
593.05	0.398	41,422.400	17,153.355	0.000	0.398	1,381.145
593.10	0.402	42,282.036	17,232.102	0.000	0.402	1,409.803
593.15	0.408	43,145.613	17,311.029	0.000	0.408	1,438.595
593.20	0.413	44,013.141	17,390.137	0.000	0.413	1,467.517
593.25	0.418	44,884.630	17,469.425	0.000	0.418	1,496.572
593.30	0.422	45,760.087	17,548.893	0.000	0.422	1,525.758
593.35	0.425	46,639.522	17,628.542	0.000	0.425	1,555.076
593.36	0.427	46,815.887	17,644.493	0.000	0.427	1,560.957
593.40	0.863	47,522.944	17,708.371	0.000	0.863	1,584.961
593.45	1.893	48,410.362	17,788.380	0.000	1.893	1,615.572
593.50	3.268	49,301.785	17,868.570	0.000	3.268	1,646.661
593.55	4.920	50,197.222	17,948.940	0.000	4.920	1,678.161
593.60	6.800	51,096.682	18,029.491	0.000	6.800	1,710.023
593.65	8.893	52,000.174	18,110.221	0.000	8.893	1,742.232
593.70	11.169	52,907.707	18,191.133	0.000	11.169	1,774.759
593.75	13.606	53,819.291	18,272.224	0.000	13.606	1,807.582
593.80	16.229	54,734.933	18,353.496	0.000	16.229	1,840.727
593.85	18.982	55,654.643	18,434.948	0.000	18.982	1,874.136
593.90	21.899	56,578.431	18,516.580	0.000	21.899	1,907.846
593.95	24.957	57,506.304	18,598.393	0.000	24.957	1,941.833
594.00	28.128	58,438.273	18,680.386	0.000	28.128	1,976.071
594.05	31.432	59,374.346	18,762.560	0.000	31.432	2,010.577
594.10	34.857	60,314.532	18,844.914	0.000	34.857	2,045.341

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
594.15	38.397	61,258.840	18,927.448	0.000	38.397	2,080.359
594.20	42.033	62,207.280	19,010.163	0.000	42.033	2,115.609
594.25	45.776	63,159.859	19,093.057	0.000	45.776	2,151.105
594.30	49.627	64,116.588	19,176.133	0.000	49.627	2,186.846
594.35	53.537	65,077.476	19,259.388	0.000	53.537	2,222.786
594.40	57.590	66,042.530	19,342.824	0.000	57.590	2,259.008
594.45	61.679	67,011.761	19,426.440	0.000	61.679	2,295.404
594.50	63.741	67,985.177	19,510.237	0.000	63.741	2,329.914
594.55	64.039	68,962.788	19,594.214	0.000	64.039	2,362.799
594.60	64.337	69,944.602	19,678.371	0.000	64.337	2,395.824
594.65	64.635	70,930.628	19,762.709	0.000	64.635	2,428.990
594.70	64.921	71,920.876	19,847.227	0.000	64.921	2,462.284
594.75	65.219	72,915.354	19,931.925	0.000	65.219	2,495.731
594.80	65.506	73,914.071	20,016.803	0.000	65.506	2,529.308
594.85	65.804	74,917.037	20,101.862	0.000	65.804	2,563.038
594.90	66.090	75,924.260	20,187.102	0.000	66.090	2,596.898
594.95	66.376	76,935.750	20,272.521	0.000	66.376	2,630.901
595.00	66.662	77,951.515	20,358.121	0.000	66.662	2,665.046
595.05	66.948	78,971.565	20,443.902	0.000	66.948	2,699.333
595.10	67.228	79,995.909	20,529.862	0.000	67.228	2,733.758
595.15	67.508	81,024.555	20,616.003	0.000	67.508	2,768.327
595.20	67.794	82,057.512	20,702.325	0.000	67.794	2,803.045
595.25	68.069	83,094.790	20,788.826	0.000	68.069	2,837.895
595.30	68.355	84,136.398	20,875.508	0.000	68.355	2,872.901
595.35	68.629	85,182.344	20,962.371	0.000	68.629	2,908.040
595.40	68.903	86,232.638	21,049.413	0.000	68.903	2,943.324
595.45	69.177	87,287.288	21,136.636	0.000	69.177	2,978.753
595.50	69.451	88,346.304	21,224.040	0.000	69.451	3,014.328
595.55	69.726	89,409.695	21,311.624	0.000	69.726	3,050.049
595.60	70.000	90,477.470	21,399.388	0.000	70.000	3,085.915
595.65	70.268	91,549.637	21,487.332	0.000	70.268	3,121.922
595.70	70.536	92,626.206	21,575.457	0.000	70.536	3,158.076
595.75	70.810	93,707.186	21,663.762	0.000	70.810	3,194.383
595.80	71.073	94,792.585	21,752.247	0.000	71.073	3,230.825
595.85	71.347	95,882.413	21,840.913	0.000	71.347	3,267.427
595.90	71.609	96,976.679	21,929.759	0.000	71.609	3,304.165
595.95	71.871	98,075.392	22,018.786	0.000	71.871	3,341.051
596.00	72.134	99,178.561	22,107.992	0.000	72.134	3,378.086
596.05	72.396	100,286.195	22,197.380	0.000	72.396	3,415.269
596.10	72.658	101,398.302	22,286.947	0.000	72.658	3,452.601
596.15	72.920	102,514.892	22,376.695	0.000	72.920	3,490.083
596.20	73.183	103,635.974	22,466.623	0.000	73.183	3,527.715
596.25	73.445	104,761.558	22,556.732	0.000	73.445	3,565.497
596.30	73.695	105,891.651	22,647.020	0.000	73.695	3,603.417
596.35	73.957	107,026.263	22,737.490	0.000	73.957	3,641.500
596.40	74.214	108,165.403	22,828.139	0.000	74.214	3,679.727
596.45	74.470	109,309.080	22,918.969	0.000	74.470	3,718.106
596.50	74.720	110,457.302	23,009.979	0.000	74.720	3,756.630
596.55	74.983	111,610.080	23,101.170	0.000	74.983	3,795.319

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
596.60	75.233	112,767.422	23,192.541	0.000	75.233	3,834.147
596.65	75.483	113,929.338	23,284.092	0.000	75.483	3,873.128
596.70	75.734	115,095.835	23,375.823	0.000	75.734	3,912.261
596.75	75.984	116,266.923	23,467.735	0.000	75.984	3,951.548
596.80	76.234	117,442.611	23,559.828	0.000	76.234	3,990.988
596.85	76.485	118,622.909	23,652.100	0.000	76.485	4,030.582
596.90	76.735	119,807.824	23,744.553	0.000	76.735	4,070.329
596.95	76.979	120,997.367	23,837.186	0.000	76.979	4,110.225
597.00	77.224	122,191.546	23,930.000	0.000	77.224	4,150.275

Subsection: Detention Time
Label: Nested Bioretention Basin (IN)
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Approximate Detention Times	
Time to Centroid (Outflow)	2,270.0 min
Time to Centroid (Inflow)	820.5 min
Detention Time (Centroid to Centroid)	1,449.5 min

Subsection: Level Pool Pond Routing Summary
Label: Nested Bioretention Basin (IN)
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	19.691 ft³/s	Time to Peak (Flow, In)	714.0 min
Flow (Peak Outlet)	0.343 ft³/s	Time to Peak (Flow, Outlet)	1,102.0 min

Elevation (Water Surface, Peak)	592.55 ft
Volume (Peak)	33,061.880 ft³

Mass Balance (ft³)	
Volume (Initial)	0.000 ft³
Volume (Total Inflow)	47,266.000 ft³
Volume (Total Infiltration)	0.000 ft³
Volume (Total Outlet Outflow)	47,268.000 ft³
Volume (Retained)	0.000 ft³
Volume (Unrouted)	2.000 ft³
Error (Mass Balance)	0.0 %

Subsection: Pond Inflow Summary
Label: Nested Bioretention Basin (IN)
Scenario: 1 yrs

Return Event: 1 years
Storm Event: SCS

Summary for Hydrograph Addition at 'Nested Bioretention Basin'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	Master Plan Improvements Inflow

Node Inflows

Inflow Type	Element	Volume (ft³)	Time to Peak (min)	Flow (Peak) (ft³/s)
Flow (From)	Master Plan Improvements Inflow	47,266.186	714.0	19.691
Flow (In)	Nested Bioretention Basin	47,266.186	714.0	19.691

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Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Inflow	2 yrs	2	61,237.000	714.0	25.529
Master Plan Improvements Inflow	2 yrs	2	65,192.000	714.0	27.155

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Outfall	2 yrs	2	61,237.000	714.0	25.529
Master Plan Improvements Outfall	2 yrs	2	32,787.000	1,088.0	0.461

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft^3)
Nested Bioretention Basin (IN)	2 yrs	2	65,192.000	714.0	27.155	(N/A)	(N/A)
Nested Bioretention Basin (OUT)	2 yrs	2	32,787.000	1,088.0	0.461	593.36	46,871.000

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method (Computational Notes)
Definition of Terms

At	Total area (acres): At = Ai+Ap
Ai	Impervious area (acres)
Ap	Pervious area (acres)
CNi	Runoff curve number for impervious area
CNp	Runoff curve number for pervious area
fLoss	f loss constant infiltration (depth/time)
gKs	Saturated Hydraulic Conductivity (depth/time)
Md	Volumetric Moisture Deficit
Psi	Capillary Suction (length)
hK	Horton Infiltration Decay Rate (time^-1)
fo	Initial Infiltration Rate (depth/time)
fc	Ultimate(capacity)Infiltration Rate (depth/time)
Ia	Initial Abstraction (length)
dt	Computational increment (duration of unit excess rainfall) Default dt is smallest value of 0.1333Tc, rtm, and th (Smallest dt is then adjusted to match up with Tp)
UDdt	User specified override computational main time increment (only used if UDdt is => .1333Tc)
D(t)	Point on distribution curve (fraction of P) for time step t
K	2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks	Hydrograph shape factor = Unit Conversions * K: = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K Default Ks = 645.333 * 0.75 = 484
Lag	Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P	Total precipitation depth, inches
Pa(t)	Accumulated rainfall at time step t
Pi(t)	Incremental rainfall at time step t
qp	Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi. = (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t)	Unit hydrograph ordinate (cfs) at time step t
Q(t)	Final hydrograph ordinate (cfs) at time step t
Rai(t)	Accumulated runoff (inches) at time step t for impervious area
Rap(t)	Accumulated runoff (inches) at time step t for pervious area
Rii(t)	Incremental runoff (inches) at time step t for impervious area
Rip(t)	Incremental runoff (inches) at time step t for pervious area
R(t)	Incremental weighted total runoff (inches)
Rtm	Time increment for rainfall table
Si	S for impervious area: Si = (1000/CNi) - 10
Sp	S for pervious area: Sp = (1000/CNp) - 10
t	Time step (row) number
Tc	Time of concentration
Tb	Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp	Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr	Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method
Computational Notes
Precipitation

Column (1)	Time for time step t
Column (2)	D(t) = Point on distribution curve for time step t
Column (3)	Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4)	Pa(t) = D(t) x P: Col.(2) x P

Pervious Area Runoff (using SCS Runoff CN Method)

Column (5)	Rap(t) = Accumulated pervious runoff for time step t
	If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
	If (Pa(t) is > 0.2Sp) then use:
	
	Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

Column (6)	Rip(t) = Incremental pervious runoff for time step t Rip(t) = Rap(t) - Rap(t-1) Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

Impervious Area Runoff

Column (7 & 8)...	Did not specify to use impervious areas.

Incremental Weighted Runoff

Column (9)	R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t) R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS Unit Hydrograph Method

Column (10)	Q(t) is computed with the SCS unit hydrograph method using R(t) and Qu(t).

Subsection: Unit Hydrograph Summary
Label: Existing Inflow
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Storm Event	SCS
Return Event	2 years
Duration	2,000.0 min
Depth	3.1 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	25.529 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	25.529 ft³/s

Drainage Area	
SCS CN (Composite)	86.665
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.5 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.8 in
Runoff Volume (Pervious)	61,237.272 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	61,237.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Unit Hydrograph Summary
Label: Master Plan Improvements Inflow
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Storm Event	SCS
Return Event	2 years
Duration	2,000.0 min
Depth	3.1 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	27.155 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	27.155 ft³/s

Drainage Area	
SCS CN (Composite)	88.112
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.3 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.9 in
Runoff Volume (Pervious)	65,192.229 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	65,192.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
590.00	0.117	0.000	5,500.000	0.000	0.117	0.117
590.05	0.117	283.332	5,834.950	0.000	0.117	9.561
590.10	0.117	583.660	6,179.800	0.000	0.117	19.572
590.15	0.117	901.477	6,534.550	0.000	0.117	30.166
590.20	0.117	1,237.280	6,899.200	0.000	0.117	41.359
590.25	0.117	1,591.563	7,273.750	0.000	0.117	53.169
590.30	0.117	1,964.820	7,658.200	0.000	0.117	65.611
590.35	0.117	2,357.548	8,052.550	0.000	0.117	78.701
590.40	0.117	2,770.240	8,456.800	0.000	0.117	92.458
590.45	0.117	3,203.393	8,870.950	0.000	0.117	106.896
590.50	0.117	3,657.500	9,295.000	0.000	0.117	122.033
590.55	0.117	4,133.057	9,728.950	0.000	0.117	137.885
590.60	0.117	4,630.560	10,172.800	0.000	0.117	154.469
590.65	0.117	5,150.502	10,626.550	0.000	0.117	171.800
590.70	0.117	5,693.380	11,090.200	0.000	0.117	189.896
590.75	0.117	6,259.688	11,563.750	0.000	0.117	208.773
590.80	0.117	6,849.920	12,047.200	0.000	0.117	228.447
590.85	0.117	7,464.573	12,540.550	0.000	0.117	248.936
590.90	0.117	8,104.140	13,043.800	0.000	0.117	270.255
590.95	0.117	8,769.118	13,556.950	0.000	0.117	292.420
591.00	0.117	9,460.000	14,080.000	0.000	0.117	315.450
591.05	0.117	10,165.783	14,151.353	0.000	0.117	338.976
591.10	0.117	10,875.138	14,222.886	0.000	0.117	362.621
591.15	0.117	11,588.075	14,294.600	0.000	0.117	386.386
591.20	0.117	12,304.601	14,366.494	0.000	0.117	410.270
591.25	0.117	13,024.727	14,438.569	0.000	0.117	434.274
591.30	0.117	13,748.461	14,510.823	0.000	0.117	458.399
591.35	0.117	14,475.813	14,583.259	0.000	0.117	482.644
591.40	0.117	15,206.790	14,655.874	0.000	0.117	507.010
591.45	0.117	15,941.403	14,728.670	0.000	0.117	531.497
591.50	0.117	16,679.660	14,801.646	0.000	0.117	556.105
591.55	0.120	17,421.570	14,874.802	0.000	0.120	580.839
591.60	0.131	18,167.143	14,948.139	0.000	0.131	605.702
591.65	0.149	18,916.387	15,021.656	0.000	0.149	630.696
591.70	0.171	19,669.312	15,095.354	0.000	0.171	655.815

