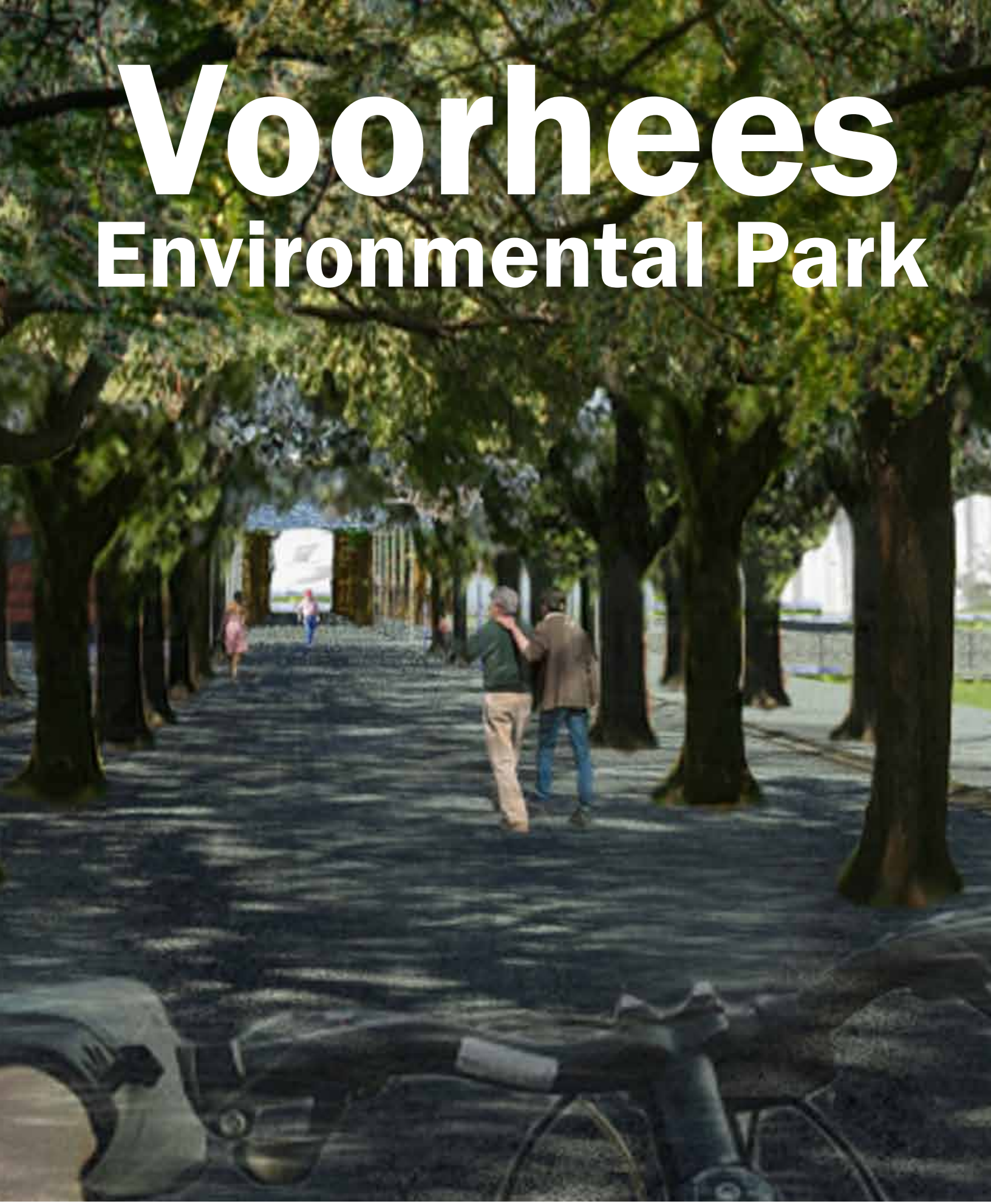
Voorhees
Environmental Park



RUTGERS

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Executive Summary

The Voorhees Environmental Park documentation contains the research, analysis and vision for the combination of a public park and renewable energy producing solar array on top of a former landfill in Southern, New Jersey. While the Center for Urban Environmental Sustainability (CUES) has worked toward the implementation of the park for just over three years, the ideal of a public park on this site has been vision of Voorhees Township, residents, and a grassroots group now known as the Voorhees Environmental and Cultural Education Foundation (VECEF), and CME Associates, Inc. (CME) for over thirty years. CUES has had the distinct honor of assisting with progressing the vision for the Voorhees Environmental Park and presents the design and research process as well as the integrated design through this document.

Chapter One: "Site Analysis"–The site of Voorhees Environmental Park, located along Centennial Boulevard in Voorhees, New Jersey in the heart of Camden County, has a long and tainted history, as postindustrial sites such as these often do. After years of operating as a landfill and accepting waste for which its past operators were not zoned to accept, Voorhees Township and General Electric, in cooperation with the New Jersey Department of Environmental Protection orchestrated an effective remediation program, ensuring that contaminates from past uses were managed and monitored per state and federal regulations to ensure the rehabilitation of the site and safety of the surrounding neighborhoods. Despite negative aspects of the site's history and due in part to the remediation, the site has developed a special character with its large open lawn surrounded by mature forest on the southern and western ends of the property. The descent to pond at the western end juxtaposed with the gentle slope to the opposite end contributes the expansive view, a rare occurrence within New Jersey. Furthermore, the unique location of the Voorhees Environmental Park will offer a critical connection to nearby recreational and cultural facilities and the open space system of Voorhees Township.

Chapter Two: "Design Exhibition"—CUES curated a design proposal exhibition with Voorhees Town Hall in April 2012, a major step in analyzing the preferences and interests of the residents of Voorhees. In the Fall of 2011, the Department of Landscape Architecture at Rutgers University held a semester-long Design Studio. Four different groups of second-year graduate students developed conceptual designs for Voorhees Environmental Park. CUES solicited feedback from the residents of Voorhees on the designs and nearly 150 people told CUES what the liked and didn't like about the four conceptual proposals.

Chapter Three: "Survey Analysis"—In addition to the feedback on the designs, a written survey of both adults and students in Voorhees Township garnered 285 responses. Information regarding demographics, the existing open space system in Voorhees Townships, anticipated uses of Voorhees Environmental Park and desired amenities for Voorhees Environmental Park were collected and analyzed.

Chapter Four: "Integrated Design"–The research and analysis, community meetings and design review meetings with VECEF, the Township and CME coalesced to the Integrated Design. A vibrant eastern redbud-studded entrance plaza welcomes most pedestrians, bicycles and drivers to the park where they may stroll down a gabion-lined, elevated promenade with a variety of trees selected for their qualities of offering diffused shade, fall color and architectural stature, as well as their ability to perform in urban settings during dry conditions and a unique hydrological situation introduced by building a park on top of a landfill, requiring the need for elevated soil volumes to support vegetation. A solar array overlook and a pond overlook begin and end the promenade with four quincunx bosquets and one solar bosquet punctuating the length in between. Adjacent to the southern side of the promenade, a great lawn and a wildflower meadow with an elevated boardwalk offer a variety of experiences to ignite the senses. And, just beyond the lawn and meadow, managed successional woodland and three quincunx bosquets offer shade and refuge from the promenade. A path descends to the pond area where two boardwalk structures allow visitors to sit over the water and view the floating treatment wetland islands and the bat houses. A loop trail enables bicyclists and pedestrians the experiences of traveling the circumference of the accessible park and maintains the ability for service vehicles to access existing monitoring wells. Visitors are guided by a signage and online "buzzbee" information system, branded, which offers keys to the phased development of the park as well as educational information on ecological processes, species (planting) lists and other information.

Chapter Five: "Phasing"—Fundraising for the park construction and maintenance is a long-term and multi-phased process. As such, VECEF and Voorhees Township foresee the implementation and construction of the integrated design to occur in multiple phases. CUES designed several recommendations for phasing the park, beginning with the construction of portions of the entrance plaza, Centennial Boulevard improvements, and more in order to create usable spaces within the park while planning and fundraising for later stages proceeds. In total, CUES has recommended six construction phases along with a separate phase for the construction of a visitor and educational center.

In conclusion, on behalf of the CUES Rutgers Principal Investigators, the Department of Landscape Architecture, Rutgers Faculty from the School of Environmental and Biological Sciences, The Rutgers Cooperative Water Resources Program and the Rutgers School of Engineering, it has been an distinct privilege to assist Voorhees Township and VECEF in realizing a vision they started thirty years ago. In this time when municipalities recognize the importance of open space and parks as a critical component to the health of their citizens, an investment in the inspiration and education of residents, and a unique proposition that attracts intelligent and creative talent to their ranks, the time for the integrated design of Voorhees Environmental Park to come to fruition is right.

Introduction

1 Site Analysis

1.1 Location of Voorhees Environmental Park

This design that is being converted into a 37-acre public park (the site of a former landfill in the suburban community of Voorhees Township, New Jersey). The future Voorhees Environmental Park is located on Centennial Boulevard in the heart of Voorhees Township, a community of over 31,000 residents located in Camden County. A suburb of the Philadelphia metro area, Voorhees Township is in the Delaware River region of New Jersey, situated between the Pinelands to the east and the Delaware River to the west. The community is served by connections to major arteries including the New Jersey Turnpike, Interstates 95 and 295, and the Atlantic City Expressway. Hydrological features are the 3,000 square mile Kirkwood-Cohansey aquifer that sits beneath the community and the groudwater fed pond located at the southern end of the site.

Figure 1. Location of Voorhees in New Jersey

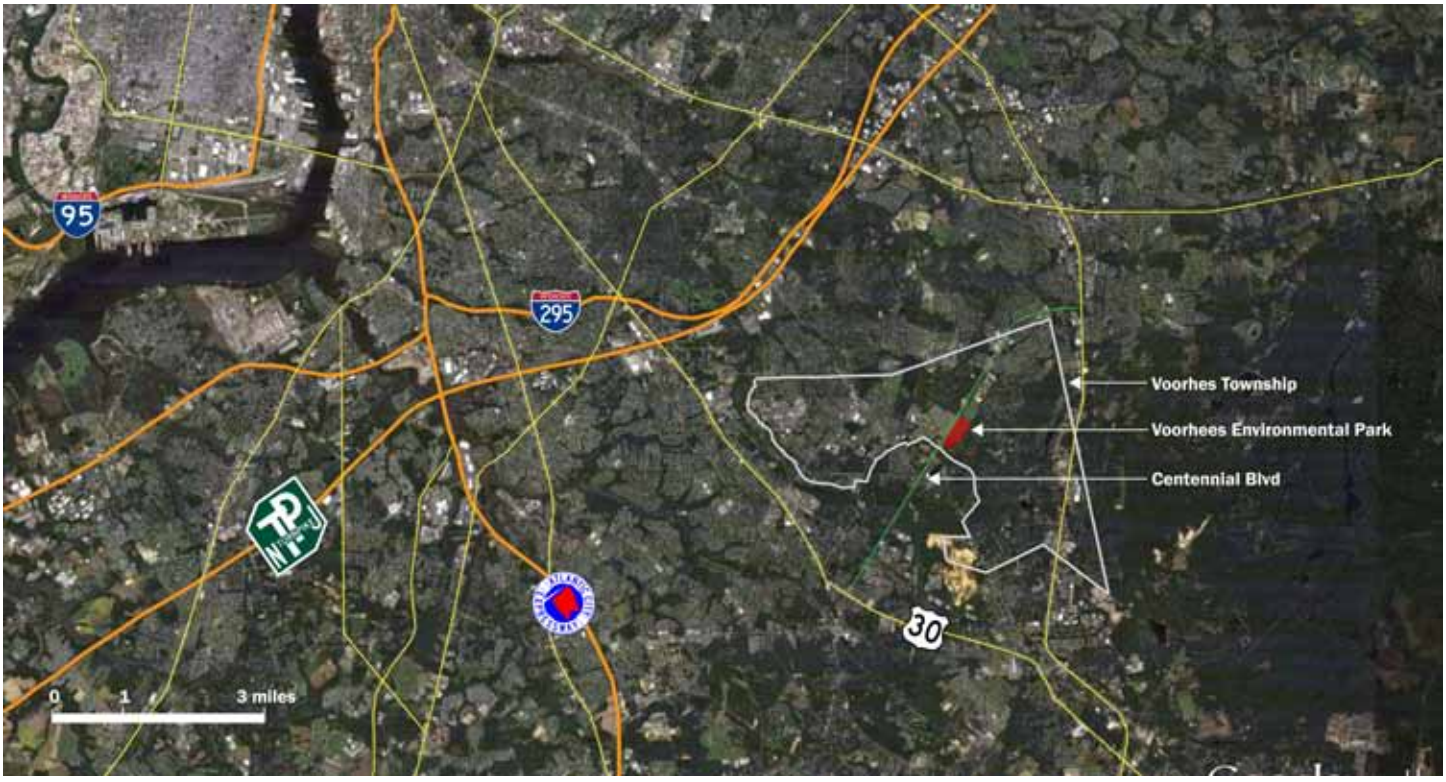


Figure 2. Voorhees Environmental Park and major arterial roads

1.2 Site History

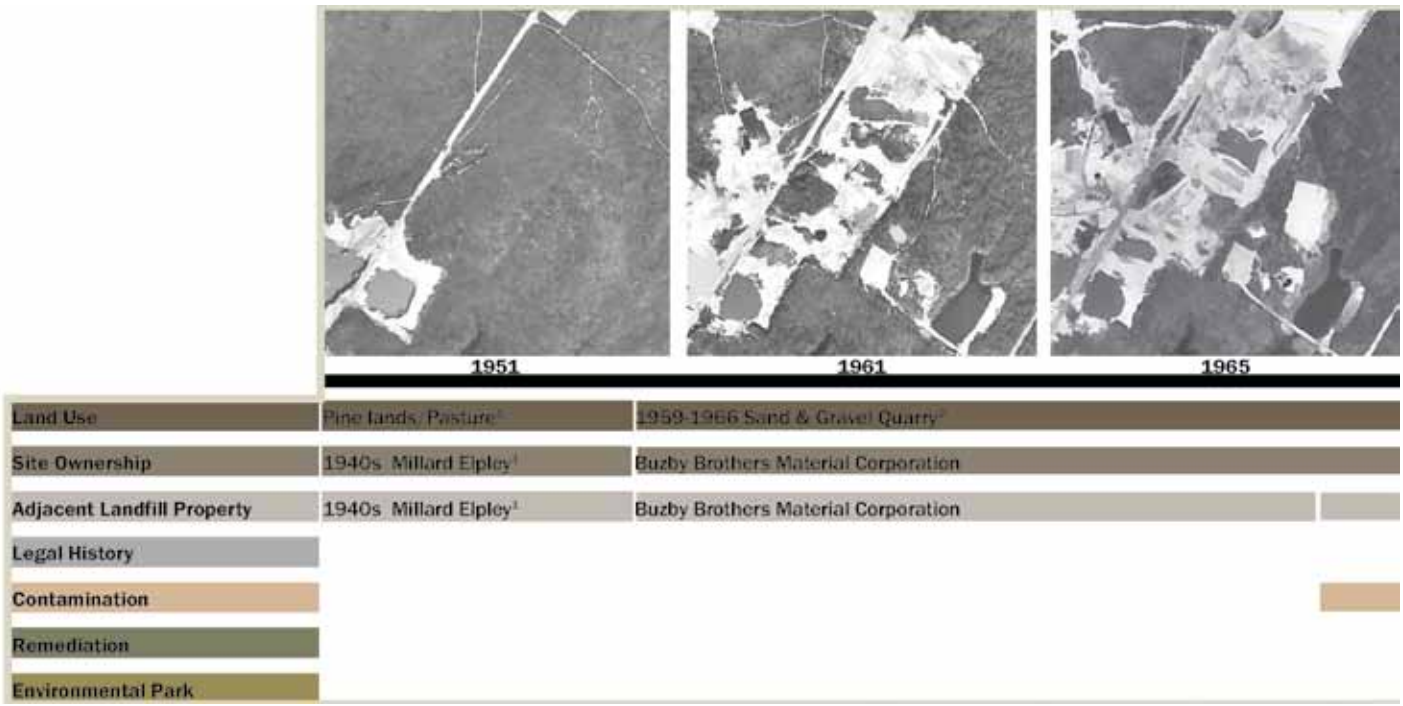


Figure 3. Historical timeline

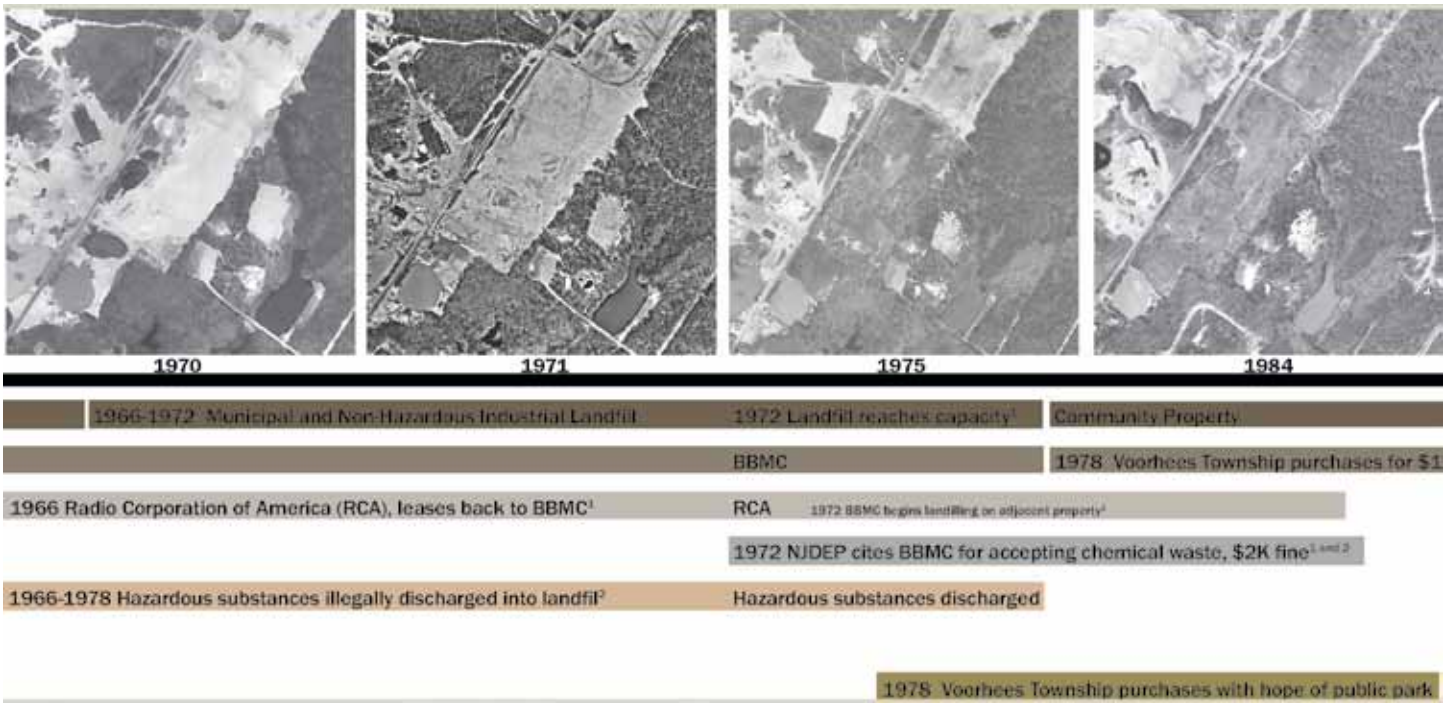
In the 1930's the township categorized the land use of the site as pinelands and pastures. In the 1940's, Millard Epley and Albert K. Plone started acquiring hundreds of acres in the area and transferred the rights to their corporation, Buzby Brothers & Co. (Maykuth 1987, "Trouble in Paradise."). The 37-acre site, now owned by Voorhees Township, and the adjacent 19-acre property, now owned by General Electric Corporation, were both initially used as gravel and sand quarries, supplying material to concrete manufacturers. According to New Jersey Department of Environmental Protection (NJDEP) documents, Buzby Brothers Material Corporation operated a sand quarry on the 37-acre portion from 1959 until approximately April of 1966. After 1966, the company operated Paradise").

In 1972, the 37-acre portion of the site, operating as a sanitary landfill, reached capacity and the company began landfilling operations on the adjacent property, leasing the land back from RCA. (Maykuth 1987, "Trouble In Paradise")

According to NJDEP records, "hazardous substances," (defined in N.J.S.A 58:10-23.11b.,) such as volatile organic compounds and heavy metals were discharged on both sites from April 1966 until 1978. According to NJDEP, unidentified corporations or individuals acting on their behalf, "delivered hazardous substances and pollutants" to the Buzby Sanitary Landfill property for disposal (NJDEP v. GE 2007). In 1975 the NJDEP cited Buzby Brothers for accepting chemical waste at the RCA-site, and fined the company $2,000 (Maykuth 1987, "Trouble In Paradise"; NJDEP v. GE 2007).

Buzby Brothers ceased operations in 1978 and capped the landfills (Maykuth 1987, "Trouble In Paradise"). Buzby Brothers declared bankruptcy in 1978 (Hand 1987, "In Voorhees, A Landfill's Grim Legacy"). At that time, president Margaret Epley[1], sold the 37-acre landfill to Voorhees Township for $1. Even at that time, the township had aspirations to open a park on top of the defunct landfill (Maykuth 1987, "Trouble In Paradise").

After NJDEP contacted GE and Voorhees Township in the late 1970's and 1980's, the township engaged in a series of remedial investigations, monitoring and remedial action planning. GE and Voorhees Township worked together to create a remedial action plan that included the two sites. In 1989, GE replaced the impermeable plastic cap on liner on their landfill property. A 1990 survey of the site determined that the former landfill did, in fact, contain chemicals and waste "that pose a potential health hazard. The study reported that although there were contaminants in the soil and groundwater beneath the landfill, neither the off-site groundwater nor the municipal water supply had been adversely affected" (Zimmer 1992, "Buzby Landfill"). In 2005, "GE established a 144-acre Classification Exception Area ("CEA") for the site, which restricts groundwater usage within its boundaries" until 2047 (NJDEP v. GE).



Voorhees Township's remedial investigation was implemented between 1994 and 2001 (Remedy Review). The time line includes the following key events:

- 2003 NJDEP approves the remediation plan.
- 2003 Consent Order for remedy executed by GE and Voorhees Township.
- 2004 Clearing and grubbing of entire site (January).
- 2004 Site survey and delineation of landfill limits.
- 2004 Sampling and evaluation of existing cap (April).
- 2004 Approval of final design of cap.
- 2004 Groundwater monitoring construction.
- 2004 New landfill cap construction completed.

In 2009, Voorhees Township in association with the Voorhees Environmental and Cultural Education Foundation (VECEF)[2], a non-governmental organization with the mission of pursuing the establishment of the Voorhees Environmental Park at the former site of the Buzby Brothers Landfill, erected a township sign announcing the future site of the park. In August of 2010, the Voorhees Township committee approved with Rutgers University to pursue the design and implementation of the public park.

Notes

1. Margaret Epley was the widow of Millard Epley and the sole stockholder of Buzby Brothers. Mrs. Epley became president of the corporation after her husband, Millard Epley, passed away in 1969 (Maykuth 1987, "Trouble In Paradise"). Margaret Epley passed away at the age of 78 in 1997 after being assaulted in her Erial home in an attempted burglary. Her death was ruled a homicide. (Jennings 1997, "Death of Erial Woman has been ruled a homicide").
2. The VECEF mission statement is: "The Voorhees Environmental and Cultural Education Foundation (VECEF) is a non-profit organization committed to fostering an understanding and appreciation of the natural environment through the creation of an environmental park in Voorhees, New Jersey. The park is a unique brownfield to greenfield project that will be an ideal venue for environmental and cultural events and activities that educate and inform the general public about the principles of ecological stewardship and environmental remediation" (VECEF).

General Electric (GE) acquires RCA

1987 NJDEP orders GE & Voorhees study 1993 Order of remediation from NJDEP[2] Township investigates contamination and remediation [1,2]

1990 Testing confirms landfill contains chemical waste[4]

2004 Groundwater contamination monitoring[6]

1994-2001 Remedial Investigation[3]

2003 Remediation Plan Approved[3]

2004 Delineation of fill[3]

2004 Site cleared/grubbed and new landfill cap placed[3]


2006
2011
Community Property
Voorhees Township
GE
Groundwater contamination monitoring[5]
2010 Town Council approves RU partner
2009 Voorhees Environmental Park sign erected

1.3 Character of the Site

Despite the tainted history of the site, the current existing conditions have a great character to it. Successfully transforming the former landfill into an environmental park will add even more beauty, but requires a thorough understanding of the environmental conditions, risks, and limitations of the site. The future park is now essentially devoid of any tree cover, except in the pond area, which is fenced off. Remediation of the landfill has two primary components: preclude human contact with potentially hazardous material and prevent groundwater contamination through leakage. A two-foot soil cap now covers the site, which is considered stabilized and safe for use. Groundwater remediation is ongoing and continued access to a ring of monitoring wells will be required as part of the final design.

The photographs (Figures 4-19) document our interpretation of the existing conditions of the site.

Figure 4. A chain-link fence separates the pond from the rest of the site.

Figure 5. A view of the pond from the high ground of the landfill cap.

Figure 6. Students descend an earthen ramp leading from the landfill cap down to the pond.

Figure 7. Monitoring wells like this one are found around the border of the site, protruding 18 inches above grade.

Figure 8. Owners of adjoining properties were allowed to choose their own fencing materials on the southern borders.

Figure 9. View to the north. The mound in the background is part of the neighboring landfill owned by GE.

Figure 10. A cleared field houses equipment used in the landfill remediation process.

Figure 11. A retention basin collects water shed from the GE landfill and the eastern portion of the Voorhees landfill.

Figure 12. Long stretches of chain link fence define many borders of the site.

Figure 13. A long view from northeast to southwest.

Figure 20. An aerial view of the current conditions of Voorhees Environmental Park, with image cues keyed to Figures 1-16.

Figure 14. A view along the northeastern border of the site.

Figure 15. A long view of the northeastern border of the site.

Figure 16. A stone-bottom swale directs water into a deeper swale which channels water toward the pond.

Figure 17. Centennial Mills is an active adult community directly across Centennial Blvd. from the site.

Figure 18. A long view of the street-facing northwestern border of the site with post and rail fencing.

Figure 19. A view across the site, from the western corner looking eastward.

1.5 Amenities & Open Space System

An inventory of the various recreational amenities offered in Voorhees Township and the surrounding communities, shows that there is an abundance of active recreation but a lack of passive recreation (figure 1). The definition for what classifies an activity as either passive or active recreation was taken from the EPA which defined the terms as:

Active Recreation- any type of structured individual or team activity which requires the use of special facilities, courses, fields and equipment.

Passive Recreation- activities which do not require the use of prepared facilities such as sports fields or pavilions.

There are many sites, such as the high school west of the project site, which offer several types of facilities for active recreation include tennis courts, soccer fields and football fields. There are also several athletic field complexes in the Township containing similar features. Because these amenities are located on school grounds or in athletic complexes there are often scheduled events, making it difficult for residents to enjoy these facilities at their leisure. While these venues offer many active recreation activities they do not offer passive recreation activities such as walking trails, bird watching, or quite natural areas.

There are a few sites that have a walking path or open grass field which can accommodate some passive recreation, but overall active recreation dominates the existing park system. Connolly Park, located approximately a mile north of the project site, features mainly passive recreation amenities and contains no structured athletic fields. The future Voorhees Environmental Park will accommodate the lack of passive recreation in the local area.

