SNOWSCAPES

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Image 1: Ugly Snow Along Roads
Image 2: Ugly Snow Pile
Image 3: Snow Melt Pattern on Stones
Image 4: Snow Melt Pattern on Vegetation
Abstract

Snow has potential to create a unique temporal picturesque environment in the landscape. Due to human interactions however, snowscapes today, are largely characterized by ugly snow pile dumps. Through my project, I aim to explore ways to exhibit the snow melt patterns, by manipulating topography. I selected Cadwalder Park in Trenton NJ as my site for exploration because of its rich history, topography and degraded condition. I conducted a thorough case study analysis of historic projects pertinent to topographic exploration, and designs enhancing the snowscapes that provided guidelines for my design exploration. By building models with different interventions, and studying them in light, I explored multiple design alternatives to observe and imagine the potential snow patterns in the landscape. Finally, I proposed a composite design for the site of Cadwalader Park with topographic and wall interventions. The proposed circulation enables people to experience the landscape through all seasons.
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Chapter 1

TOPIC INTRODUCTION
I am fascinated by snow. I was speechless when I first saw snow fall from the sky. This occurred four years ago just after I moved from India to central New Jersey. I held out my hand and watched the delicate white flakes melt in my hand. I then noticed how snow changes the way people perceive and experience the environment.

Snow brings calmness and serenity to the environment. It muffles noises. The air smells fresh. The ground surface reflects the dramatic blue-violet shadows of the trees (Figure 1). Children play in the snow. They make snowmen and throw snowballs. (Figure 2) People step outside to shovel the snow. They interact with neighbors and often help each other clear the snow. Piles of snow appear everywhere (Figure 3). Yet, once the initial excitement wanes, the piles of snow lie ignored in the landscape. Overtime, due to dust and dirt in the air, the snow darkens in color and creates an ugly mess, as it gradually melts (Figure 4). Thus, the snow and its temporal qualities are witnessed and perceived by the public in an unattractive, unpleasant way.

My project explores the temporal qualities of snow. It does so by creating a rolling topography that al-
allows the snow to create dramatic landscape patterns as it melts. The site for this exploration is Cadwalader Park in Trenton, New Jersey. (Figure 5, 6 and 7)

I chose Cadwalader Park as the site for my explorations for two reasons. First, Cadwalader Park is the only park in New Jersey that was designed by Frederick Law Olmsted, Sr. Second, the park occupies hilly terrain, which makes it ideal for my exploration. The aspect of the site that really caught my attention, however, was a degraded stream corridor along the western edge of the park that was in need of restoration. Poor maintenance and neglect was the obvious cause for the landscape's condition (Figure 8 and 9).

My examination of snow and snow melt, therefore, is also intended to help restore the topography of the degraded stream corridor. Finally, I also observed that the roads in the park and the neighborhood were plowed during the winter, creating huge piles of snow. Routine snow maintenance at the park entails plowing the parking lots and streets and dumping snow at certain junctions. I wish to explore how this routine snow maintenance for the roads can compliment my intended design exploration.
Chapter 2

SITE HISTORY AND INVENTORY
This chapter analyses Olmsted’s preliminary plan for Cadwalader Park and draws upon the existing conditions of the site selected for exploration.

2.1 Cadwalader Site Historic Background:

Cadwalader Park located in the city of Trenton was designed by Frederick Law Olmsted in 1891. As of April 19, 2013, The Cadwalader Master Plan listed on the City of Trenton, NJ official website, that was developed by the City of Trenton, an Advisory Committee of local residents and the master planning team, traces out the history of the site property, in detail, right from 1680 till date. According to the Master Plan, the landscape history of Cadwalader Park shows that the site has always been rich in topography (Cadwalader Master Plan 2013).

After reading through the History of Site, I noticed that Cadwalader Park was utilized in multiple ways by different owners through time. Initially, the site was a part of a larger land property which over time got bifurcated into multiple smaller plots, one of which became the Cadwalader Park. This land property was acquired by the City of Trenton and Olmsted was hired to design a public park. In figures 10 and 11, it can be seen that the park boundary as see today, did not exist until 1931. Olmsted designed the park combining the two plots. One was owned by the city and the second Olmsted hoped, the city would buy eventually. This significantly influenced the design along the western corridor because the plot was not bought by the city for a long time. The park design envisioned by Olmsted differed from the actual constructed park.

In the subsequent sections, I will examine the design of the stream corridor by Olmsted and compare it to the existing stream corridor.
Figure 10

Figure 11
2.2 Frederick Law Olmsted and the Olmsted Firm:

While conducting archival research at The Olmsted Archives in Brookline Massachusetts to collect the existing drawings of Cadwalader Park for study, I came across three drawings. One was the preliminary master plan (Figure 12). The other two were sectional drawings. I learnt after reading the Master Plan that the drawings besides the three mentioned above, were sent to the city of Trenton. These got destroyed because of a fire accident in 1975. The preliminary plan (Figure 12) was presented by John C. Olmsted to the Park Committee (Cadwalader Master Plan 2013).