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
591.75	0.200	20,425.926	15,169.232	0.000	0.200	681.064
591.80	0.215	21,186.238	15,243.290	0.000	0.215	706.423
591.85	0.227	21,950.258	15,317.528	0.000	0.227	731.903
591.90	0.240	22,717.994	15,391.947	0.000	0.240	757.507
591.95	0.250	23,489.455	15,466.546	0.000	0.250	783.232
592.00	0.260	24,264.652	15,541.326	0.000	0.260	809.082
592.05	0.270	25,043.591	15,616.286	0.000	0.270	835.056
592.10	0.279	25,826.283	15,691.426	0.000	0.279	861.155
592.15	0.287	26,612.737	15,766.746	0.000	0.287	887.378
592.20	0.294	27,402.961	15,842.247	0.000	0.294	913.726
592.25	0.303	28,196.964	15,917.929	0.000	0.303	940.202
592.30	0.310	28,994.757	15,993.790	0.000	0.310	966.802
592.35	0.317	29,796.346	16,069.832	0.000	0.317	993.529
592.40	0.324	30,601.743	16,146.054	0.000	0.324	1,020.382
592.45	0.330	31,410.955	16,222.457	0.000	0.330	1,047.361
592.50	0.336	32,223.992	16,299.040	0.000	0.336	1,074.469
592.55	0.343	33,040.862	16,375.803	0.000	0.343	1,101.705
592.60	0.349	33,861.575	16,452.747	0.000	0.349	1,129.068
592.65	0.354	34,686.140	16,529.871	0.000	0.354	1,156.559
592.70	0.362	35,514.565	16,607.175	0.000	0.362	1,184.181
592.75	0.366	36,346.860	16,684.660	0.000	0.366	1,211.928
592.80	0.372	37,183.034	16,762.325	0.000	0.372	1,239.807
592.85	0.377	38,023.096	16,840.170	0.000	0.377	1,267.813
592.90	0.381	38,867.054	16,918.196	0.000	0.381	1,295.949
592.95	0.388	39,714.918	16,996.402	0.000	0.388	1,324.218
593.00	0.393	40,566.697	17,074.788	0.000	0.393	1,352.616
593.05	0.398	41,422.400	17,153.355	0.000	0.398	1,381.145
593.10	0.402	42,282.036	17,232.102	0.000	0.402	1,409.803
593.15	0.408	43,145.613	17,311.029	0.000	0.408	1,438.595
593.20	0.413	44,013.141	17,390.137	0.000	0.413	1,467.517
593.25	0.418	44,884.630	17,469.425	0.000	0.418	1,496.572
593.30	0.422	45,760.087	17,548.893	0.000	0.422	1,525.758
593.35	0.425	46,639.522	17,628.542	0.000	0.425	1,555.076
593.36	0.427	46,815.887	17,644.493	0.000	0.427	1,560.957
593.40	0.863	47,522.944	17,708.371	0.000	0.863	1,584.961
593.45	1.893	48,410.362	17,788.380	0.000	1.893	1,615.572
593.50	3.268	49,301.785	17,868.570	0.000	3.268	1,646.661
593.55	4.920	50,197.222	17,948.940	0.000	4.920	1,678.161
593.60	6.800	51,096.682	18,029.491	0.000	6.800	1,710.023
593.65	8.893	52,000.174	18,110.221	0.000	8.893	1,742.232
593.70	11.169	52,907.707	18,191.133	0.000	11.169	1,774.759
593.75	13.606	53,819.291	18,272.224	0.000	13.606	1,807.582
593.80	16.229	54,734.933	18,353.496	0.000	16.229	1,840.727
593.85	18.982	55,654.643	18,434.948	0.000	18.982	1,874.136
593.90	21.899	56,578.431	18,516.580	0.000	21.899	1,907.846
593.95	24.940	57,506.304	18,598.393	0.000	24.940	1,941.816
594.00	28.120	58,438.273	18,680.386	0.000	28.120	1,976.063
594.05	31.432	59,374.346	18,762.560	0.000	31.432	2,010.577
594.10	34.857	60,314.532	18,844.914	0.000	34.857	2,045.341

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
594.15	38.397	61,258.840	18,927.448	0.000	38.397	2,080.359
594.20	42.033	62,207.280	19,010.163	0.000	42.033	2,115.609
594.25	45.776	63,159.859	19,093.057	0.000	45.776	2,151.105
594.30	49.627	64,116.588	19,176.133	0.000	49.627	2,186.846
594.35	53.537	65,077.476	19,259.388	0.000	53.537	2,222.786
594.40	57.590	66,042.530	19,342.824	0.000	57.590	2,259.008
594.45	61.679	67,011.761	19,426.440	0.000	61.679	2,295.404
594.50	63.741	67,985.177	19,510.237	0.000	63.741	2,329.914
594.55	64.039	68,962.788	19,594.214	0.000	64.039	2,362.799
594.60	64.337	69,944.602	19,678.371	0.000	64.337	2,395.824
594.65	64.635	70,930.628	19,762.709	0.000	64.635	2,428.990
594.70	64.921	71,920.876	19,847.227	0.000	64.921	2,462.284
594.75	65.219	72,915.354	19,931.925	0.000	65.219	2,495.731
594.80	65.506	73,914.071	20,016.803	0.000	65.506	2,529.308
594.85	65.804	74,917.037	20,101.862	0.000	65.804	2,563.038
594.90	66.090	75,924.260	20,187.102	0.000	66.090	2,596.898
594.95	66.376	76,935.750	20,272.521	0.000	66.376	2,630.901
595.00	66.662	77,951.515	20,358.121	0.000	66.662	2,665.046
595.05	66.948	78,971.565	20,443.902	0.000	66.948	2,699.333
595.10	67.228	79,995.909	20,529.862	0.000	67.228	2,733.758
595.15	67.508	81,024.555	20,616.003	0.000	67.508	2,768.327
595.20	67.794	82,057.512	20,702.325	0.000	67.794	2,803.045
595.25	68.069	83,094.790	20,788.826	0.000	68.069	2,837.895
595.30	68.355	84,136.398	20,875.508	0.000	68.355	2,872.901
595.35	68.629	85,182.344	20,962.371	0.000	68.629	2,908.040
595.40	68.903	86,232.638	21,049.413	0.000	68.903	2,943.324
595.45	69.177	87,287.288	21,136.636	0.000	69.177	2,978.753
595.50	69.451	88,346.304	21,224.040	0.000	69.451	3,014.328
595.55	69.726	89,409.695	21,311.624	0.000	69.726	3,050.049
595.60	70.000	90,477.470	21,399.388	0.000	70.000	3,085.915
595.65	70.268	91,549.637	21,487.332	0.000	70.268	3,121.922
595.70	70.536	92,626.206	21,575.457	0.000	70.536	3,158.076
595.75	70.810	93,707.186	21,663.762	0.000	70.810	3,194.383
595.80	71.073	94,792.585	21,752.247	0.000	71.073	3,230.825
595.85	71.347	95,882.413	21,840.913	0.000	71.347	3,267.427
595.90	71.609	96,976.679	21,929.759	0.000	71.609	3,304.165
595.95	71.871	98,075.392	22,018.786	0.000	71.871	3,341.051
596.00	72.134	99,178.561	22,107.992	0.000	72.134	3,378.086
596.05	72.396	100,286.195	22,197.380	0.000	72.396	3,415.269
596.10	72.658	101,398.302	22,286.947	0.000	72.658	3,452.601
596.15	72.920	102,514.892	22,376.695	0.000	72.920	3,490.083
596.20	73.183	103,635.974	22,466.623	0.000	73.183	3,527.715
596.25	73.445	104,761.558	22,556.732	0.000	73.445	3,565.497
596.30	73.695	105,891.651	22,647.020	0.000	73.695	3,603.417
596.35	73.957	107,026.263	22,737.490	0.000	73.957	3,641.500
596.40	74.214	108,165.403	22,828.139	0.000	74.214	3,679.727
596.45	74.470	109,309.080	22,918.969	0.000	74.470	3,718.106
596.50	74.720	110,457.302	23,009.979	0.000	74.720	3,756.630
596.55	74.983	111,610.080	23,101.170	0.000	74.983	3,795.319

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
596.60	75.233	112,767.422	23,192.541	0.000	75.233	3,834.147
596.65	75.483	113,929.338	23,284.092	0.000	75.483	3,873.128
596.70	75.734	115,095.835	23,375.823	0.000	75.734	3,912.261
596.75	75.984	116,266.923	23,467.735	0.000	75.984	3,951.548
596.80	76.234	117,442.611	23,559.828	0.000	76.234	3,990.988
596.85	76.485	118,622.909	23,652.100	0.000	76.485	4,030.582
596.90	76.735	119,807.824	23,744.553	0.000	76.735	4,070.329
596.95	76.979	120,997.367	23,837.186	0.000	76.979	4,110.225
597.00	77.224	122,191.546	23,930.000	0.000	77.224	4,150.275

Subsection: Level Pool Pond Routing Summary
Label: Nested Bioretention Basin (IN)
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	27.155 ft³/s	Time to Peak (Flow, In)	714.0 min
Flow (Peak Outlet)	0.461 ft³/s	Time to Peak (Flow, Outlet)	1,088.0 min

Elevation (Water Surface, Peak)	593.36 ft
Volume (Peak)	46,870.980 ft³

Mass Balance (ft³)	
Volume (Initial)	0.000 ft³
Volume (Total Inflow)	65,192.000 ft³
Volume (Total Infiltration)	0.000 ft³
Volume (Total Outlet Outflow)	32,787.000 ft³
Volume (Retained)	32,386.000 ft³
Volume (Unrouted)	-19.000 ft³
Error (Mass Balance)	0.0 %

Subsection: Pond Inflow Summary
Label: Nested Bioretention Basin (IN)
Scenario: 2 yrs

Return Event: 2 years
Storm Event: SCS

Summary for Hydrograph Addition at 'Nested Bioretention Basin'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	Master Plan Improvements Inflow

Node Inflows

Inflow Type	Element	Volume (ft^3)	Time to Peak (min)	Flow (Peak) (ft^3/s)
Flow (From)	Master Plan Improvements Inflow	65,192.199	714.0	27.155
Flow (In)	Nested Bioretention Basin	65,192.199	714.0	27.155

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Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Inflow	100 yrs	100	191,989.000	714.0	77.613
Master Plan Improvements Inflow	100 yrs	100	197,652.000	714.0	79.262

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Outfall	100 yrs	100	191,989.000	714.0	77.613
Master Plan Improvements Outfall	100 yrs	100	163,490.000	720.0	63.635

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft^3)
Nested Bioretention Basin (IN)	100 yrs	100	197,652.000	714.0	79.262	(N/A)	(N/A)
Nested Bioretention Basin (OUT)	100 yrs	100	163,490.000	720.0	63.635	594.50	67,935.000

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method (Computational Notes)

Definition of Terms

At	Total area (acres): At = Ai+Ap
Ai	Impervious area (acres)
Ap	Pervious area (acres)
CNi	Runoff curve number for impervious area
CNp	Runoff curve number for pervious area
fLoss	f loss constant infiltration (depth/time)
gKs	Saturated Hydraulic Conductivity (depth/time)
Md	Volumetric Moisture Deficit
Psi	Capillary Suction (length)
hK	Horton Infiltration Decay Rate (time^-1)
fo	Initial Infiltration Rate (depth/time)
fc	Ultimate(capacity)Infiltration Rate (depth/time)
Ia	Initial Abstraction (length)
dt	Computational increment (duration of unit excess rainfall) Default dt is smallest value of 0.1333Tc, rtm, and th (Smallest dt is then adjusted to match up with Tp)
UDdt	User specified override computational main time increment (only used if UDdt is => .1333Tc)
D(t)	Point on distribution curve (fraction of P) for time step t
K	2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks	Hydrograph shape factor = Unit Conversions * K: = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K Default Ks = 645.333 * 0.75 = 484
Lag	Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P	Total precipitation depth, inches
Pa(t)	Accumulated rainfall at time step t
Pi(t)	Incremental rainfall at time step t
qp	Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi. = (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t)	Unit hydrograph ordinate (cfs) at time step t
Q(t)	Final hydrograph ordinate (cfs) at time step t
Rai(t)	Accumulated runoff (inches) at time step t for impervious area
Rap(t)	Accumulated runoff (inches) at time step t for pervious area
Rii(t)	Incremental runoff (inches) at time step t for impervious area
Rip(t)	Incremental runoff (inches) at time step t for pervious area
R(t)	Incremental weighted total runoff (inches)
Rtm	Time increment for rainfall table
Si	S for impervious area: Si = (1000/CNi) - 10
Sp	S for pervious area: Sp = (1000/CNp) - 10
t	Time step (row) number
Tc	Time of concentration
Tb	Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp	Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr	Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method
Computational Notes
Precipitation

Column (1)	Time for time step t
Column (2)	D(t) = Point on distribution curve for time step t
Column (3)	Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4)	Pa(t) = D(t) x P: Col.(2) x P

Pervious Area Runoff (using SCS Runoff CN Method)

Column (5)	Rap(t) = Accumulated pervious runoff for time step t
	If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
	If (Pa(t) is > 0.2Sp) then use:
	
	Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

Column (6)	Rip(t) = Incremental pervious runoff for time step t Rip(t) = Rap(t) - Rap(t-1) Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

Impervious Area Runoff

Column (7 & 8)...	Did not specify to use impervious areas.

Incremental Weighted Runoff

Column (9)	R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t) R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS Unit Hydrograph Method

Column (10)	Q(t) is computed with the SCS unit hydrograph method using R(t) and Qu(t).

Subsection: Unit Hydrograph Summary
Label: Existing Inflow
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Storm Event	SCS
Return Event	100 years
Duration	2,000.0 min
Depth	7.2 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	77.613 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	77.613 ft³/s

Drainage Area	
SCS CN (Composite)	86.665
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.5 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.6 in
Runoff Volume (Pervious)	191,988.787 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	191,989.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Unit Hydrograph Summary
Label: Master Plan Improvements Inflow
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Storm Event	SCS
Return Event	100 years
Duration	2,000.0 min
Depth	7.2 in
Time of Concentration (Composite)	3.2 min
Area (User Defined)	408,187.000 ft²

Computational Time Increment	6.0 min
Time to Peak (Computed)	714.0 min
Flow (Peak, Computed)	79.262 ft³/s
Output Increment	1.0 min
Time to Flow (Peak Interpolated Output)	714.0 min
Flow (Peak Interpolated Output)	79.262 ft³/s

Drainage Area	
SCS CN (Composite)	88.112
Area (User Defined)	408,187.000 ft²
Maximum Retention (Pervious)	1.3 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.8 in
Runoff Volume (Pervious)	197,651.877 ft³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	197,652.000 ft³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	3.2 min
Computational Time Increment	6.0 min
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	86.210 ft³/s
Unit peak time, Tp	4.9 min
Unit receding limb, Tr	19.7 min
Total unit time, Tb	24.6 min

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
590.00	0.117	0.000	5,500.000	0.000	0.117	0.117
590.05	0.117	283.332	5,834.950	0.000	0.117	9.561
590.10	0.117	583.660	6,179.800	0.000	0.117	19.572
590.15	0.117	901.477	6,534.550	0.000	0.117	30.166
590.20	0.117	1,237.280	6,899.200	0.000	0.117	41.359
590.25	0.117	1,591.563	7,273.750	0.000	0.117	53.169
590.30	0.117	1,964.820	7,658.200	0.000	0.117	65.611
590.35	0.117	2,357.548	8,052.550	0.000	0.117	78.701
590.40	0.117	2,770.240	8,456.800	0.000	0.117	92.458
590.45	0.117	3,203.393	8,870.950	0.000	0.117	106.896
590.50	0.117	3,657.500	9,295.000	0.000	0.117	122.033
590.55	0.117	4,133.057	9,728.950	0.000	0.117	137.885
590.60	0.117	4,630.560	10,172.800	0.000	0.117	154.469
590.65	0.117	5,150.502	10,626.550	0.000	0.117	171.800
590.70	0.117	5,693.380	11,090.200	0.000	0.117	189.896
590.75	0.117	6,259.688	11,563.750	0.000	0.117	208.773
590.80	0.117	6,849.920	12,047.200	0.000	0.117	228.447
590.85	0.117	7,464.573	12,540.550	0.000	0.117	248.936
590.90	0.117	8,104.140	13,043.800	0.000	0.117	270.255
590.95	0.117	8,769.118	13,556.950	0.000	0.117	292.420
591.00	0.117	9,460.000	14,080.000	0.000	0.117	315.450
591.05	0.117	10,165.783	14,151.353	0.000	0.117	338.976
591.10	0.117	10,875.138	14,222.886	0.000	0.117	362.621
591.15	0.117	11,588.075	14,294.600	0.000	0.117	386.386
591.20	0.117	12,304.601	14,366.494	0.000	0.117	410.270
591.25	0.117	13,024.727	14,438.569	0.000	0.117	434.274
591.30	0.117	13,748.461	14,510.823	0.000	0.117	458.399
591.35	0.117	14,475.813	14,583.259	0.000	0.117	482.644
591.40	0.117	15,206.790	14,655.874	0.000	0.117	507.010
591.45	0.117	15,941.403	14,728.670	0.000	0.117	531.497
591.50	0.117	16,679.660	14,801.646	0.000	0.117	556.105
591.55	0.120	17,421.570	14,874.802	0.000	0.120	580.839
591.60	0.131	18,167.143	14,948.139	0.000	0.131	605.702
591.65	0.149	18,916.387	15,021.656	0.000	0.149	630.696
591.70	0.171	19,669.312	15,095.354	0.000	0.171	655.815