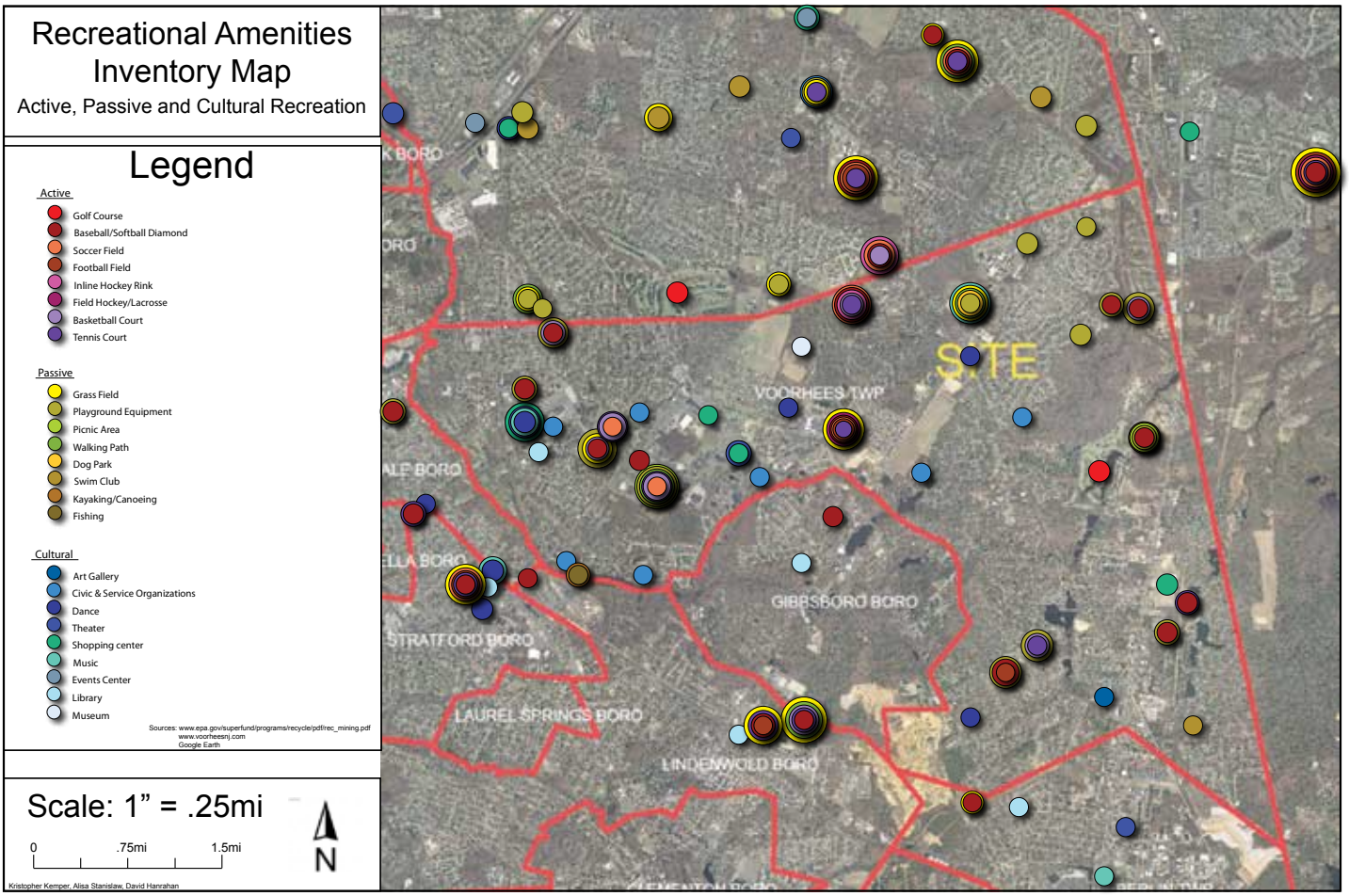


Figure 21. Inventory Map of Recreational Amenities offered in and around Voorhees Township (image not to original scale)

An analysis of the amenities and open spaces within Voorhees Township shows that many of the sites offering recreation are located near schools and shopping centers. It also shows that the majority of the land within the township and surrounding areas has been developed. There is also a clear void of park amenities located to the south and east of the project site which are mostly residential developments. This means that people living in this area will most likely have to drive their car to other areas of the township for passive recreation. There is also no clear open space system in the township that link the various parks. The Voorhees Environmental Park location on Centennial Blvd. will play a vital role in filling in this void, giving the people living in the nearby residential developments a place for passive recreation within walking distance. A park in this location could also be a key link in creating an open space system given the existing bike lane on Centennial Blvd. as well as the sites close proximity to Connolly Park. As pointed out in the inventory and analysis of the local circulation, the existing open spaces in the township are very disconnected from each other, forcing people to rely on vehicular transportation.

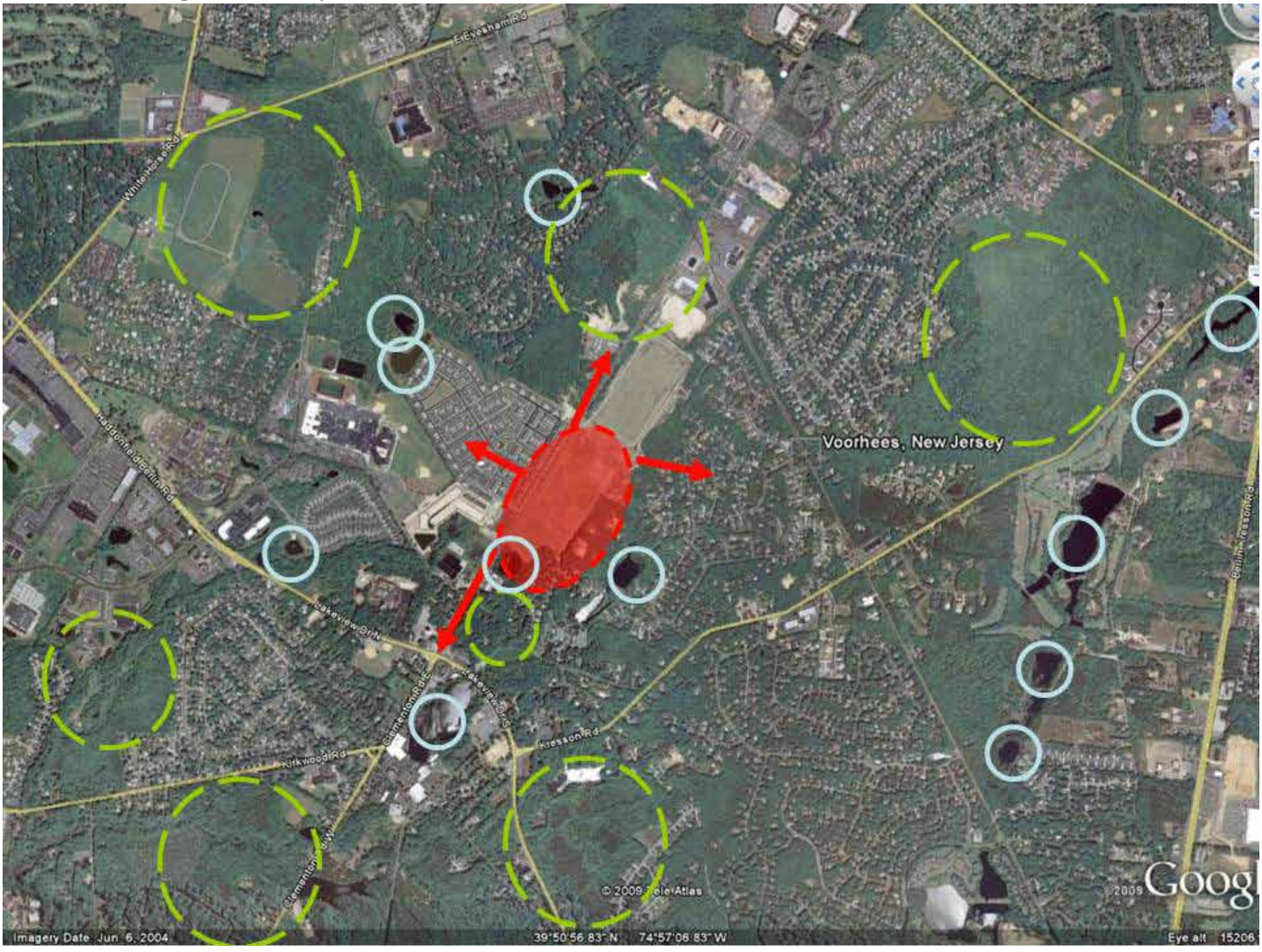


Figure 22. Local open space areas

1.4 Vegetation

The site is located in the uplands of southern New Jersey bordering the Pine Barrens. The surrounding woodland bordering the site consists of mixed oaks *(Quercus spp.)*, sweetgums *(Liquidambar styraciflua)*, sourwoods *(Oxydendrum arborea)* and a variety of pines including pitch pine *(Pinus rigida)*... and white pine *(Pinus strobus)*. On the site itself, grass is the dominant vegetation with mugwort *(Artemisia vulgaris)* encroaching the space along with other common weeds found in turf grasses.

There are many trees off the site behind the chain link fence that are in poor condition. The trees of highest quality were white oaks. Adjacent to the pond, there are species that seem to be in a healthy condition both on and off the site. These include a pin oak (Quercus palustris), sweetgum, sourwood, red oak (Quercus rubrum), and sassafras *(Sassafras albidum)*. The site shows the red oak and white oak *(Quercus alba)* are the dominant species. To prevent infiltration, the site is covered in grass, however, it demands high maintenance to mow the 37-acre area, taking up to three days in order to mow according to a Voorhees newsletter in 2006.

A few species that are identified by National Invasive Species Information Center in Camden County. Although native, in the pond there are Phragmites *(Phragmites australis)* growing within the water that do not seem to be threatening to spread throughout the site, Mugwort proliferating along the lawn which if given the opportunity, will out compete the grass, and tree of heaven *(Ailanthus altissima)* cropping up along the edges of the site. Also, along the northwestern side of the pond there is an unidentified invasive vine twining and shading out the trees in the area.

Figure 23. Vegetation and fencing Inventory Map.

Conceptual Designs by:
Fall 2011 Second Year Graduate Studio
Rutgers, The State University of New Jersey
The Graduate School of New Brunswick
Department of Landscape Architecture

Instructor: Dr. Wolfram Hoefer

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Baewon Suh
Jim Taranto

Figure 25. Exhibition in Voorhees Town Hall.

Figure 24. Voorhees Environmental Park Exhibition Announcement

2 Design Exhibition

2.1 Introduction

The Center for Urban Environmental Sustainability (CUES) at Rutgers University curated an exhibition of conceptual design proposals for the future of Voorhees Environmental Park at the Voorhees Town Hall between March 19 and April 14, 2012. The four design proposals represented four months of design work by Rutgers University graduate students enrolled in the Fall 2011 Second Year Graduate Design Studio, in the Department of Landscape Architecture. Dr. Wolfram Hoefer and Dr. Beth Ravit officially launched the exhibition with an overview presentation of four design proposals developed by groups of graduate students. Approximately 50 citizens from Voorhees Township attending the presentation and exhibition opening and were invited to publicly comment on the design proposals. At the same time, CUES also launched a questionnaire designed to evaluate the preferences of citizens toward each of the design proposals (Chapter 2) and gather additional information regarding the Open Space System in Voorhees Township and citizens' desires for the future of Voorhees Environmental Park (Chapter 3).

The purpose of the following chapter is to summarize the information provided in the Design Exhibition at Voorhees Township; namely, the objectives of the Fall 2011 Design Studio process, a review the four design proposals by the graduate students, and a summary of the public response to and preferences toward each of the design proposals gleaned from the exhibition and survey process.

The objective of this semester-long design studio was to develop an integrated concept for open space, commercial use (solar panels) and storm water management that generates innovative solutions with regards to existing social, economic, and ecological aspects while allowing active input by the public and major stakeholders. Voorhees Township and Voorhees Environmental and Cultural Education Foundation (VECEF) requested that Rutgers University develop a creative solution for developing a public park on top of a closed landfill. Per the regulations set forth by the New Jersey Department of Environmental Protection, all design proposals were required to maintain the integrity of the landfill (soil) cap. This meant that any landform alterations would be achieved through the use of soil fill and that any cut operations were prohibited.

Voorhees Township's commitment to creative seek a solution to funding the maintenance and implementation of the park also factored in to each of the four design proposals. The Township had determined to designate a substantial portion within the northern 10-acre "Deed of Restriction" area of the Voorhees Township parcel, adjacent to the General Electric parcel for the generation of solar energy. The incentives from the solar array shall support the building and maintenance of the park. This challenge has broader impact because financing of public parks is becoming more and more difficult for municipalities.

Solar panels and park uses are juxtaposed to each other. A solar panel array is usually a fenced in light industrial area that is not suited for public access. A public park, on the other hand, allows free movement for everybody, providing open spaces for active play, social interaction and enjoyment of nature. Developing a meaningful relationship between solar energy production and in a public park was a main challenge for the Rutgers Landscape Architecture graduate students

Each of the four graduate student groups developed a unique design concept:

- **In Solis Pacem**: Dialogue between modern technology and nature is developed through celebrating solar panels and a stylized nature (Asian influence) as end points of a promenade.
- **Nucleus**: For the designers, nature is the nucleus represented by the pond, moving gradually away from nature leads though a large open space towards the solar field, representing man-made technology.
- **Succession by Design**: Ecological succession, defined as the observed process of change of an ecological community over time informs the concept of succession of space, species and energy.
- **Interlock**: Connects the former technological and industrial uses of the site with the potential of reestablishing natural processes once present on the site.

The following sections of this chapter summarize the four graduate student design proposals[1] in greater detail as well as a review of the citizen's responses to each of the designs. Each conceptual design developed by a student group is presented. The preferences for and responses to each conceptual design that were gleaned from a portion of the questionnaire during the Exhibition, and again at a local Junior High School in Voorhees Township follow each design overview. Twenty-one individuals noted their preferences to the design proposals at the Exhibition. And, 125 students responded with their preferences to the design proposals. Responses are presented separately in the sections that follow.

1 A full presentation and analysis of the Fall 2011 Graduate Design Studio work on the CUES website (cues.rutgers.edu).

2.2 IN SOLIS PACEM

Kris Kemper
Kevin Perry
Baewon Suh

Figure 26. In Solis Pacem: Dialogue between modern technology and nature is developed through celebrating solar panels and a stylized nature (Asian influence) as end points of a promenade. Master Concept and Group Design.

Technology is part of modern life. Whether we feel stifled by technology, or enhanced, is a matter of feeling as personal as our taste buds. But whether or not one would be an adopter of the latest personal technological gadget, we are all nonetheless subject to a certain level of societal technological approval, from an acknowledgment that our automobiles run with internal computers, to the idea that our power grid can become both smart and clean in years to come.

Nature is also part of modern life. While in over 400 years of development we have subjugated most of what could be considered wild nature in New Jersey, we still look to a certain idea of nature as a place of solace and renewal. Indeed, in contrast to the many technological demands of our productive lives, the idea of nature exists as a place of emotional refuge.

Voorhees Environmental Park is a unique combination of technology and nature. Its history as a quarry and municipal landfill reminds us that not a square inch of this property has gone untouched by the hand of man. And yet, it will become a place where plants are invited to grow by the process of natural succession, and a place in which a person can find a daily dose of the meditative solace of nature.

Our plan for the park begins with a discussion about technology and nature. A field of solar panels to produce economic revenue for the development and maintenance of the park is to be installed on the northern end of the site. Asking visitors to consider technology and energy, a Solar Garden exists among the panels. In contrast, an Asian-inspired Pond Garden is designed for the southern end of the site, using the existing pond as the focal point. It is a place of reflection and emotional repose. As we balance nature and technology in our lives, these two contrasting spaces are balanced on the strength of a quarter-mile Promenade to serve as both a unifying agent and main corridor. The main entrance to the park, as defined by the installation of a building to serve as an education and meeting center, is located at the midpoint of the promenade, acting as the balancing point between the two experiences on either end.

Smaller secondary pathways branch off of the Promenade and promote circulation around the remainder of the site. The majority of structured planting occurs along the promenade and within the Asian-inspired garden. Just south of the solar field is the Great Lawn, its oval form to be defined by raising the landform around its edges to form a berm. Upon and around this berm, the process of natural succession will bring plant life prominent height, further defining the edge condition of the Great Lawn.

Figure 27. Plan of Site Entrance showing the visitors center, courtyard garden and a portion of the promenade

Figure 28. Plan of Asian pond design

Like Very Much

Asian Pond (8/21)

Promenade (5/21)

Walking Trails (2/21)

Integration of Solar Park (2/21)

Floating Islands (2/21)

Dislike

Parking on Centennial (6/21)

Solar Field Area (4/21)

Lack of Green Space (3/21)

Additional Comments

“This design was my favorite and mixes public gathering spaces such as the great lawn and promenade with quieter trail spaces. Some adds like the boardwalk around the lake from Interlock would be nice.”

“Need to see interior of park from road. Want less solar area.”

“Promenade might be nice but entry into solar field might be too abrupt.”

Like Very Much

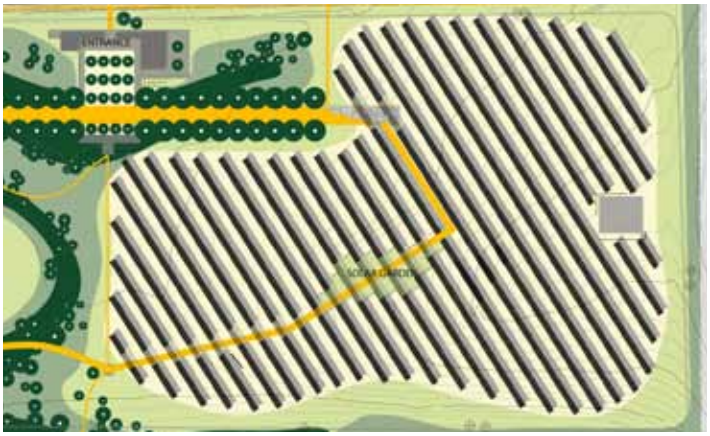
Great Lawn (25/125

Pathways (11/125)

Pond (10/125)

Dislike

Solar Array (15/125)



Additional Comments

“The path and trees are great, but it needs more places to just hang out”

“No skate park”

“Promenade might be nice but entry into solar field might be too abrupt.”

“I would like a maze.”

2.3 Nucleus

Adam Cesanek
Mukta Jadhav
Wan Huang
Erik Maietta

Figure 29. Nucleus: For the designers, nature is the nucleus represented by the pond, moving gradually away from nature leads though a large open space towards the solar field, representing man-made technology. Master Concept and Group Design.

Nature is our nucleus. As we move away from the center, we divert away from nature and move closer to technology. In our design, the pond is a representation of nature, while the solar field on the extreme side is a representation of the man-made technology.

We provide a connection between these two opposite concepts and offer a place of self reflection for the users through our design. On another layer, we also hope for this environmental park to become the Nucleus or the center of the Voorhees Township.

The design offers views and vistas, places to observe and not be in.

The entrances from the Centennial Boulevard bring people to the information center through a plaza. An overlooking deck at the edge of the plaza brings people to the most open area of the site. This prospect allows people the view of the solar structure on one end and the bosquet trees on the other while incorporating a sense of being in the meadow.

The entrance deck, the solar panel overlook and the pond overlook are connected by this primary pathway, while providing rest spaces intermittently. These rest spaces provide views to the meadow and the woodlands.

The main spaces are located on the outer edges of the primary path. The inner space formed by this path loop is designed as a uniformly-graded meadow area. People can walk from the solar panel overlook to the bosquet through this meadowland.

The woodlands define the primary path and the meadow area as well as provide enclosure for the park. The bosquet serves as a transitional meditational experience. The designed spacing of the trees enhances the user experience, preparing the visitor for the surprising view of the pond.

Figure 30. Section of Bosquet Overlook

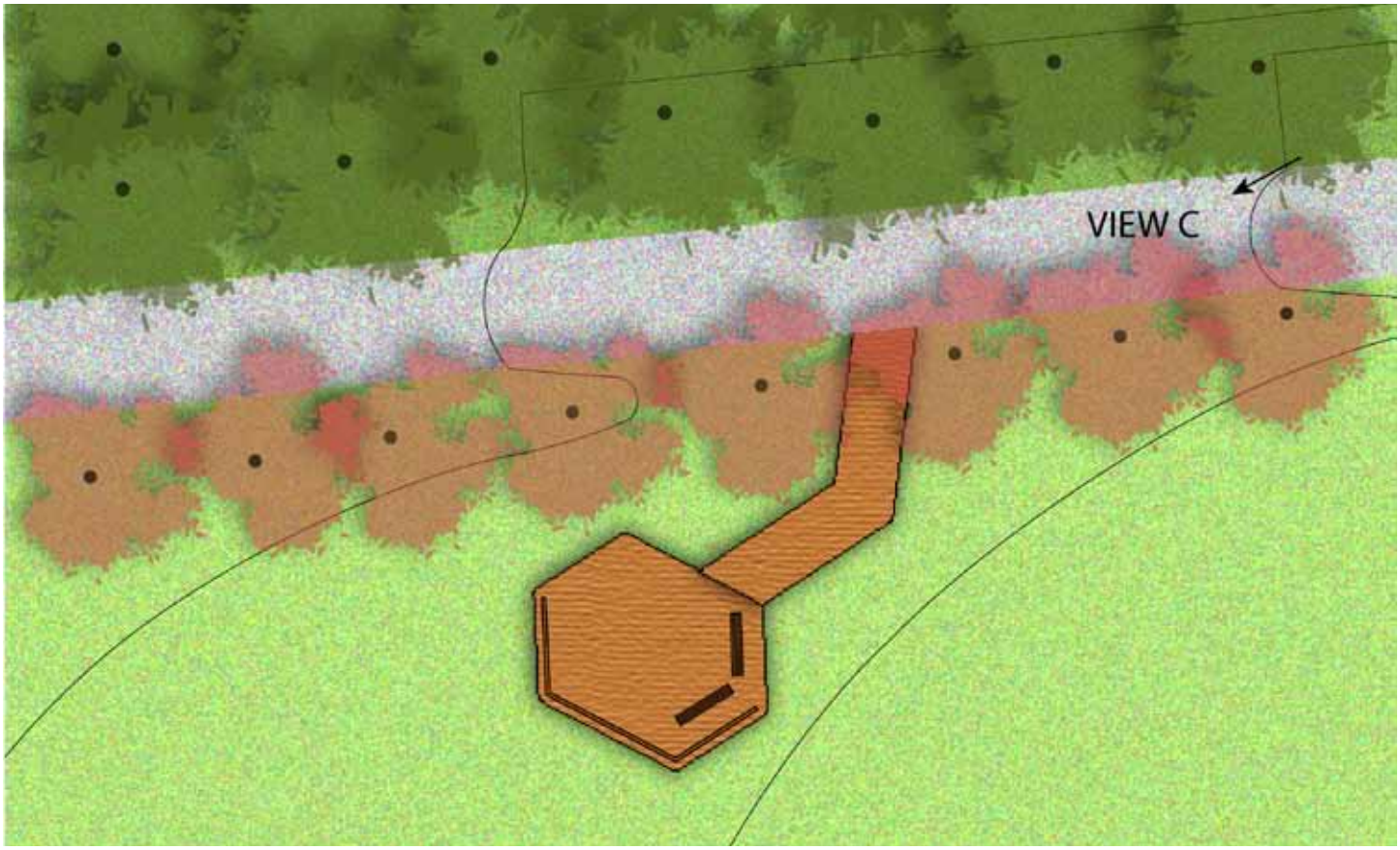


Figure 31. Bird Blinds Looking Out into Meadow

Figure 32. Solar Overlook

Public Response to Nucleus

Like Very Much

Pond Concept (7/21)

Solar Overlook (6/21)

Overall “Back to Nature” Concept (6/21)

Dislike

Too Much Open Space (4/21)

Path System (3/21)

Solar Overlook (3/21)

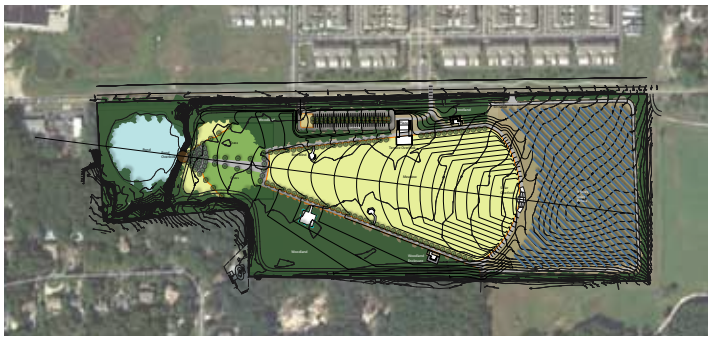
No Access to Pond (2/21)

Additional Comments

“I love the pond overlook, but would also like to be able to get down to walk around the pond.”

“My favorite for integrating solar field”

“Not enough variety of experience as you walk around the park.”



Student Response to Nucleus

Like Very Much

Pond Concept (15/125)

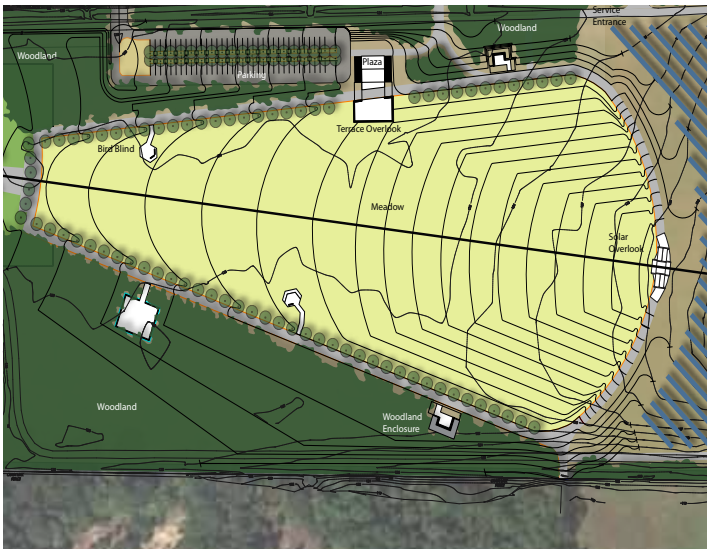
Solar Overlook (13/125)

Pond Overlook (12/125)

Dislike

Meadow (27/125)

Form/Shape (12/125)



Additional Comments

“How deep is the pond? If deep, can canoes/paddle boats be used in the pond?”

“The solar panels on the overlook was very clever”

“I like when the park is natural, its nicer to look”

“I want the meadow to be accessible”

2.4 Succession By Design

Kim Nuccio
Denisse Ortiz
Alisa Stanislaw

Figure 33. Succession by Design: Ecological succession, defined as the observed process of change of an ecological community over time informs the concept of succession of space, species and energy. Master Concept and Group Design.

Ecological succession, defined as the observed process of change of an ecological community over time forms the basis for our master plan design. The concept is succession; succession of space, species and energy.

The succession of space being the conversion of a closed landfill to a community destination. Succession of species, represented by natural forces at work in the woodland and meadow, and finally, the succession of energy usage, evolution from carbon-based fuels to solar energy. The park celebrates this evolution through a connection between natural and engineered spaces within the park to the solar array. A connection has been established between the alignment of park structures and spaces to the alignment of the solar panels to the sun.