1891: The Preliminary Plan of Cadwalader Park:

The preliminary plan of Cadwalader Park in Figure 12 depicts a typical Olmsted design, characterized by biomorphic pathways, vegetative buffer along the edges of the park, and naturalistic water bodies. *Cadwalader Park Landscape Master Plan Philosophy and Approach* critically analyzes the planting design of the plan. The unique tree composition comprised groups of trees and single specimen trees, accentuated views and provided new vistas to the visitors, as they moved through the meadows or path. We can see that with a unified composition of Topography and Vegetation, Olmsted created a cohesive system that defined spaces and choreographed rich experiences for the park users. Like in most of his park designs, this plan too demonstrates thick vegetation along the boundaries of the park property. By doing so, Olmsted strived to screen the urban environment from the park in order to achieve an escape from the city life.

Circulation, as always the case in Olmsted designs, also played an important role in the design of Cadwalader Park. As seen in the design, a primary path encircles majority of the park by forming a loop and serves as a vehicular pathway. The secondary paths are pedestrian and bike friendly and provide a rich experience by guiding the people through open spaces along pools, ponds and alternate sparse and dense vegetation.

Design along the Western Stream Corridor:

As the Master plan states and as we can see in the plan, Olmsted designed naturalistic pools, flanked by secondary paths. The pools on the southern side are surrounded by dense vegetation. Contrastingly, the vegetation around the pools in the north is less dense in nature. The primary path loop included the pools and open spaces which provided a circulation for the park users without any undesirable intersection of vehicular traffic. The Master plan states that Olmsted envisioned these pool features to be an integral part of the park.
Figure 12
1891: The Preliminary Plan for Cadwalader Park, Trenton (The Olmsted Archives, Brookline Massachusetts).
Development of the Western Stream Corridor over time and comparison to Olmsted’s design:

In Figure 13, I have reproduced the maps from the Master Plan that mark the evolution of the stream corridor over time. Arranged in chronological order, the figure provides a visual analysis of the modification of the stream corridor. As we can see, the western corridor was primarily a stream until the land was privately owned. As the construction of the park began, the stream got modified to create lower pools. This can be observed in the map of 1889-1911. The map of 1912-1936 shows the formation of the upper pond. It is important to note that the pools were formed outside the primary path which was a major difference and conflicting aspect to Olmsted’s design. In this case, the primary path proved to be a barrier for the people between the large open spaces and the pools. The intention in Olmsted’s design to separate the vehicular and pedestrian circulation clearly was unsuccessful through this modification. This barrier divided the park into two parts – one which was the stream corridor and second was the large open space. Though history shows that the western stream corridor was active in the past, today, it is a totally degraded site which is also fenced out and inaccessible to public. Highly unmaintained, the degraded stream corridor exhibits an unpleasant experience which was completely opposite to the original intentions of Olmsted. I propose to explore designs that will improve the conditions.
Figure 13.
Neighborhood Plan

Figure 14 shows the neighborhood plan of Cadwalader Park. As we can see, the park marks a prominent open space in the neighborhood. Being mostly residential, the neighborhood has a typical New Jersey suburban character. The Delaware Raritan Canal walk passes through the Cadwalader Park as seen in Figure 14, and divides the lower recreational areas from the northern side of the park. The Ellarslie Villa today, serves as the Trenton City Museum.

There are two vehicular entrances to the park – one from the park side avenue and other from Stuyvesant Avenue. Three entrances marked in green are the pedestrian entrances. The degraded Western Ravine is fenced and inaccessible to the public. The city sewer and storm lines run through the western stream corridor area and are mapped in Figure 14.

I have reproduced Figure 15 from the Hydrology section in The Cadwalader Master Plan. As the figure shows, there are three main watersheds. The Eastern and Western watersheds guide the storm water to the city storm sewers and then drain to the Delaware River. The central watershed guides the water directly into the Delaware and Raritan Canal.

Figure 15.
Watershed diagram, Cadwalader Park, Trenton, NJ (Reproduced from the map in Cadwalader Park Master Plan http://www.trentonnj.org/PARKS/CWP_Plan_Chapter2.html).
Figure 14.
Figure 16 shows the detailed plan of the western stream corridor. It is characterized by three ponds, connected by the stream. The stream corridor is flanked by vehicular roads namely Stuyvesant Avenue, Cadwalader Drive and Circuit Drive. While the two lower ponds are defined by steep topography, the area around upper pond is more accessible via pathways along shallow slopes. A bridge also runs over the upper pond connecting the paths on either side thereby providing pedestrian access to the adjoining neighborhood. The two structures in the central portion, along the Cadwalader Drive, are unused. As mentioned before, the city storm and sewer lines run along the length of the stream corridor north south. The storm water ground runoff flows into the pond in addition to the water from the underground storm pipe system. The ponds thus, serve as catchment basins. The lower pond has a culvert that runs under the Delaware Raritan Canal. This culvert guides the water eventually to the city storm water system (Cadwalader Master Plan 2013).
Figure 16.
Chapter 3

CASE STUDIES AND DESIGN GUIDELINES
This section includes a chronological examination of projects that illustrate how major designers have manipulated topography. This study will provide clues on how to best manipulate the land to enhance the temporal qualities of snow.

For inspiration, I first looked at Olmsted’s designs of Back Bay Fens (1887) and Biltmore (1890). I also studied The Soros Residence (1970) and Gainesway Farm (1975) by A. E. Bye and The Dell (2004) at University of Virginia, by Nelson Byrd Woltz. A telephone interview as well as plans, sections and photographs provided by the Olmsted Archives and Facility Resource center at University of Virginia facilitated this analysis.