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
591.75	0.200	20,425.926	15,169.232	0.000	0.200	681.064
591.80	0.215	21,186.238	15,243.290	0.000	0.215	706.423
591.85	0.227	21,950.258	15,317.528	0.000	0.227	731.903
591.90	0.240	22,717.994	15,391.947	0.000	0.240	757.507
591.95	0.250	23,489.455	15,466.546	0.000	0.250	783.232
592.00	0.260	24,264.652	15,541.326	0.000	0.260	809.082
592.05	0.270	25,043.591	15,616.286	0.000	0.270	835.056
592.10	0.279	25,826.283	15,691.426	0.000	0.279	861.155
592.15	0.287	26,612.737	15,766.746	0.000	0.287	887.378
592.20	0.294	27,402.961	15,842.247	0.000	0.294	913.726
592.25	0.303	28,196.964	15,917.929	0.000	0.303	940.202
592.30	0.310	28,994.757	15,993.790	0.000	0.310	966.802
592.35	0.317	29,796.346	16,069.832	0.000	0.317	993.529
592.40	0.324	30,601.743	16,146.054	0.000	0.324	1,020.382
592.45	0.330	31,410.955	16,222.457	0.000	0.330	1,047.361
592.50	0.336	32,223.992	16,299.040	0.000	0.336	1,074.469
592.55	0.343	33,040.862	16,375.803	0.000	0.343	1,101.705
592.60	0.349	33,861.575	16,452.747	0.000	0.349	1,129.068
592.65	0.354	34,686.140	16,529.871	0.000	0.354	1,156.559
592.70	0.362	35,514.565	16,607.175	0.000	0.362	1,184.181
592.75	0.366	36,346.860	16,684.660	0.000	0.366	1,211.928
592.80	0.372	37,183.034	16,762.325	0.000	0.372	1,239.807
592.85	0.377	38,023.096	16,840.170	0.000	0.377	1,267.813
592.90	0.381	38,867.054	16,918.196	0.000	0.381	1,295.949
592.95	0.388	39,714.918	16,996.402	0.000	0.388	1,324.218
593.00	0.393	40,566.697	17,074.788	0.000	0.393	1,352.616
593.05	0.398	41,422.400	17,153.355	0.000	0.398	1,381.145
593.10	0.402	42,282.036	17,232.102	0.000	0.402	1,409.803
593.15	0.408	43,145.613	17,311.029	0.000	0.408	1,438.595
593.20	0.413	44,013.141	17,390.137	0.000	0.413	1,467.517
593.25	0.418	44,884.630	17,469.425	0.000	0.418	1,496.572
593.30	0.422	45,760.087	17,548.893	0.000	0.422	1,525.758
593.35	0.425	46,639.522	17,628.542	0.000	0.425	1,555.076
593.36	0.427	46,815.887	17,644.493	0.000	0.427	1,560.957
593.40	0.863	47,522.944	17,708.371	0.000	0.863	1,584.961
593.45	1.893	48,410.362	17,788.380	0.000	1.893	1,615.572
593.50	3.268	49,301.785	17,868.570	0.000	3.268	1,646.661
593.55	4.920	50,197.222	17,948.940	0.000	4.920	1,678.161
593.60	6.800	51,096.682	18,029.491	0.000	6.800	1,710.023
593.65	8.893	52,000.174	18,110.221	0.000	8.893	1,742.232
593.70	11.169	52,907.707	18,191.133	0.000	11.169	1,774.759
593.75	13.606	53,819.291	18,272.224	0.000	13.606	1,807.582
593.80	16.229	54,734.933	18,353.496	0.000	16.229	1,840.727
593.85	18.982	55,654.643	18,434.948	0.000	18.982	1,874.136
593.90	21.899	56,578.431	18,516.580	0.000	21.899	1,907.846
593.95	24.940	57,506.304	18,598.393	0.000	24.940	1,941.816
594.00	28.120	58,438.273	18,680.386	0.000	28.120	1,976.063
594.05	31.432	59,374.346	18,762.560	0.000	31.432	2,010.577
594.10	34.857	60,314.532	18,844.914	0.000	34.857	2,045.341

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
594.15	38.397	61,258.840	18,927.448	0.000	38.397	2,080.359
594.20	42.033	62,207.280	19,010.163	0.000	42.033	2,115.609
594.25	45.776	63,159.859	19,093.057	0.000	45.776	2,151.105
594.30	49.627	64,116.588	19,176.133	0.000	49.627	2,186.846
594.35	53.537	65,077.476	19,259.388	0.000	53.537	2,222.786
594.40	57.590	66,042.530	19,342.824	0.000	57.590	2,259.008
594.45	61.679	67,011.761	19,426.440	0.000	61.679	2,295.404
594.50	63.741	67,985.177	19,510.237	0.000	63.741	2,329.914
594.55	64.039	68,962.788	19,594.214	0.000	64.039	2,362.799
594.60	64.337	69,944.602	19,678.371	0.000	64.337	2,395.824
594.65	64.635	70,930.628	19,762.709	0.000	64.635	2,428.990
594.70	64.921	71,920.876	19,847.227	0.000	64.921	2,462.284
594.75	65.219	72,915.354	19,931.925	0.000	65.219	2,495.731
594.80	65.506	73,914.071	20,016.803	0.000	65.506	2,529.308
594.85	65.804	74,917.037	20,101.862	0.000	65.804	2,563.038
594.90	66.090	75,924.260	20,187.102	0.000	66.090	2,596.898
594.95	66.376	76,935.750	20,272.521	0.000	66.376	2,630.901
595.00	66.662	77,951.515	20,358.121	0.000	66.662	2,665.046
595.05	66.948	78,971.565	20,443.902	0.000	66.948	2,699.333
595.10	67.228	79,995.909	20,529.862	0.000	67.228	2,733.758
595.15	67.508	81,024.555	20,616.003	0.000	67.508	2,768.327
595.20	67.794	82,057.512	20,702.325	0.000	67.794	2,803.045
595.25	68.069	83,094.790	20,788.826	0.000	68.069	2,837.895
595.30	68.355	84,136.398	20,875.508	0.000	68.355	2,872.901
595.35	68.629	85,182.344	20,962.371	0.000	68.629	2,908.040
595.40	68.903	86,232.638	21,049.413	0.000	68.903	2,943.324
595.45	69.177	87,287.288	21,136.636	0.000	69.177	2,978.753
595.50	69.451	88,346.304	21,224.040	0.000	69.451	3,014.328
595.55	69.726	89,409.695	21,311.624	0.000	69.726	3,050.049
595.60	70.000	90,477.470	21,399.388	0.000	70.000	3,085.915
595.65	70.268	91,549.637	21,487.332	0.000	70.268	3,121.922
595.70	70.536	92,626.206	21,575.457	0.000	70.536	3,158.076
595.75	70.810	93,707.186	21,663.762	0.000	70.810	3,194.383
595.80	71.073	94,792.585	21,752.247	0.000	71.073	3,230.825
595.85	71.347	95,882.413	21,840.913	0.000	71.347	3,267.427
595.90	71.609	96,976.679	21,929.759	0.000	71.609	3,304.165
595.95	71.871	98,075.392	22,018.786	0.000	71.871	3,341.051
596.00	72.134	99,178.561	22,107.992	0.000	72.134	3,378.086
596.05	72.396	100,286.195	22,197.380	0.000	72.396	3,415.269
596.10	72.658	101,398.302	22,286.947	0.000	72.658	3,452.601
596.15	72.920	102,514.892	22,376.695	0.000	72.920	3,490.083
596.20	73.183	103,635.974	22,466.623	0.000	73.183	3,527.715
596.25	73.445	104,761.558	22,556.732	0.000	73.445	3,565.497
596.30	73.695	105,891.651	22,647.020	0.000	73.695	3,603.417
596.35	73.957	107,026.263	22,737.490	0.000	73.957	3,641.500
596.40	74.214	108,165.403	22,828.139	0.000	74.214	3,679.727
596.45	74.470	109,309.080	22,918.969	0.000	74.470	3,718.106
596.50	74.720	110,457.302	23,009.979	0.000	74.720	3,756.630
596.55	74.983	111,610.080	23,101.170	0.000	74.983	3,795.319

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
596.60	75.233	112,767.422	23,192.541	0.000	75.233	3,834.147
596.65	75.483	113,929.338	23,284.092	0.000	75.483	3,873.128
596.70	75.734	115,095.835	23,375.823	0.000	75.734	3,912.261
596.75	75.984	116,266.923	23,467.735	0.000	75.984	3,951.548
596.80	76.234	117,442.611	23,559.828	0.000	76.234	3,990.988
596.85	76.485	118,622.909	23,652.100	0.000	76.485	4,030.582
596.90	76.735	119,807.824	23,744.553	0.000	76.735	4,070.329
596.95	76.979	120,997.367	23,837.186	0.000	76.979	4,110.225
597.00	77.224	122,191.546	23,930.000	0.000	77.224	4,150.275

Subsection: Level Pool Pond Routing Summary
Label: Nested Bioretention Basin (IN)
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	590.00 ft
Volume (Initial)	0.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	79.262 ft³/s	Time to Peak (Flow, In)	714.0 min
Flow (Peak Outlet)	63.635 ft³/s	Time to Peak (Flow, Outlet)	720.0 min

Elevation (Water Surface, Peak)	594.50 ft
Volume (Peak)	67,934.924 ft³

Mass Balance (ft³)	
Volume (Initial)	0.000 ft³
Volume (Total Inflow)	197,652.000 ft³
Volume (Total Infiltration)	0.000 ft³
Volume (Total Outlet Outflow)	163,490.000 ft³
Volume (Retained)	34,142.000 ft³
Volume (Unrouted)	-20.000 ft³
Error (Mass Balance)	0.0 %

Subsection: Pond Inflow Summary
Label: Nested Bioretention Basin (IN)
Scenario: 100 yrs

Return Event: 100 years
Storm Event: SCS

Summary for Hydrograph Addition at 'Nested Bioretention Basin'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	Master Plan Improvements Inflow

Node Inflows

Inflow Type	Element	Volume (ft^3)	Time to Peak (min)	Flow (Peak) (ft^3/s)
Flow (From)	Master Plan Improvements Inflow	197,651.775	714.0	79.262
Flow (In)	Nested Bioretention Basin	197,651.775	714.0	79.262

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Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Inflow	100 yr LFB	100	191,989.000	714.0	77.613
Master Plan Improvements Inflow	100 yr LFB	100	197,652.000	714.0	79.262

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)
Existing Outfall	100 yr LFB	100	191,989.000	714.0	77.613
Master Plan Improvements Outfall	100 yr LFB	100	200,858.000	720.0	64.053

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (min)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft^3)
Nested Bioretention Basin (IN)	100 yr LFB	100	197,652.000	714.0	79.262	(N/A)	(N/A)
Nested Bioretention Basin (OUT)	100 yr LFB	100	200,858.000	720.0	64.053	594.55	69,012.000

Subsection: Outlet Input Data
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Requested Pond Water Surface Elevations	
Minimum (Headwater)	590.00 ft
Increment (Headwater)	0.05 ft
Maximum (Headwater)	597.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Overflow Pipe	Forward	Outfall Pipe	593.36	597.00
User Defined Table	Bioretentio n Filter	Forward	Outfall Pipe	590.00	597.00
Culvert-Circular	Outfall Pipe	Forward	TW	587.50	597.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Structure ID: Outfall Pipe Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	30.00 in
Length	125.00 ft
Length (Computed Barrel)	125.20 ft
Slope (Computed)	0.057 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.009
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.067
T2 ratio (HW/D)	1.169
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	590.17 ft	T1 Flow	27.165 ft³/s
T2 Elevation	590.42 ft	T2 Flow	31.046 ft³/s

Subsection: Outlet Input Data
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Structure ID: Overflow Pipe
Structure Type: Inlet Box

Number of Openings	1
Elevation	593.36 ft
Orifice Area	18.00 ft²
Orifice Coefficient	0.600
Weir Length	18.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Bioretention Filter
Structure Type: User Defined Table

Elevation (ft)	Flow (ft³/s)
0.00	0.116
1.50	0.116
7.00	0.116

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
590.00	0.117	583.41	0.00
590.05	0.117	583.41	0.00
590.10	0.117	583.41	0.00
590.15	0.117	583.41	0.00
590.20	0.117	583.41	0.00
590.25	0.117	583.41	0.00
590.30	0.117	583.41	0.00
590.35	0.117	583.41	0.00
590.40	0.117	583.41	0.00
590.45	0.117	583.41	0.00
590.50	0.117	583.41	0.00
590.55	0.117	583.41	0.00
590.60	0.117	583.41	0.00
590.65	0.117	583.41	0.00
590.70	0.117	583.41	0.00
590.75	0.117	583.41	0.00
590.80	0.117	583.41	0.00
590.85	0.117	583.41	0.00
590.90	0.117	583.41	0.00
590.95	0.117	583.41	0.00
591.00	0.117	583.41	0.00
591.05	0.117	583.41	0.00
591.10	0.117	583.41	0.00
591.15	0.117	583.41	0.00
591.20	0.117	583.41	0.00
591.25	0.117	583.41	0.00
591.30	0.117	583.41	0.00
591.35	0.117	583.41	0.00
591.40	0.117	583.41	0.00
591.45	0.117	583.41	0.00
591.50	0.117	583.41	0.00
591.55	0.117	583.41	0.00
591.60	0.117	583.41	0.00
591.65	0.117	583.41	0.00
591.70	0.117	583.41	0.00
591.75	0.117	583.41	0.00
591.80	0.117	583.41	0.00
591.85	0.117	583.41	0.00
591.90	0.117	583.41	0.00
591.95	0.117	583.41	0.00
592.00	0.117	583.41	0.00
592.05	0.117	583.41	0.00
592.10	0.117	583.41	0.00
592.15	0.117	583.41	0.00
592.20	0.117	583.41	0.00
592.25	0.117	583.41	0.00
592.30	0.117	583.41	0.00
592.35	0.117	583.41	0.00

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
592.40	0.117	583.41	0.00
592.45	0.117	583.41	0.00
592.50	0.117	583.41	0.00
592.55	0.117	583.41	0.00
592.60	0.117	583.41	0.00
592.65	0.117	583.41	0.00
592.70	0.117	583.41	0.00
592.75	0.117	583.41	0.00
592.80	0.117	583.41	0.00
592.85	0.117	583.41	0.00
592.90	0.117	583.41	0.00
592.95	0.117	583.41	0.00
593.00	0.117	583.41	0.00
593.05	0.117	583.41	0.00
593.10	0.117	583.41	0.00
593.15	0.117	583.41	0.00
593.20	0.117	583.41	0.00
593.25	0.117	583.41	0.00
593.30	0.117	583.41	0.00
593.35	0.117	583.41	0.00
593.36	0.117	583.41	0.00
593.40	0.548	583.41	0.00
593.45	1.574	583.41	0.00
593.50	2.947	583.41	0.00
593.55	4.587	583.41	0.00
593.60	6.461	583.41	0.00
593.65	8.548	583.41	0.00
593.70	10.816	583.41	0.00
593.75	13.260	583.41	0.00
593.80	15.877	583.41	0.00
593.85	18.635	583.41	0.00
593.90	21.544	583.41	0.00
593.95	24.600	583.41	0.00
594.00	27.772	583.41	0.00
594.05	31.061	583.41	0.00
594.10	34.482	583.41	0.00
594.15	38.028	583.41	0.00
594.20	41.687	583.41	0.00
594.25	45.455	583.41	0.00
594.30	49.329	583.41	0.00
594.35	53.310	583.41	0.00
594.40	57.387	583.41	0.00
594.45	61.572	583.41	0.00
594.50	63.741	583.41	0.00
594.55	64.039	583.41	0.00
594.60	64.337	583.41	0.00
594.65	64.635	583.41	0.00
594.70	64.921	583.41	0.00

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
594.75	65.219	583.41	0.00
594.80	65.506	583.41	0.00
594.85	65.804	583.41	0.00
594.90	66.090	583.41	0.00
594.95	66.376	583.41	0.00
595.00	66.662	583.41	0.00
595.05	66.948	583.41	0.00
595.10	67.228	583.41	0.00
595.15	67.508	583.41	0.00
595.20	67.794	583.41	0.00
595.25	68.069	583.41	0.00
595.30	68.355	583.41	0.00
595.35	68.629	583.41	0.00
595.40	68.903	583.41	0.00
595.45	69.177	583.41	0.00
595.50	69.451	583.41	0.00
595.55	69.726	583.41	0.00
595.60	70.000	583.41	0.00
595.65	70.268	583.41	0.00
595.70	70.536	583.41	0.00
595.75	70.810	583.41	0.00
595.80	71.073	583.41	0.00
595.85	71.347	583.41	0.00
595.90	71.609	583.41	0.00
595.95	71.871	583.41	0.00
596.00	72.134	583.41	0.00
596.05	72.396	583.41	0.00
596.10	72.658	583.41	0.00
596.15	72.920	583.41	0.00
596.20	73.183	583.41	0.00
596.25	73.445	583.41	0.00
596.30	73.695	583.41	0.00
596.35	73.957	583.41	0.00
596.40	74.214	583.41	0.00
596.45	74.470	583.41	0.00
596.50	74.720	583.41	0.00
596.55	74.983	583.41	0.00
596.60	75.233	583.41	0.00
596.65	75.483	583.41	0.00
596.70	75.734	583.41	0.00
596.75	75.984	583.41	0.00
596.80	76.234	583.41	0.00
596.85	76.485	583.41	0.00
596.90	76.735	583.41	0.00
596.95	76.979	583.41	0.00
597.00	77.224	583.41	0.00