Our goal for this project was to create safe and usable open space for passive recreation in Voorhees that would not affect the health and safety of the park's users. The contaminates will continue to be monitored and controlled, the solar panels installed in an effective manner, and natural ecosystems restored. In addition, providing safe access for people to enjoy the benefits of park and pond spaces is also very important, as is offering habitat and access for wildlife.

Our second goal is to ensure environmental sustainability in terms of storm water, structures, plants and preservation. When deciding on plants, the root systems will be evaluated proportionally to the amount of fill so the cap will not be punctured. Structures will be limited to those requiring only shallow footings. Additionally, our design will include a water management plan that continues to divert all runoff to the pond.

Another project goal is to create a design with cultural relevance, and to recognize and be cognizant of various local ethnic populations. In the original master plan, there was a large emphasis on Asian gardens split into individual spaces. One of our goals is to incorporate and merge cultural identities within this public realm, whether it be through gardens, or perhaps passive recreation relevant to the various backgrounds within the community.

Finally, community education, which is very important to the residents of Voorhees will also be very important to the design. Rain gardens, kiosks, brochures and onsite activities will support this.

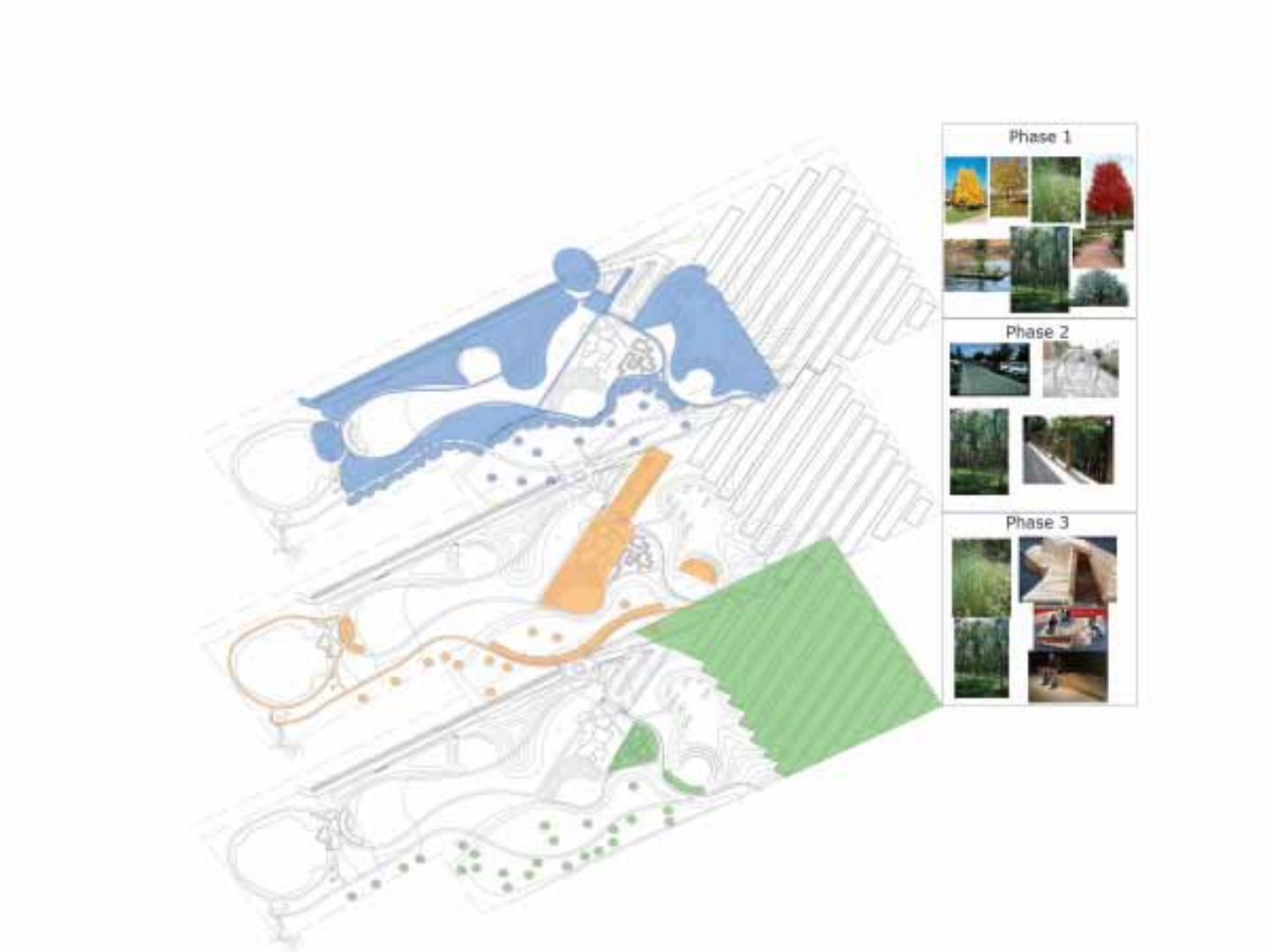


Figure 34. Phasing Diagram

Figure 35. Pond Overlook

Like Very Much

Pathways (4/21)

Floating Wetlands (3/21)

Pond Overlook Concept (2/21)

Stormwater Management Plan (2/21)

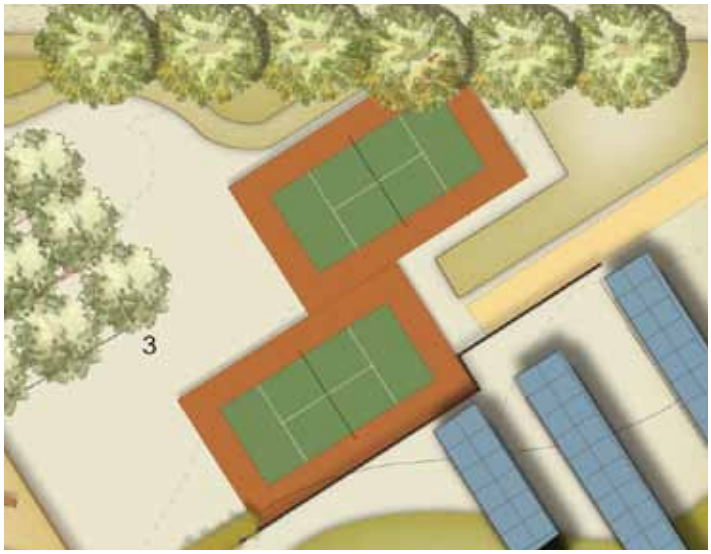
Walkway Through Meadow (2/21)

Dislike

Tennis Courts (3/21)

Too Much Space for Solar Panals (2/21)

Open Space (2/21)



Additional Comments

"Parking lot & tennis courts require additional & long term maintenance costs"

"My ideal park: flowing lines of meadow, water plants of Succession; Interlock boardwalk around a Succession meadow with pond access of Interlock; pond/panel overlook of Nucleus"

"Wish you had more integration of rest space within the solar park"

Like Very Much

Pathways (31/125)

Pond (11/125)

Dislike

No Labels (20/125)

Form/Shapes (18/125)

Additional Comments

“The paths are nice, and I like how they go into the forest a little, but there isn’t much to do in the land in the middle except sports like soccer or Frisbee”

“Not enough trees”

“It does have many things, trees or wildlife, too much grass”

“Paths could be a little less swervy.”

2.5 INTERLOCK

James Bykowski
David Hanrahan
Jim Taranto

Figure 36. Interlock: Connects the former technological and industrial uses of the site with the potential of reestablishing natural processes once endemic on the site. Master Concept and Group Design.

For over 60 years, the future site of the Voorhees Environmental Park has been altered to operate as a technological component in the Voorhees municipal infrastructure. From the late 1950's it served as the site for a gravel and sand quarry. And after the closure of the quarry, began to accept municipal and industrial waste through landfill operations. From the landfill closure until today, the site has been remediated, in an attempt to correct the contamination issues introduced during the landfill period.

The master plan design, INTERLOCK, connects the former technological and industrial uses of the site with new forms of technology as well as the potential of reestablishing natural processes once endemic on the site. First, INTERLOCK integrates the sustainable technology of solar energy production at the northern end of the site. Secondly, INTERLOCK introduces reforestation through segments of the central and southern portions of the site. Lastly, the design establishes and maintains the first stage of succession with an open meadow at the southern portion of the site near the pond area.

Programmed spaces for passive recreation vary; but, follow a similar design typology throughout the site. The main programmed areas of the site include an entrance plaza surrounded by a bosquet, a café and cultural center, a sun deck looking out from the middle of the solar panel array, grass lawn gathering areas surrounded by elevated soil volumes planted with various bosquets of different species and successional growth of vegetation, and a half mile boardwalk meandering through the meadow and pond areas.

INTERLOCK endeavors to provide a functional gathering area and community park for all residents in Voorhees. Particular attention was paid to increasing pedestrian connections between nearby neighborhoods such as Centennial Mills, Alluvium, Alluvium Woods, Traditions, Wilderness Lakes and Lost Tree, as well as the future Haddonbrook development, increasing walkability between neighborhoods. Elements to ease pedestrian access across the busy Centennial Boulevard from Centennial Mills were implemented by establishing a center tree island that functions both as a traffic 'choking'/slowing device and a place where pedestrians may stop after crossing one lane of traffic. In total, approximately two-miles of pedestrian pathways have been designed through the site.

The outline of the existing gravel road was maintained and altered slightly to maintain access to existing wells required to monitor groundwater contamination. The road now functions as a mixed pedestrian and bicycle path that circles the site. In total a bicycle path just over one-mile in length has been added and incorporated into the Voorhees master bicycle plan.

Figure 39. Perspective looking from boardwalk to meadow.

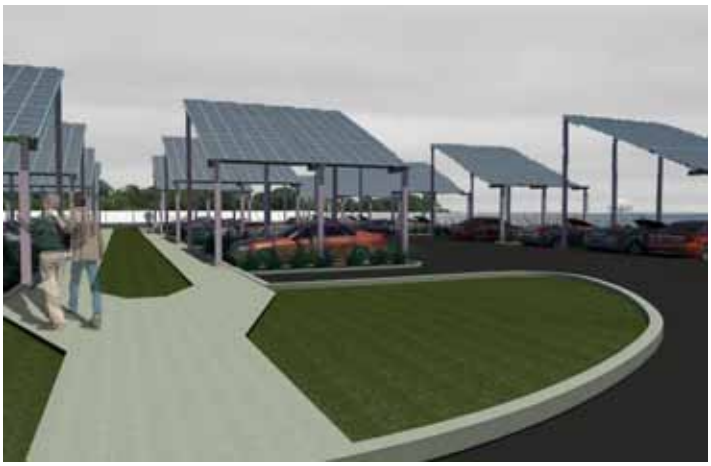


Figure 37. Parking lot with overhead solar structures.

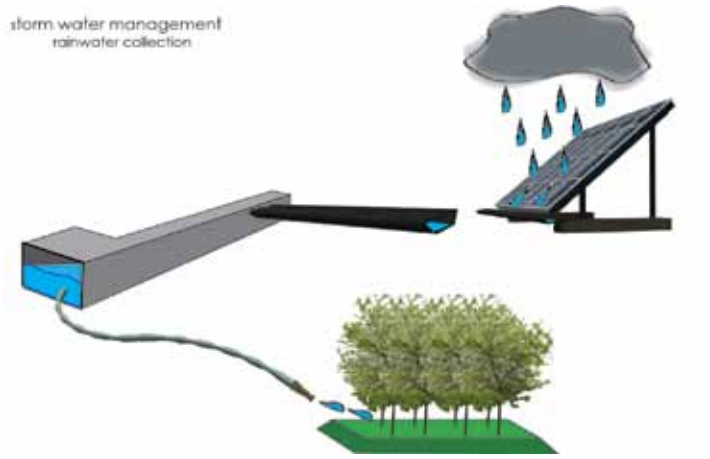


Figure 40. Rainwater collection from solar panes and tree irrigation.

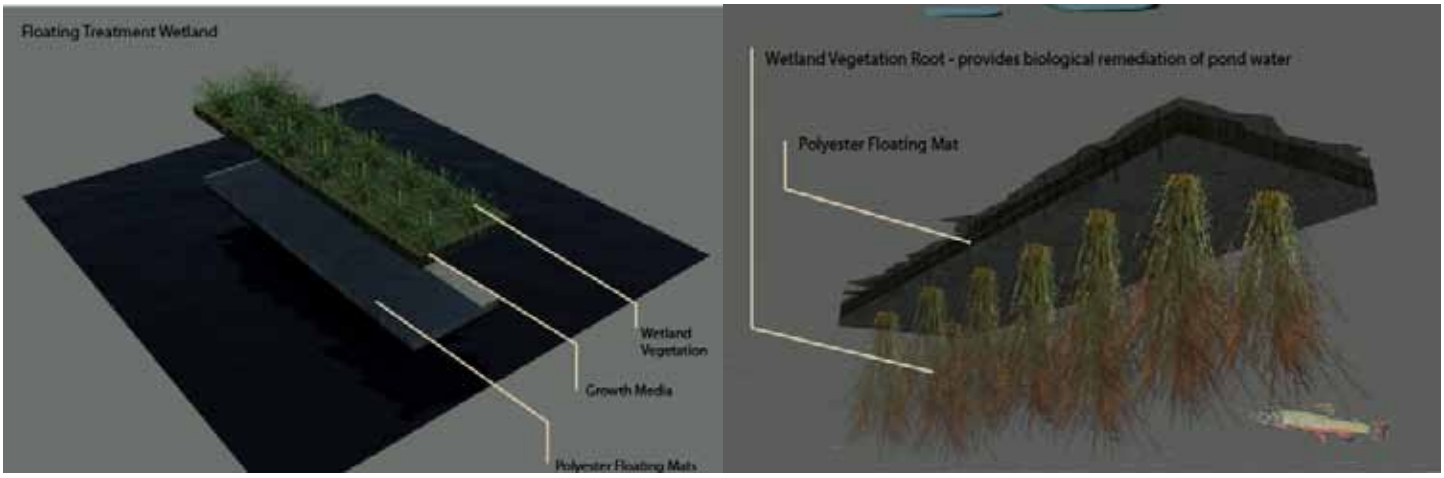


Figure 38. Diagram of floating treatment islands.

Like Very Much

Boardwalk (10/21)

Solar Panel Parking (6/21)

Trail System (6/21)

Variety of Uses (5/21)

Access from Centennial (5/21)

Meadow Space (4/21)

Tree Coverage (3/21)

Less use of Fill (3/21)

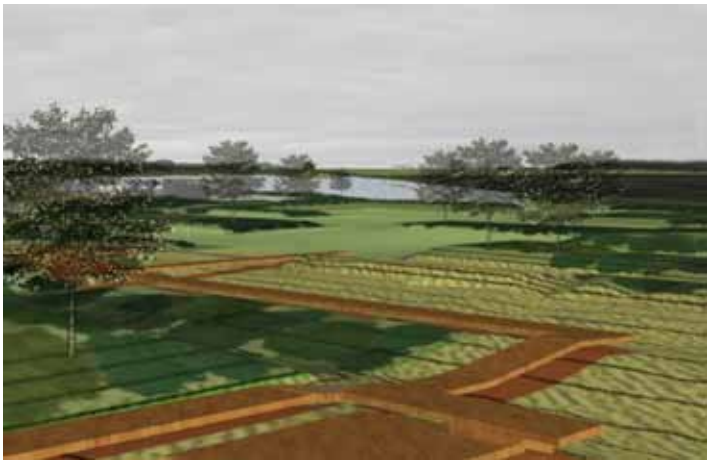
Dislike

Too Angular (8/21)

Solar Array (2/21)

Cafe (1/21)

Deck Around Pond (1/21)



Additional Comments

“This one seems the most practical and parts of the design could be implemented very quickly and cost effectively”

“I like the parking spaces w/solar panels in a few spots; good opportunity for large sponsorship dollars: ex: Electric car charging parking spot: powered by the sun, brought to you by Chevy Volt”

“It’s a cool design, but not good for watching your kids play”

“Use this as a base, and merge ideas from other into it.”

Student Response to Interlock

Like Very Much

Pathways (35/125)

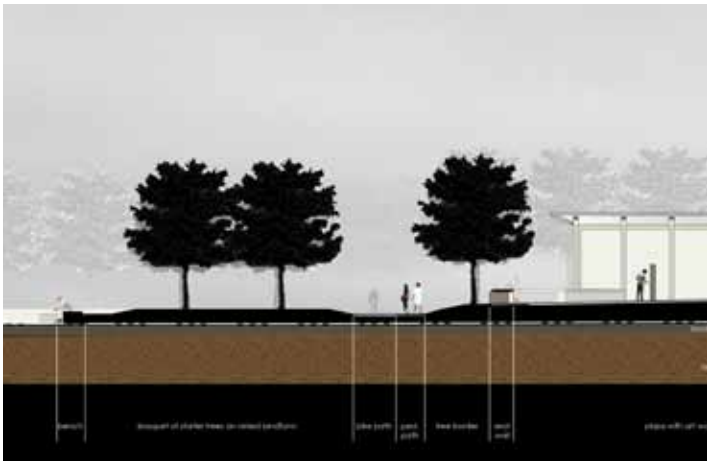
Angular Form (17/125)

Boardwalk (15/125)

Labyrinth (12/125)

Great Lawn (11/125)

Pond (10/125)



Dislike

Too Angular (30/125)

Additional Comments

Unique!”

“Cool”

“Treehouse, zipline, rock climbing”

“The trees provide a nice shady area for all sorts of activities and gives a little privacy for people”

“I would love to see flowers and themes in this park, my favorite design”

“just not natural looking enough”

3 Survey Analysis

3.1 Introduction

In order to better understand the preferences of Voorhees residents and their responses to the graduate student design options for the future Voorhees Environmental Park, CUES developed a qualitative survey. The questions asked included:

Demographics (3.2)

- Age, proximity of home and work to the park (check one)

Open Space in Voorhees Township (3.3)

- Favorite park in Voorhees or nearby community. (open ended response)
- What is lacking in the Voorhees park system? (check all that apply)

Use of Voorhees Environmental Park (3.4)

- Anticipated mode of transportation (check one).
- Which activities do respondents see themselves engaged in while in the park? (check all that apply)

Desired Amenities (3.5)

- Which amenities respondents hope for in the park? (check top five)
- Preferences for solar integration. (check one)

Likes and Dislikes of Graduate Student Design Options (Chapter 2)

- What do respondents like/dislike about the four student design proposals? (open-ended responses/ see Chapter 2 for public responses to each student design proposal)

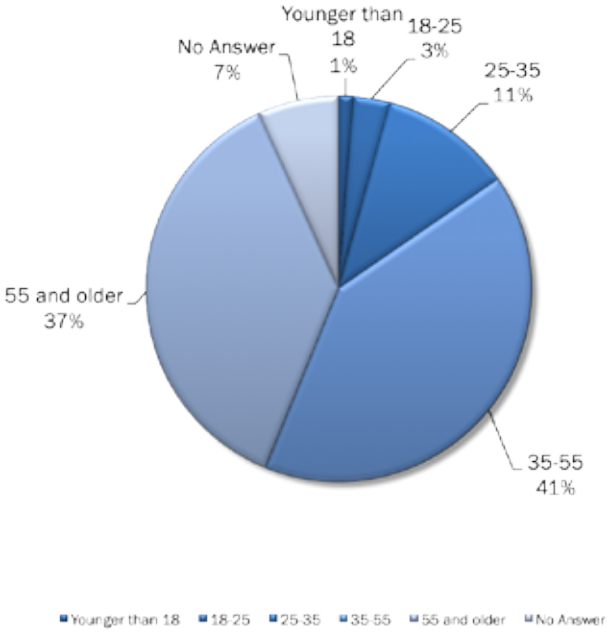
Voorhees residents were surveyed in two phases, between March 19, 2012 and May 24, 2012. The Design Option Survey was first made available to residents of Voorhees, New Jersey via the Voorhees Town Hall meeting on March 19, 2012. Residents completed the written survey while viewing an Exhibition (Chapter 2) of the four graduate student design proposals. Twenty-one written surveys were submitted. After the meeting, an online version of the survey was made available on the CUES website (cues.rutgers.edu) for a three-week period. 139 individuals responded. Written surveys and online responses were combined and 160 responses were analyzed.

In order to recruit more youth to take part in the questionnaire, a second phase of survey was initiated on May 24, 2012 at the Voorhees Middle School to the 7th grade class. 125 students responded after listening to a presentation of the four Rutgers' design proposals by Dr. Beth Ravit, CUES Co-Director.

3.2 Demographics

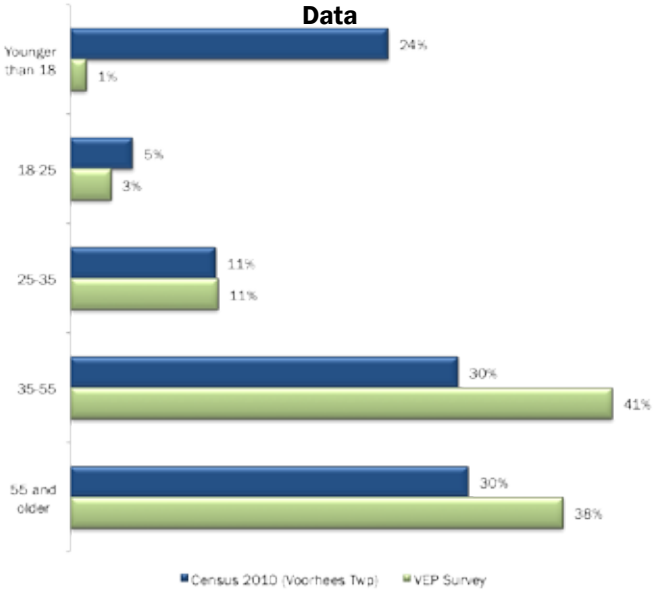
Not surprisingly, the questionnaire launched at the Voorhees Town Hall meeting captured the responses of mostly adults. The largest age group (41%) of responses were from individuals aged 33-55, followed by individuals aged 55+ (37%). 15% of respondents were under 35.

Age of "Adult" Survey Respondents



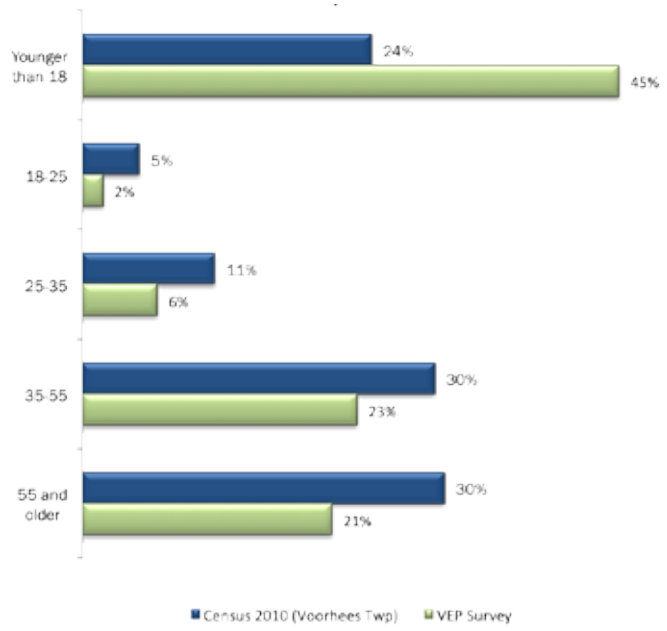
Individuals ages 35 and up were over represented in the survey, compared to the 2010 US Census Bureau data for Voorhees Township. People aged younger than 18 were extremely under represented. The 2010 U.S. Census data shows that individuals under 19 make up the third largest age group in Voorhees Township. (Note: US. Census – Age classes for the survey's "younger than 18" segment include 19 year olds.)

Voorhees Township 2010 Census Data versus "Adult" Survey Data



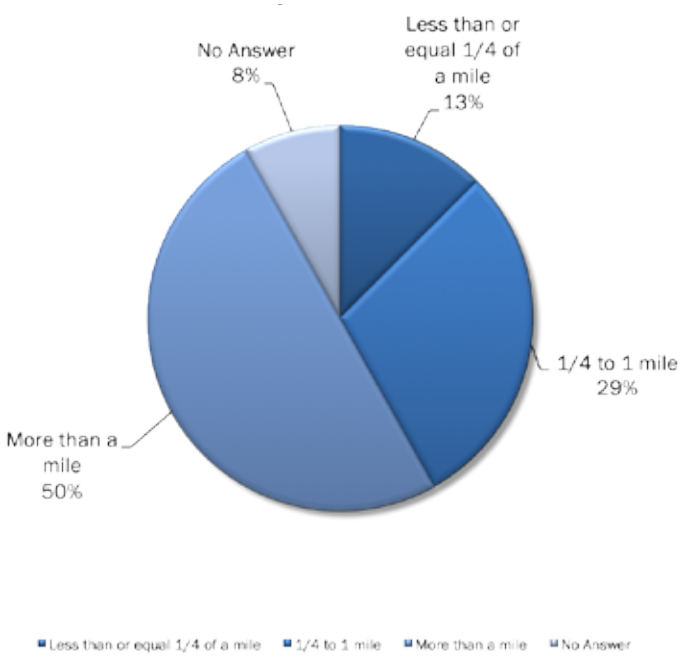
All Responses to the student survey were from individuals younger than 18. When added to the adult Survey's demographic comparison between the survey response and census data, the individuals under 18 years old are the largest age segment in the survey results and are over-represented given their proportion of the Voorhees population (2010 US Census Bureau).

Voorhees Township 2010 Census Data versus "Adult" Survey Data (with the addition of the Student Survey responses)



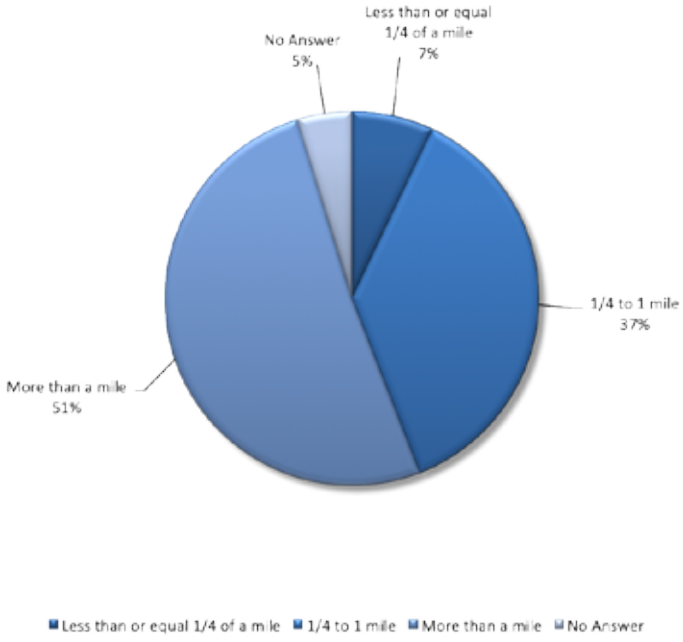
A nearly equal mix of adults that live over one mile and adults that live under a mile responded to the survey. 50% of adults live more than a mile from the park. Only about 13% live within a 5-minute walk (¼ mile).

Proximity to Voorhees Environmental Park



The majority of students live over a mile away from VEP. Only 7% live within a 5-minute walk of Voorhees Environmental Park. When compared with the adult responses, the results are highly consistent.