The first two case study projects namely, The Back Bay Fens and Biltmore demonstrate a classic nineteenth century landscape architecture, rich in picturesque qualities, well developed circulation system and harmonized integration of water and topography to enhance the user experience. Soros and Gainesway Farm projects, by A. E Bye, provide unique insights into the relationship between topographic manipulation and dramatic snow melt patterns. The Dell provides insight into storm water management system. Together, the diverse set of these case studies offer a set of guidelines pertinent to my design work at Cadwalader Park. (Figure 17).

**Figure 17.**
Literature Review Diagram, by Author.
3.1: Frederick Law Olmsted (April 26, 1822 – August 28, 1903):

I will first trace out Olmsted's personal experiences, how they played an integral role in defining the principles and theories for his designs. Further I will elaborate on how topography was a most common tool that Olmsted used to achieve his design objectives. With the help of case studies, I will carry out a detailed analytical study of topography, water and structures and explore their relationships. The lessons learned shall guide my design at the stream corridor at Cadwalader Park, Trenton.

Background and his Inspirations:

Olmsted was born in 1822. During this period, over ninety percent of the population lived on sparsely populated farms and villages. People were close to nature. Even people living in cities had easy access to rural settings. When Olmsted died in 1903, the country had completely transformed due to urbanization. Cities like New York and Chicago experienced immense population growth. (Fabos, Milde, Weinmayr, 4).

During the period when America as a nation was experiencing urbanization, at a scale and rate, unimaginable, Olmsted and his designs helped define an image of the landscape. In his autobiographic book, he stated:

I offer a small contribution of individual experience towards the history of the later half of the first century of the American Republic, the period in which the work of the railroad, the electrical telegraph, the ocean steamship, the Darwinian hypothesis and of Universal suffrage began; in which what is called the temperance reformation and the abolition of slavery have occurred; in which millions of people have been concentrating at New York, Philadelphia, Boston, Baltimore, Cincinnati, Chicago, St. Louis, and Saint Francisco while rural neighborhoods in New England, Virginia, the Carolinas and Georgia have been rapidly loosing population and still more rapidly loosing various forms of wealth and worth (Olmsted Jr, and Kimball, page 43).

Olmsted was a great visionary. He had envisioned urban development and realized the importance that urban parks, like Central Park, would hold in the future. He said:

The time will come when New York will be built up when all the grading and filling will be done and when the picturesque - varied, rocky formations of the island will have been converted into foundations for rows of monotonous straight streets and piles of erect angular buildings. There will be no suggestion left of its present varied surface, with the single exception of the park. Then the priceless value of the present picturesque outlines of the ground will be more distinctly perceived and its adaptability for its purpose more fully recognized. It therefore seems desirable to interfere with its easy, undulating outlines and picturesque, rocky scenery as little as possible and on the other hand to endeavor rapidly and by every legitimate means to increase and judiciously develop these particularly individual characteristics sources of landscape effects (Rybczynski, 174)

Olmsted's idea of creating a rural, picturesque landscape began with his childhood during long carriage rides. In the autobiographic book, he states:

The happiest recollections of my early life are the walks and rides I had with my father and the drives with my father and (step)-mother in the woods and fields. Sometimes these were quite extended and really tours in search of picturesque (Olmsted Jr and Kimball, page 46).

In addition, Olmsted's experience as a farmer, though unsuccessful, taught him how to manipulate the landscape (Rybczynski, 87). His concept of the picturesque landscape further developed during a visit to England. In A Clearing in the Distance, Rybczynski noted that after one such visit to the Park of Hall, a large estate in Cheshire, Olmsted wrote:

A gentle undulating surface of close-cropped pasture land, reaching way off illimitably; very old, but not very large trees scattered single and in
groups – so far apart as to throw long unbroken shadows across broad openings of light, and leave the view in several directions unobstructed for a long distance. Herds of fallow-deer, fawns, cattle, sheep and lambs quietly feeding near us, and moving slowly in masses at a distance; a warm atmosphere, descending sun and sublime shadows from fleecy clouds transiently darkening in succession, sunny surface, cool woodside, flocks and herds and foliage. (Rybczynski, 87)

Olmsted was also impressed by Joseph Paxton’s design of Birkenhead Park. In the book A Clearing in the Distance, Rybczynski notes that Olmsted was amazed at how the man-made landscape, with its “picturesque ponds, random clumps of trees, rolling meadows, overgrown hillocks and meandering footpaths”, looked natural. In May 1851, Olmsted wrote an article, in which he describes the water and topography at Birkenhead. Olmsted was in awe at how the flat site was converted into a picturesque park. (Rybczynski, 93)

**Design Principles and the Integral Role of Topography:**

Olmsted drew upon his personal experiences to create a set of design principles that he applied to most of his projects. These principles built upon the picturesque qualities that he observed in England.

Olmsted attempted to bring such wilderness right into the city by creating large-scale parks in an urban setting, so that the city people could benefit from nature. While creating such landscapes he often screened the park from its surrounding urban setting, so that it offered a restorative escape from the busy life. Within the park, he separated passive and active areas. He created landscape spaces that allowed views and vistas. Olmsted choreographed the movement through these spaces in a way that the visitors would become totally engrossed. (Olmsted’s Philosophy, 2011)
3.1.1 Back Bay Fens (1887) Boston MA (1887): The Creative Manipulation of a Degraded Stream Corridor.