Contributing Structures

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
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Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
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Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
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Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
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Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
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Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Bioretention Filter,Outfall Pipe (no Q: Overflow Pipe)
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
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Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
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Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
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Overflow Pipe,Bioretention Filter,Outfall Pipe
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Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Composite Rating Curve
Label: Bioretention Low Flow Blocked
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Composite Outflow Summary

Contributing Structures
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
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Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe
Overflow Pipe,Bioretention Filter,Outfall Pipe

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	593.34 ft
Volume (Initial)	46,466.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
590.00	0.117	0.000	5,500.000	0.000	0.117	0.117
590.05	0.117	283.333	5,834.982	0.000	0.117	9.561
590.10	0.117	583.663	6,179.866	0.000	0.117	19.572
590.15	0.117	901.485	6,534.652	0.000	0.117	30.166
590.20	0.117	1,237.293	6,899.340	0.000	0.117	41.360
590.25	0.117	1,591.584	7,273.930	0.000	0.117	53.169
590.30	0.117	1,964.851	7,658.421	0.000	0.117	65.612
590.35	0.117	2,357.591	8,052.815	0.000	0.117	78.703
590.40	0.117	2,770.298	8,457.110	0.000	0.117	92.460
590.45	0.117	3,203.467	8,871.307	0.000	0.117	106.899
590.50	0.117	3,657.594	9,295.406	0.000	0.117	122.036
590.55	0.117	4,133.173	9,729.407	0.000	0.117	137.889
590.60	0.117	4,630.699	10,173.310	0.000	0.117	154.473
590.65	0.117	5,150.669	10,627.115	0.000	0.117	171.805
590.70	0.117	5,693.576	11,090.821	0.000	0.117	189.902
590.75	0.117	6,259.916	11,564.430	0.000	0.117	208.780
590.80	0.117	6,850.184	12,047.940	0.000	0.117	228.456
590.85	0.117	7,464.875	12,541.352	0.000	0.117	248.946
590.90	0.117	8,104.484	13,044.666	0.000	0.117	270.266
590.95	0.117	8,769.507	13,557.882	0.000	0.117	292.433
591.00	0.117	9,460.437	14,081.000	0.000	0.117	315.464
591.05	0.117	10,166.271	14,152.354	0.000	0.117	338.992
591.10	0.117	10,875.676	14,223.888	0.000	0.117	362.639
591.15	0.117	11,588.662	14,295.602	0.000	0.117	386.405
591.20	0.117	12,305.239	14,367.497	0.000	0.117	410.291
591.25	0.117	13,025.415	14,439.571	0.000	0.117	434.297
591.30	0.117	13,749.199	14,511.827	0.000	0.117	458.423
591.35	0.117	14,476.601	14,584.262	0.000	0.117	482.670
591.40	0.117	15,207.628	14,656.878	0.000	0.117	507.037
591.45	0.117	15,942.292	14,729.675	0.000	0.117	531.526
591.50	0.117	16,680.599	14,802.651	0.000	0.117	556.136
591.55	0.117	17,422.560	14,875.808	0.000	0.117	580.869
591.60	0.117	18,168.183	14,949.145	0.000	0.117	605.723
591.65	0.117	18,917.477	15,022.663	0.000	0.117	630.699
591.70	0.117	19,670.452	15,096.361	0.000	0.117	655.798

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
591.75	0.117	20,427.116	15,170.239	0.000	0.117	681.020
591.80	0.117	21,187.479	15,244.298	0.000	0.117	706.366
591.85	0.117	21,951.549	15,318.537	0.000	0.117	731.835
591.90	0.117	22,719.336	15,392.956	0.000	0.117	757.428
591.95	0.117	23,490.848	15,467.556	0.000	0.117	783.145
592.00	0.117	24,266.094	15,542.336	0.000	0.117	808.986
592.05	0.117	25,045.084	15,617.296	0.000	0.117	834.953
592.10	0.117	25,827.827	15,692.436	0.000	0.117	861.044
592.15	0.117	26,614.331	15,767.757	0.000	0.117	887.261
592.20	0.117	27,404.606	15,843.259	0.000	0.117	913.603
592.25	0.117	28,198.660	15,918.940	0.000	0.117	940.072
592.30	0.117	28,996.503	15,994.802	0.000	0.117	966.667
592.35	0.117	29,798.143	16,070.844	0.000	0.117	993.388
592.40	0.117	30,603.590	16,147.067	0.000	0.117	1,020.236
592.45	0.117	31,412.853	16,223.470	0.000	0.117	1,047.212
592.50	0.117	32,225.940	16,300.053	0.000	0.117	1,074.315
592.55	0.117	33,042.861	16,376.817	0.000	0.117	1,101.545
592.60	0.117	33,863.625	16,453.761	0.000	0.117	1,128.904
592.65	0.117	34,688.240	16,530.885	0.000	0.117	1,156.391
592.70	0.117	35,516.716	16,608.189	0.000	0.117	1,184.007
592.75	0.117	36,349.062	16,685.674	0.000	0.117	1,211.752
592.80	0.117	37,185.287	16,763.339	0.000	0.117	1,239.626
592.85	0.117	38,025.399	16,841.185	0.000	0.117	1,267.630
592.90	0.117	38,869.408	16,919.211	0.000	0.117	1,295.763
592.95	0.117	39,717.323	16,997.417	0.000	0.117	1,324.027
593.00	0.117	40,569.153	17,075.804	0.000	0.117	1,352.422
593.05	0.117	41,424.907	17,154.371	0.000	0.117	1,380.947
593.10	0.117	42,284.593	17,233.118	0.000	0.117	1,409.603
593.15	0.117	43,148.221	17,312.045	0.000	0.117	1,438.391
593.20	0.117	44,015.801	17,391.153	0.000	0.117	1,467.310
593.25	0.117	44,887.340	17,470.441	0.000	0.117	1,496.361
593.30	0.117	45,762.848	17,549.910	0.000	0.117	1,525.545
593.35	0.117	46,642.334	17,629.559	0.000	0.117	1,554.861
593.36	0.117	46,818.709	17,645.510	0.000	0.117	1,560.740
593.40	0.548	47,525.807	17,709.388	0.000	0.548	1,584.741
593.45	1.574	48,413.275	17,789.398	0.000	1.574	1,615.350
593.50	2.947	49,304.749	17,869.587	0.000	2.947	1,646.438
593.55	4.587	50,200.237	17,949.958	0.000	4.587	1,677.928
593.60	6.461	51,099.748	18,030.508	0.000	6.461	1,709.786
593.65	8.548	52,003.291	18,111.239	0.000	8.548	1,741.991
593.70	10.816	52,910.875	18,192.150	0.000	10.816	1,774.511
593.75	13.260	53,822.509	18,273.242	0.000	13.260	1,807.344
593.80	15.877	54,738.202	18,354.513	0.000	15.877	1,840.483
593.85	18.635	55,657.963	18,435.966	0.000	18.635	1,873.900
593.90	21.544	56,581.802	18,517.598	0.000	21.544	1,907.604
593.95	24.600	57,509.726	18,599.411	0.000	24.600	1,941.590
594.00	27.772	58,441.746	18,681.404	0.000	27.772	1,975.830
594.05	31.061	59,377.870	18,763.578	0.000	31.061	2,010.323
594.10	34.482	60,318.107	18,845.931	0.000	34.482	2,045.086

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
594.15	38.028	61,262.466	18,928.466	0.000	38.028	2,080.110
594.20	41.687	62,210.956	19,011.180	0.000	41.687	2,115.386
594.25	45.455	63,163.587	19,094.075	0.000	45.455	2,150.907
594.30	49.329	64,120.367	19,177.150	0.000	49.329	2,186.674
594.35	53.310	65,081.305	19,260.406	0.000	53.310	2,222.687
594.40	57.387	66,046.410	19,343.841	0.000	57.387	2,258.934
594.45	61.572	67,015.692	19,427.458	0.000	61.572	2,295.428
594.50	63.741	67,989.159	19,511.254	0.000	63.741	2,330.047
594.55	64.039	68,966.820	19,595.231	0.000	64.039	2,362.933
594.60	64.337	69,948.685	19,679.388	0.000	64.337	2,395.960
594.65	64.635	70,934.762	19,763.725	0.000	64.635	2,429.127
594.70	64.921	71,925.061	19,848.243	0.000	64.921	2,462.423
594.75	65.219	72,919.589	19,932.941	0.000	65.219	2,495.872
594.80	65.506	73,918.358	20,017.820	0.000	65.506	2,529.451
594.85	65.804	74,921.374	20,102.879	0.000	65.804	2,563.183
594.90	66.090	75,928.649	20,188.118	0.000	66.090	2,597.045
594.95	66.376	76,940.189	20,273.537	0.000	66.376	2,631.049
595.00	66.662	77,956.005	20,359.137	0.000	66.662	2,665.195
595.05	66.948	78,976.106	20,444.917	0.000	66.948	2,699.485
595.10	67.228	80,000.500	20,530.878	0.000	67.228	2,733.911
595.15	67.508	81,029.197	20,617.018	0.000	67.508	2,768.481
595.20	67.794	82,062.205	20,703.339	0.000	67.794	2,803.201
595.25	68.069	83,099.534	20,789.841	0.000	68.069	2,838.053
595.30	68.355	84,141.192	20,876.523	0.000	68.355	2,873.061
595.35	68.629	85,187.189	20,963.385	0.000	68.629	2,908.202
595.40	68.903	86,237.533	21,050.427	0.000	68.903	2,943.487
595.45	69.177	87,292.235	21,137.650	0.000	69.177	2,978.918
595.50	69.451	88,351.302	21,225.053	0.000	69.451	3,014.495
595.55	69.726	89,414.743	21,312.637	0.000	69.726	3,050.217
595.60	70.000	90,482.568	21,400.400	0.000	70.000	3,086.085
595.65	70.268	91,554.786	21,488.344	0.000	70.268	3,122.094
595.70	70.536	92,631.406	21,576.469	0.000	70.536	3,158.250
595.75	70.810	93,712.436	21,664.774	0.000	70.810	3,194.558
595.80	71.073	94,797.886	21,753.259	0.000	71.073	3,231.002
595.85	71.347	95,887.765	21,841.924	0.000	71.347	3,267.606
595.90	71.609	96,982.081	21,930.770	0.000	71.609	3,304.345
595.95	71.871	98,080.845	22,019.796	0.000	71.871	3,341.233
596.00	72.134	99,184.064	22,109.002	0.000	72.134	3,378.269
596.05	72.396	100,291.748	22,198.389	0.000	72.396	3,415.454
596.10	72.658	101,403.906	22,287.956	0.000	72.658	3,452.788
596.15	72.920	102,520.547	22,377.704	0.000	72.920	3,490.272
596.20	73.183	103,641.679	22,467.631	0.000	73.183	3,527.905
596.25	73.445	104,767.313	22,557.739	0.000	73.445	3,565.689
596.30	73.695	105,897.456	22,648.028	0.000	73.695	3,603.610
596.35	73.957	107,032.119	22,738.496	0.000	73.957	3,641.695
596.40	74.214	108,171.309	22,829.145	0.000	74.214	3,679.924
596.45	74.470	109,315.036	22,919.975	0.000	74.470	3,718.305
596.50	74.720	110,463.309	23,010.985	0.000	74.720	3,756.831
596.55	74.983	111,616.138	23,102.175	0.000	74.983	3,795.521

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Nested Bioretention Basin
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Elevation (ft)	Outflow (ft^3/s)	Storage (ft^3)	Area (ft^2)	Infiltration (ft^3/s)	Flow (Total) (ft^3/s)	2S/t + O (ft^3/s)
596.60	75.233	112,773.530	23,193.545	0.000	75.233	3,834.351
596.65	75.483	113,935.495	23,285.096	0.000	75.483	3,873.333
596.70	75.734	115,102.042	23,376.827	0.000	75.734	3,912.468
596.75	75.984	116,273.181	23,468.738	0.000	75.984	3,951.757
596.80	76.234	117,448.919	23,560.830	0.000	76.234	3,991.198
596.85	76.485	118,629.267	23,653.102	0.000	76.485	4,030.794
596.90	76.735	119,814.232	23,745.554	0.000	76.735	4,070.543
596.95	76.979	121,003.825	23,838.187	0.000	76.979	4,110.440
597.00	77.224	122,198.054	23,931.000	0.000	77.224	4,150.492

Subsection: Level Pool Pond Routing Summary
Label: Nested Bioretention Basin (IN)
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	593.34 ft
Volume (Initial)	46,466.000 ft³
Flow (Initial Outlet)	0.117 ft³/s
Flow (Initial Infiltration)	0.000 ft³/s
Flow (Initial, Total)	0.117 ft³/s
Time Increment	1.0 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	79.262 ft³/s	Time to Peak (Flow, In)	714.0 min
Flow (Peak Outlet)	64.053 ft³/s	Time to Peak (Flow, Outlet)	720.0 min

Elevation (Water Surface, Peak)	594.55 ft
Volume (Peak)	69,011.543 ft³

Mass Balance (ft³)	
Volume (Initial)	46,466.000 ft³
Volume (Total Inflow)	197,652.000 ft³
Volume (Total Infiltration)	0.000 ft³
Volume (Total Outlet Outflow)	200,858.000 ft³
Volume (Retained)	43,252.000 ft³
Volume (Unrouted)	-7.000 ft³
Error (Mass Balance)	0.0 %

Subsection: Pond Inflow Summary
Label: Nested Bioretention Basin (IN)
Scenario: 100 yr LFB

Return Event: 100 years
Storm Event: SCS

Summary for Hydrograph Addition at 'Nested Bioretention Basin'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	Master Plan Improvements Inflow