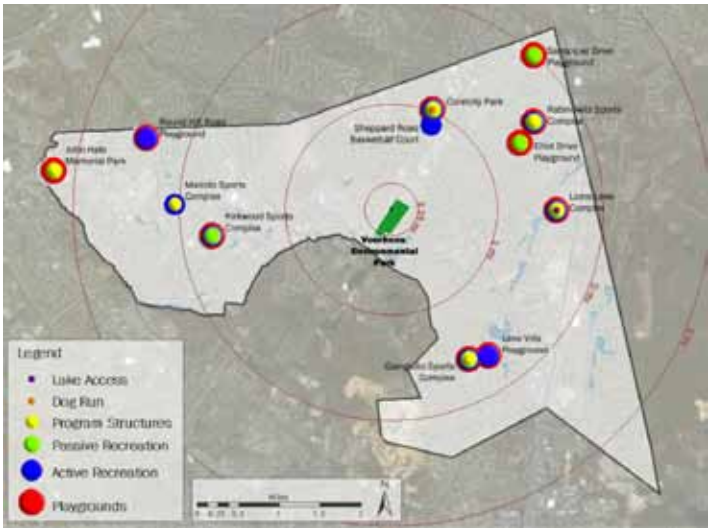
Proximity of Students to Voorhees Environmental Park



3.3 Open Space in Voorhees Township

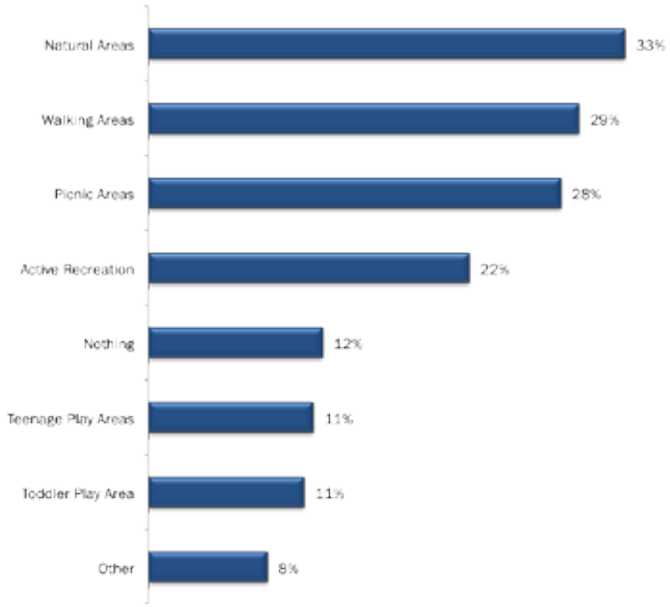
The park system in Voorhees Township is comprised of 13 parks of varying sizes distributed almost uniformly near the northwest and northeast borders of the Township, with two parks near the southern border. The Voorhees Environmental Park will be uniquely positioned near the center of the Township's park system. According to the Township website, the majority of existing parks in the system offer active recreation (such as organized team sports fields), toddler play areas, and picnic areas.

Voorhees Township Park System



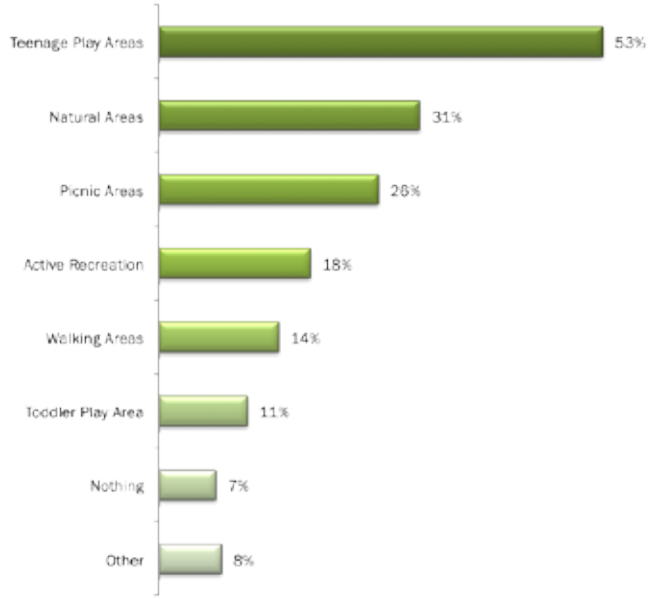
After being asked what they believe is lacking in the Voorhees Township park system, adults responded that natural areas, walking areas, picnic areas and active recreation are amenities lacking in the Voorhees Park System. One-third of adults felt natural, walking and picnic areas are lacking. About a quarter of respondents felt that active areas are lacking in Voorhees.

What is Perceived by Adults to be Lacking in the Voorhees Park System



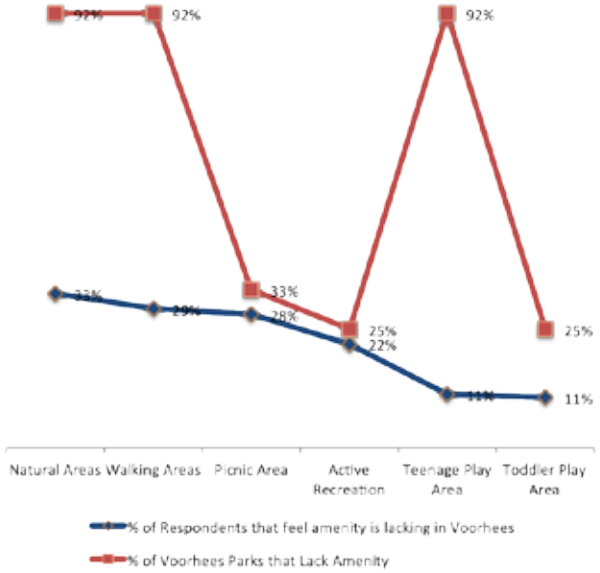
Teenage play areas, natural areas, picnic areas, and active recreation were chosen by the largest number of students as amenities lacking in the Voorhees Park System. When compared with the adult survey, the selection of natural areas, active recreation and picnic areas was similar. Teenage play areas and walking areas differed greatly.

What is Perceived by Students to be Lacking in the Voorhees Park System



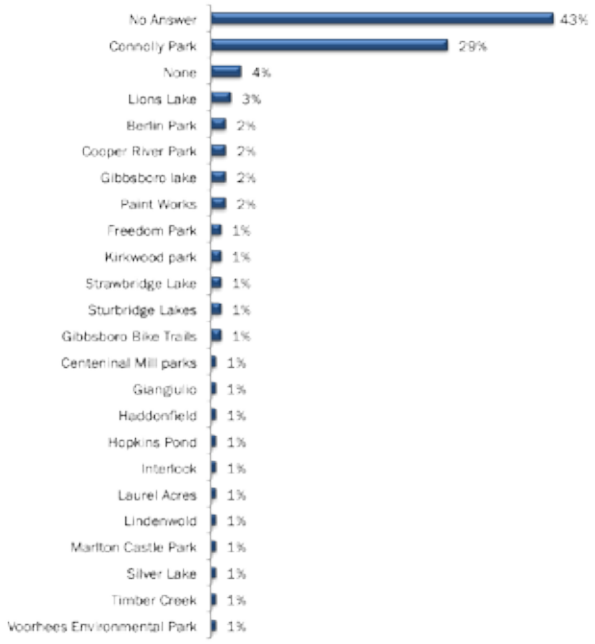
According to amenities listed on the Voorhees Township Website (Voorhees Township 2012; Spot), 92% of parks in the Township lack natural areas and walking areas. While the perceived lack of walking areas and natural areas aligns with the park amenities reported by Voorhees, adults also perceived active recreation and picnic areas to be lacking. According to the website, the majority of parks offer these amenities.

Amenities Perceived by Adults to be Lacking in Voorhees versus Amenities Reported in Parks



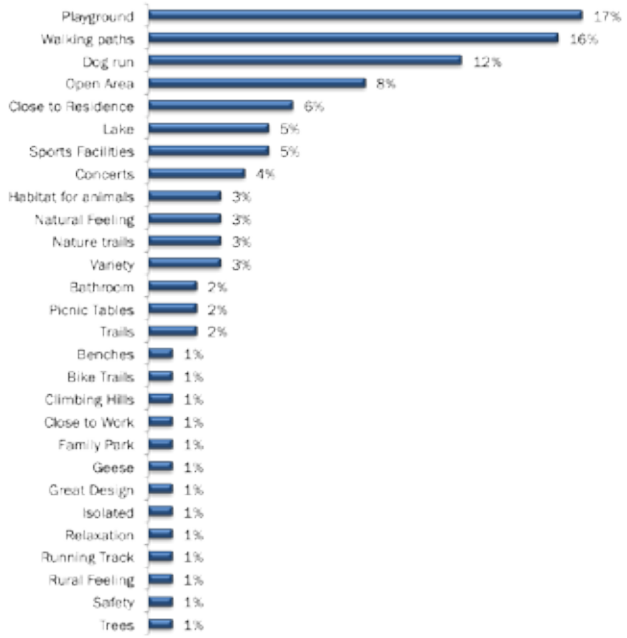
Adults chose a range of parks were as favorites from both Voorhees and nearby communities. Nearly half, though, didn't list a favorite park indicating that there are a large number of adults who may still desire an iconic park or desire amenities that are not currently offered in the existing park system. Connolly Park is favored by a third of the respondents.

Favorite Parks selected by Adults



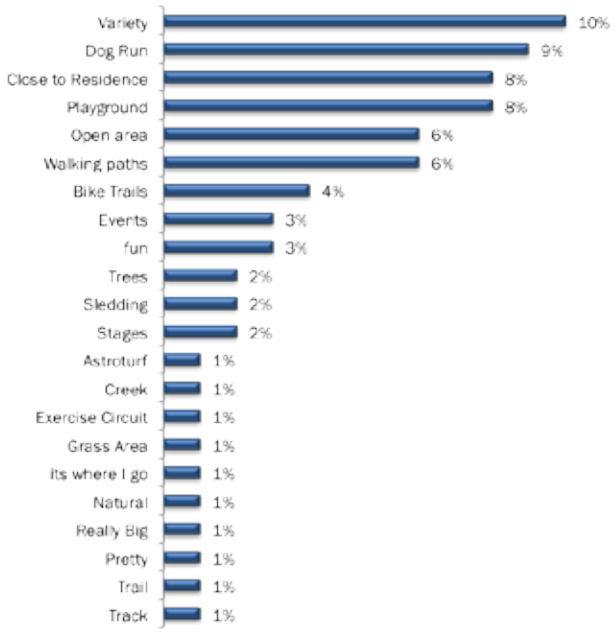
Adults indicated an equally wide range of reasons why they listed their favorite park. Playgrounds, walking paths and dog runs were among the top three reasons listed.

Adults' Reasons for their Favorite Park



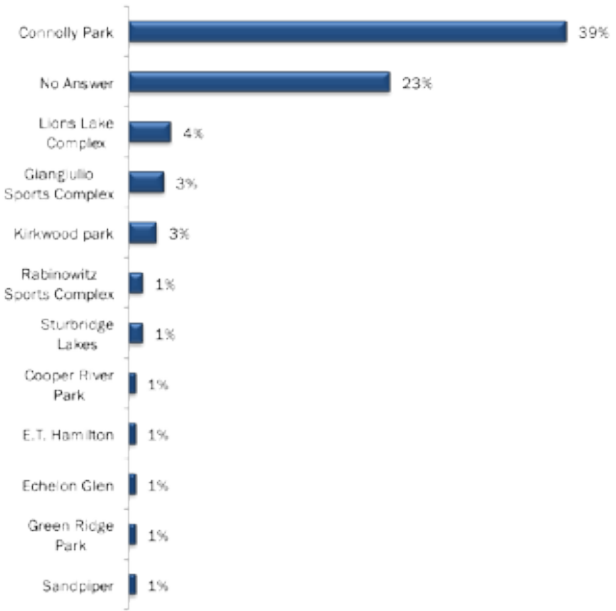
Students also indicated a wide range of reasons why they selected their favorite park. The top four reasons were variety, dog runs, proximity to residence and playgrounds. Dog Runs and Playgrounds were also listed as top reasons adults selected their favorite park. Students did not select walking paths as often as adults did as to why they selected their favorite park.

Students' Reasons for their Favorite Park



Students also reported a wide range of parks as their favorites from the Voorhees Park System. The largest group of students, 39%, favor Connolly Park (vs. 29% of adults). Fewer students (23%) than adult respondents (43%) selected no answer. This may indicate that those students already have an iconic park or a park that satisfies their open space preferences while older respondents may not.

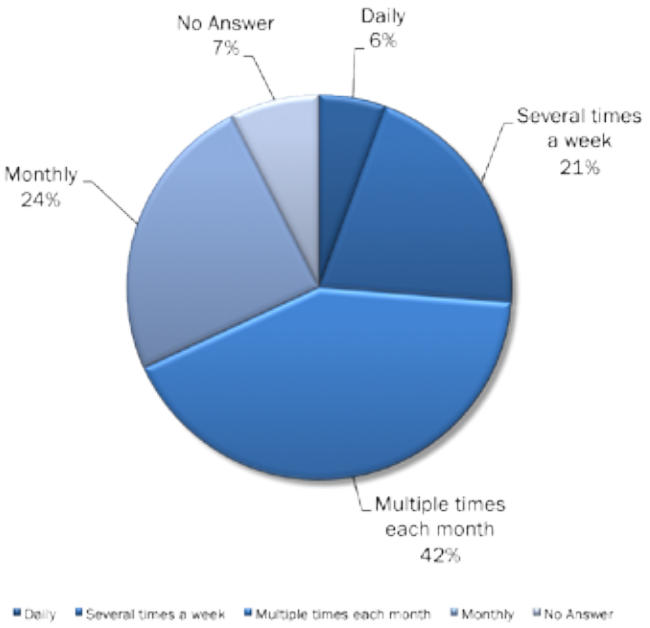
Favorite Parks Selected by Students



3.4 Use of Voorhees Environmental Park

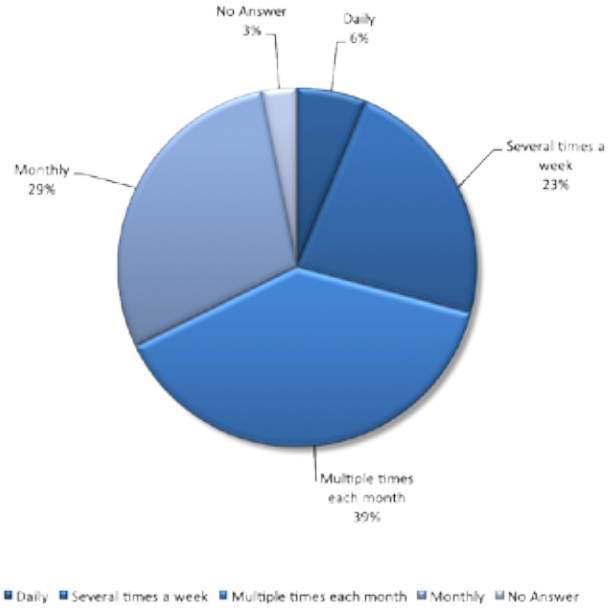
Few adults estimate that they will use Voorhees Environmental Park daily. Only 6% see themselves visiting the park daily. Almost one-quarter (21%) of adults plan to visit several times each week. And, the majority plan to visit less frequently.

Estimated Visitation by Adults



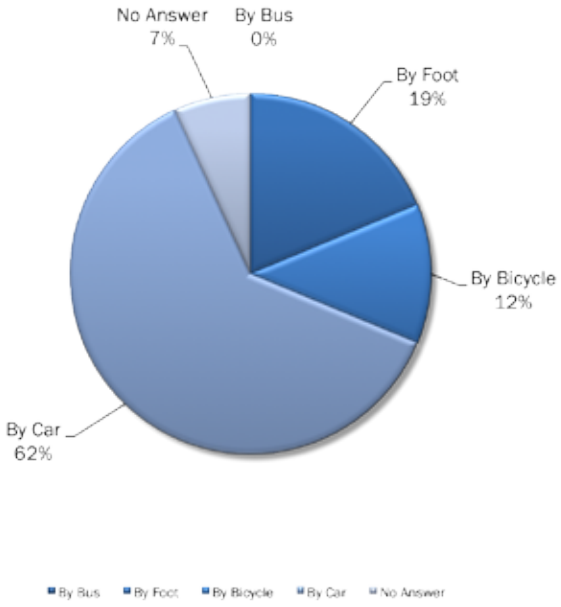
Similar to adults, only 6% of students see themselves visiting the park daily and 23% plan to visit several times per week. The largest group of students plan to visit less frequently (multiple times each month and monthly. The results are highly consistent with the adult respondents.

Estimated Visitation by Students



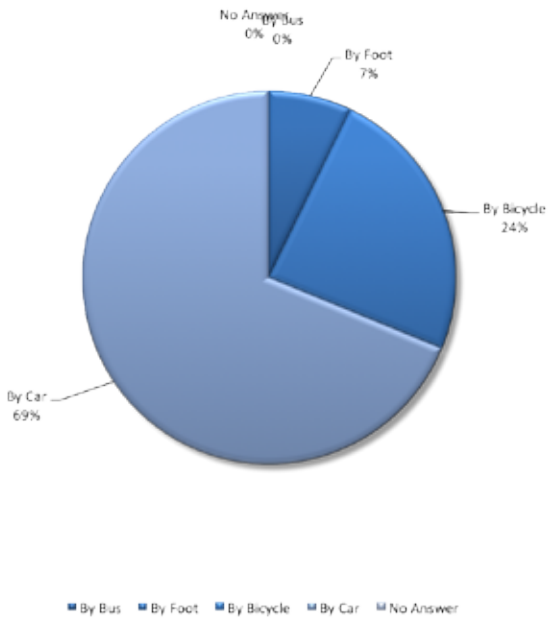
The importance of parking should not outweigh the importance of safe bicycle and pedestrian connections, potentially reducing the need to drive to the park. Although nearly two-thirds of adults envision driving to the Park, over 30% see themselves travelling by alternate modes of transport. The need for safe pedestrian access across Centennial Boulevard as well as access from the southern ("Haddonbrook") edge of the property are required--19% of adults would walk. Connections to the Voorhees bicycle system are also required--12% of adults would travel by bicycle.

Most Likely Mode of Transportation by Adults



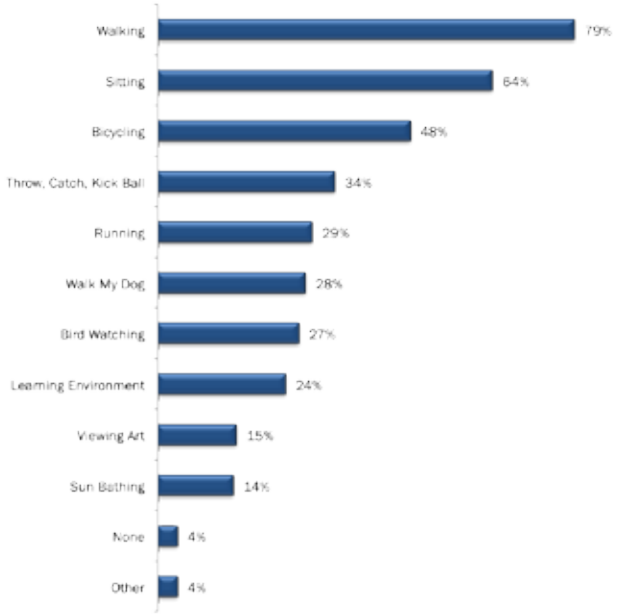
The majority of students also indicate that they are likely to visit the park by car. These results (69%) are higly consistent with the adults (62%). Almost twice as many students (24%) said that they would bike to the park, further indicating the requirement for complimentary bicycle connections. Fewer students indicated that they would walk to the park (7% vs. 19%).

Most Likely Mode of Transportation by Students



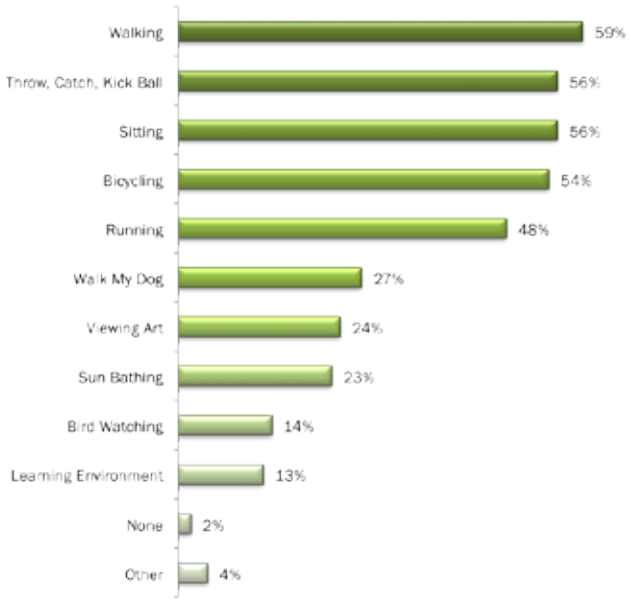
Passive Recreation such as walking, sitting and bicycling emerged as the top three anticipated activities for adults in Voorhees Environmental Park. Only about one-quarter of adults mentioned that they envisioned an environmental education component in their activities in the park. This may indicate an opportunity for VECEF to focus on the integration "passive" environmental education into a passive recreation features of the park.

Anticipated Park Activities by Adults



Students also envisioned themselves engaged in more passive forms of recreation in the park. The largest groups of students saw themselves Passive Recreation such as walking, sitting and bicycling emerged toward the top of anticipated activities in the park. Many more students (56%), than adults (34%) expect to be engaged in active recreation in the park. Fewer students (13%) than adults (24%) expect to learn about the environment in the park.

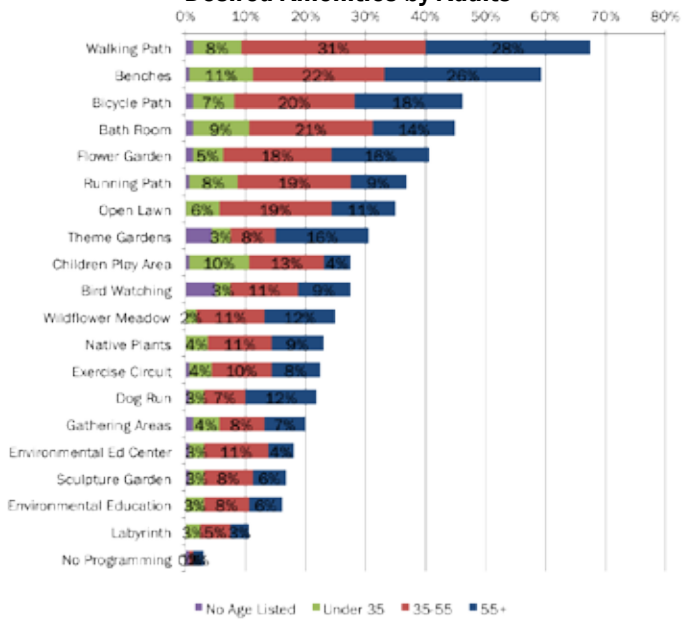
Anticipated Park Activities by Students



3.5 Desired Amenities

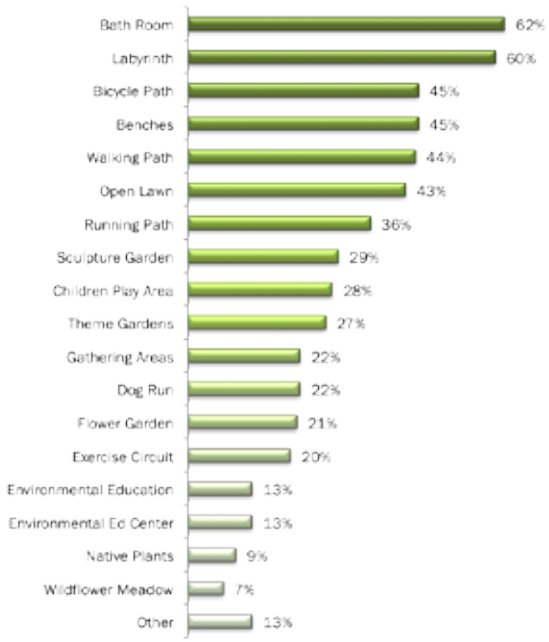
The top desired amenities specified for VEP were walking paths, benches, bicycle paths and bathrooms. Flower gardens and running paths were also desired by approximately 40% of respondents. Only about one-third desire Theme gardens (Asian Gardens, etc.),

Desired Amenities by Adults



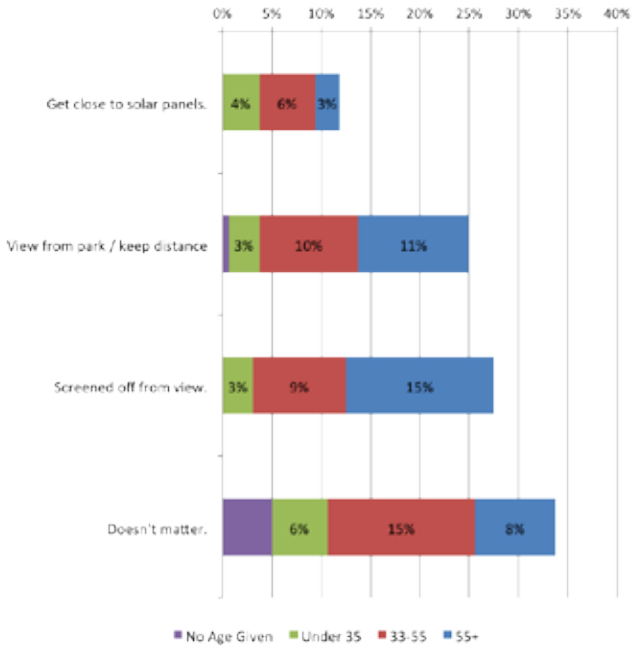
The top five desired amenities by students were bathrooms, a labyrinth, bicycle paths, benches, and walking paths. About one-third desire Theme Gardens (Asian Gardens, etc.), similar to the adult responses. More students than adults, though, prefer an open lawn (43% vs. 35%). Fewer students desire flower gardens (21% vs. 40%). And, many more students than adults would prefer to have a Labyrinth (60% vs. 11%). This, in fact, was one of the more popular desired amenities.

Desired Amenities by Students



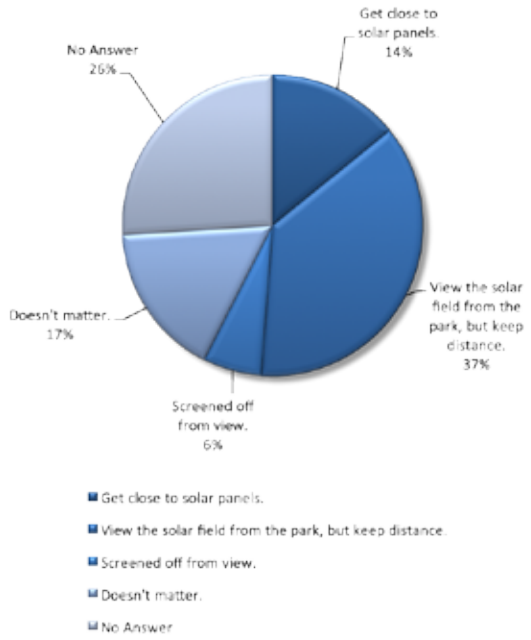
Response to the integration of a solar array in the park was mixed. Approximately 34% of the adults said that the interaction between solar and the park did not matter. 15% of 55+ group felt that the solar array should be screened from view. 37% felt that some connection (visual/tactile) would be appropriate, leading to the inclusion of an overlook.

Adult Solar Integration Preference by Age



Student response to the integration of a solar array in the park was also mixed. The largest group (37%) said solar should be viewed (vs. 25% of adults). Students had a much stronger preference to solar integration than adults did. Only 17% of students said that the solar integraiton strategy did not matter (vs. 34% of adults). Only 6% of students said solar should be screened from view (vs. 28% of adults). The majority of students, 54%, felt that some connection (visual/tactile) would be appropriate.