Back Bay Fens completed by Olmsted in 1900 forms a boundary between Boston and Brookline. The Park initially served as a drainage area for the townships of Roxbury, Dorchester, South End and Back Bay (Julkus GY. Fabos, Gordon T Milde, and V.Michael Weinmayr, 57, 58) (Figure 18). Though the design predicated upon storm water management and control, what is critical for my project is the way Olmsted manipulated the topography of the site.

Of particular note for my project is the way Olmsted graded the stream corridor. (Figure 19) Olmsted designed a narrow, winding stream corridor. The winding form increased the length of the stream, decreased the water flow.

Figure 18.
Back Bay Fens Before Design. Fens area marked with dotted red line. Original image from Frederick Law Olmsted and the Boston Park System by Cynthia Zaitsevsky).

Figure 19.
1887: Back Bay Fens Plan by Olmsted. Winding formed traced in blue color. (Original image without the traced winding from is from The Olmsted Archives, Brookline, Massachusetts).

and subsequently the water run off from the surroundings. He added a lot of landfill along the sides of the stream and engineered the topography such that it enabled catchment areas for flood water.

Figure 20 shows a detail of the grading technique along the stream. The earth along the edges of the river is deliberately designed with multiple indentations along the river that facilitated catchment areas. The slope in these indentations is shallow, providing additional volume and opportunity for smaller pools. The shallow slope also prevented erosion. Also, the positioning of these catchment areas complemented the direction of the water flow.

Figure 20.
Detail of the Engineered Topography along the stream corridor (The Olmsted Archives, Brookline, Massachusetts).

Figure 21.
Image of a Bridge at Back Bay Fens, Boston (The Olmsted Archives, Brookline, Massachusetts).

Figure 21 shows an image view of the bridge entrance to the site. As we can see, Olmsted used the stone bridges, similar to most of his parks.
3.1.2 Biltmore (1890 - 1900), Ashville, NC

The Biltmore, an estate located in Ashville, North Carolina, illustrates how Olmsted graded a steep sloping site, a condition analogous to that at Cadwalder Park (Figure 22). What is integral for my study is the way Olmsted controlled the water flow of the stream corridor and manipulated the land to create a naturalistic landscape.

The Approach Road to the mansion was designed in an informal way (Rybczynski, 381). Olmsted described it as “natural and comparatively wild and secluded character, is borders rich with varied forms of vegetation, with incidents growing out of the vicinity of springs and streams and pools, steep banks and rocks, all consistent with the sensation of passing through the remote depths of a natural forest” (Rybczynski, 38).

To achieve this naturalistic effect, a nearby stream channel branch was diverted and manipulated to create ponds and pools using damns, walls and weirs. One of the interesting features on the estate is Bass Pond. Olmsted created this pond by constructing a 20-foot high dam on a four mile creek (Figure 23).

Figure 22.
View of the Biltmore Mansion located at a high elevation, overlooking the River (The Olmsted Archives, Brookline, Massachusetts).
Figure 24 shows a bridge over a winding stream. It is interesting to observe the way different textures in the landscape integrate well into each other, serving the functional as well as the aesthetic purpose. Together, the composition offers a natural effect.

The bridge is constructed out of a stone material. To prevent erosion, stone embankments can be seen along the stream. Besides this, stones have also been placed at random locations along the stream corridor. The stone on the ground connects to the stone of the Bridge and visually links the structure and topography of the site. In addition, the ground cover along the stream corridor provides a balance with respect to color and texture in the landscape.

Figure 25 shows a stream bank along the road. This picture reinforces his design idea as mentioned in the quote above. The steep slope bank is distinguished by different sizes of rocks and stones, varied vegetation planted in groups and clumps. Forest marks one edge of the road and also can be seen in the background. Again, it is interesting to note how the composition creates a picturesque quality to the landscape.
Figure 26: Shows a stream cutting across topography. Because of the steep slope, the stones and small rocks are used to prevent erosion. But again they are positioned in a way that provides a natural effect.

Figure 27 shows a bridge over the bass pond, along the Approach Road. The bridge blends well with the topography and integrates with the landscape. The curve of the road is accentuated by the stones, placed along the edge which eventually joins the edge of the bridge. This image demonstrates how the winding curve of the road frames a view of the pond, the bridge and the undulating topography beyond.
3.2 Arthur Edwin Bye, Jr (1919 - 2001)

“To create effectively, the landscape architect must work outdoors to feel each rock and stone, the trees and vines, sand and earth, the sky and water, reflecting light and shadow, the mist, the snow the ice, the rain, the wind and the odors and the noises that are all about us.” (A. E. Bye, 19)

In an interview of A. E Bye, conducted on 14th July 1990 by Cynthia B. Hanson, for the Los Angeles Times, Bye referred to his landscape designs as art. According to Bye, a landscape can have a mood as a conceptual base for design or a theme like “grotesque, mysterious, serene or sublime” (Cynthia B. Hanson, 1990). His projects are integral for my study as the snow creates a serene mood in the landscape, which I will consider during my design exploration.