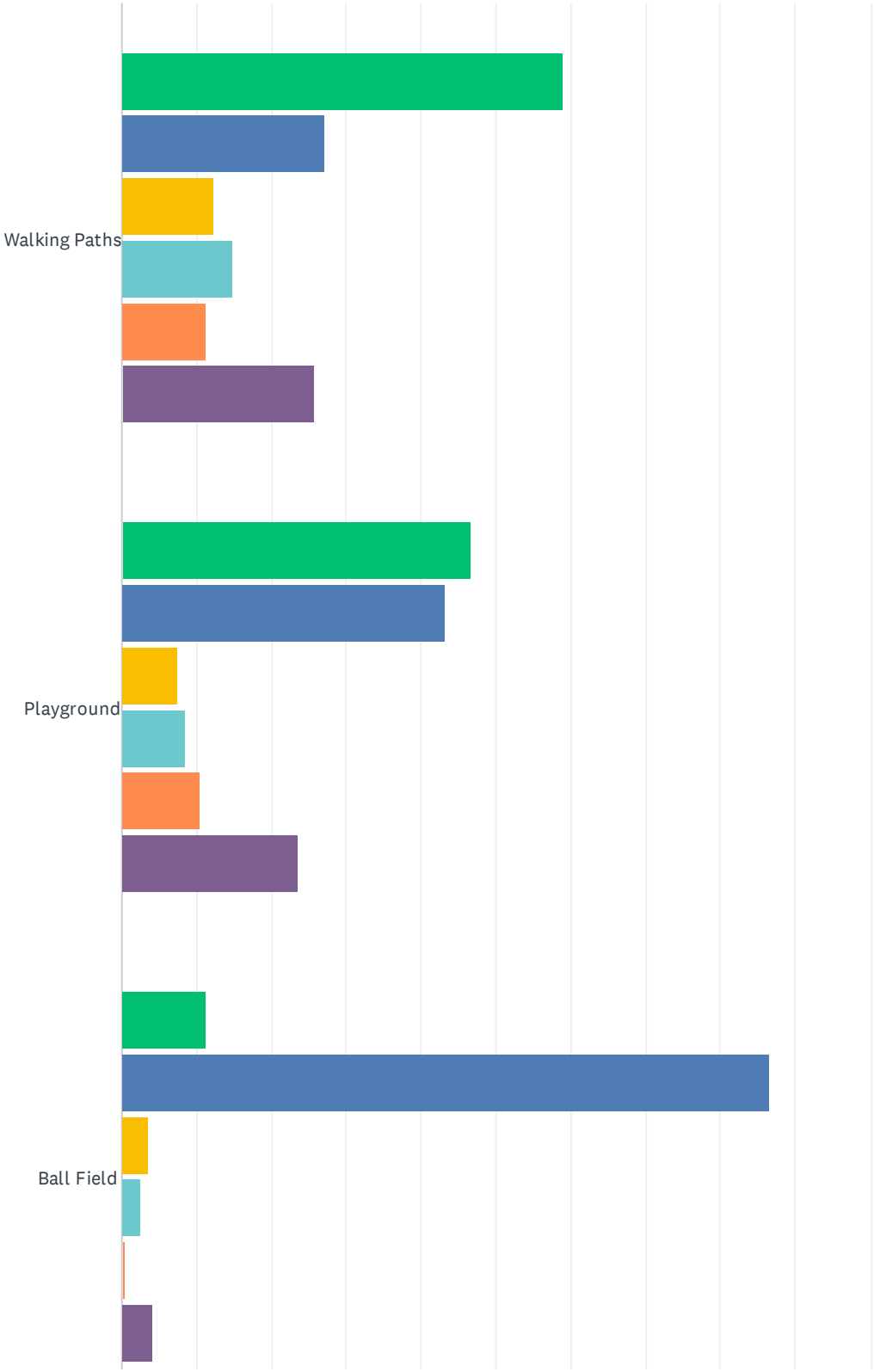
Node Inflows

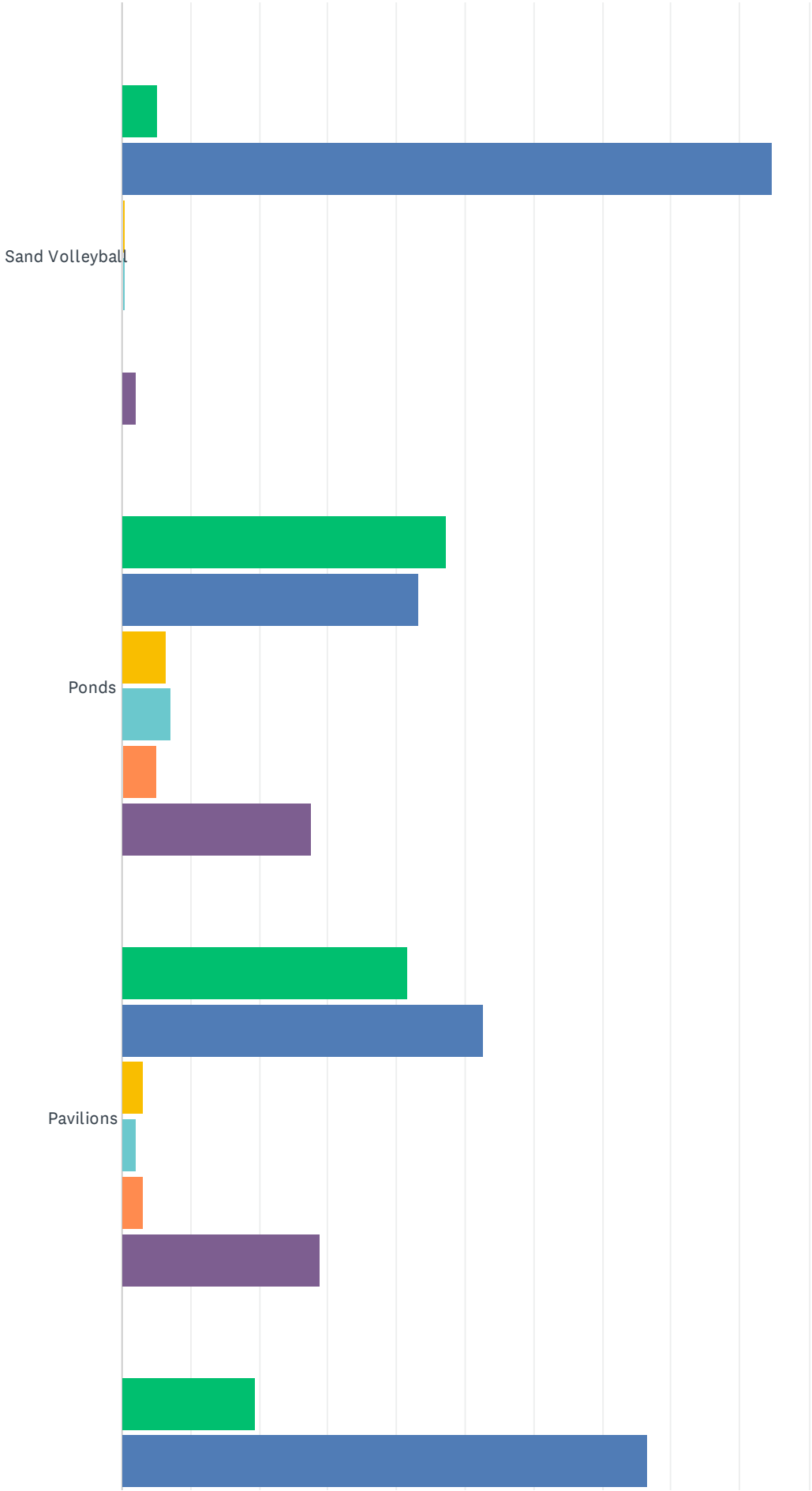
Inflow Type	Element	Volume (ft³)	Time to Peak (min)	Flow (Peak) (ft³/s)
Flow (From)	Master Plan Improvements Inflow	197,651.775	714.0	79.262
Flow (In)	Nested Bioretention Basin	197,651.775	714.0	79.262

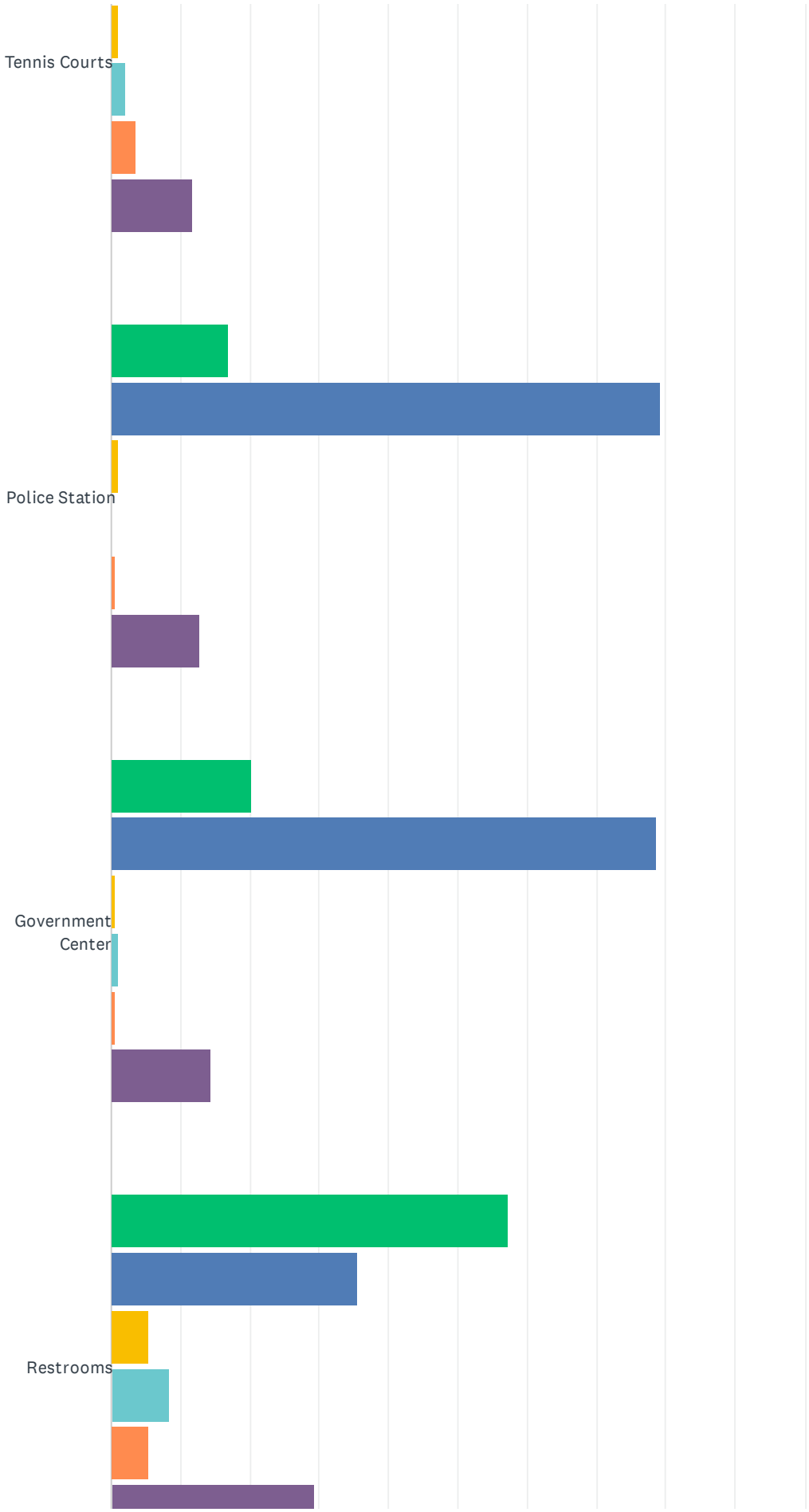
Index

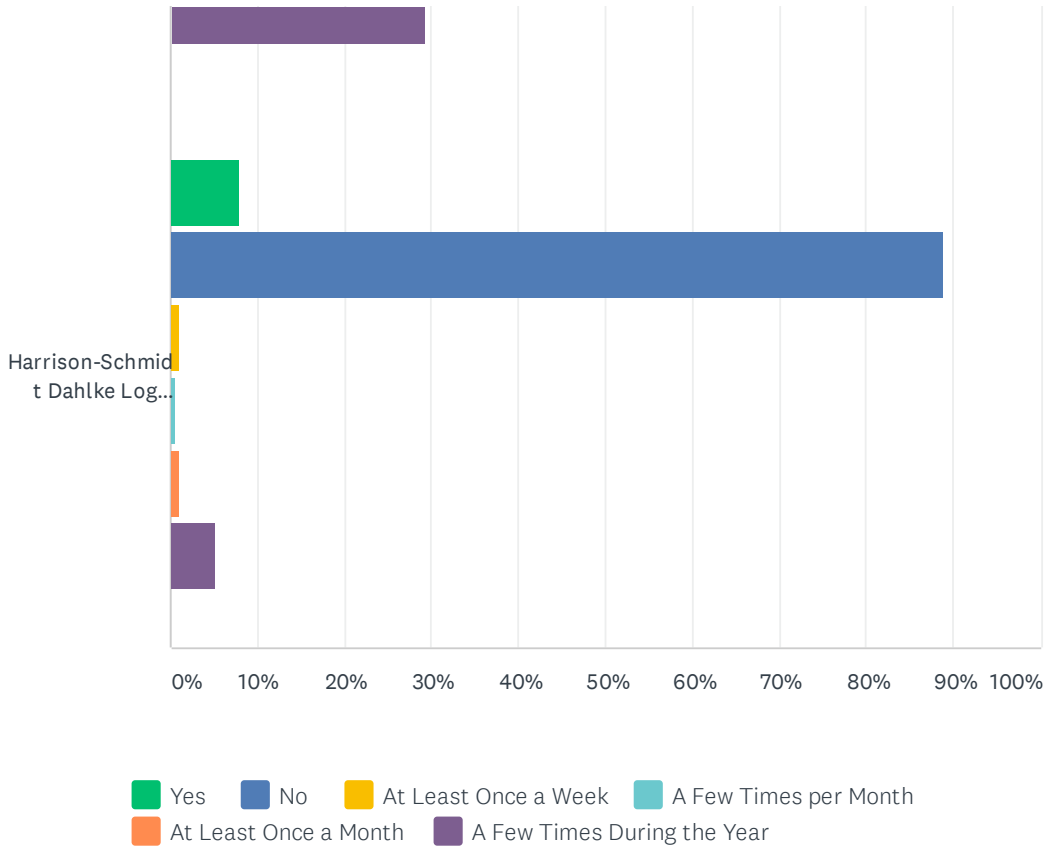
Q1 Have you or members of your household visited Vlasis Park, and used its amenities during the past year? FOR EACH YES: How often did you or members of your household use each amenity during the past 12 months?

Answered: 210 Skipped: 0




Sand Volleyball
Ponds
Pavilions

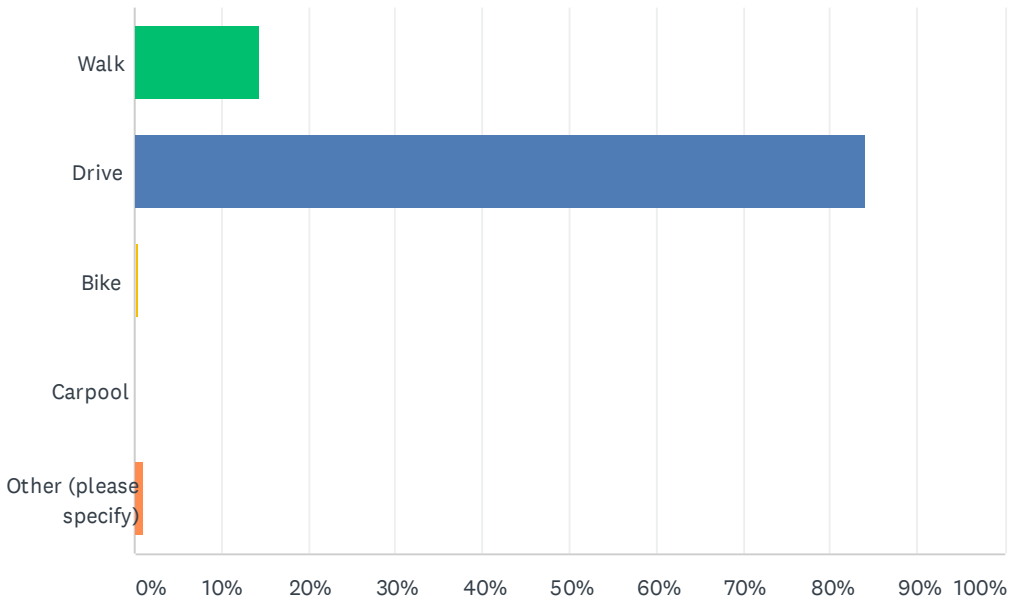

Tennis Courts
Police Station
Government Center
Restrooms



	YES	NO	AT LEAST ONCE A WEEK	A FEW TIMES PER MONTH	AT LEAST ONCE A MONTH	A FEW TIMES DURING THE YEAR	TOTAL RESPONDENTS
Walking Paths	58.91% 119	27.23% 55	12.38% 25	14.85% 30	11.39% 23	25.74% 52	202
Playground	46.73% 93	43.22% 86	7.54% 15	8.54% 17	10.55% 21	23.62% 47	199
Ball Field	11.34% 22	86.60% 168	3.61% 7	2.58% 5	0.52% 1	4.12% 8	194
Sand Volleyball	5.18% 10	94.82% 183	0.52% 1	0.52% 1	0.00% 0	2.07% 4	193
Ponds	47.24% 94	43.22% 86	6.53% 13	7.04% 14	5.03% 10	27.64% 55	199
Pavilions	41.62% 82	52.79% 104	3.05% 6	2.03% 4	3.05% 6	28.93% 57	197
Tennis Courts	19.39% 38	76.53% 150	1.02% 2	2.04% 4	3.57% 7	11.73% 23	196
Police Station	16.93% 32	79.37% 150	1.06% 2	0.00% 0	0.53% 1	12.70% 24	189
Government Center	20.21% 38	78.72% 148	0.53% 1	1.06% 2	0.53% 1	14.36% 27	188
Restrooms	57.43% 116	35.64% 72	5.45% 11	8.42% 17	5.45% 11	29.21% 59	202
Harrison-Schmidt Dahlke Log House	7.89% 15	88.95% 169	1.05% 2	0.53% 1	1.05% 2	5.26% 10	190

Q2 And how do you typically travel to Vlasis Park?