Student Solar Integration Preference



3.6 Key Observations

Key Observations from the Survey of Adults

Adult respondents expressed a strong desire for passive recreation.

- Walking paths (78%), benches (59%), bicycle paths (46%) and running paths (37%)
- Approximately 1/3 thought that natural and walking areas are lacking in park system.

The reaction to contact with the solar array differed slightly by age group.

- A larger proportion of respondents under 55 preferred some connection with the solar array than those that are 55+.
- 37% of all respondents felt that some connection (visual/tactile) would be appropriate. 28% felt it should be screened off. 34% said it did not matter

The car is an important mode of transportation; however, pedestrian and bicycle connectivity is critical.

- While the majority of people will drive, just over 1/3 state they will be without a car at VEP.

There appeared to be little public demand for an Environmental Education Center.

- About 18% of the respondents expressed interest in a center and only 25% said they envisioned learning about the environment at the park.

There was interest in ornamental gardens

- Interest in flower gardens was relatively high (41%)
- Theme Gardens (Asian Gardens, etc.) demand was lower than expected (31%)

Key Observations from the Survey of Students

Students expressed a strong desire for passive recreation, but also wanted to take part in active recreation.

- Labyrinth (60%), Bicycle Paths (45%), Benches (45%) Walking paths (44%),
- Open Lawn was desired by 43% and over half envision playing ball (56%)
- Approximately 1/3 thought that Natural and Walking areas are lacking in park system.

The reaction to contact with solar was much stronger with students.

- 54% preferred some contact/ 37% Visual, 14% want to get close
- Only 6% wanted them screened off.
- 17% said it did not matter.

The car is still an important mode of transportation for students; however, more see bicycle connectivity as critical.

- 24% envision riding their bike to the park, 7% will walk
- 69% will arrive by car

53% of students said that Teenage Play areas are lacking in Voorhees.

There appeared to be little student demand for an Environmental Education component.

- 13% expressed interest in the environmental education and 13% said they envisioned learning about the environment at the park.

- Could there be an opportunity to combine "nontraditional" environmental education and teen play areas?

There was interest in ornamental gardens

- Over ¼ desired Theme Gardens (Asian Gardens, etc.) (27%)
- Interest in flower gardens (21%), meadows (7%) and native plants (9%) was relatively low.

3.7 Additional Comments

Additional Adult Survey Comments

Survey respondents were also asked to offer additional comments in an open-ended format. Select comments from the Phase One survey were as follows:

- "I would like to thank everyone involved in this project. Voorhees residents desperately need a park that can serve as a place to learn about and meditate on the beauty and wonder of nature."
- "The entire area should be leased out to a solar provider with revenues directed back to Voorhees township. Voorhees does not need another park but it does need a new source of income."
- "Voorhees has many parks for active recreation and lots of protected open space, but it is not accessible to the public. I see this park as place that is a quiet place to walk bike or run."
- "We would very much like wildflower meadows with boardwalk paths all around and the boardwalk access to the pond. Habitat creation very important to us. ADA accessible with boardwalk (vs. gravel)."
- "Please consider the needs of the small animals & birds when considering the final design. Would like to share the space with them, not exclude them."
- "Lets get this up and running before I drop dead!"

Additional Student Survey Comments

Survey respondents were also asked to offer additional comments in an open-ended format. Select comments from the Phase Two survey were as follows:

- "Instead of solar panels in the park, there should be free ones on houses."
- "I want a labyrinth really bad."
- "A huge water fountain in the middle of the park, and a stage."
- "Public art sculptures, graffiti wall, skate park, horseback riding."
- "Artwork display, painting wall, photo center."
- "Maybe look like central park or a bee raising farm."
- "Concrete paths for scooters/skateboards."
- "Big rocks to sit on, trails through the forest."
- "Please can we have a skate park?"

4 Integrated Design

4.1 Introduction

The combination of feedback from the Voorhees community and an iterative design process that included on-going feedback from Voorhees Township, Voorhees Environmental and Cultural Education Foundation (VECEF), and CME Associates, Inc. led to the production of this conceptual design that represents the vision for the Voorhees Environmental Park.

The public response to the Rutgers graduate studio designs and the informational survey provided the Center for Urban Environmental Sustainability (CUES) with a starting point from which to coordinate and revise features from each of the four student group designs into a single and comprehensive design. The responses (detailed in Chapter 3 of this document) by both individuals representing a wide spectrum of ages and locations in Voorhees Township and the surrounding communities were integral in better understanding their preferences and desires for the park's design. It became evident after the survey analysis, and through conversations with VECEF and the Township, that the main attribute for Voorhees Environmental Park should focus on passive recreation. Large numbers of respondents expressed support for walking, biking, and sitting on benches as opposed to more active recreation such as sports or playing ball. The park was seen as a place with a variety of trails that offer different experiential characteristics enhanced by places to sit and relax.

An elevated, sixty-foot wide promenade lined with a double allée of trees became the dominant design feature that runs the length of the park providing a strolling, linear walk as well as seating. The promenade terminates on each end with two overlooks. The northern end addresses the desire to have a connection with the solar field in the form of an elevated solar overlook. The southern end of contains a view over the pond. The pond was originally considered one of the most pleasant and important features on the site and many respondents to the survey expressed a strong desire for a peaceful connection to this area. Adjacent to the promenade the northern area is a great lawn, offering sufficient open space for visitors to the park to engage in a variety of activities. In an adjacent area is a wildflower meadow equipped with bird blinds and a boardwalk to provide a very different walking experience to the promenade and other trails. The meadow and boardwalk address the desires for variety as well as bird watching, and a quiet place to stroll and sit. On the western side of the promenade are three areas designated for theme gardens. These are the spaces where flower gardens, a labyrinth, playgrounds, a skating rink, or environmental education gardens could be implemented based on future needs. The idea of theme gardens initially came from a request for park designed in the style of an Asian garden, an idea that has perpetuated throughout the design discourse, possibly orignating prior to CUES involvement with the design process. CUES has established opportunities for the placement of and recommendations for different "design themes" recognizing the probability of the evolving preferences of the community and VECEF throughout the implementation of the park.

4.2 Design Walkthrough

The design walkthrough is a written guide accompanied by images of what the feeling and qualities of the different areas of the park will be. It describes the park in different sections providing more detail about the design in that particular area. Later sections in this chapter provide more information and technical data about the prominent features in the design.

Centennial Boulevard

In order to create a safe and attractive entrance to the park that is compatible with existing vehicular flow on Centennial Boulevard, alterations to the street will be required. The entrance directly opposite the Centennial Mills entrance will include trees in an elevated planter that will replace asphalt in the center of the road. The street trees will add an additional aesthetic quality to the road while serving as a marker for the park entrance that can be seen from both directions on Centennial Boulevard. Along with a high aesthetic quality, the design change has two main functions. The first is to calm the traffic on Centennial Boulevard. The trees function by promoting the perception of a road that becomes slightly constricted, using traffic calming devices known as "chokers." By slowing the speed of automobiles, the entrance and street edge of the park become a safer environment for pedestrians and bikers. The second purpose is to provide a crossing haven in the middle of the street. This will provide a safe area for pedestrians and cyclists attempting to cross Centennial Boulevard from the Centennial Mills side of the road. The Road itself will need widening to allow for proper deceleration lands as well as turning lanes.

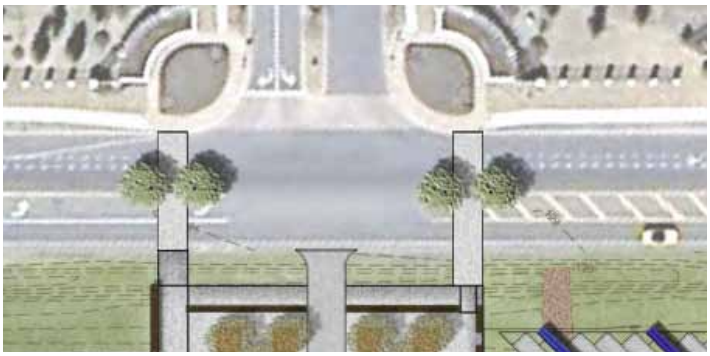


Figure 41. Street trees in Centennial Boulevard

Figure 42. Integrated Desgin - Conceptual Plan

Figure 43. View approaching the entrance plaza

Entrance Plaza

Visitors arrive in the entrance plaza immediately after turning off of Centennial via car or crossing on foot or bike. Automobiles will drive through the center of the plaza on a paved road, while pedestrian and bicycle paths leading from Centennial Boulevard are placed along the outer edges of the plaza. The beauty and appeal of the entrance plaza comes in the form of flowering Eastern Redbud (*Cercis Canadensis)* trees that provide a canopy for both cars and pedestrians to pass under upon entering the park. These trees will be installed in planters to provide adequate soil for growth. The planters, which range in height from one foot to three feet due to the slope of the ground, will provide pleasant seating niches under the beautiful trees right at the entrance of the park. In the beginning construction phase, this will be the focal area of the new park. The planters should be a basic cost effective design, constructed from a simple metal frames and panels of recycled plastic arranged in a ten foot by ten foot square. This provides the tree with adequate soil for healthy growth and appropriate spacing between planters for walking and sitting. Using solar energy to up-light the trees at night, after park closes, provides visual interest for people passing by at all hours.

Two different materials were chosen for the ground surface of the entrance plaza. The portion designated for automobiles will be bordered with a Belgian block curb and paved with stamped asphalt. The rest of the ground surface in the plaza serves the purpose of pedestrian traffic and will be a water bound surface. Three foot high Gabions will be used on three of the four sides of the entrance plaza to create a physical border that doesn't impede sight lines for adults but does create a spatial edge. The fourth side borders the promenade and will have six-inch stairs up to the largest portion of the promenade, the solar bosquet. The steps will contain Eastern Redbuds (*Cercis candensis*) to provide shade on the steps and create another sense of arrival by passing under the trees up onto the promenade.

Figure 44. View looking down the promenade

The Promenade

The promenade is the strongest design element in the park. In order to plan trees on the landfill a minimum of two feet six inches of sol is needed to provide adequate root soil volume to maintain a healthy tree. Elevating the trees also aids in protecting the integrity of the soil cap. From a design perspective, strolling along an elevated promenade provides a feeling of a more powerful walk. An elevated path, statue, or building enhances that feature by adding a sense of prominence. This feature allows pedestrians or cyclists to look out over the rest of the park while still walking, sitting or riding comfortably under the shade of the trees. The trees will be planted in a double allée comparable providing a central walkway that is twenty-feet wide. The length of the promenade is comparable in length to other famous promenades such as the one in Central Park that passes through an allée of American elm. To add interest, the double alee is punctuated with different species of trees planted in the form of quincunx bosquets. A benefit of different tree species is that they provide habitat for wildlife and seed stock for the area of the park designated as the successional woodland.

A sixty-foot wide promenade can comfortably provide enough space for walkers, cyclists, benches and trees. Gabion walls, which are used to hold the fill for the promenade in place, will rise above the surface of the promenade roughly a foot and a half on most outer edges of the promenade. The wall provides seating if desired and a safe border for the elevated promenade. The surface of the promenade will be compacted stone dust, which is sufficient for walking and bicycling. It also accommodates tree growth as it allows water to permeate the surface and does not inhibit the growth of the trees. It is also appealing to view trees growing directly out of the surface of the promenade rather than from tree wells.

Figure 45. Trees and stone dust at the Miller Garden

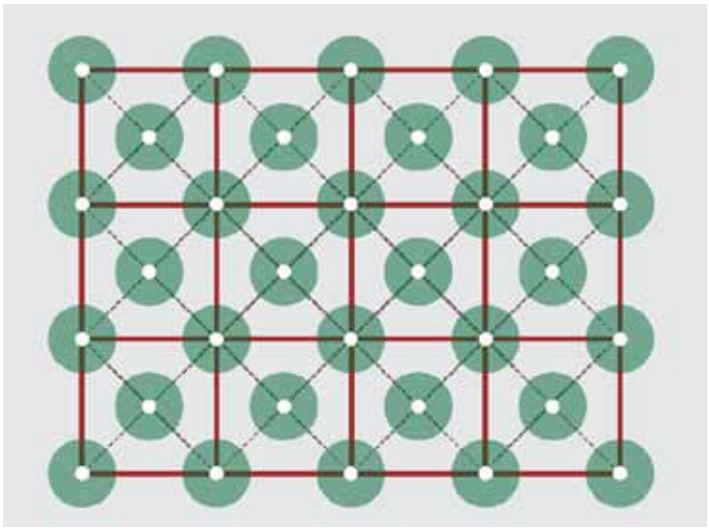


Figure 46. Quincunx bosquet diagram

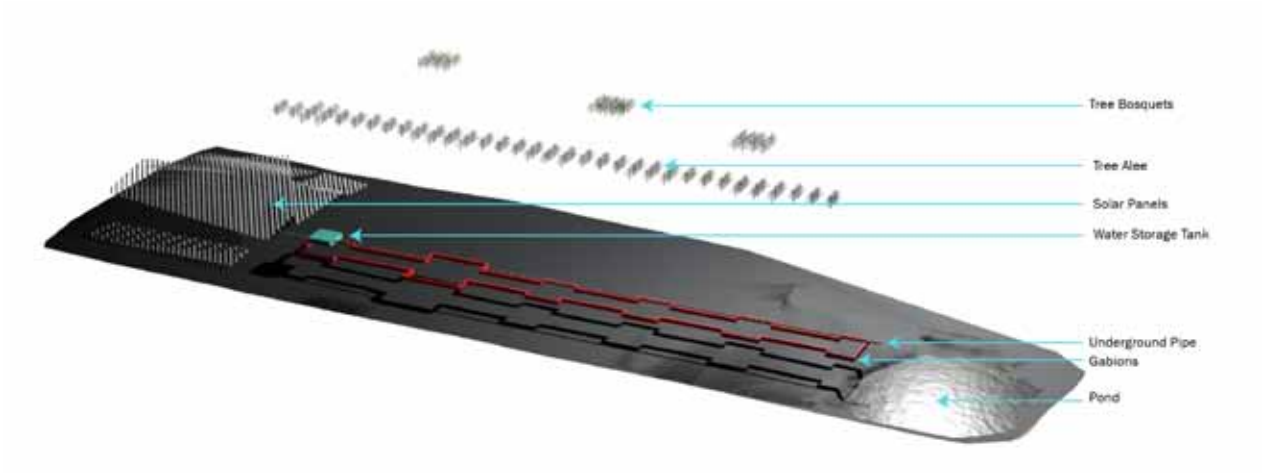


Figure 47. Diagramatic water storage and reticulation system along the promenade

Solar Overlook

The solar overlook is at the northern terminus of the promenade. The slope of the promenade very gradually rises as the solar overlook is approached. At the end, there is a bosquet of trees followed by an open area at the highest point that is publically accessible in the park. From here a grand view out over the solar array provides a connection with the solar technology funding the park. The overlook will be equipped with signage explaining the solar array and solar energy and explaining that the solar revenues pay for building and maintaining Voorhees Environmental Park. Below the solar overlook, buried under the stone dust surface and fill and supporting that portion of the promenade is a water collection cistern. The stormwater collection and reticulation system is explained in greater detail in Section 4.4. The cistern will store the stormwater drainage from half of the solar array, pumped from the cistern and reticulated through two permeable Belgian block lined swale running the entire length of the promenade, between each row of trees. From the solar overlook, one can walk back toward the southern end of the promenade or travel down a ramp to the great lawn and the combined walking and bicycle trail that circles the outer edges of the park.

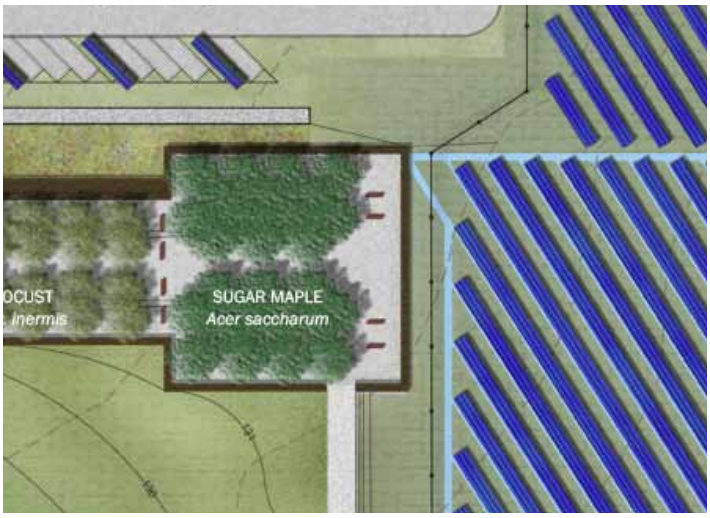


Figure 48. Solar Overlook plan

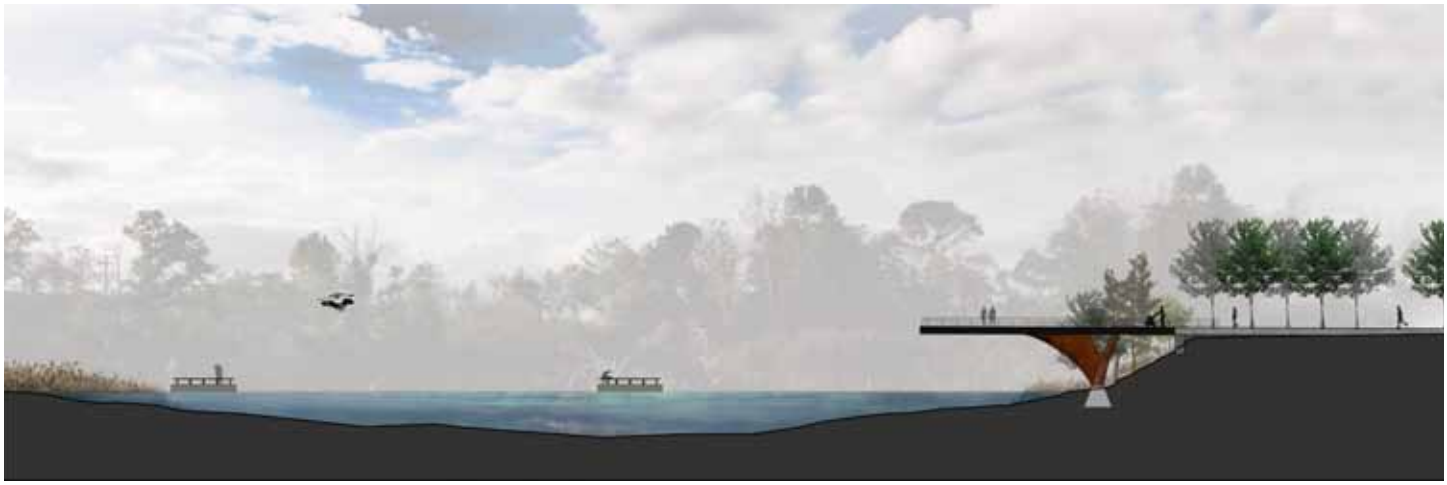


Figure 49. Pond Overlook section

Pond Overlook

On the southern terminus of the promenade is the industrial spire that supports the overlook cantilevering above the pond. A decking platform extends out from the promenade over the edge of the slope surrounded by existing trees leading down to the pond. This acts as a peaceful spot for relaxation and meditation where one can sit and view the prominent water feature of the park. Similar to the solar overlook, one approaching the pond overlook will pass under one final quincunx bosquet of trees and arrive at the elevated platform that slopes upward slightly offering a 360-dregree view of the pond.

Solar Bosquet

The solar bosquet is the largest rectangular-shaped area of the promenade and the most prominent area that is not planted with trees. It is situated adjacent to the entrance plaza and is the main area where visitors access the promenade. To maintain the same design language, recycled I-beam posts offering support for the overhead solar and shade structure are “planted” into the surface of the promenade in the same quincunx bosquet pattern that repeats along the promenade. On top of the metal posts a trellis system will be constructed to house solar panels that provide renewable energy for the park. Energy from these solar panels will be used to power the hydro-pump for the water system and for the up-lighting of the trees in the entrance plaza. In the early phases of construction, a tent or overhead structure should be added to the trellis system to provide shad and a gathering place at the center of the park. In the longer term, this area has the potential to house an environmental center that can also be powered from the solar panels above. It should be noted that these solar panels are separate from the solar array and will be maintained by Voorhees Township

Figure 50. View from the great lawn looking back at the promenade and solar bosque

and would not be the responsibility of the solar provider selected to implemented the solar array at the northern edge of the park.

The solar bosquet is situated as the center point alon one edge of the great lawn and is an area where parents and grandparents may gather while their children play on the lawn. There are also steps and gabion walls leading down from this area that provide more seatin and easy access to the lawn area.

Great Lawn

The great lawn is a larg open area of the park that will be maintained as a manicured lawn. The lawn will be designed to slope up and meet the promenade. The other sides of the lawn will slope to connect with walking paths that border the meadow, successional forest and the northern portion of the loop trail. The lawn is accessible from all sides and is designed to be open space within the park for a variety of activities. The lawn will, for the most part, be exposed to full sun throughout the day. Visitors may find shade near its edges next to the successional woodland and under the trees and solar bosquet of the promenade.

The great lawn is an area for children to play, caregivers to relax and watch from a distance or enjoy a book or conversation. It can also be a spot for laying out in the sun, picnics or yoga. It is an ideal location for passive recreation of all types.

Figure 51. View looking from the boarwalk across the meadow at a bird perch

Meadow and Boardwalk

The meadow and boardwalk were the most preferred feature of the graduate student designs. The wildflower meadow is an area that requires patience and minimal maintenance. The area should be roped off from foot traffic to allow for wildflowers to establish. In the beginning phases the meadow will be an area to observe wildlife that inhabit the site. Bird blinds will be constructed to allow visitors to sit and bird watch. Bat houses and bird perches will be constructed in the meadow to attract diverse wildlife and promote the ecological processes within the park. Both bats and birds are effective for seed dispersal and controlling insect populations. The boardwalk can be accessed from several places. There are two entrances from the promenade, two entrances from the loop trail and an entrance from the successional woodland path. The boardwalk is elevated slightly over the meadow. The boardwalk provides a peaceful walk from the promenade around the outer edge of the meadow and connects with two larger quincunx bosquets of evergreens at its outer corners where visitors may access the loop trail and connect with the path that separates the great lawn from the successional woodland.

Solar Array

One exciting challenge and opportunity in the design of the park was the integration of a commercial solar array and with a public park on a brownfield site. The development of a solar arrays on former landfills is common in New Jersey and throughout the United States. But the commitment by Voorhees and VECEF to explore the integration of the two, a public park and a solar array, represents a cutting edge commitment that has the opportunity to become a model for sustainability and urban ecology. The solar array occupies about 10 acres and is not publicly accessible. Solar arrays are a unique feature and important technology, but unfortunately, the are typically fenced off to protect the equipment, infrastructure and public safety. Although the solar array is not accessible to foot traffic, visitors to the park can still enjoy looking at this 21st century, renewable energy source. The proceeds from leasing the land to a solar provider will be used to fund the maintenance of the park. In addition to providing funds for maintenance, the solar array will also be used to harvest rainwater. As a impermeable surface, the panels of the array are ideal

Figure 52. View from the white pine bosquet looking across the lawn towards the successional woodland area

for directing and sheeting stormwater to the park's water collection and reticulation system, minimizing the amount of stormwater entering the water bodies surrounding the park. The water harvested from the solar panels will then be used to water the trees of the promenade.

Successional Woodland

This successional woodland is a portion of the park which is intended to remain in a more 'natural state.' At one time, the landfill was covered with small- and medium-sized trees and shrubs before it was grubbed and maintained as mowed grass to promote stormwater runoff and discourage infiltration of water into the soil landfill cap. Succession, a series of changes in a vegetation community that occur over the span of decades. Through small-caliper tree and shrub plantings spaced in tight grids throughout the successional woodland as well as the quincunx bosquets, the park design promotes seed dispersal and through successional processes over decades, hopes to establish a moderately-sized woodland on the southern and western edges of the park. Critics of early successional processes often claim that areas appear "messy" when vegetation is small and appears similar to a sporadic and unmaintained scrubland. The scrubland characteristics are actually an exciting stage within the successional development of a woodland where species are competing with one another for survival and genetic dispersal. With the proper signage indicating offering information about the successional processes, a well-orchestrated environmental education, and a volunteer- or education-based management plan for aggressive invasive plants, future generations of Voorhees Township will enjoy moderately sized, healthy woodland in Voorhees Environmental Park.

While foot traffic will be restricted from accessing the successional woodland in order to safeguard the initial clusters of planted trees and shrubs as well as the successional processes that evolved through the years, the existing loop road will pass through the successional woodland. This path will be reconstructed and maintained as quiet walk on the outer edges of the park. Future generations will enjoy a densely shaded walk through trees and shrubs on either side.

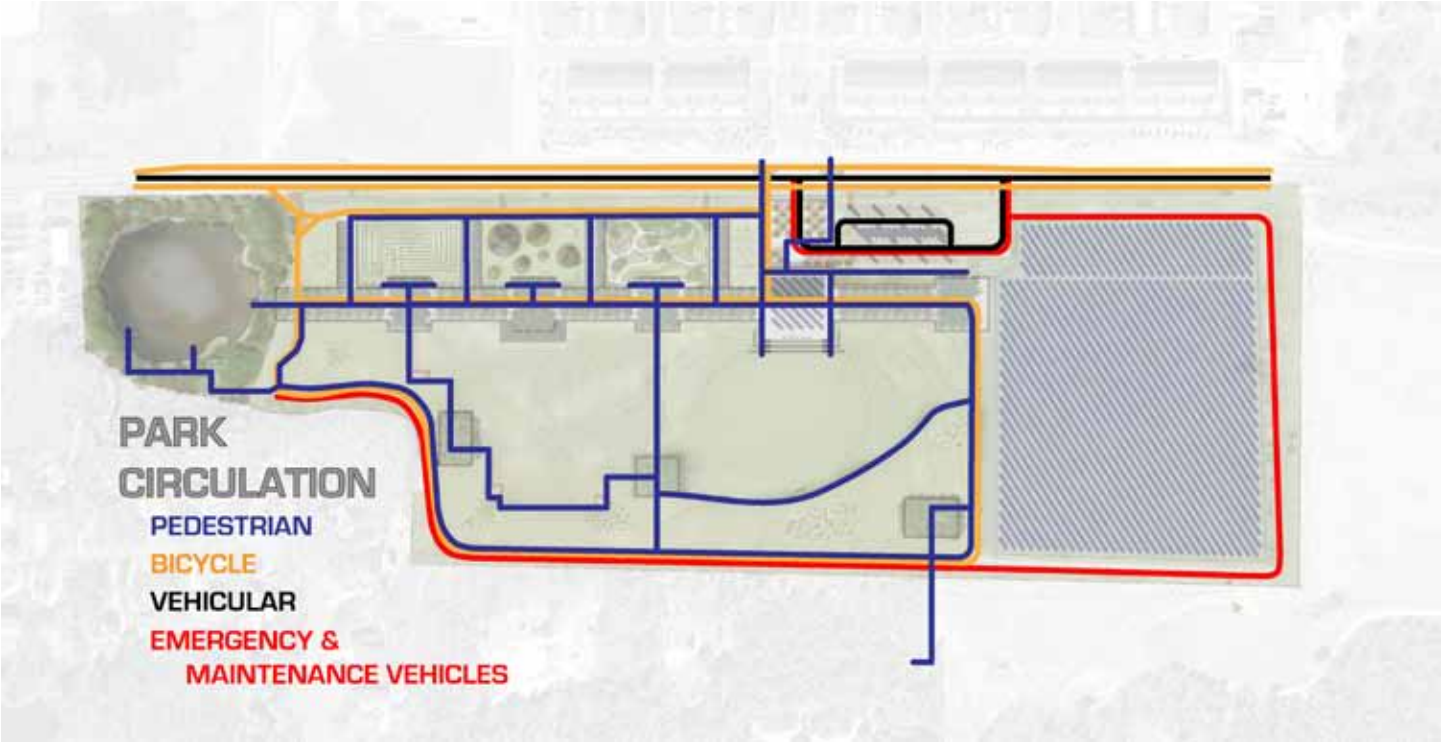


Figure 53. Circulation Diagram

Loop Trail

The existing, onsite loop road will be enhanced with a surface suitable for biking and walking. The loop road will also be maintained for ongoing monitoring, maintenance and an emergency vehicle route. The loop trail is designed as a continuous circuit for walkers and cyclist to move through the park. Starting in the entrance plaza one can pass on the street side of the theme gardens and follow the loop trail around up to the pond overlook. From there the trail continues through the successional woodland and runs along the side of the solar array until it reaches the solar overlook. The promenade then becomes part of the loop and one eventually reaches a decision where they can continue down the promenade to the pond overlook or for a longer route they can turn back through the entrance plaza and begin the trail over again. A variety of experiences occur while walking or riding on the loop trail as it passes through many different areas of the park with distinctly different feelings and functions. There also several different locations along the loop trail to get off and on to different path systems.