3.2.1 Soros Residence (1980), South Hampton, NY

The four acre property of Soros is distinguished by rolling terrain. As mentioned by A. E. Bye, in the book Art in Landscape Landscapes in Art, the central idea behind this undulating topography came from the client’s desire to have a rolling landscape. A. E Bye describes the landscape as:

“Gentle valleys, hills and depressions of varying lengths generate a spatial motion. The designed landscape demonstrates the abstract patterns of melting snow in the winter that represents motion and rhythm of subtlety and serenity. The landscape for a brief time becomes sinuous as the snow slowly melts. Another but similar pattern will emerge at the next snow melt creating another landscape composition.” (A.E. Bye, 1,9,10)

Analysis:

An analysis of the snow melt pattern at the Soros Residence (Figures 28, 29) revealed factors critical to my project. The snow on the low ridges melts quickly. The southern and the western parts also melt rapidly due to sun exposure during winter. The snow remains on the northern and eastern side of the image. The result is a dramatic pattern of dark and light that changes as the snow melts.
Figure 28.
Winter Sun Pattern Analysis (Image modified and reproduced from Art in Landscape Landscape in Art by A.E.Bye).

Figure 29.
Grading Plan of the Soros Residency ((Image modified and reproduced from Art in Landscape Landscape in Art by A.E.Bye).
3.2.2 Gainesway Farm: Ha Ha Wall (1980), Lexington, Kentucky.

The Gainesway Farm designed in 1980, is one of the most well known projects of A. E. Bye. This project proved important for my study as I learnt how difference in material can affect how snow melts. In addition, the design is also a good example of how a structure can become a part of the topography and help guide the snow melt.

The idea behind Gainesway Farm was conceived when A. E. Bye experienced a visually disturbing fence in the center of a meadow. He then designed a Ha Ha wall to replace it. While talking about this Design, A. E. Bye says:

"The fence was profiled to echo the clean rises and falls of the surrounding fields and fences thereon and the edge of the lake across the valley to the west. The earth along with the fence was graded such that it would disappear in the plan" (A.E. Bye, 101)

Analysis:

A photograph of the Ha Ha Wall (Figure 30) below shows how walls create shadows and influence the melting of the snow. Walls trap heat and increase temperature causing the snow to melt quicker. Walls also help emphasize the north and south aspect and can enhance or diminish the snow melt. In the photograph, the stone wall has a dark surface that contrasts with the white snowscape. This creates a playful relationship with the dark shadows of the trees. It brings about a variation in texture and color, and along with the tree structures breaks the otherwise monotonous white snowscape. The contrasting dark and light shades and the shape of the wall agrees and adds to the sinuous quality in the landscape.
Figure 30.
View of the Ha Ha wall during Winter (Image modified and reproduced from *Art in Landscape Landscape in Art* by A.E.Bye).

Figure 31.
Plan of the Gainesway Farm Project (Image modified and reproduced from *Art in Landscape Landscape in Art* by A.E.Bye).
3.3. Nelson Bryd Woltz Firm:
This landscape architectural firm is based in Virginia and New York. The philosophy of this firm states that “design is inspired and informed by historic analysis, site observations, and site interpretation. Through use of localized materials, they maintain and reflect the local ethos of the place of their projects through their designs” (Firm Philosophy)

3.3.1 The Dell, University of Virginia, 2004:
Much of my information came from a personal conversation with Steve Benz, the engineer for this project. When asked to describe the Dell Project, Steve Bens referred to a Christmas card with a picture of the Dell that said “Dell Pond is highly calibrated storm water feature that is designed to regulate the flow to minimize the impact on the development of the campus”. Steve Bens said that while “the words expressed the functionality, the picture spoke about its aesthetics”. The project thus serves as a good functional as well as an aesthetic purpose.

Though the main aim of the project was to create a storm water system, what is relevant to my study are the design techniques that relate to regulating appropriate amount of water flow, preventing erosion and the use of contemporary materials. My analysis showed that the project is a contemporary manifestation of design techniques observed in Olmsted designs.

Figure 32 shows the analysis of the stream slope before and after the design. As noted, the design reduced the slope of the stream to almost half, by the use of a winding form (Figure 35). The same technique has been observed in Olmsted’s design of Back Bay Fens.

The diagram (Figure 33) shows that the stone embankments were used along the slopes to prevent erosion. This technique was also observed in Olmsted’s design. However, the major difference is that Olmsted executed this idea to create landscapes of naturalistic look, while the Dell exhibits a contemporary look.

Figures 34 and 36 show how the walls were designed in the project that guided the water flow. These walls also integrated well into the topography. We can see linear forms of walls suggesting contemporary expression.

Figure 37 shows the weir was used to control the rate of water flow from the sediment forebay into the pond.

![Figure 32](image)

**Figure 32.**
Slope analysis of the stream corridor before and after the design of the project (diagram created was based on the landscape drawings of the Dell project acquired from the Facility Resource Center at University of Virginia during Archival Research).
Figure 33.
Stone Embankement Diagram (diagram created was based on the landscape drawings of the Dell project acquired from the Facility Resource Center at University of Virginia during Archival Research).

Figure 34.

Figure 35.
Plan of The Dell, University of Virginia (image reproduced by Google Maps, acquired April, 2013).