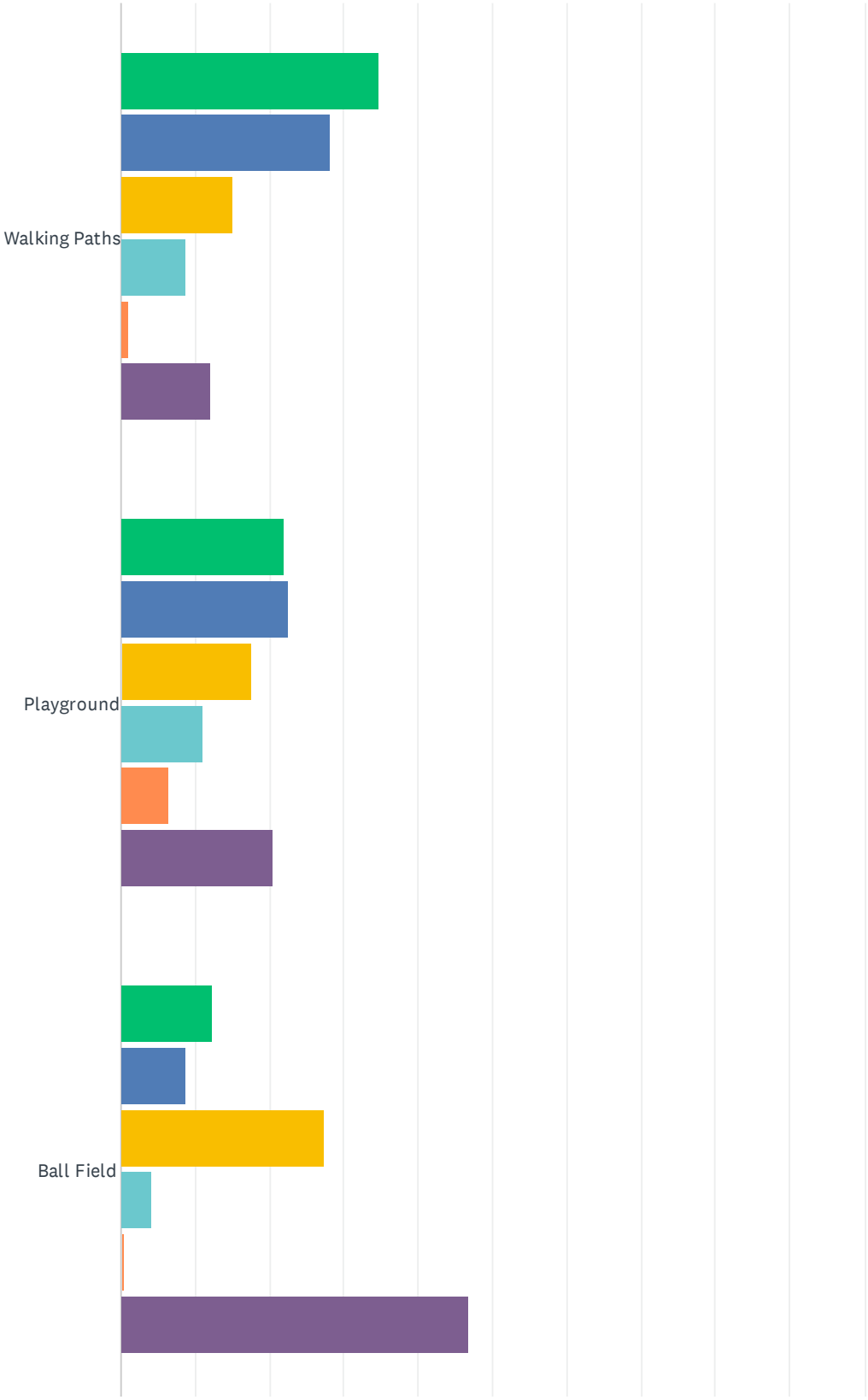
Answered: 207 Skipped: 3

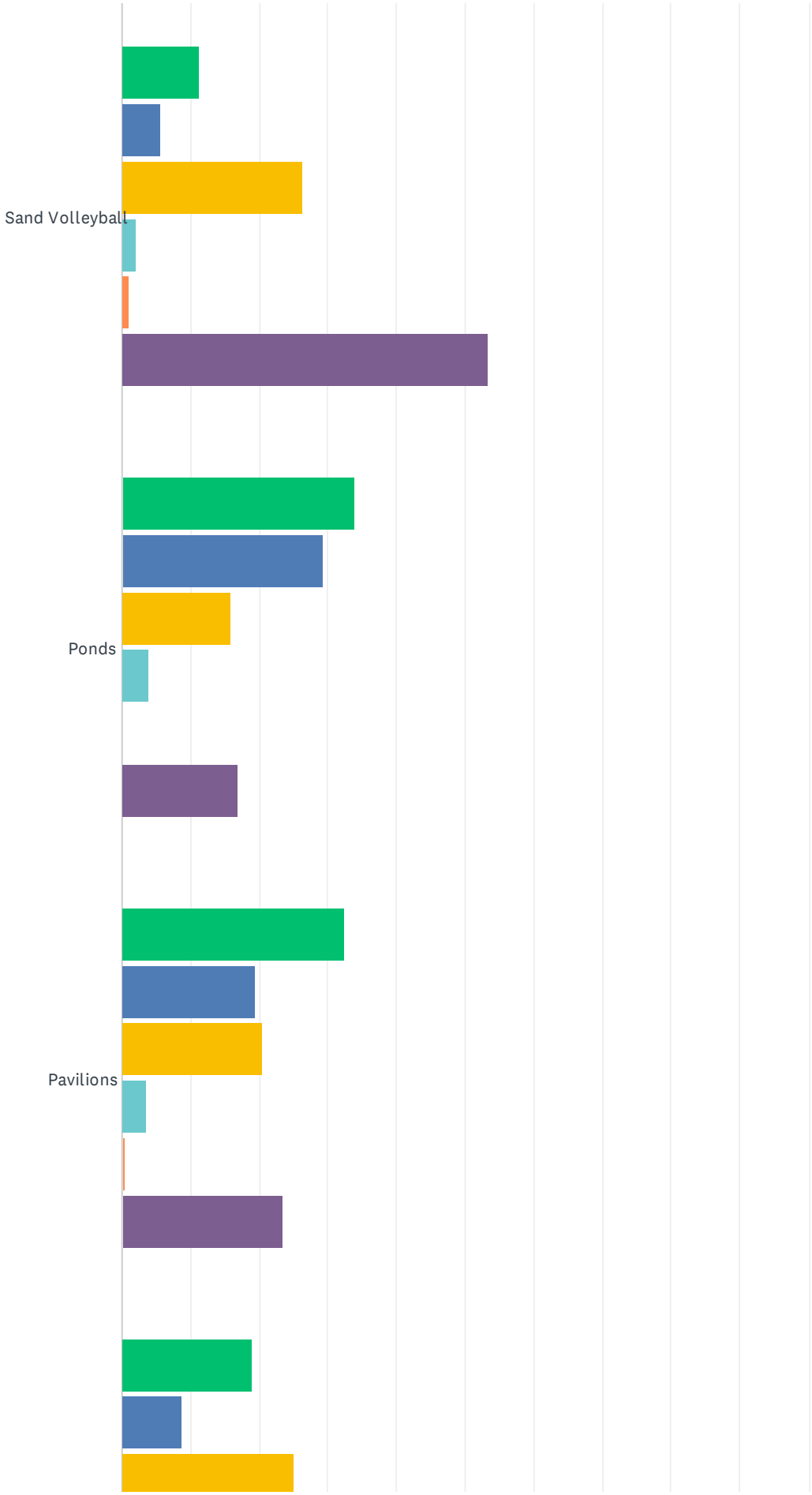


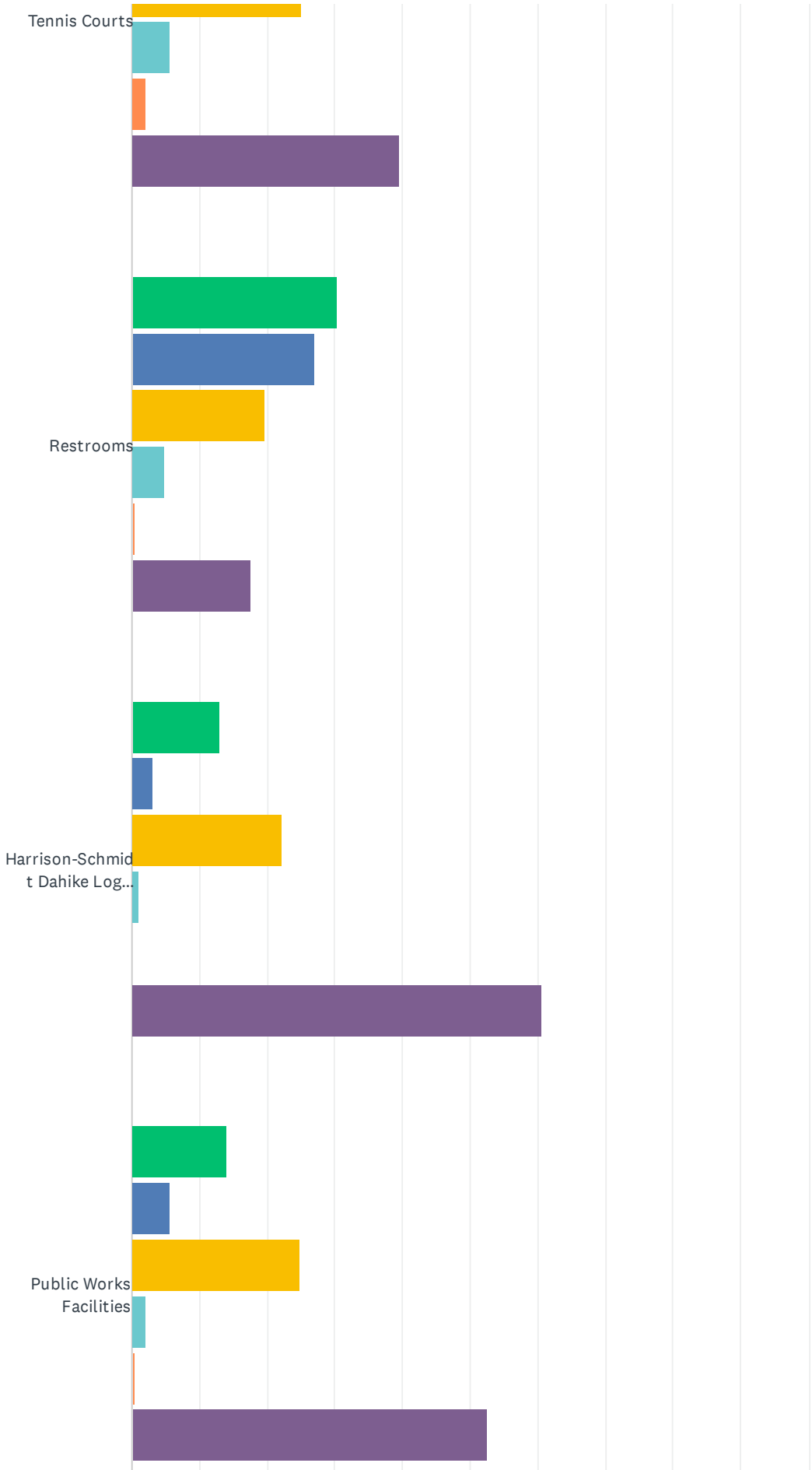
ANSWER CHOICES	RESPONSES	
Walk	14.49%	30
Drive	84.06%	174
Bike	0.48%	1
Carpool	0.00%	0
Other (please specify)	0.97%	2
TOTAL		207

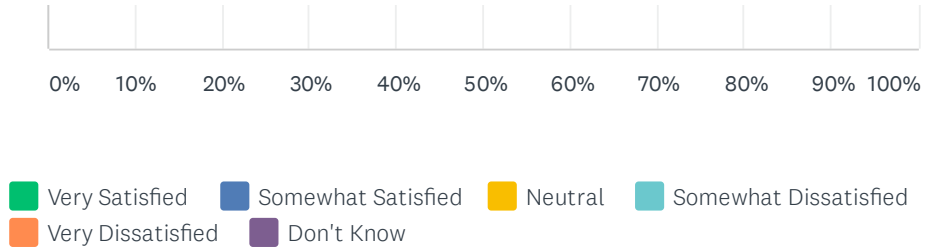
Q3 How satisfied are you with the physical conditions of each of the following at Vlasis Park?