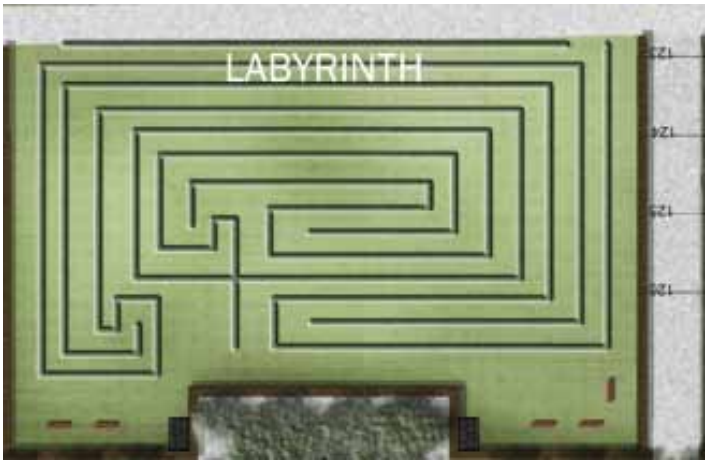


Figure 54. Theme Garden - Labyrinth

Figure 56. Theme Garden - Sensory Garden

Figure 55. Theme Garden - Pollinator Garden

Figure 57. Theme Garden image from Rutgers Gardens

Theme Gardens

On the western side of the promenade adjacent to Centennial Boulevard there are three areas designated for theme gardens. This term is being used loosely because the three rectangular areas were designed with equal dimensions offering the flexibility to introduce gardens of various themes according to the evolving preferences and desires of the community, the educational goals of VECEF, or at the behest of funders. The theme gardens are easily accessible from the promenade by stairs and ramps. They would also be accessed from the loop trail that passes on the edge of the park between the theme gardens and the swale adjacent to Centennial Boulevard.

In the Integrated Design, we have placed three suggestions for theme gardens. From the survey we learned that a labyrinth was a popular feature. Secondly, a sensory garden is a garden in which vegetation "ignites" the senses. Generally, plants are chosen which are known to appeal to one or more senses, depending upon availability and desired effect: sight (e.g. peeling/shaggy bark, brilliant red stems in winter, etc.), smell (e.g. fragrant blossoms, etc.), touch (e.g. thorns, wart-like bark, etc.), taste (e.g. edible blossoms, fruits, etc.) or sound (e.g. plants that attract noisy insects, or plants with branches that are well-suited to gentle or sudden movements with breezes, etc.). Sensory gardens are ideal for education programs for young children, restorative programs and interaction with blind adults and children. The final suggested theme garden in the Integrated Design is a pollinator garden. Pollinator gardens highlight plants that attract specific birds, insects and other wildlife to the plant as a food source and opportunely assist with pollination and survival through genetic dispersal. Plants that attract hummingbirds and other birds, native honeybees and other insects, bats, etc. could be selected depending upon availability and the educational programs developed by VECEF.

The three theme garden designs are purely suggestions for implementation. In actuality, theme gardens could run the gamut–promoting education, recreation, artistic expression, cultural exploration, community interaction, etc. More specifically, CUES has discussed options such as a winter skating rink, playground, dog run, front-lawn conversion display, adult playground (exercise circuits), bocce, ping-ping, outdoor classroom/amphitheater, trash garden display, sculpture garden, art walls, Buzby Brothers site history, compost education garden, native plant display, climate change vegetation garden, and many more, backyard perennial display garden, flower garden, Asian garden, and many more.

Figure 58. View looking towards pond docks

Pond Access and Floating Islands

The pond is located at the southern end of the site. The waterline of the pond is about thirteen feet below the elevation of the landfill cap. The pond has been fenced off for years, allowing many trees to mature around its edges, their roots not subject to the structural constraints of the adjacent landfill cap. The area around the pond has a more naturalistic atmosphere than what we find on the landfill cap, and by making this atmosphere accessible to visitors, the overall experience of Voorhees Environmental Park is enriched.

Access to the pond is enabled by a series of ramps which extend from the loop path at the southern end of the site. The ramps will be made of wood decking with railings. It can be secured with a traditional footing foundation, since the structure will occupy the space beyond the landfill cap. Landings are included every 30-35 feet, so that the ramps will be wheelchair accessible.

After descending along the ramps, two docks extend into the pond. The docks offer seating and immersive views of the nearby floating treatment wetlands and close-up views of any wildlife that may be living in the pond.

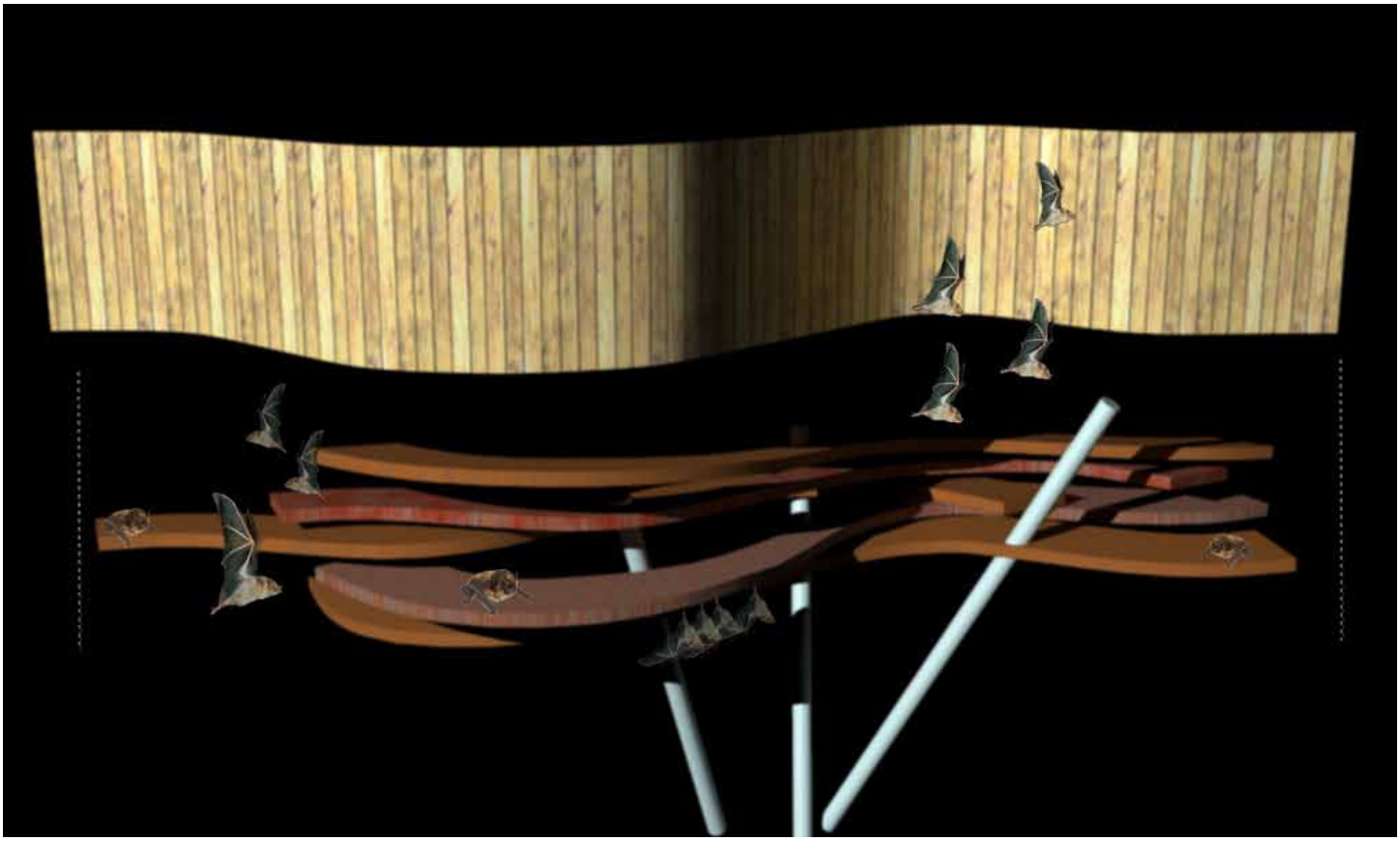


Figure 59. Bats provide a way to naturally control mosquito population without the use of persticides. The bat condo houses them.

Three bat condos (houses) are also constructed at various points around the pond. Bat houses promote the establishment of a healthy community of insect-eating bats that will assist in controlling the mosquito population. Insects consumed by bats include both aerial and ground-dwelling insects. Each bat is typically able to consume one-third of its body weight in insects each night, and several hundred insects in a few hours.

Looking out to the pond visitors will experience three floating treatment islands. The constructed floating islands cleanse the water in the pond through mimicking natural filtration processes that occur in wetlands where water passes through dense aquatic vegetation. The technology is being used in the landscape to treat storm water run off in urban and agricultural landscapes. The three floating treatment systems will be planted with emergent wetland plants on a structure floating on the pond. Invisible to park visitors is a fine root mass web floating in the water below the structure, trapping nutrients and other pollutants in the water and allowing microorganisms living on the plant roots to break down the structure of the pollutants.

4.3 Additional Information

Trees

Regarding tree species, selection must be carefully considered relating to shade tolerance, height, space and environmental conditions. Other factors such as fall color and flowering/fruiting elements add character to a place, while offering habitat and food for insects and birds. On the site of Voorhees Environmental Park, trees must be tolerant of extreme conditions, considering the shallow layer of soil and landfill beneath. In the sections of the promenade, outer bosquets and entrance, trees should thrive due to the extra soil brought in (at least 2.5 feet), allowing more space for the root systems, while avoiding the liabilities that come from overturn during high winds (Figure 1).

When entering the park, there will be a planting of eastern redbud *(Cercis canadensis)*, a medium sized tree that will still provide shade for those that want to sit under it. In addition, redbuds bloom beautifully in the early spring, with bright fuchsia pea shaped flowers. Along the promenade, the dominant tree is the thornless honeylocust *(Gleditsia tricanthos var. inermis)*. Known for its dappled shade pattern and fall color, the honeylocust is a great tree planted en masse. The bosquets of blackgum *(Nyssa sylvatica)* and red maple *(Acer rubrum)* on the promenade are known for their brilliant red and orange fall color. Shagbark hickory *(Carya ovata)* has shaggy bark, offering winter interest along with the evergreen bosquet of virginia pine *(Pinus virginiana)*.

The three bosquets away from the promenade contain species that grow quickly into large and strong mature trees. Eastern white pine *(Pinus strobus)* is the central evergreen planting, and will offer a green space during the winter. Flanking the pine are two oak species, the pin oak *(Quercus palustris)* that offers an excellent shady area, and willow oak *(Quercus phellos)* has delicately textured leaves, offering softness to the space (Figure 2).

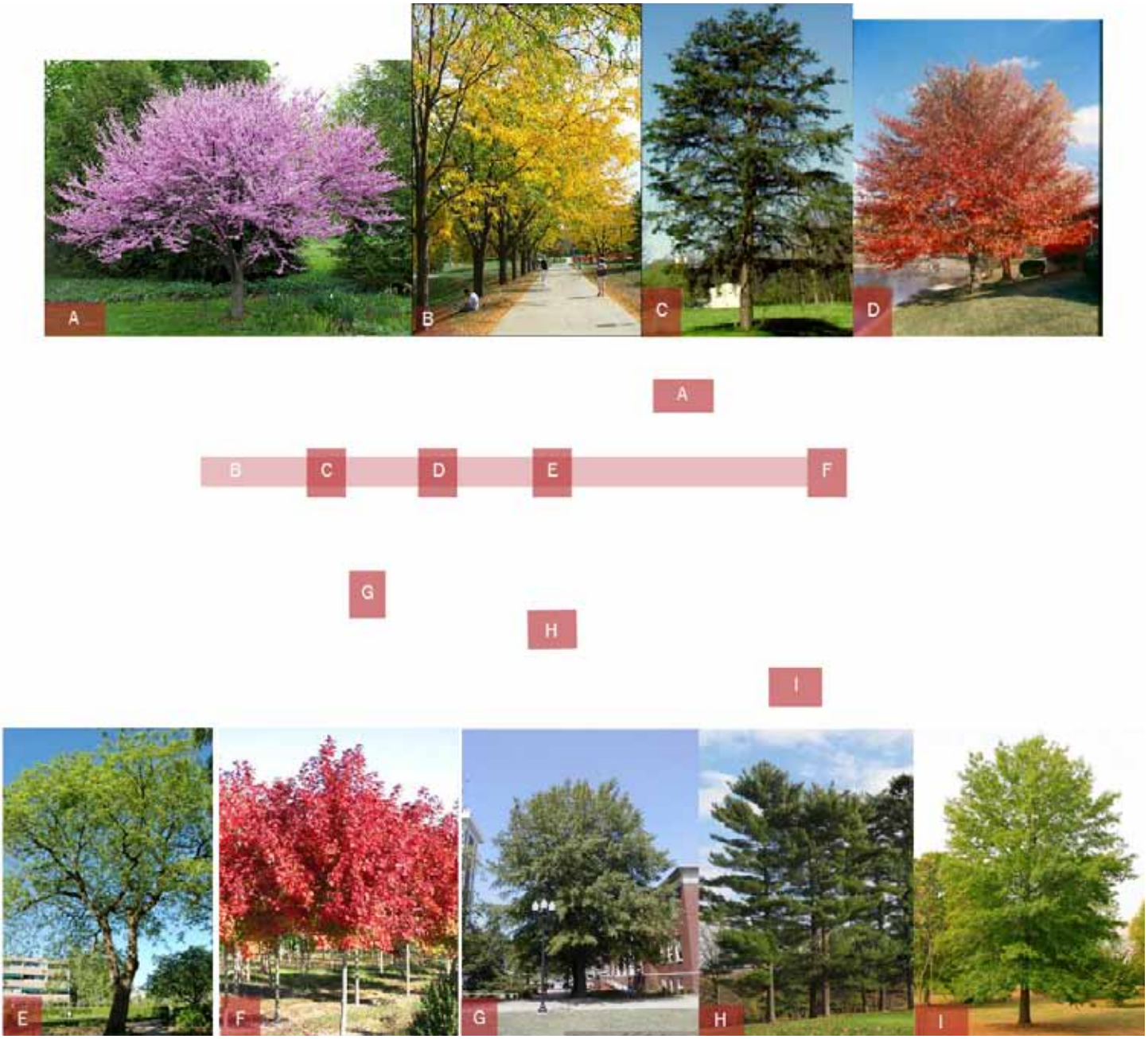


Figure 60. Tree species

A: Eastern Redbud, *Cercis canadensis*

B: Thornless Honeylocust, *Gleditsia tricanthos var. inermis*

C: Virginia Pine, *Pinus virginiana*

D: Blackgum, *Nyssa sylvatica*

E: Shagbark Hickory, *Carya ovata*

F: Red Maple, *Acer rubrum*

G: Willow Oak, *Quercus phellos*

H: White Pine, *Pinus strobus*

I: Pin Oak, *Quercus palustris*

BOSQUE AND PROMENADE TREES	Growth Height (ft)	Canopy Spread (ft)	Structure	Growth Rate	Fall Color	Flower	Fruit	Bark
Eastern Redbud *Cercis canadensis*	20-30	25-35	Rounded, then broad/flat topped	Medium	Yellow green	Purple/pink flowers April	Small seed pods	Brown and orange
Thornless Honeylocust *Gleditsia tricanthos var. inermis*	up to 40	out to 40	Rounded, offering light shade	Fast	Yellow	Small and greenish May	Seed pod	Gray, platelike
Virginia Pine *Pinus virginiana*	40-70	25-30	Irregular, then Flat-topped	Fast	Evergreen	None	Spiky cone	Reddish-brown
Red Maple *Acer rubrum*	45-55	25-35	Pyramidal, then spreading	Fast	Red/orange	Showy Red late March	Samara	Smooth gray
Shagbark Hickory *Carya ovata*	up to 80	out to 60	Cylindrical	Slow	Yellow	Catkins May	Hickory nut, edible	Shaggy, unique
Blackgum *Nyssa sylvatica*	30-50	20-30	Pyramidal in youth then flat topped	Slow	Bright red	Non ornamental	Bluish/black (F)	Irregular ridges
Willow Oak *Quercus phellos*	up to 55	out to 40	Pyramidal in youth, Oval when mature	Fast	Yellow to bronze	Catkins May	Acorn	Ridge and furrow
Eastern White Pine *Pinus strobus*	50-80	30-50	Conical in youth, then picturesque	Fast	Evergreen	None	6-8" cones	Grayish-green
Pin Oak *Quercus palustris*	up to 55	out ot 40	Slightly rounded	Fast	Red/bronze	Catkins May	Acorn	Smooth

Figure 61. Tree species characteristics

Meadows

In the Northeastern United States, managed meadows provide a natural alternative to the traditional lawn. Meadows come with many benefits including erosion control and pollution filtering, while offering habitat and food sources for many species of birds and insects. Meadows are diverse ecosystems that can bring interest to the young and old alike during the entire year due their ever-changing nature (Figure 62).

Figure 62. Meadow Image

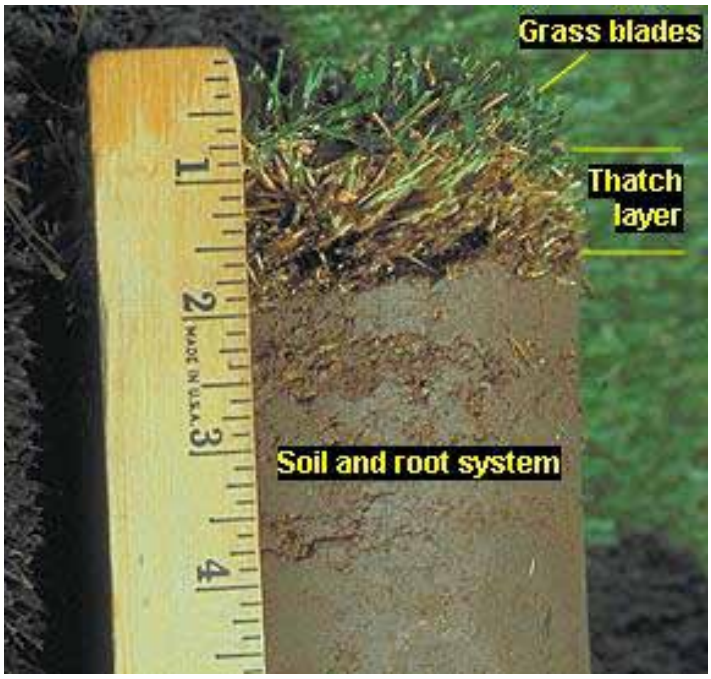


Figure 63. Soil Section

The managed wildflower meadow will be installed after preparing the existing ground, followed by seeding and planting, and then by managing the area through mowing and weeding out woody plants and undesirable species. In order to establish a wildflower meadow, species must be carefully chosen. Meadows in the northeast are a successional stage leading up to a woodland, so in order to preserve a meadow, the trees and shrubs that develop must be pulled in order to prevent meadow plants from being shaded out.

Preparation

The meadow area will be prepared for seeding by using a dethatching machine. Thatch is "the layer of living and dead stems, roots, stolons, and rhizomes between the green blades of grass and the soil surface"(University of California, Davis 2009)(Figure 63). The dethatching machine removes the layer of thatch, preparing the ground for inter-seeding into the lawn. A rake attachment to a tractor will also implemented in order to create a bare as possible ground for seeding to commence. Using a slit seeder, which is a machine that creates openings in the ground while depositing seed, will sow the seed mix (University of Illinois 2012). This method encourages the germination of seed and the establishment of different species. In addition, planting plugs by hand creates an immediate meadow effect along the edges and throughout the space, and it is also helpful to choose plugs for the species that take a long time to mature such as blue indigo (Baptisia australis). Seeding will occur in late September or early October for the species that need winter temperatures to germinate, while planting plugs can be done in the spring.

Management

YEAR 1:

- Mow the meadow about once a month the first year after seeding to keep invasive weeds from taking over again.
- Once weeds reach 1 foot, mow them back to 6 inches tall. Native grasses and wildflowers grow slowly their first season, so this will not damage them.
- Do not mow at the end of the first growing season - leave some plant litter to help insulate the soil over winter.

YEAR 2:

- Mow the meadow to the ground in early spring of the second year and rake (with tractor attachment) to remove cuttings, if possible.
- If invasive weeds are still a major problem this year, mow again once in late spring or early summer to a height of about 1 foot. Continue to mow each year in early spring.

YEAR 3 AND ON:

- Once meadow is well established (after the third or fourth year), it can be partially mowed each year to limit disturbance to pollinators and other wildlife.

Plant Palette

In the first year the seed of an annual cover crop Fagopyrum esculentum, or buckwheat will be sown in the spring to prevent other vegetation from emerging, while offering nectar sources for pollinators. Since it takes some wildflowers and grasses a year or two to come up, the cover crop will grow and then die back, allowing the perennial species to flourish. In addition, the early successional species will add interest, and the meadow should be established by its fourth year. Below is the recommended plant list that can be acquired through Ernst Seed, which combines wildflowers and grasses that attract pollinators while offering seasonal interest through structure, color and texture (Ernst Conservation Seeds 2012). This is a planting guide regarding the percentage of seed needed for each species, but different ones can be added or omitted without a problem (Figures 64 & 65).

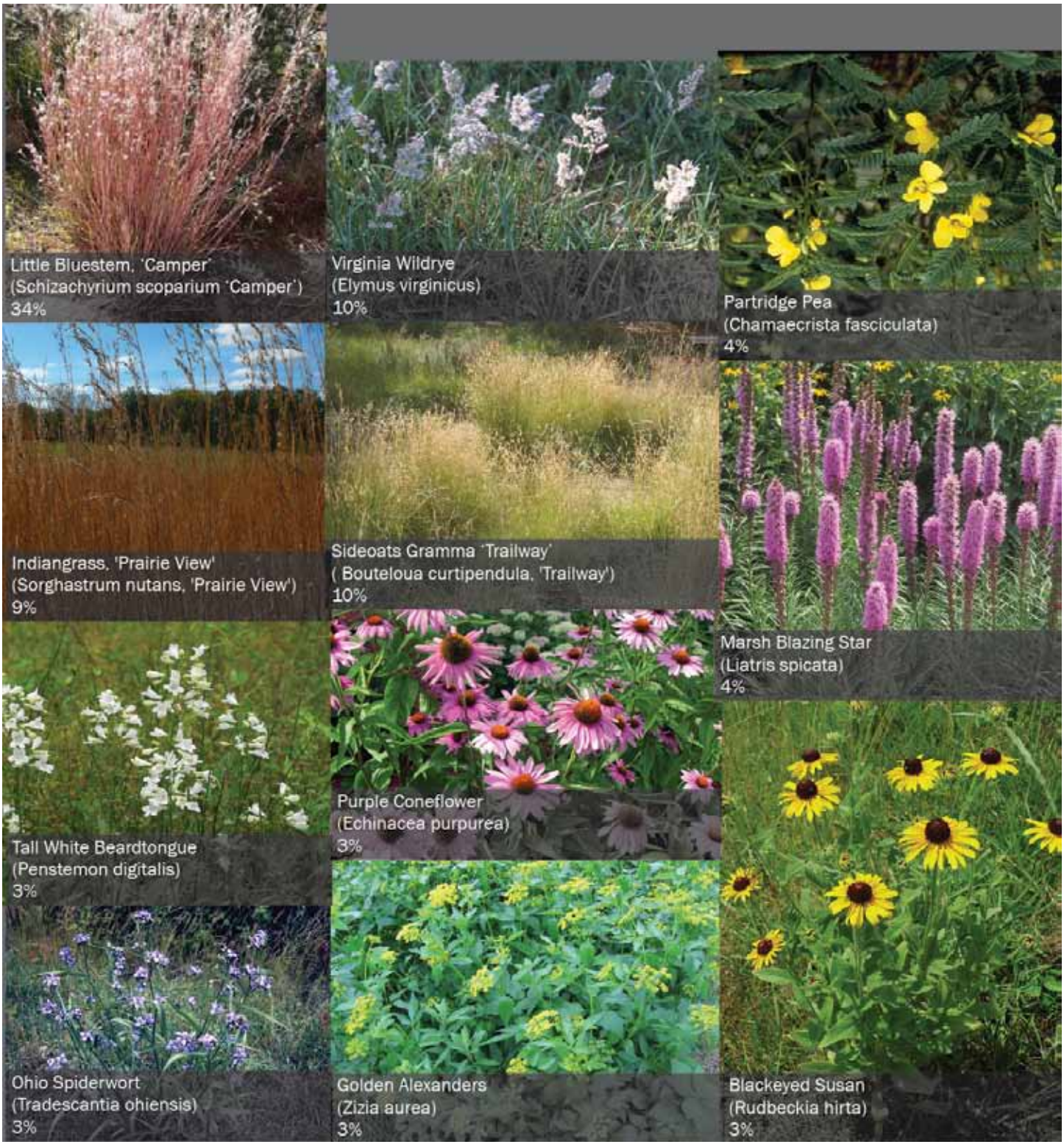


Figure 64. Meadow plant species

Figure 65. Meadow plant species

Succession

Succession is an ecological term that predicts typical vegetation changes over time. (Collins and Anderson 12). Succession is important because it gives an idea of how long it will take plantings to reach maturity and fulfill the goal of exhibiting spatial qualities. Ecological succession can appear "messy" to the untrained eye. Therefore, aesthetics and cues to care for the area through human intervention must be visible.

Rutgers Professor Steven Handel and colleagues (Handel 1992) observed successional woodland species that thrived on a former landfill. They planted shrubs and trees, and evaluated what survived on the site, while attempting to determine what methods were successful in stimulating succession and recruitment of species from remnant woodlands. White pine (Pinus strobus), red maple (Acer rubrum), American sycamore (Platanus occidentalis) and pin oak (Quercus palustris) deemed most successful. (Robinson et. al, 1992) They observed that after two years there were many recruits from the neighboring woodland. "Successful colonization of a new species can result from a series of isolated invasions by small populations that eventually coalesce" (Robinson et. al, 1992). Recruitments are important when attempting to establish a woodland, but management of dense herbaceous cover is equally important, since it tends to limit growth and opportunity.