Figure 36.
Contemporary Structures guiding the water flow (image from “Grounds and C’Ville”, The University of Virginia http://uvamagazine.org/photo_gallery/grounds_cville/dell_pond_1).

Figure 37.
Wiers to Control the water flow (image from “ASLA 2009 Honor Award”, American Society of Landscape Architects http://www.asla.org/2009awards/567.html).
3.4 Design Guidelines and Inspirations from Case Studies:

Lessons learned from Olmsted’s Case Study and the Dell:

(1) Winding form: In Back Bay Fens case study, Olmsted reduced the slope of the stream by creating an extreme winding form and thereby lengthening its stream corridor. Similar idea was applied for the project Dell (Figure 38)

(2) Stone embankments: Both case studies of Olmsted namely the Back Bay Fens and Biltmore revealed that Olmsted used stone embankments to prevent erosion along the steep slopes. Stone embankments were also an important feature in the Dell project (Figure 39)

(3) Use of dams, walls and weirs: In the Biltmore case study, an integral part of Olmsted’s design was to manipulate the stream corridor and create a series of pools and ponds with the help of dams and walls. In the Dell project, weirs were used to control the water flow, in addition to the walls that guided the water flow (Figure 40)

(4) Topographic manipulation: Manipulating topography can be seen in both of the case studies of Olmsted. In the Back Bay Fens case study, Olmsted graded the topography in a way that enabled multiple catchment areas along the streams. In the Biltmore case study, he manipulated topography to divert the streams (Figure 42)
(5) Accentuate Views: Through his designs, Olmsted always accentuated views to enrich the experience of the users. (Figure 41)

Lessons learned from A. E. Bye Case Studies:

(1) Textures and Colors: A. E. Bye’s case study of Gainesway Farm suggested that textures and colors affect the rate of snow melt. Specific to the case study, the snow on the stone wall melted faster than the ground cover (Figure 44).

(2) Ridges versus Swales: The analysis of Soros Residence landscape design showed that the snow along the ridges melt quicker than the snow on swales. This creates a wonderful pattern on an undulating topography (Figure 45).

(3) Sun pattern: The analysis of snow pattern on the Soros residence showed that the sun pattern played an important role in its formation. Snow on the western and southern side melted while snow in the northern parts clearly remained (Figure 46).

(4) Biomorphic forms: Both of A. E. Bye’s case studies showed that he used biomorphic forms which created a sinuous quality that not only enhanced the topography but also formulated the snow patterns (Figure 43).

Figure 43.
Biomorphic Forms.

Figure 44.

Figure 45.
Ridges and Swales.

Figure 46.
Winter Sun patterns.
Chapter 4

SITE SELECTION ANALYSIS
The Design guidelines projected specific site requirements for design interventions.

- **Water flow Analysis:** The water flow analysis was done in order to determine the swales and ridges on the existing topography.
- **Optimum Slope for Re-Grading (topographic Analysis):** In order to locate sites flexible for re-grading, the slope analysis was performed.
- **Minimize Disruption to Existing Trees (Vegetation Analysis):** In order to minimize the disruption to the minimal trees while re-grading, sites with minimum trees were located by doing a vegetation analysis of the site.
- **Aspect (Solar Analysis including aspect, tree shadows and time of day analysis):** Because the sun plays an integral role in casting the snow patterns, a critical aspect analysis of the site was done in order to determine the directions that the surfaces face.

**Water Flow Analysis:**

Figure 47 shows the water drainage diagram. As can be observed, the site has three main ponds. The stream corridor, non-meandering in nature, directly flows into each of these ponds. The topography on both sides of the stream corridor has multiple swales and ridges. Multiple swales enable streams that flow into the main stream corridor and ponds. There are six main high points along the stream corridor.
The design began with Frederick Law Olmsted but ended with Olmsted Brothers.

Figure 47. Drainage Diagram Illustrating swales, ridges and high points. (Contours traced from Existing Conditions Viewshed Map by March Associates. Existing Water and Sewer City lines data based on drawings provided by City of Trenton, County of Mercer, State of New Jersey, during Archical Research. Parcels traced from Google Earth. 2010 TIGER/Line Shapefiles:Roads (tl_2010_34021_roads.shp), U. S. Census Bureau. http://www.census.gov/cgi-bin/geo/shapefiles2010/file-download).
Slope Analysis:

Figure 48 shows the slope analysis. The analysis was categorized into four groups: 0–5%; 5–12%; 12–30% and more than 30%. The analysis showed that the topography around the ponds have steep slopes. The deer paddock area and the upper area lie under the category of 0–5%. Gently sloped, areas also allow re-grading, and this makes them eligible for potential interventions.
Figure 48.
Tree Shadow Analysis:

The tree shadow analysis was done for January 15, 9am when the shadows are longest as the sun angle is the lowest. Thus, the analysis highlighted sites that were not covered by the shadows of the trees and were exposed to the winter sun. (Figure 49)
Figure 49. Shadows cased during the lowest sun angle in January. (Contours and trees traced from Existing Conditions Viewshed Map by March Associates. Existing Water and Sewer City lines data based on drawings provided by City of Trenton, County of Mercer, State of New Jersey, during Archical Research. Parcels traced from Google Earth. 2010 TIGER/Line Shapefiles:Roads (tl_2010_34021_roads.shp), U. S. Census Bureau. http://www.census.gov/cgi-bin/geo/shapefiles2010/file-download).
Aspect Analysis:

Figure 50 shows the aspect analysis for all the three winter months – January, February and March at 9 AM, 12 PM and 3 PM. As can be seen, the stream marks a sharp division between surfaces that are exposed to the sun and the ones that are not. Hence during winter, we get to perceive a monotonous snow pattern, with one side of the stream full of snow and the other with no snow. As observed through all the seasons, the western surface of the stream corridor is more exposed to the sun while the eastern is not. The upper part of the stream has areas that are exposed to all the surfaces.
Figure 50.
Site Selection:

Based on the criteria and analysis, two sites were selected for design interventions as shown in figure 49. Both sites have optimum slope which allow re-grading. The areas have minimum trees which creates minimum disruption. Being exposed to sun, these sites are ideal for interventions that caste shades and formulate the snow patterns. (Figure 51)
Figure 51.
Sun - Shade Study.

Before starting with the design exploration, I did a quick study of the shadow effects on three feet walls according to the winter sun angles. Figure 52 shows the analysis.
Figure 52. Analysis of Shadow cast by a 3 feet wall, January through March (Sun angle data from “Sun Position”, Sun Earth Tools http://www.sunearthtools.com/dp/tools/pos_sun.php).
Chapter 5

DESIGN EXPLORATION
My design exploration took place in two steps. The first step included vigorous experimentation with topography and walls to study their corresponding shadow patterns in order to enable desired snow patterns during winter. Second step was to explore one composite plan for the site selected for study, with respect to its circulation and programming. An important part of this step was also to think about ways to handle snow from the adjacent roads.

**Step 1**

The first step of the design process began by manipulating the topography and placing wall interventions to study the sun-shadow effects. The case study analysis had showed that the snow melt would occur rapidly in areas exposed to sunlight, whereas the areas under shade would host snow for a longer duration. Thus my experiments helped me explore multiple kinds of shadow patterns that my interventions formed, anticipating corresponding snow patterns. This was done by building models and placing them under a light that represented the mid-winter sun angles at 9am, 12pm and 3pm.

**Topography:**

The main intentions while re-grading and manipulating the topography were:

1. To enable multiple north, south, east and west facing surfaces using biomorphic forms of earth.
2. While doing so, improve the stream form and its neighboring topography.
3. Reduce the slope of the stream.

For the first site selected for intervention, I experimented with only topography. I re-graded the area to create ridges and swales that formulated multi-directional surfaces (Figure 53). Further, according to the sun pattern and aspect, I created impressionistic drawings of snow melt patterns at different stages. I then also built a study model to examine and confirm the sun – shadow effect cast by the new topography at the mid winter sun angles. (Figure 54, 55, 56). The resulting shadow patterns complemented the snow patterns designed. As seen in the model – shadows are caste on the north facing surfaces during all times of the day. Correspondingly in Figure 57 we can see a snow pattern, where snow melts from all other surfaces except the north surface.

For second site, I first re-graded the stream corridor into a winding form to reduce its slope. The Sinuous character of the new topography broke the monotonous single facing surface into multi – direction facing surfaces. Study models in light showed the play of sunny and areas under shade that the winter sun would caste. This in turn would enable dramatic snow patterns, enhancing the beauty of the topography temporally.

**Walls:**

I decided to further explore the second site for various snow patterns by placing walls that would accentuate north - south directions.
**Figure 53.**
Proposed grading plan with Ridges and Swales.

**Figure 54.**
Shadows formed by sunrays at 9 am January

**Figure 55.**
Shadows formed by sunrays at 12 pm January

**Figure 56.**
Shadows formed by sunrays at 3 pm January
Figure 57 shows the impressionistic shadow patterns, inspired from the sun-shade analysis of the model.
Linear walls:

Initially, I started by placing walls in the east-west direction to accentuate the north and south facing areas (Figure 58). After studying the shadow patterns (Figure 59, 60, 61) I realized that while it cast strong shadows in north side around 12 noon, the areas were receiving sunlight from the east and the west direction at 9 am and 3 pm respectively. This implied the need for a barrier, north-south oriented, in addition to the walls in east-west direction. In other words, the areas where I anticipated snow accumulation had to be cast with shadows all throughout the day.

I noticed that in certain areas, topography blocked the east-west sun rays. I also noticed the north-south facing wall of the two buildings helped in blocking the east and west rays. Correspondingly, I then explored two options namely: (a) The topography would block the east–west walls, and (b) Build north-south walls, perpendicular to the east-west walls to block sunrays.

Figure 58. Plan showing East-West oriented wall conformations.

Figure 59. Shadows formed by the sunrays at 9 am.

Figure 60. Shadows formed by the sunrays at 12 pm.

Figure 61. Shadows formed by sunrays at 3 pm.
For option (a), I wanted to explore if the topography could block the east and west sun rays. I placed three main walls across the stream, accentuating the north and south while blending into the topography, that hopefully would act as the barrier for east and west sun rays (Figure 62).

However, as can be seen in figures 63, 64 and 65 the topography was not steep enough and the sun angle was not low enough for topography to act as walls and prevent the east and west sunrays. So, I decided to experiment with walls to see if it would be successful.

Figure 62.
Plan showing the three wall interventions. (bridges) across the stream.