Answered: 210 Skipped: 0




Sand Volleyball
Ponds
Pavilions

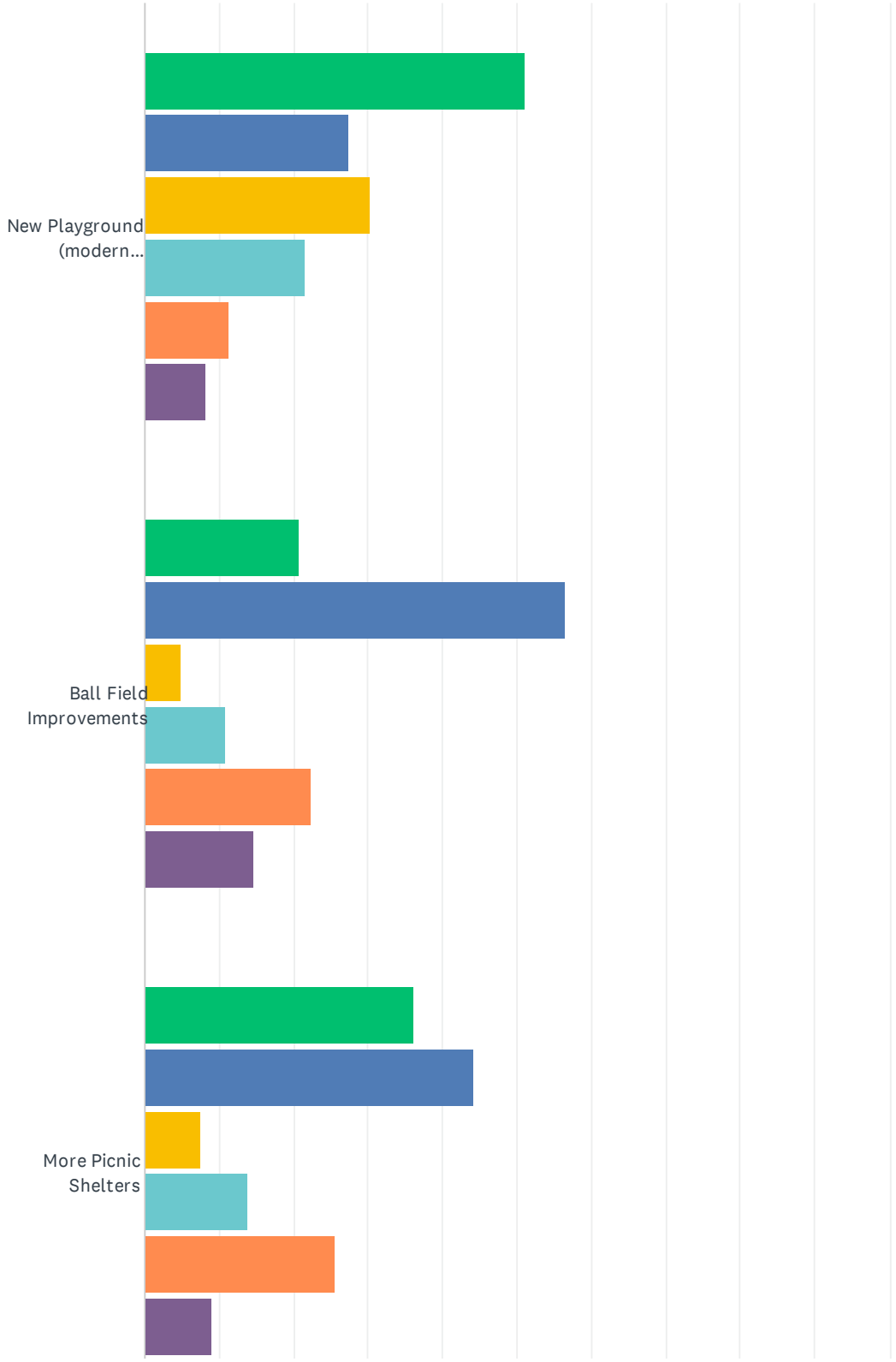

Tennis Courts
Restrooms
Harrison-Schmidt Dahike Log...
Public Works Facilities

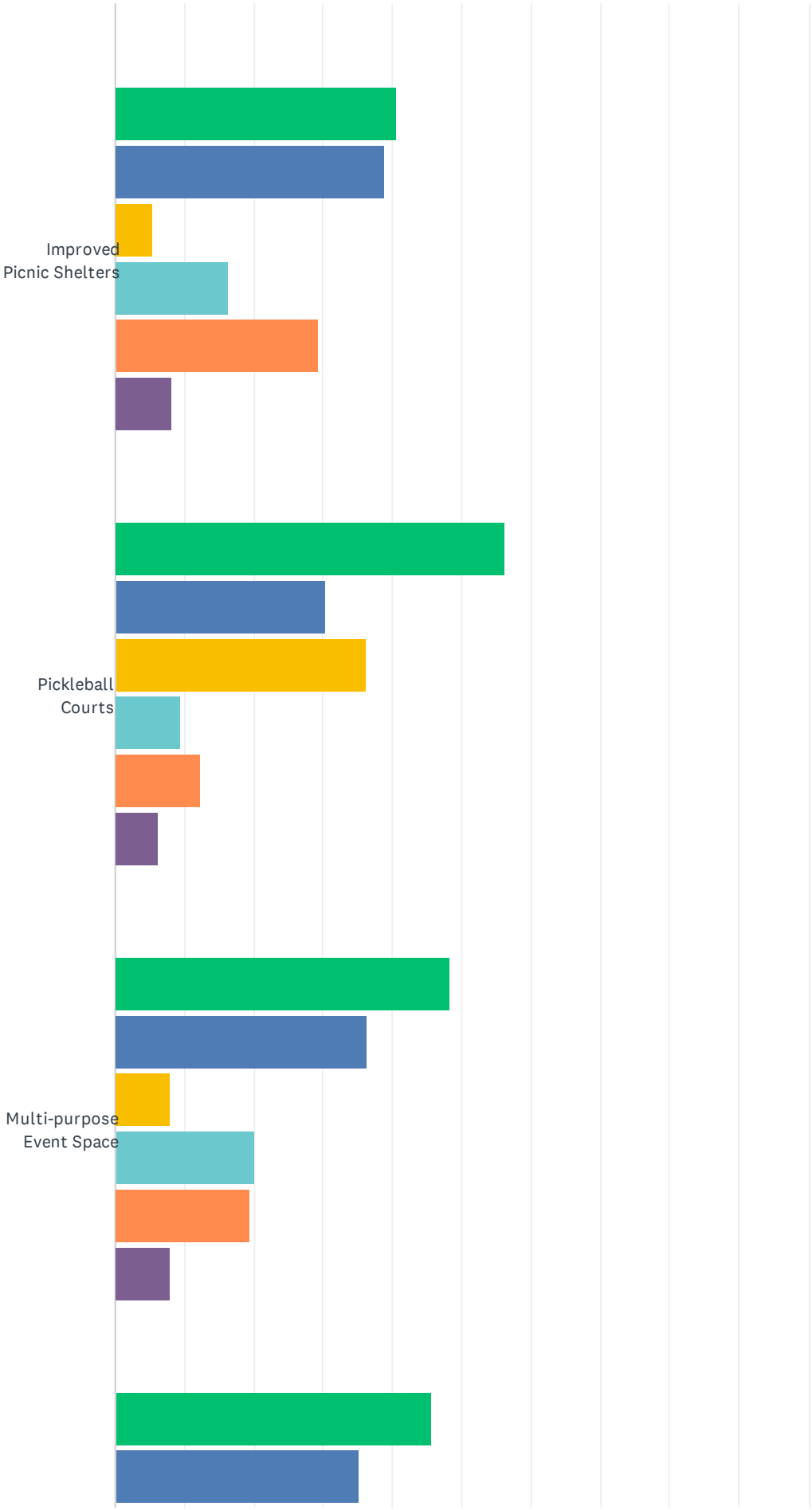


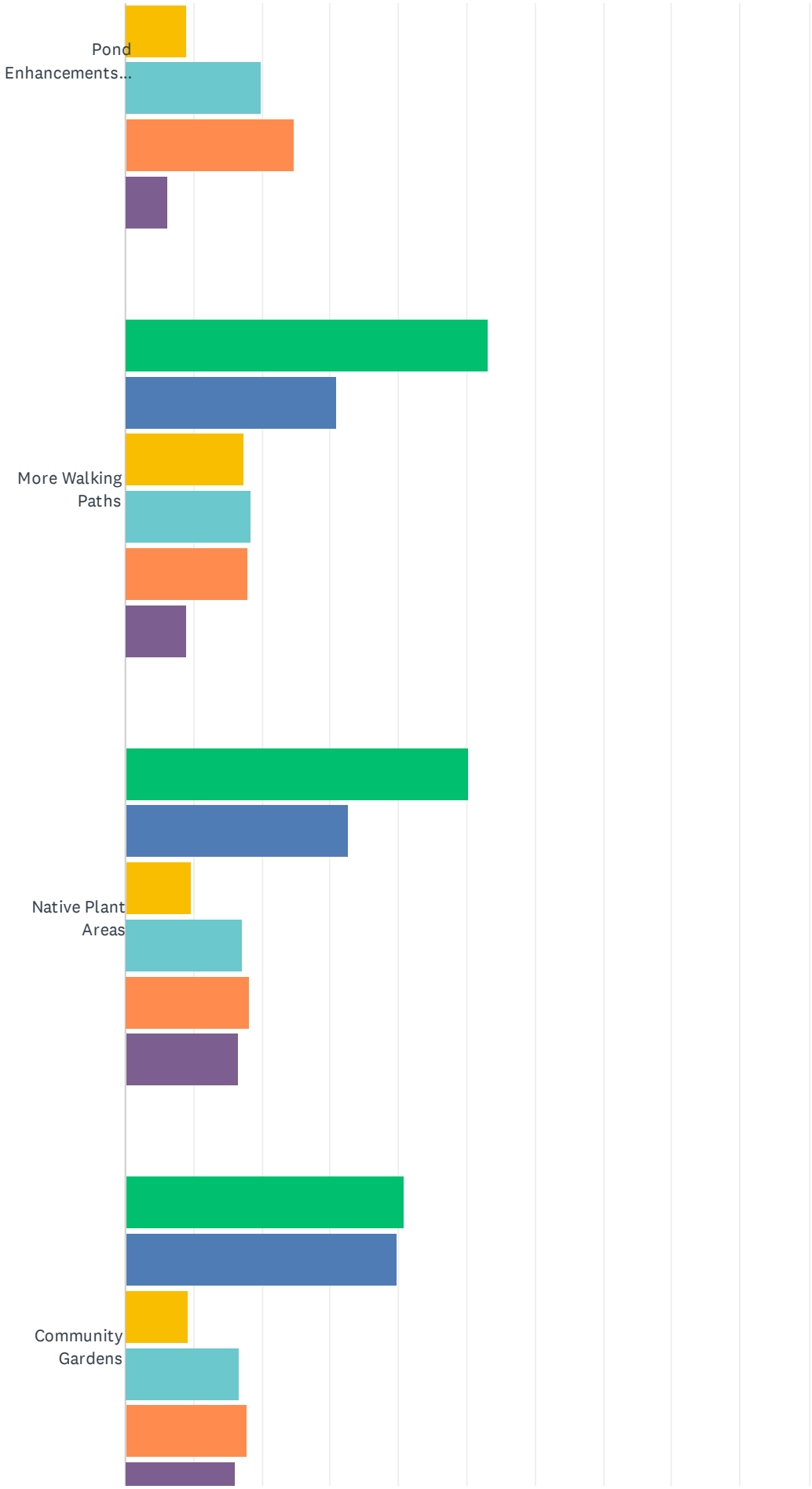
	VERY SATISFIED	SOMEWHAT SATISFIED	NEUTRAL	SOMEWHAT DISSATISFIED	VERY DISSATISFIED	DON'T KNOW	TOTAL	WEIGHTED AVERAGE
Walking Paths	34.63% 71	28.29% 58	15.12% 31	8.78% 18	0.98% 2	12.20% 25	205	3.50
Playground	22.00% 44	22.50% 45	17.50% 35	11.00% 22	6.50% 13	20.50% 41	200	2.81
Ball Field	12.37% 24	8.76% 17	27.32% 53	4.12% 8	0.52% 1	46.91% 91	194	1.88
Sand Volleyball	11.40% 22	5.70% 11	26.42% 51	2.07% 4	1.04% 2	53.37% 103	193	1.64
Ponds	33.83% 68	29.35% 59	15.92% 32	3.98% 8	0.00% 0	16.92% 34	201	3.42
Pavilions	32.50% 65	19.50% 39	20.50% 41	3.50% 7	0.50% 1	23.50% 47	200	3.10
Tennis Courts	18.97% 37	8.72% 17	25.13% 49	5.64% 11	2.05% 4	39.49% 77	195	2.18
Restrooms	30.39% 62	26.96% 55	19.61% 40	4.90% 10	0.49% 1	17.65% 36	204	3.29
Harrison-Schmidt Dahike Log House	12.95% 25	3.11% 6	22.28% 43	1.04% 2	0.00% 0	60.62% 117	193	1.46
Public Works Facilities	14.06% 27	5.73% 11	25.00% 48	2.08% 4	0.52% 1	52.60% 101	192	1.73

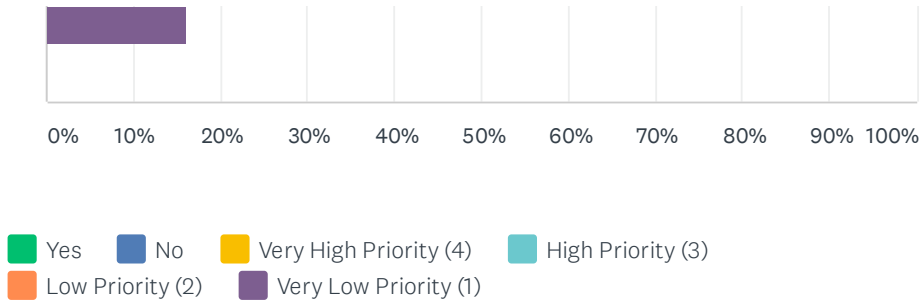
Q4 Please indicate if YOU or any member of your HOUSEHOLD has a need for each of the parks amenities listed below.FOR EACH AMENITY: How would you rate the priority of this amenity for Vlasis Park?

Answered: 210 Skipped: 0




Improved Picnic Shelters
Pickleball Courts
Multi-purpose Event Space

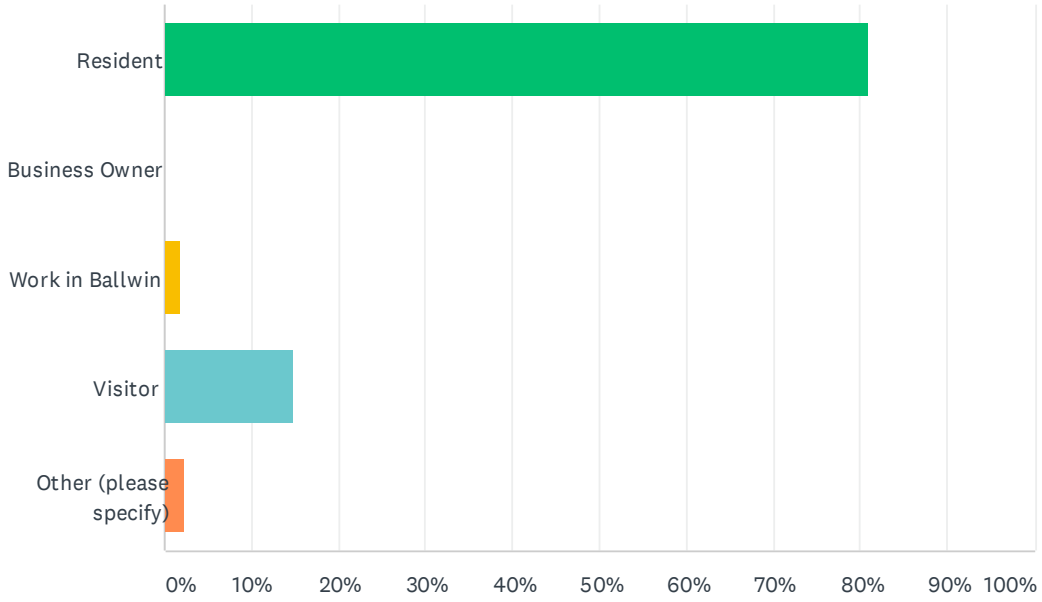

Pond Enhancements...
More Walking Paths
Native Plant Areas
Community Gardens



	YES	NO	VERY HIGH PRIORITY (4)	HIGH PRIORITY (3)	LOW PRIORITY (2)	VERY LOW PRIORITY (1)	TOTAL RESPONDENTS
New Playground (modern equipment, themed, improved accessibility, surfacing, etc.)	51.03% 99	27.32% 53	30.41% 59	21.65% 42	11.34% 22	8.25% 16	194
Ball Field Improvements	20.65% 38	56.52% 104	4.89% 9	10.87% 20	22.28% 41	14.67% 27	184
More Picnic Shelters	36.17% 68	44.15% 83	7.45% 14	13.83% 26	25.53% 48	9.04% 17	188
Improved Picnic Shelters	40.54% 75	38.92% 72	5.41% 10	16.22% 30	29.19% 54	8.11% 15	185
Pickleball Courts	56.37% 115	30.39% 62	36.27% 74	9.31% 19	12.25% 25	6.37% 13	204
Multi-purpose Event Space	48.42% 92	36.32% 69	7.89% 15	20.00% 38	19.47% 37	7.89% 15	190
Pond Enhancements (edge improvements, water access points, dredging, etc.)	45.55% 87	35.08% 67	8.90% 17	19.90% 38	24.61% 47	6.28% 12	191
More Walking Paths	53.16% 101	31.05% 59	17.37% 33	18.42% 35	17.89% 34	8.95% 17	190
Native Plant Areas	50.27% 94	32.62% 61	9.63% 18	17.11% 32	18.18% 34	16.58% 31	187
Community Gardens	40.86% 76	39.78% 74	9.14% 17	16.67% 31	17.74% 33	16.13% 30	186

Q5 What is your relationship to the City of Ballwin?

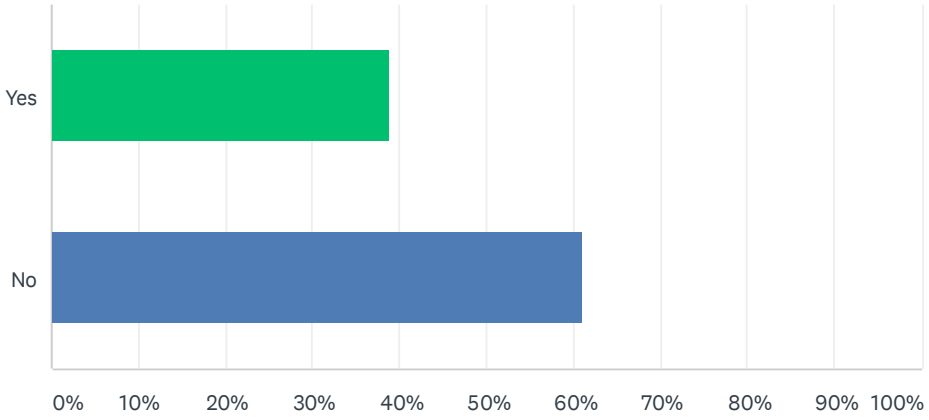
Answered: 209 Skipped: 1



ANSWER CHOICES	RESPONSES	
Resident	80.86%	169
Business Owner	0.00%	0
Work in Ballwin	1.91%	4
Visitor	14.83%	31
Other (please specify)	2.39%	5
TOTAL		209

Q6 Does your household include children under the age of 18 years old?