Survival, reproduction, and recruitment of woody plants after 14 years on a reforested landfill have also been studied. Of the plants used, Chokeberry (Aronia arbutifolia), Hackberrry (Celtis occidentalis), Bayberry (Myrica pensylvanica) and Wild Black Cherry (Prunus serotina) were the successful species. (Robinson, Handel Schmalhofer 267) How the plantings were configured is important when establishing recruits when considering the concept of habitat islands. The planting design can speed up succession through habitat islands with ample perches and fleshy fruits for birds by aiding in dispersal (Robinson, Handel Schmalhofer 269). Once e habitat islands are established, the woodland will fill in naturally due to recruitments and dispersal.

Many of the above woodland species were found on the edge of the Voorhees Environmental Park, and the planting palette should include already adjacent species to the park. Other species chosen that were not found on the site should have fleshy fruit for birds to disperse in the open areas between the habitat islands, such as Chokeberry. Root length should not be an issue, since there are scientific studies proving that they will not penetrate the cap, due to the severe lack of nutrients in the landfill.

Aside from penetration of the cap, a large concern regarding encouraging a woodland on the site is that when trees reach mature heights, strong winds can cause overturn, since there is not the proper amount of soil to support the root systems of larger tree specimens (Figure 66). Within the sections of the designed park where trees are planted within fill brought to the site, there is little to no concern about overturn because there is enough soil for the roots to establish a solid foundation.

Figure 66. Overturned Tree

In order to avoid overturn, there are different management options. After "cluster bombing" the site with small caliper species, a management team can go through the area throughout the years to weed out those that can be a threat to the cap and wait to see what grows within the woodland space. Smaller trees and shrubs will be included within this cluster bombing of species in Figure 2 as well as the ones mentioned above. Another option is to cut down the woodland every 10 years to be used for mulch or timber, and then plant a cover crop until the woodland emerges again.

In conclusion, there are issues to consider when creating plant communities on a former landfill. Careful decisions in species, planting plans and most importantly long term management will help the park reach maturity.

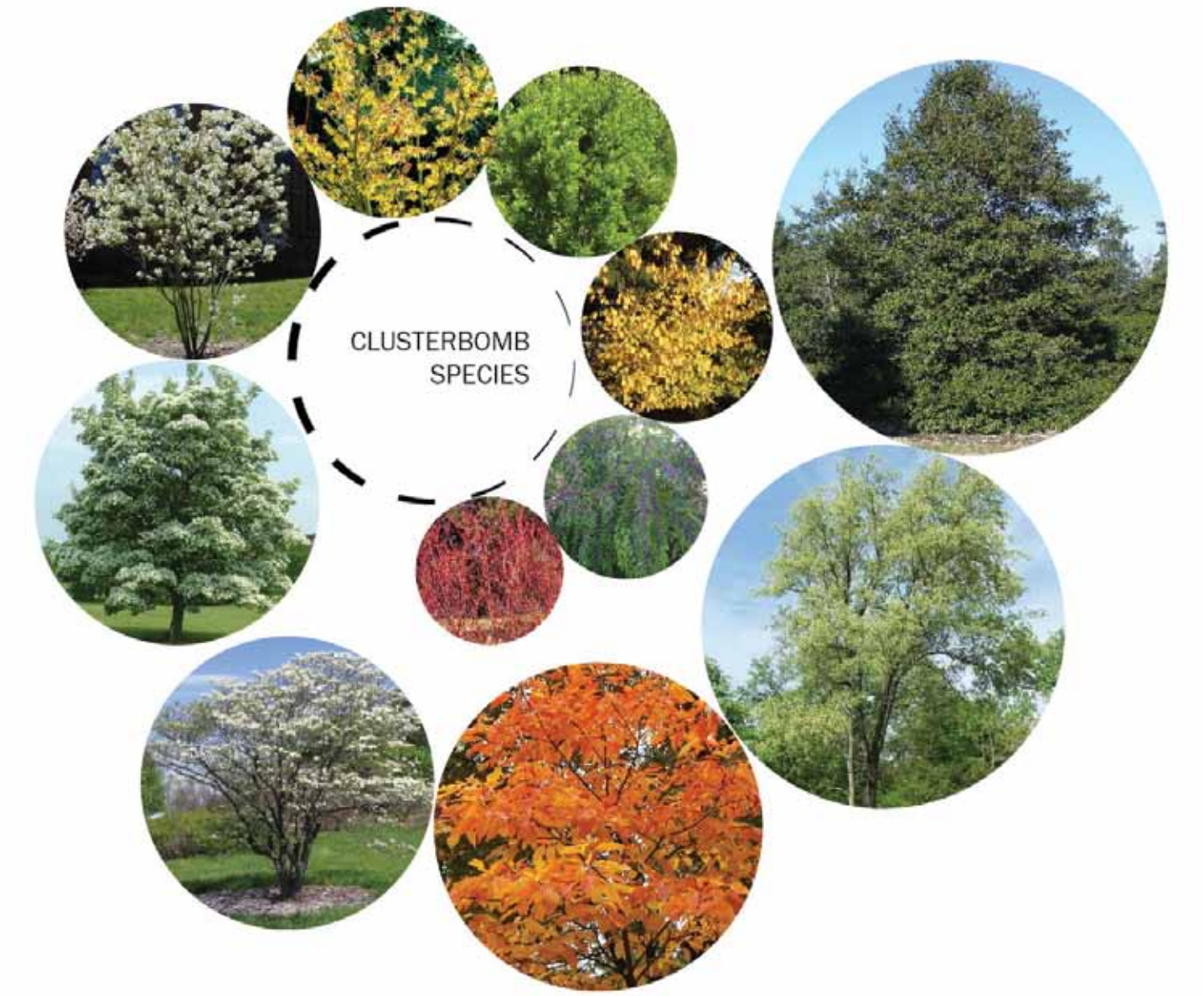


Figure 67. Species to clusterbomb through small caliper trees and shrubs. From largest to smallest: American Holly (Ilex opaca), Black Cherry (Prunus serotina), Sassafras (Sassafras albidum), Flowering Dogwood (Cornus florida), Fringetree (Chionanthus virginicus), Serviceberry (Amelanchier arborea), Common Witch Hazel (Hamamelis virginiana), Bayberry (Myrica pensylvanica), Spicebush (Lindera benzoin), Beautyberry (Calicarpa spp.), Redosier Dogwood (Cornus sericea)

Hydrology

Introduction

One of the goals of the Voorhees Environmental Park is the promotion of environmental literacy and stewardship practices through the physical features of the park. While the proposed 10-acre photovoltaic array represents a physical manifestation of this environmental ethic, there is more to be accomplished than solely the production of solar electricity. As physical occupants of the landscape, solar panels are highly productive, however, they are not without liability. One environmental aspect of a Voorhees Environmental Park solar array is that it adds a large impervious surface. We propose to turn this liability into an asset through the design of solar panels to collect storm-water runoff that would ordinarily be lost and employ that water to irrigate the trees that will be planted on the park promenade.

Figure 68. Proposed solar array area

Design Challenge

The proposed solar array at Voorhees Environmental Park occupies a 10-acre fenced area at the northern end of the park. Of those 10 acres, an estimated 2 to 2.5 acres are devoted to fencing, buffers, and vehicular access, while the remaining 7.5 to 8 acres constitute the footprint of the solar array in the landscape (Figure 68). Within that footprint, the solar panels create about 133,000 square feet of impervious surface1.

The challenges for a storm-water collection, storage, and redistribution system at Voorhees Environmental Park are:

- to collect a sufficient amount of water to supplement the irrigation of the trees planted on the promenade,
- to identify and work within the constraints of the landfill cap conditions present at Voorhees Environmental Park,
- to utilize gravitational force for moving water wherever possible,
- and, to avoid any interference which would hinder the production of solar energy.

Proposed Solution

The existing field conditions of the designated solar area at Voorhees Environmental Park, in general, move storm-water in two directions. Zone A moves storm-water toward the collection swale along Centennial Boulevard, and Zone B moves storm-water toward the retention basin located in Block 206 Lot 6 (Figure 69). The proposed Conceptual Design for the park includes the long promenade upon which approximately 400 trees will be planted. The location of the trees in the design plan corresponds with the storm-water as it moves through Zone A. Therefore, Zone A represents an ideal combination of proximity and existing flow pattern for storm-water collection and redistribution, while avoiding structural modification to the existing landfill cap.

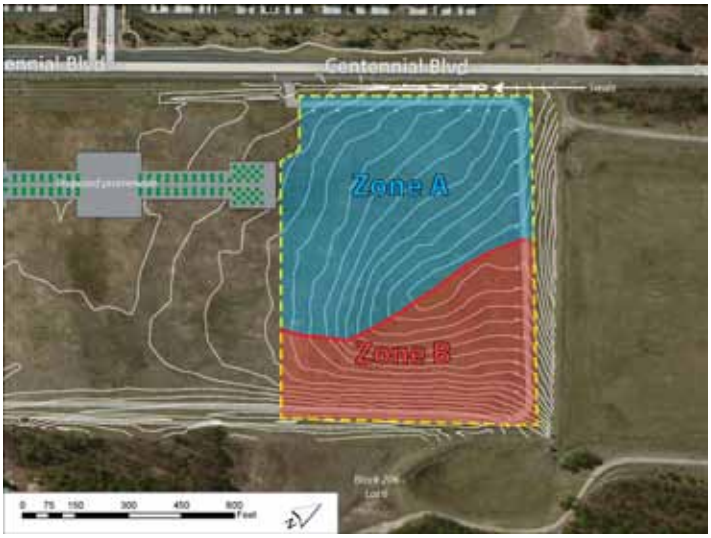


Figure 69. Zones of solar field based on existing grading

After capturing storm-water from solar panels, the next issue is to channel and transport that storm-water to a central collection location. An integral aspect of channeling storm-water collected from the solar panels is the physical structure of the apparatus to be used, which must respect the constraints of the landfill cover and attach to the solar panels without causing any interference in energy production. In this case, it is suggested that a collection gutter be attached to the lower edge of each row of solar panels located in Zone A (Figure 70). Each collection gutter, then, acts as a tributary, channeling the collected storm-water from a row of panels into one of two main channels. The main channels then direct all collected storm-water into a cistern located beneath the promenade (Figures 71 and 72).

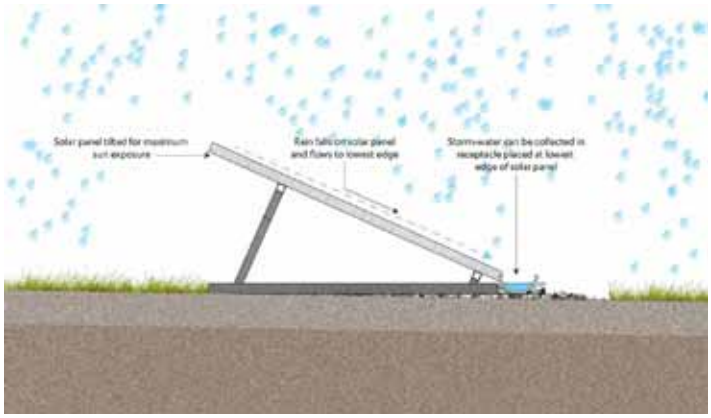


Figure 70. Solar panel structural section

Figure 71. Water collection and reticulation system diagram

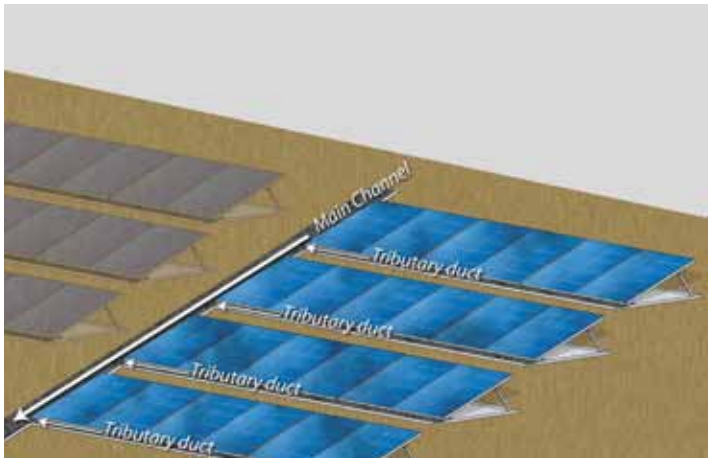


Figure 72. Water collection of solar panels diagram

This system of collection gutters mounted upon ballast-style solar panel structures works within the constraints of the landfill cap. It also conforms to the existing topography, since the structures are placed upon the earthen landfill cap, rather than set into it, thereby eliminating the need to modify existing terrain. The water is already flowing in the desired direction; the channels only coordinate that flow for collection and re-use. However, it may be necessary to employ an electric pump at the juncture where the collected storm-water enters the cistern. It is suggested that any such pump be powered by solar electricity.

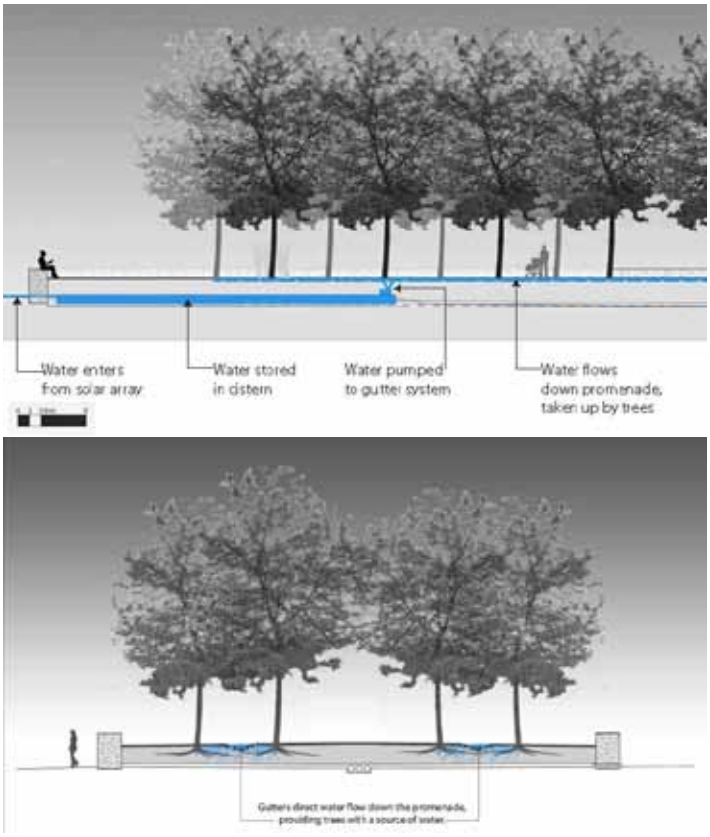


Figure 73. Sections of water collection system

Considering a design storm of 1.25 inches of rain over 2 hours, it is estimated that over 46,000 gallons of storm-water would enter the system. That storm-water would flow through the tributary channels, through the main channels, and make its way into a cistern housed within the promenade. The cistern will have dimensions of approximately 60' x 60' x 1.5' and hold 40,000 gallons of water, which equates to 100 gallons of stored water per tree. Excess storm-water would be directed to the existing storm-water management areas on the site: the swale along Centennial Boulevard for Zone A and the retention basin at Block 206 Lot 6 for Zone B.

To distribute the collected storm-water from the cistern, it must be pumped, using a solar-powered pump, vertically to the surface of the promenade (Figure 72). Upon the surface, the pump introduces the water into two concrete gutters which span the length of the promenade (Figure 73). By intentionally sloping the surface of the promenade from a high point at the end with the cistern to a low point at the end at the pond, the water is distributed to the trees by force of gravity. Within the base of the promenade structure, pipes can capture excess water and deposit it in the existing swale or pond.

Conclusion

By collecting, channeling, and re-using the storm-water that is generated on solar panels in the field, the environmental return on investment in solar infrastructure increases. Not only will the solar panels provide clean energy to nearby residents, they will also provide irrigation water to the 400 trees composing the central design feature of Voorhees Environmental Park, eliminating the costs associated with the purchasing and delivery of supplemental water. In its current form, this design would harvest storm-water from 45% of the overall surface area of the solar array, taking advantage of the existing slope of the terrain combined with the placement of tributary gutters and main collection channels. The potential for water collection from the "untapped" remaining extent of the solar array does exist. However, it may require a more heavily-engineered system of cisterns and pumps, and furthermore, a need for such additional supplemental water has not been identified in the current state of the design.

It is advised that the Township of Voorhees RFP for solar providers include a mandatory response area for storm-water collection as part of the overall solar array proposal. The costs of such a system are likely diminished when accounted for up front rather than retroactively. Moreover, the collection and re-use of storm-water at Voorhees Environmental Park is a central feature of the design proposal, and must be considered as such for the successful implementation of the park design.

Storm-water Collection from Solar Array			
Area of Solar Panels		60,000 ft^2	
		Runoff Volume (ft.^{3})	Runoff Volume (gal.)
Water Quality Design Storm (DEP) 1.25" of Rain Over 2 Hours		6250	46,753
Design Storms for Camden County (x" of rain over 24 hours)			
Year	Precipitation (in.)	Runoff Volume (ft.^{3})	Runoff Volume (gal.)
1	2.73	13,650	102,109
2	3.31	16,550	123,803
5	4.25	21,250	158,961
10	5.06	25,300	189,257
25	6.28	31,400	234,888
50	7.33	36,650	274,161
100	8.51	42,550	318,296

Figure 74. Estimate of portential volumes of water captured during different sized storms

Appendix

Figure 74 provides a series of estimates for the potential volume of water to be captured using this system. The total surface area used to estimate storm-water volumes is derived from the per-row estimates listed in Figure 75.

Figure 75 provides an estimate of the total impervious surface area of each row of solar panels contributing to the water collection system. Rows are assigned identification numbers T1-T42. The correspondent visual representation of each row appears in Figure 71.

Notes

1. Please refer to Figure 87 of the article "Special Considerations for a Solar Array".
2. Please refer to Figure 83 in the article referenced in Note 1.
3. Please refer to Figure 84 in the article referenced in Note 2.
4. These calculations are derived from correspondence on the subject with Rutgers Water Resources Program, June 18-20, 2012.

Surface Area of Tributary Solar Panels T1-T42 (Figure 4)			
Row	Area (ft.^{2})	Row	Area (ft.^{2})
T1	693	T22	1747
T2	841	T23	1701
T3	980	T24	1655
T4	1170	T25	1607
T5	1340	T26	1554
T6	1472	T27	1503
T7	1616	T28	1451
T8	1724	T29	1399
T9	1836	T30	1348
T10	1946	T31	1299
T11	2048	T32	1262
T12	2184	T33	1238
T13	2149	T34	1216
T14	2101	T35	1201
T15	2054	T36	1124
T16	2008	T37	961
T17	1960	T38	797
T18	1916	T39	633
T19	1872	T40	470
T20	1830	T41	306
T21	1788	T42	142
		Total	60,142

Figure 75. Estimate of total impervious surface area for each row of solar panels

Gabions

History

The term gabion comes from the Italian word, *gabbione*, and translates to English as "big cage." Gabions have been utilized throughout history, primarily in military and large civil engineering projects. The oldest recorded use of a gabion was that of a bank protection along the River Nile almost 7,000 years ago (Anping Yuanxi Metal Products Co., Ltd. 2009). Leonardo da Vinci designed the Corbeille Leonard for use as the foundations of San Marco Castle in Milan, Italy (Kobox Magyarorszag Kft. 2009). "The first major steel wire gabion structure was built using the sausage (sack) type gabion in 1893, to repair erosion damage on the river Reno at Casalecchio di Reno in Northern Italy (Anping Yuanxi Metal Products Co., Ltd. 2009). Contemporary use of the gabion is most often implemented through the use of a metal wire cage filled with locally harvested stone. Gabions are commonly associated with stream bank protection, erosion control, bridge abutments and other large civil engineering projects; however gabions are now also being employed in "high design" and garden-scale backyard grading and structural modifications as an efficient, effective, environmentally-sound, and aesthetic approach in landscape design.

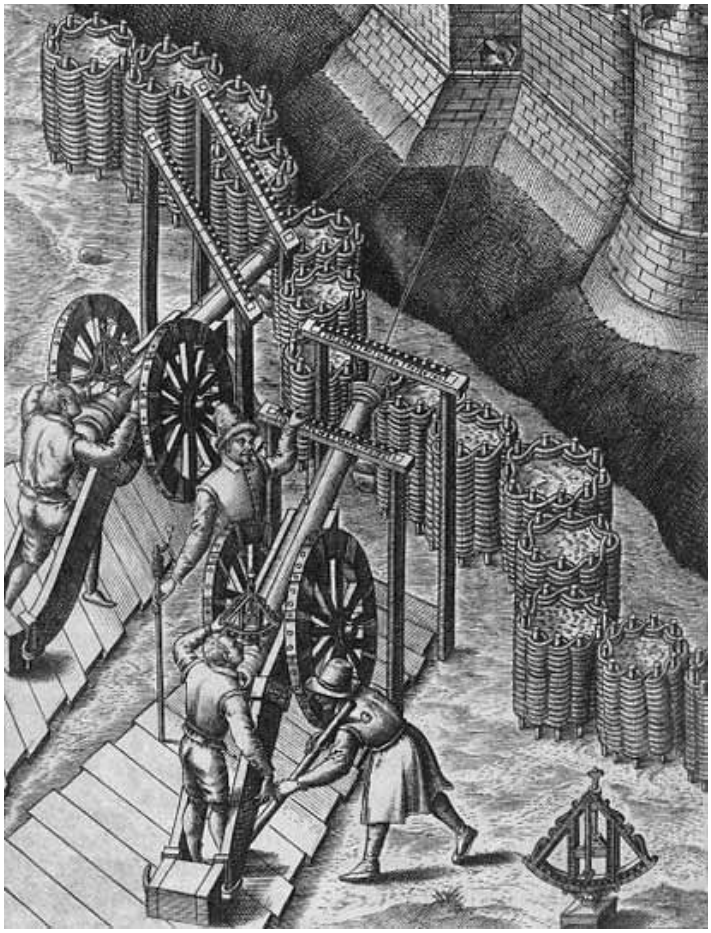


Figure 76. Depiction of sixteenth century cannon placements with gabion blockades

Figure 77. Stone gabions at the BUGA Gera und Ronneburg

Benefits

Gabions fall into the class of structural construction methods that share characteristics with other freestanding walls. Namely, they typically do not require an invasive foundation or footing, which in the case of the Voorhees Environmental Park's location on a closed landfill makes them an effective solution for creating retaining walls that secure soil volumes necessary to support the growth of trees and other vegetation. They are typically constructed with wire netting and filled with local stone, soil or broken glass (and now even other recycled materials) that cumulatively provide sufficient weight to remain upright as a free-standing wall or retain earth on either side. "To prevent the casing, which usually consist of wire netting, being deformed by the pressure of the filling material, struts must be built in between the casing walls. Due to their higher dead weight, stone filling reduces the necessary volume of the support element in relation to soil filling" (Zimmerman 2008, 302). Gabions are flexible in that they are generally manufactured in boxes of various sizes and can be stacked on top of each other, functioning as a modular system which, when combined, is able to

Figure 78. Free-standing gabion wall.

Figure 79. Diagram of gabion use at Voorhees Environmental Park with approximation of casing length and fill volume.

create a wall of various heights, lengths and widths. Filled wire cages can be attached to one other for extra support. A better arrangement (stepped up) and angling of baskets (up to 10 degrees) may also be implemented offering both an aesthetically appealing finish and additional structural support to the final system.

The beauty of the locally harvested rock or recycled materials arranged randomly or in an ordered fashion provides the flexibility to create multiple visual effects inside gabion baskets. For example, rock may be stacked in a pre-determined pattern depending upon the size, shape and structure of the rock. Alternatively, baskets may be filled randomly with stone of various sizes and configurations to achieve a dramatic random effect. Gabion fill must be a hard durable and non-frost susceptible material, having a minimum dimension not less than the mesh opening. While the lifespan of the fill material depends upon the material used, stone fill will generally outlive the wire casing of gabion baskets. Many manufactures estimate that gabions have a relatively long lifespan of approximately 50 years.

The Dominus Winery in Yountville, California, designed by Herzog and de Meuron in 1996, is one famous example of the use of gabions. Galvanized baskets contain a basalt rock from the nearby American Canyon. Rock of irregular sizes without mortar was used. Some baskets contain large rocks that allow sunlight to pass through the gabion wall during the day, creating a pattern of shadow and light on the floor of the interior of the structure, while allowing artificial light to pour out of the structure at night. Furthermore, the winery has been nicknamed, the Stealth Winery, because of the way the natural materials within the gabion baskets blend with the landscape. In fact, one of the benefits of gabions is that they offer a more "natural" feel than many constructed or pre-cast retaining walls because of the use of local rock without mortar joints.

Figure 80. Dominus Winery, Yountville, California designed by Herzog and de Meuron uses gabions filled with local basalt rock.

Implementation at Voorhees Environmental Park

The use of gabions at Voorhees Environmental Park has multiple benefits. Because of the landfill cap, constructing footings for retaining walls would be problematic. Gabions enable placement directly on the exiswting vegetated surface without the need for an invasive footing. The gabions allow elevation in the tree-lined promenade above the existing surface of the landfill cap, retaining a planting bed and walkway system with over 2.5 feet of fill. The gabions also minimize the amount of clean topsoil fill necessary to create the elevated promenade and planting bed.

There are two general types of gabion casings: welded mesh gabions and double-twisted mesh gabions. According to some manufacturers, welded mesh gabions are more often used in public areas and gardens, where straight lines, precision and accuracy are paramount, while double-twisted casings are generally used in erosion protection and water applications. "The welded mesh constructs a massive, rigid structure. It does not deform, [and] keeps its original shape" (Kobox Magyarorszag Kft. 2009).

Lastly, the gabions minimize the amount of material required to construct benches and other landscape elements in the park. Because the gabion edges, are raised above the ground plane of the promenade, they provide a platform on which to construct bench tops and seating areas. They also provide a ledge with a defined edge that separates elevated portions of the promenade from areas such as the parking lot, the meadow and overlooks.

Figure 81. Welded Mesh Gabion.

Aggregate fill for gabions at Voorhees Environmental Park may be approached in different ways throughout the various phases of implementation depending upon the desired aesthetic effect, budget and availability of locally harvested or recycled material. For the gabions used at the entrance sequence constructed during phase one (as well as later phases), quarried stone would be the most practical, both for performance (having good interlock properties) as well as its aesthetics. Quarried rock will depend upon available local materials but could be one of the types listed below:

- Sandstone (not soft sandstone that is degradable);
- Limestone (beware of sources of Rag Stone that contain Hassock);
- Granite;
- Basalt;
- Slate (Flat in nature. The dimension can be larger than 200mm in the longest dimension).

In other areas, where gabions will be less prominent and integrated more into other park features, recycled and less expensive material should be used, depending upon local availability:

- Flint Reject or Cobblestone—machine-placed; self-packing;
- Crushed Concrete—cheapest; from a structural application; non-degradable; free from debris; requires careful packing due to round edges;
- Aggregates—self-compacting, small stone size requires internal mesh with small aperture;
- Brick Fill—whole brick coursed; must be of an engineering type brick; whole brick can be arranged/stacked as a facing with broken brick infill; whole brick should never be used as the mass fill, as there is potential for arching to occur within the fill resulting in possible settlements and distortion of the facing (Enviromesh).

Solar Array Special Considerations

Introduction

A 10-acre solar array has long been a desired feature of Voorhees Environmental Park. The goal of such an array is two-fold. First, it takes advantage of an already cleared field with strong sun exposure to provide clean solar energy to local residents. And second, it provides a revenue stream from which to fun the ongoing costs associated with park maintenance. The goal of this section is to propose a design for the photovoltaic array that would be appropriate to deploy at Voorhees Environmental Park and provide an estimate of the return in solar energy.