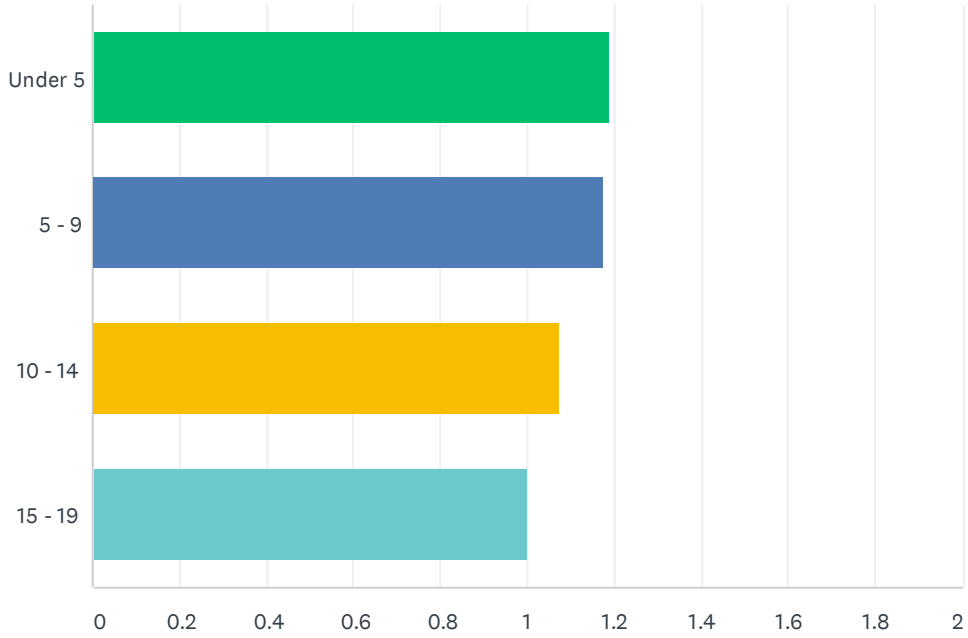
Answered: 208 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	38.94%	81
No	61.06%	127
TOTAL		208

Q7 How many children in your household are:

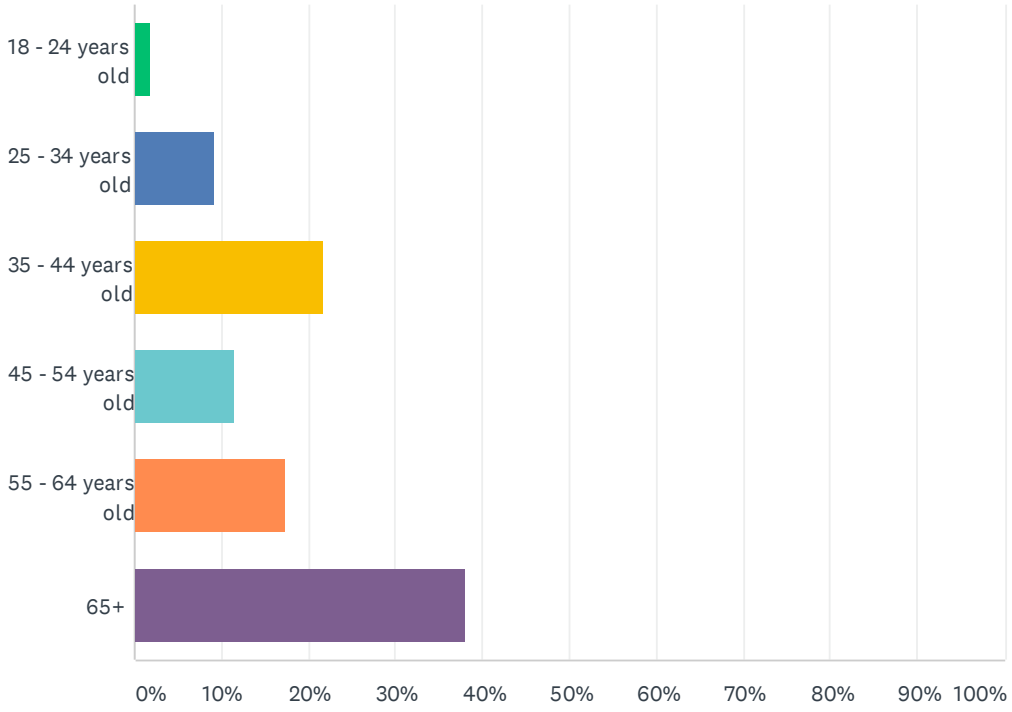
Answered: 92 Skipped: 118



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Under 5	1	63	53
5 - 9	1	60	51
10 - 14	1	42	39
15 - 19	1	23	23
Total Respondents: 92			

Q8 What is your age?

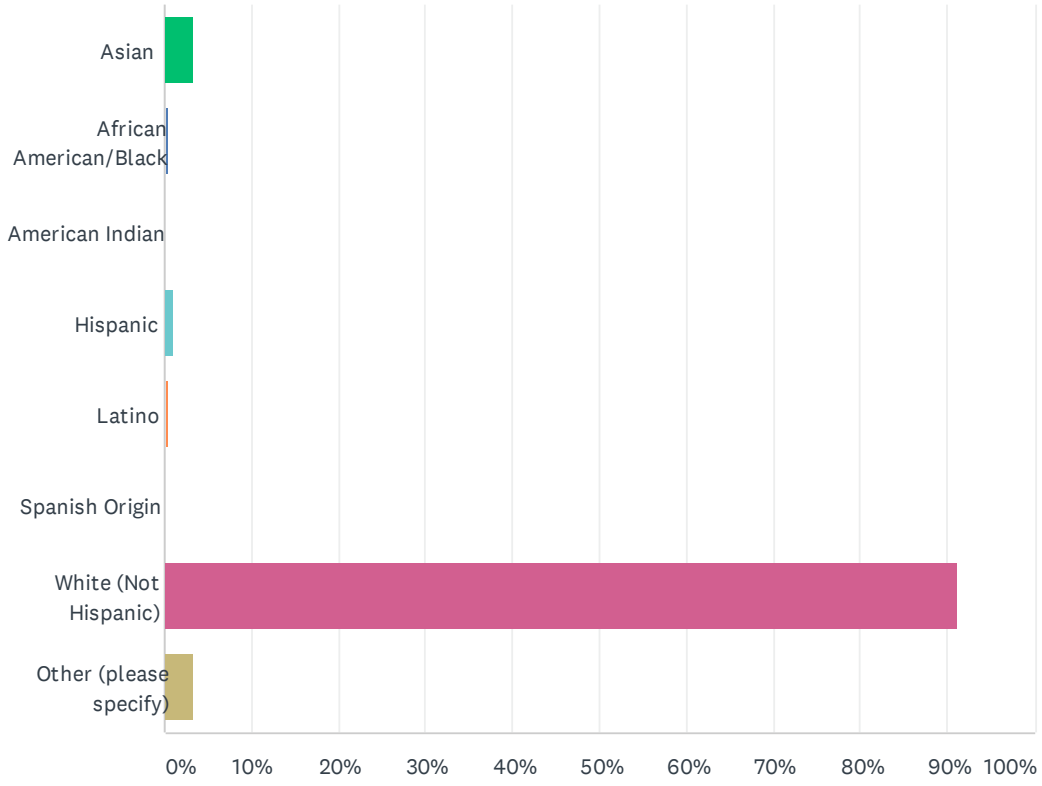
Answered: 207 Skipped: 3



ANSWER CHOICES	RESPONSES	
18 - 24 years old	1.93%	4
25 - 34 years old	9.18%	19
35 - 44 years old	21.74%	45
45 - 54 years old	11.59%	24
55 - 64 years old	17.39%	36
65+	38.16%	79
TOTAL		207

Q9 What of the following BEST describes your race?

Answered: 207 Skipped: 3



ANSWER CHOICES	RESPONSES	
Asian	3.38%	7
African American/Black	0.48%	1
American Indian	0.00%	0
Hispanic	0.97%	2
Latino	0.48%	1
Spanish Origin	0.00%	0
White (Not Hispanic)	91.30%	189
Other (please specify)	3.38%	7
TOTAL		207

Q10 What comes to mind when you hear Vlasis Park? (and any other comments)

Answered: 139 Skipped: 71

- a quiet place to visit and take your kids and grandkids.....
- We love fishing here, but all of the fish have been dead in the pond lately
- The big playground. It is a good facility but is really showing its age of late.
- Fun, good facilities. Safe
- Centralized and Room for improvement to host community events
- The big slide park behind Wendy's off Manchester.
- Beautiful! Don't forget that many residents also bring Grandchildren to this park for a wide range of activities incl fishing, playground etc.
- Nice family place
- Ballwin Days
- Can be a good place to find a tennis court without a long wait. Has restrooms if I need one.
- A very nice park with easy access for all Ballwin residents. A tremendous plus for prospective home buyers considering Ballwin. Please do NOT allow a high rise apartment building at the old Ballwin Govt. building site. I would be so out of place!!
- That I do not want a big apartment building going up and destroying the area.
- Nice area for families and walking
- Do not let them build that apartment complex on these grounds! Please! As the people!
- Small park, I haven't really used it much over the years since kids are older. It would be nice if they had more trees to shade the walking paths. Too hot in the summer to walk. It would be nice to have "winter" activities...like outdoor ice rink.
- Wonderful open space. Never overpopulated. Memories of my children enjoying the park and meeting friends for fun.
- A quiet, clean park with something for everyone. My whole family can enjoy this place multiple times per week and never get bored.
- No Pickleball courts.
- DO NOT BUILD HIGH RISE APARTMENTS!!!!!!!!!!!!!!!!!!!!!!!
- A great place to gather with your kids for an outdoor experience
- Nice little local park that offers green space to our community and access to our police and government centers.
- Ballwin
- Hidden park in need of improvements including an amphitheater.
- My husband and I have lunch every week (Wednesday's) at Vlasis. It's a very hodgepodge park. A lot of green space sort of, but in weird ways, and not always a very friendly park (and a 7 story apartment will only make it worse). The log cabin is so interesting, but the park is disjointed in how the log cabin area doesn't meet the rest of the park. The city of Ballwin has no dog park, no outdoor auditorium, no community garden, no dedicated basketball facilities (e.g. parking lots), too much concrete. There are no walking/biking paths, no water features, and way too much goose poop. There are some lovely benches that are near the pond, but you wouldn't know it as the shrubs are overgrown. The public works department uses pavilion 2 as a second parking lot. There used to be a splash area, but it disappeared. The playground area is worn and old, and it shows. We could use the park to expand. Remove the unused horseshoe toss, tear down the old government building, add some value to the biggest park in our city. We need more green space, not less. And, yes, I'll gladly pay more in taxes.
- Very nice peaceful place to walk and fish.
- A beautiful park in the heart of West County that could be utilized even more for other Events! Keep up the good work!
- playgroun and pond
- Childhood
- Fishing and annual festival
- I am happy when I hear Vlasis Park. Since moving to Ballwin in 2019, I have lived next to the park and choose it as a very safe place to walk with my partner. We love the walking paths, and the beautiful scenery in and around the park. In April of 2021, my partner proposed to me on a walk in Vlasis Park. It will always be a

special place for us!
- Fun time
- Pickles.
- Needs a better splash pad
- Great family-friendly place to hang out!
- Open, safe
- Memories, Excellent Green Space, New apartments being planned will ruin the park.
- Ballwin Days
- quality park
- Neighborhood park
- The city of ballwin took away a ballfield to build the government center without any input from neighbors or residents , Very disappointing
- dirty and deteriorated condition of the plaza and the playground equipment.
- Ballwin Days, fishing, baseball/softball
- Fun
- Fun! My boys love climbing up to the big slides. They love the metal slide too but it needs shade for the summer
- Needs more shade, water play area
- Good playground for the grands, but it needs maintenance.
- Ballwin days
- Play ground
- kids fishing and going through to play pickleball at thr northe pointe pool location
- Nice park
- good park!
- A peaceful refuge. Green space. You all took away green space with the building of the new city hall. You told the citizens of Ballwin you would return green space--and then some--with the destruction of the old city hall. You would create a "front door" for Ballwin. A "Town Center". Now you are selling out to the highest bidder. Not what the citizens of Ballwin want----according to all of the Plans and Surveys done in the past. The citizens of Ballwin have wasted their time, efforts and money on these Plans and Surveys, only to be ignored. Disappointing.
- Children play area
- Please don't sell the old city hall and let it be developed into a giant apartment complex. Turn it into a nice amphitheater or replace the ball field that was used to build the new city hall on. Whatever you do please turn it back into park space that was lost. If there is a tall building there it will really change the feel of the park.
- Great park….adding pickleball courts will bring multi generations together
- great place for more pickleball courts
- Either North Pointe or two courts at Vlasis should be devoted strictly to Pickleball.
- City center. It's nice but could be better.
- Fun place to go
- green area, peacefull
- Ballwins Premier Park
- Please add pickleball courts - as many as possible - much needed and will be used by many, many people.
- pond
- Diverse park, family friendly, joining the community
- Nice park
- Nice park with wasted use of Tennis courts. Stripe them forPickleball.
- Beautiful!
- Beautiful area! Definitely need real Pickleball courts! You can build 4 Pickleball courts on the space of 1 tennis court. You need 4 to 8 Pickleball courts, Fasted growing sport in USA! Most tennis courts are used very little!
- Nice and clean park. Easy to access. Perfect place for pickle ball players
- Nice park. Would love pickle ball courts not facing east/west due to sun!
- Going Sledding 55 years ago. Otherwise I just pass through it to get to the golf course. Build dedicated pickleball courts and I am there every day.
- Ballwin Days
- I love it!
- Ballwin days
- Beautiful park that would be great to have Pickleball courts to use.

- Old
- A fairly large park with government facilities. In addition to needing the noted pickleball courts in Valasis park, there is a need for dedicated pickleball courts at Holloway park as well. Currently pickleball shares courts with tennis and this has caused some fairly violent events.
- Picnics and Ballwin Days
- Log cabin
- Fishing at the pond for children
- Pond
- Lion drinking fountain
- Sorry that you took up more green space for the new city hall.
- Ballwin Days
- Big playground, water features, tennis court. My husband and I would love to see dedicated pickleball courts added.
- Fishing Pods
- Great park. Ballwin has great recreational facilities.
- Great possibilities
- I would attend to play pickleball with my friends.
- Great park. Would love to see geese gone and their poop
- Not utilized well .
- Big playground
- Kinda small
- Ponds, green space
- Wish there were pickle ball courts.
- I think of unused tennis courts that should be converted to pickleball courts. I also think of the growing need for pickleball courts and how this would be an ideal site for them.
- Family
- Ballwin Days
- Softball Practice, Craft Brew Festival
- Beat up playground.
- Fun, family friendly space
- a suburban oasis and gathering spot
- Ballwin Days, Craft Beer Festival, playground, tennis courts, the log cabin, the pond., Memorial Day ceremony. Adding pickleball courts and community gardens are very good ideas. My children are past the playground stage so I'm no longer familiar with the age & condition of that equipment and whether it needs updating. At one time, there was a grant possible to add a walkway over or under Manchester Rd. That would be expensive but would make Vlasis Park more accessible to those living south of Manchester but within walking distance.
- Entertainment for my children. They like the walk around the pond and the playground.
- We love the park! The playground area could use some upgrades
- Vlasis Park tries to offer the public big park experience with a very small land area and fails. So the cut wanted money for the land where the police buildings. Let's move the police buildings to the park. A win win for the city, but loss public area in the park. I prefer going to new balls in park.
- Ballwin Days
- Playground
- Beautiful pond Ballwin Days Craft Beer Festival
- The outdated playground area
- Family recreation
- My kids know vlasis park by the tall slides. One of their favorite parts of the park.
- Ballwin days Fun playground for me kids that makes me worry about an injury because stuff is falling apart
- Torn playground surface, broken arm from that snake slide thing that there is nothing to hold on to. Bees in the dome always
- Crowded playground and nowhere for the kids to run. Need an open space near the playground (such as the old ball field that was replaced with the building)
- We like this park and appreciate the shade umbrellas at the playground since there would be very little shade otherwise. We miss the splash pad water feature that used to be there. I tend to be extra on guard at this park because a handful of parents have reported their children being approached by strangers at this park.
- Need to improve playground and ball field

- My kids love the playground. It is unique and challenging for them. However, every time I go there I notice how worn down the playground is and wonder when it will get some updates.
- Busy and chaotic playground. My kids love it, but the equipment is way past its prime and the sightings are terrible for keeping an eye on kids.
- Beautiful well-maintained park. Perfect place for walking the dogs
- splash pad
- Playground
- I bring my four grandchildren (under the age of 9) weekly-often daily in the summer. Vlassis is a COMMUNITY park. It does NOT need 350 more parking spaces adjacent to it.
- Ballwin Days and a splash pad that is almost never actually running.
- Walking Paths. Beer festival
- Nice open space. Outdated playground equipment.
- I think families. I think open space. I think let the children run and play. NOT A TOWERING APARTMENT COMPLEX!
- Would be nice to have a splash pad here and better equipment. Obstacle course would be nice also.
- Ballwin Days The fountains and waterfall Love the wildlife, but wish there wasn't so much goose poop all over the sidewalks, and wish they weren't so threatening to walk past. Would love to have more live concerts at Vlasis. All summer concerts seem to be held at New Ballwin (except for Ballwin Days) Would be awesome to have some restaurants or walkable places of interest bordering the park!
- A relaxing greenspace and recreational area. PLEASE, PLEASE, PLEASE do not let the Parc Place mixed use complex be built!!! It will change the whole face and entrance to our beloved Vlasis Park! It doesn't align with our Comprehensive Plan, either. Can't we consider just removing the old City Hall and leaving the parking lot so residents can park there and enjoy enjoy visiting Vlasis Park? We have spent a lot of time in that park for the past 20 years of living here, but will no go back again if Parc Place is built there. We are not against it being built in Ballwin (maybe old Hobby Lobby lot?) but please, not in Vlasis Park!
- Old playground equipment. Kids mostly like seeing ducks in the pond. I would love to see a nature playscape similar to the recent installment in Forest Park.
- That hideous apartment complex that our governing body approved to be built on the edge of Vlasis Park at the corner of Manchester & Seven Trails. Insane idea! And from literally every Ballwin resident I've spoken with is adamantly against this monstrosity being built. Certainly won't make visits to Vlasis Park more enjoyable.
- Ballwin Days, baseball practices. Center of The City of Ballwin
- picnic
- I love it
- Trout Fishing and ducks
- Walking path needs to be even. More benches to sit around the park Kids water spray can be improved like Vago park in Maryland,MO Replace the sand with beach sand in the volleyball court A kid soccer field will be nice to have