The existing physical state of the former landfill influences the structural actions that can be taken to install a photovoltaic array. The physical characteristics that must be considered include the structural profile of the landfill cap (Figure 83) and the optimal angles of azimuth and attitude for solar energy production.

Placement

The solar array is to be placed within the 10-acre area delineated by the yellow dotted line in Figure 1 at the northeast end of Voorhees Environmental Park property.

Figure 82. Solar Array Placement

Structural Considerations

Solar panels must be anchored to the surface upon which they rest, be it a roof or the ground. Any system used to anchor the solar panels must comply with the structural limitations of the installation site and must secure the solar panels so that they are immovable by common forces of wind, rain, and snow.

Under normal circumstances a solar array in New Jersey would be anchored by a structural system with a foundation of footings extending 3-4 feet into the earth. However, the landfill cap at Voorhees Environmental Park precludes the use of any type of invasive footing. The cap cannot be breached, and furthermore, were it to be breached, the depth of available soil before reaching the landfill contents is insufficient for the effective use of a footing. Therefore, it is recommended that any structure devised to secure the solar panels at Voorhees Environmental Park use a ballast system, whereby the weight of the structure itself is sufficient to secure the solar panels in place, with due calculation for forces related to wind, rain, and snow. (Figure 3). A ballast system has been employed in a similar landfill cap situation at a solar field in Pennsauken, New Jersey. (Messics, 2009).

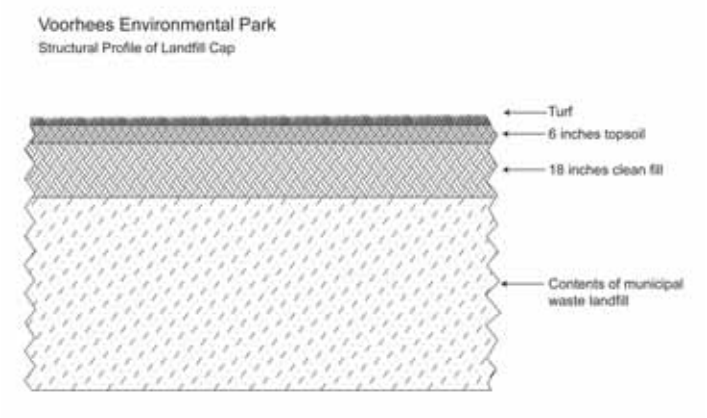


Figure 83. Structure Profile

Optimal Angle: Azimuth

In order to achieve maximum efficiency in solar energy production the solar panels at Voorhees Environmental Park must be oriented directly south. In Figure 85, the movement of the sun across the horizontal ground plane is analyzed. Because the sun movement throughout the year is not skewed to either the east or the west, and is centered upon the southern axis, it is recommended that the solar panels be oriented due south for maximum sun exposure. This means that the slope of attitude should be pointed to the south.

Figure 84. Plateau Panel Structural Design

Optimal Angle: Attitude

The attitude, or angle of inclination – the tilt above the horizontal plane – of any solar array, relates to energy production in two ways. First, there is a relationship between the attitude of the panels and the amount of solar irradiance to which they are exposed on both a daily and a seasonal basis. Figure 5 compares the values of "Hours of equivalent midday sun per day" among a range of attitude options: optimized by month or season, fixed for the highest yield year round (40°), summer-optimized (24°), winter-optimized (56°), flat (horizontal, 0°) or upright (90°) (Boxwell, 2011). Second, different angles of inclination result in different heights for solar arrays in the field, which in turn affects the amount of shadowing produced by each row, thereby influencing the distance

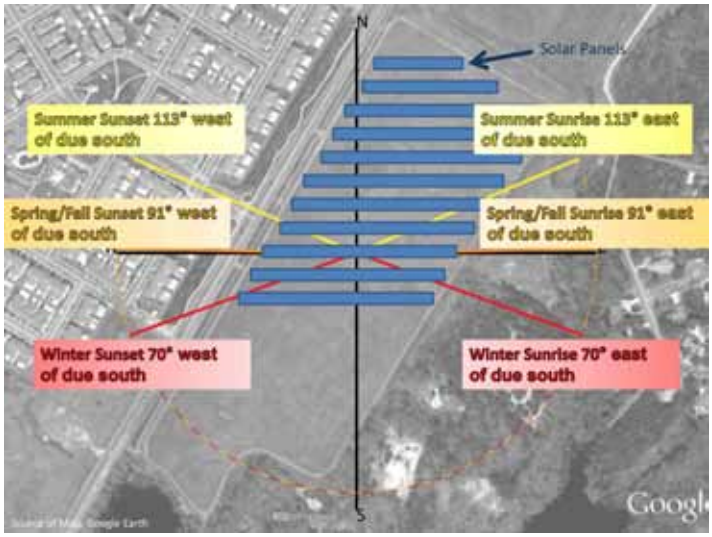


Figure 85. Sun path across the sky

necessary between every two rows of solar panels. For instance, a solar panel that is 6 feet tall would have a vertical height of 3.8 feet if mounted at an attitude of 40°. The same panel would have a vertical height of 2.4 feet if mounted at an attitude of 24°. Depending upon whether the difference in height of the lower attitude allows for a greater raw number of rows to be installed, due to reduced space between rows, there is potential to gain greater energy production.

Figure 87 provides the calculations that were used to compare two different models of solar panel and three different angles of attitude appropriate to New Jersey. The Kyocera KD320 and KD220, which differ by both overall size and output rating, were used in this calculation, (the use of these solar panels in no way constitutes any endorsement). By these calculations, it was determined that the smaller panel, the KD220, at the lowest angle, 24°, allows for the greatest return of solar energy due to the fact it provides the highest square footage of photovoltaic surface.

As a caution, the calculations used in this section do not consider the costs associated with materials, installation, and upkeep, which may strongly influence final selection.

New Jersey Solar Insolation Values Related to Angle of Inclination

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Monthly	3.37	3.91	4.41	4.82	5.28	5.63	5.55	5.13	4.73	4.3	3.39	3.1	4.47
Quarterly	3.35	3.91	4.41	4.66	4.81	5.42	5.38	5.1	4.7	4.26	3.24	3.07	4.36
40° Year Round	3.18	3.84	4.41	4.66	4.81	4.96	4.97	4.85	4.7	4.26	3.24	2.88	4.23
24° Summer	2.82	3.57	4.32	4.81	5.16	5.42	5.38	5.1	4.69	4.01	2.93	2.53	4.23
56° Winter	3.35	3.91	4.28	4.28	4.25	4.29	4.33	4.38	4.48	4.28	3.38	3.07	4.02
Flat	1.92	2.71	3.69	4.57	5.21	5.61	5.51	4.97	4.15	3.13	2.07	1.66	3.77
Upright	3.03	3.25	3.18	2.77	2.49	2.39	2.45	2.69	3.15	3.47	2.99	2.83	2.89

Unit: Hours of equivalent midday sun per day

Figure 86. New Jersey solar insolation values

However, it is worth noting that there are many variables involved in calculating the return on a solar array. This example illustrates that the biggest panel may not necessarily be the most effective panel for total energy production.

Conclusion

The major technical challenge to overcome is the need for a foundation that does not breach the landfill cap and yet provides sufficient support to the solar panels. The solution may lie in a ballast structure, as was employed at the Pennsauken solar landfill. Other than that structural challenge, the recommendation for the physical arrangement of solar panels is straightforward. However, in the spirit of environmental stewardship to be exhibited at Voorhees Environmental Park, storm-water conservation within the solar array should be included as a requirement in the RFP for solar providers.

Kyocera KD Series polycrystalline rigid solar panels

Source: http://www.kyocerasolar.com/assets/001/5134.pdf

	KD320	KD220
Maximum Power (Watts)	320	220
Number of Cells	80	54
Maximum System Voltage	600	600
Maximum Power Voltage	40	27
Maximum Power Current (amps)	8	8
Length (in)	65	59
Width (in)	52	39
Area (sq. ft)	24	16
Depth (in)	2	2
Weight (lbs)	61	40
Power per sqare foot (W/ft2)	13.5	13.7
Power per pound	5.3	5.5

Average length of PV row = 451 feet

Lenth of solar zone through center at 0° north = 799 feet

Angle of Inclination: 40 degrees		
High point off ground (feet)	3.9	3.5
Space between PV rows (feet) using shadow length multiplier 3.5	13.7	12.3
PV row width at angle of attitude (feet)	4.9	4.5
Footprint (PV row + space, in feet)	18.6	16.8
Rows Possible (799 / footprint)	43	48
Linear Feet of Solar Panel Rows (Rows possible * Avg lenth of PV row)	19,426	21,513
Area in square feet	105,871	105,953
Output in megawatts (Power per sqaure foot * Area)	1.43	1.46
Angle of Inclination: 32 degrees		
High point off ground (feet)	3.3	2.9
Space between PV rows (feet) using shadow length multiplier 3.5	11.6	10.2
PV row width at angle of attitude (feet)	5.3	4.9
Footprint (PV row + space, in feet)	16.9	15.1
Rows Possible (799 / footprint)	47	53
Linear Feet of Solar Panel Rows (Rows possible * Avg lenth of PV row)	21,386	23,943
Area in square feet	116,552	117,922
Output in megawatts (Power per sqaure foot * Area)	1.58	1.62
Angle of Inclination: 24 degrees		
High point off ground (feet)	2.6	2.3
Space between PV rows (feet) using shadow length multiplier 3.5	9.1	8.1
PV row width at angle of attitude (feet)	5.7	5.3
Footprint (PV row + space, in feet)	14.8	13.4
Rows Possible (799 / footprint)	54	60
Linear Feet of Solar Panel Rows (Rows possible * Avg lenth of PV row)	24,348	26,992
Area in square feet	132,696	132,938
Output in megawatts (Power per sqaure foot * Area)	1.80	1.83

Figure 87. Solar panel model and angle calculations

Information System

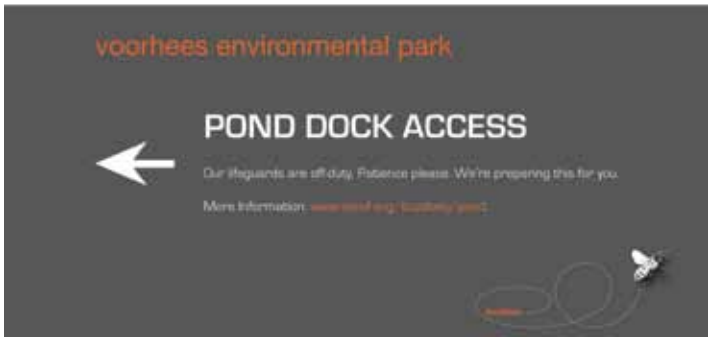
Because Voorhees Environmental Park will be constructed in multiple phases spanning many years, it is crucial to establish an information system while construction begins. The information system will accomplish the following:

- Welcome users to the park
- Enable users to enjoy portions of the park while informing them about natural and planned processes occuring in marked off areas.
- Market the park and announce programs
- Document all activities and material/vegetation plans
- Guide users navigating the constructed portions of the park (pedestrians, bicyclists, etc.)
- Highlight areas planned for future phases of development
- Highlight areas where landscape establishment is in progress (yet may not be visible, such as meadow establishment, forest succession, etc.)
- Direct users to an online information system with detailed information on biophysical processes, history, ecological processes, materials, environmental benefits, and plant identification.
- Offer opportunities to park users and non-park users to gather detailed information about the park
- Offer educational opportunities outside the park

The Voorhees Environmental Park information could be branded as the "buzzbee" information system, and could include a combination of on-site and on-line information that users follow both within the park or online via a handheld device. The name, "buzzbee" reappropriates the former name of the landfill, Buzby Brothers Landfill, and positions it within contemporary environmental uses of the park. Reappropriating a name that may historically have negative connotations and realigning it in a positive light is not unique. Reappropriation of terminology is a common cultural process throughout time. In fact, the method has also been used in park design. Recently, Freshkills Park in Staten Island, New York (also a former landfill with reported negative connotations), rebranded the actual name of the park from the landfill name, Fresh Kills Landfill. Similarly, establishing the buzzbee information system offers the Voorhees Environmental Park a method to repurpose a negative situation from the past as something positive, while still referencing the rich history the park land. The environmentally positive symbol of the honeybee is used to aid in this reappropriation.

Below are examples of park signs for Voorhees Environmental Park. The signs use the Voorhees Environmental Park name at the top. The noted park feature is the most prominent text on the sign with an arrow pointing in its direction, followed by a "catchy" phrase offering some instruction, warning or more information. The sign also shows where the user may go to learn more detailed information about the plant list, the ecological process, the history, etc. And, finally, the sign shows the branding of the buzzbee information system.

Other park signs may indicate, bicycle circulation, solar array, environmental center, parking, gabions, monitoring wells and "starter" bosquets.



Finally, the buzzbee information system should be used in two locations in the park to offer a full written explanation of the park, its history, sponsors, and the proposed design. The two signs would include a full park map, keyed with specific locations of interest. The main park signs will be placed immediately before the main pedestrian entrance to the future environmental center area and at the opposite side of the park.

Figure 88. Entrance Sign

Color Swatches for buzzbee information system

RBG = 87, 87, 87

RBG = 58, 74, 105

RBG = 116, 173, 180

RBG = 156, 35, 32

RBG = 241, 93, 35

RBG = 255, 255, 255

Text for buzzbee information system

voorhees environmental park

- Helvetica Neue, lowercase, regular, size 80% of main, RBG 241, 93, 35

PARK FEATURE

- Eurostile, uppercase, bold, size 100% (largest on board), RBG = 255, 255, 255

"Catchy Phrase" & More Information:

- Eurostile, mixed case, regular, size 40% of main, RBG = 255, 255, 255

vcef.org/buzzbee web link

- Eurostile, lowercase, regular, size 40% of main, RBG = 255, 255, 255

buzzbee

- Eurostile, lowercase, regular, 35% of main, RBG 241, 93, 35

5 Phasing

Figure 89. Existing conditions of the site

Due to the need to raise sufficient funding, the Voorhees Environmental Park will be built in phases. In each phase we looked at what the overall feeling of the park would be at that moment, the cost of that phase, and the constructability of the next phase with what is in place. These factors guided our recommendations for optimal phasing of the park.

It should be noted that the most cost effective and efficient way to construct the park would be to do it all at one time, or to combine phases whenever possible.

The phasing diagram explains what changes are recommended in that particular phase by going through each section of the design covered in the design walkthrough.

Phase 1

Phase one is the most critical and exciting phase of the project because it represents the first concrete step the dream of a Voorhees Environmental Park that has been in progress on for many years. It is also the most challenging to design because there are few existing features on the site.

Centennial Boulevard

The expensive item in phase one is addressing the street changes to Centennial Boulevard and constructing the main entrance the Voorhees Environmental Park. For traffic flow creating a new entrance opposite the existing Centennial Mills entrance makes the most sense. Changes include a pedestrian crossings, street trees, new deceleration lanes and both automobile and pedestrian bridge crossings over the existing swale on the park property.

Entrance Plaza

Gabion walls should be placed to create a border for the plaza and hinder four wheeled vehicles from reaching other areas of the park. The stamped asphalt road and Belgium block curb should be constructed. Tree planters should be constructed and properly installed so that the eastern red buds (*Cercis canadensis*) can be bought and planted as soon as possible. The appropriate amount of fill and grading should be applied within the plaza and the water bound surface would be installed in all areas.

Figure 91. Entrance Plaza design model - angled planters

Figure 92. Entrance Plaza design model - interior gabion walls

Figure 90. Phase 1 plan

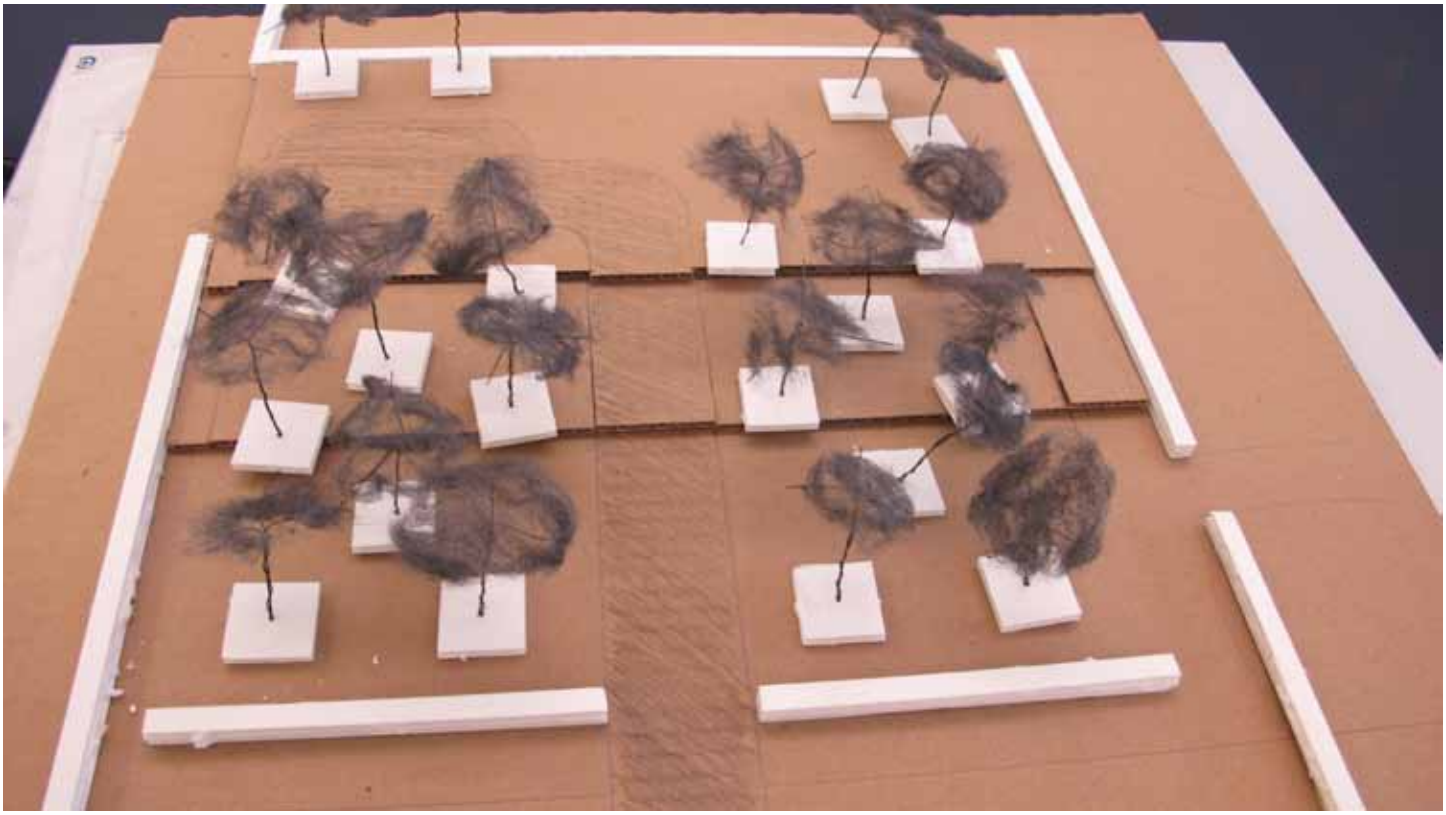


Figure 93. Entrance Plaza design model - square planters - chosen design

Parking Lot

The parking lot in phase one would be a gravel lot that is strong enough to support the necessary ware and tear of cars driving and parking on it. This will allow cars to drive onto the site through the newly constructed entrance and leave through the existing entrance that will be enhanced and paved. A gravel parking lot will function well enough until more of the park is completed and higher visitor traffic is expected.

Promenade

To provide a vision of the future, as well as prevent four wheel vehicles from driving on the cap, one row of gabion walls will be placed to outline a portion of the promenade which includes the solar bosquet and solar overlook.

Outlining a section of the promenade with one layer of gabion walls around the pond overlook will provide a vision of the park and provide a walking destination that passes by the newly seeded meadow.

Solar array

There is no predetermined time when the solar array will be installed, but the chain link fence will be installed in phase one to prevent public access to the deed restricted area. The fence along with the gabion wall blocks the access of vehicles on to the cap.

Great Lawn

The lawn area will be kept in the existing condition state of maintained grass. The surrounding paths of the great lawn will be laid out with gravel to allow for additional walking paths and provide mowing lines for maintenance personnel to follow.

Meadow and Boardwalk

It is important to seed the meadow as early in the construction process as possible as wildflower meadows typically take several years to fully establish.

This area should be roped off to deter public access, and it is crucial that the meadow is marked with the proper signage to inform the public about the planned process.

Construction of the boardwalk will not occur until later in the project.

Successional Woodland

It is important to plant many species of small trees and shrubs in this area as early as possible. By cluster bombing the area, the process of succession is expedited which will insure that the woodland area establishes quicker than would naturally occur.

If funding is available the three starter bosquets located in the successional woodland should be planted to create shady destinations along the existing loop road.

Similar to the wildflower meadow, this area should be roped off and marked with proper signage to explain about the process of succession.

Loop Trail

The existing loop road will be maintained as the walking path around the outer edges of the park. This will also insure that the ongoing monitoring of the landfill will not be hindered.

Theme Gardens

Maintain exisitng conditions

Pond Access and Floating Islands

Maintain exisitng conditions

Additional Notes

What is equally as important in phase one, is that a watering plan be set up. The new trees that are going to be planted both in the entrance plaza and near the successional woodland are going to need careful attention and watering for a couple of years to help them establish.

Phase 2

Centennial Boulevard

Completed

Entrance Plaza

The entrance plaza is completed by adding the steps up to the solar bosquet as well as the main pedestrian and bicyclist ramp that leads from the Centennial Boulevard crossing to the solar bosquet.

Parking Lot

The ramp leading from the parking area onto the solar bosquet will be constructed along with an ADA approved path.

Promenade/Solar Bosquet/Solar Overlook

Phase two marks the beginning construction of the promenade and installing the water cistern. The previous outline of the solar bosquet, and solar overlook are fully constructed. Gabion walls will be stacked to achieve the desired height and the interior of the walls will be filled with soil. The recycled I-beam and solar structure are to be installed on top of the solar bosquet and solar panels should be put in as soon as possible to power the pump for the watering system. Additional gabions and steps down to the great lawn will be added to allow for easy access. The promenade will be planted with the double allée of honey locust (Gleditsia triacanthos var inermis) and the bosquet of sugar maples (Acer saccharum) on top of the solar overlook should be planted as well.

Additional gabion walls will need to be stacked along the side of the ramps for safety. The solar bosquet, promenade and solar overlook should be finished with a stone dust surface.

Installing the water channel with the solar pump and connecting to the cistern is crucial to properly water the trees.

The addition of a tent structure and appropriate seating provides a desired destination on top of the solar bosquet.

Great Lawn

Fill will be added to the northern half of the lawn in order to meet the promenade on grade in that area. Sod will be laid down on top of the fill to reestablish the lawn in that area.

Loop Trail

The portion of the loop trail that borders the lawn will be graded and constructed with a stone dust finish.

Theme Gardens

Maintain exisitng conditions

Pond Access and Floating Islands

Maintain exisitng conditions

Figure 94. Phase 2 plan

Phase 3

Centennial Boulevard

Completed

Entrance Plaza

Completed

Parking Lot

No change

Promenade

Construction on the next portion of the promenade is prominent in this phase. Another section of the double allée of honey locusts (Gleditsia triacanthos var inermis) will be installed as well as another bosquet of shagbark hickory (Carya ovata).

The stone dust surface and irrigation system will be continued and connect to the existing portion of the promenade .The ramp from the promenade down to the loop trail will be constructed. In between the ramp and the entrance plaza the area will be planted with low shrubs and grasses.

Solar Overlook

No change

Solar Bosquet

No change

Pond Overlok

No change

Great Lawn

The path that connects the promenade to the bosquet of white pine *(Pinus strobus)* and creates the border for both the meadow and great lawn will be constructed at this phase. Additional fill will be added to the southern half of the lawn so that it can meet the promenade on grade. Sod will be installed on the new fill to restore the lawn area to grass.

Meadow and Boardwalk

Assuming phase three is a couple of years down the line from phase one, this opportunity should be taken to use meadow plugs in the wildflower meadow. The new portion of fill that is added for the pathway will need to be planted with plugs while adding new species that did not establish in meadow will make the area richer and more beautiful.

Successional Woodland

No change

Loop Trail

No change

Theme Gardens

Maintain exisitng

Pond Access and Floating Islands

Maintain exisitng conditions

Figure 95. Phase 3 plan

Phase 4

Centennial Boulevard

Completed

Entrance Plaza

Completed

Parking Lot

No change

Promenade

The southern portion of the promenade that connects to the pond overlook will be constructed to provide the support necessary for the pond overlook.

Solar Overlook

Completed

Solar Bosquet

No change

Pond Overlook

Phase four focuses around the pond area and at this time that the pond overlook should be constructed to allow visitors to enjoy this desired natural ammenity.

Meadow and Boardwalk

No change

Successional Woodland

No change

Loop Trail

No change

Theme Gardens

Maintain exisitng

Pond Access and Floating Islands

In this phase constructing the trail system that leads down to the two docks will allow visitors access to the water's edge. The floating wetland treatment islands can be considered independent of phasing but should be implemented at this point if they have not already.

Figure 96. Phase 4 plan

Phase 5

Centennial Boulevard

Completed

Entrance Plaza

Completed

Parking Lot

No change

Promenade

At this time most of the other major construction should be completed allowing the rest of the promenade to be constructed. More sections of honey locusts (Gleditsia triacanthos var inermis) will be planted as well as a bosquet of black gum (Nyssa sylvatica) and a bosquet of virginia pine (Pinus virginiana).

Completing the water channel is a priority to insure that all of the trees along the promenade will recieve adequate water.

Solar Overlook

Completed

Solar Bosquet

No change

Pond Overlook

Completed

Meadow and Boardwalk

No change

Successional Woodland

No change

Loop Trail

No change

Theme Gardens

Placing the gabion walls to outline the areas for the theme gardens as well as constructing the ramps from the promenade to the loop trail are apart of this phase. More plantings of small shrubs and grasses alongside of the ramp will create the visual buffers between the spaces for the them gardens.

Pond Access and Floating Islands

Completed

Figure 97. Phase 5 plan

Phase 6

Centennial Boulevard

Completed

Entrance Plaza

Completed

Parking Lot

No change

Promenade

Completed

Solar Overlook

Completed

Solar Bosquet

No change

Pond Overlook

Completed

Meadow and Boardwalk

At this point the meadow should be established and constructing the minimally invasive boardwalk should be a priority to provide access for visitors.

Successional Woodland

No change

Loop Trail

The existing loop road should be rebuilt with a surface layer of compacted stone dust.

Theme Gardens

At this time the theme gardens should be decided on and constructed.

Pond Access and Floating Islands

Completed

Figure 98. Phase 6 plan

Building Phase

Solar Bosquet

The building phase is considering independent of the ordering of phasing and can be implemented whenever there is the funding or demand for it. This would consist of removing the tent structure and constructing the environmental center in its place. Extending the solar panels on top the roof of the building will provide more energy to power the environmental center and park if needed.

Parking Lot

Included in the building should be the final construction of the parking lot with the solar energy stations to charge cars. With a new environmental center the park should be expecting more visitors as well as field trips from local school. A proper parking lot and drop off goes hand in hand with the construction of the environmental center.

Additional Notes

Ideally the building phase will occur at the same time as phase two so that footings for the building can be constructed before fill is added to the solar bosquet

Figure 99. Building Phase

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