Figure 63.
Shadows formed by the sunrays at 9 am.

Figure 64.
Shadows formed by the sunrays at 12 pm.

Figure 65.
Shadows formed by sunrays at 3 pm.
Finally, when I built option (b), I placed new north south oriented wall in perpendicular to the previously places east west oriented walls (Figure 66). I anticipated that these new walls would block the east west sun rays.

However the analysis showed that the walls prevented either the east or the west sunrays, but not both. The shadow patterns that resulted were consistent for two times of the day (Figure 67, 68, 69).

Figure 66.
Plan showing the North-South and East-West Walls.

Figure 67.
Shadows formed by the sunrays at 9 am.

Figure 68.
Shadows formed by the sunrays at 12 pm.

Figure 69.
Shadows formed by sunrays at 3 pm.
To make the pattern more accurate, I experimented with wall angles such that they would strongly prevent the east and the west sunrays. I decided to rotate the walls from the previous conformation to a small degree in a way that the new conformation would address both east and west sun rays, in addition to the south (Figure 70).

The sun shade analysis (Figures 71, 72, 73) thus showed that the new conformation indeed helped in casting shadows at consistent areas across different times of the day.
(2) Curved walls

My previous experiment with linear walls had showed that the conformation would need to block rays from east, west and south to achieve shadow patterns in consistant areas. This time I visualized a specific shadow pattern (Figure 74) and experimented with biomorphic forms to achieve the desired effect.

Figure 74.
Impressionistic Drawings of the desired Shadow and snow patterns.
By placing 3 walls curving along the stream I created darker shadow areas along the steep topography (Figure 75).

Sun – shade analysis showed that the desired shadow pattern could not be formed because the walls failed to block the southern rays (Figure 76, 77, 78).

Figure 75. Plan showing interventions of the three curved walls.

Figure 76. Shadows formed by the sunrays at 9 am.

Figure 77. Shadows formed by the sunrays at 12 pm.

Figure 78. Shadows formed by sunrays at 3 pm.
To rectify this, I added east west walls. Reanalysis confirmed the formation of the desired shadow pattern (Figure 79).

**Figure 79.**
Plan showing interventions of the E-W walls in addition to curved walls.

**Figure 80.**
Shadows formed by the sunrays at 9 am.

**Figure 81.**
Shadows formed by the sunrays at 12 pm.

**Figure 82.**
Shadows formed by sunrays at 3 pm.
Step 2] Composite Design:

As stated before, the main intention behind the design has been to create dramatic snow patterns in the landscape that exhibit the temporal qualities of snow in contrast to the regular urban winterscape where snow gets displayed in the form of ugly snow piles, thereby providing a rich experience for the people.

While the park provides opportunities for public to actually interact with the snow, the western stream corridor with its new topography is proposed to provide a rich experience of the changing landscape and accentuated views through all seasons - Summer, Fall, Winter and Spring.

After exploring different kinds of interventions that enabled different snow patterns, I created a composite plan for the whole site combining two options: (i) curved wall option and (ii) ridges and swales (Figure 80). The undulating topography in combination with the walls formulates an interesting pattern during snow.

To unify the design along the stream corridor as a whole, I extended the biomorphic nature of wall interventions into an exploratory pedestrian pathway that not only offers views but also connects the neighborhood to the park. The pathway choreographs the movement of the park visitors through paths along the topography, over bridges across the stream and on walls along the stream, offering dramatic views of snow patterns formed by the interventions.

Feasibility across multiple seasons:

While my focus has been to create a landscape for winter, I believe with a few basic modifications and alterations, the design can also enact as a storm water system during other seasons. The intervention on the north side of the park that includes ridges and swales enables additional water catchment areas. The re-graded winding stream reduces the slope. Together they reduce the rate of water flow. Adding vegetative buffers can also help in improving the water quality and also increase infiltration.

In addition, the undulating topography also allows picturesque views for people to experience across multiple seasons.
Figure 83.
Composite Plan.
Snow from the Streets:

As opposed to the undisturbed snowscapes that would be formed on the canvas created using earth and structures, the snow plowed from the roads will be dumped at allocated locations. The locations, highly exposed to the sun, will guide the melted snow along the swales of the topography into the stream (Figure 81).
Figure 84.
Snow dump locations.
Chapter 6

CONCLUSIONS
In summary, my project was formulated from a simple observation of the unpleasant snow accumulation in the landscape during winter, followed by an urge to explore a way to represent snow and its temporal qualities in a better way. A critical historic analysis of the site, its present conditions, in addition to a thorough study and re-interpretation of historic landscape architectural projects pertaining to the subject, inspired my design exploration. The outcomes of my rigorous examination of topography, walls and corresponding sun-shade effects, were impressionistic visions of dramatic snow patterns in the landscape. I will now summarize the lessons learnt through my project. They are indeed invaluable and will facilitate my practice in the future.

**Simple observation:** I realized that people tend to get used to the routine phenomenon like snowfall and fail to notice the effects that it causes in the landscape. It becomes a part and parcel of everyday life. In this process, the full potential of the snow to transform a landscape temporally into a picturesque environment, remains unexplored and invisible to the public. As designers, it is our duty to take advantage through observations and create landscapes that exhibit the snow qualities. Thus, observation plays an important role in project formulation.

**History and site conditions inform design in a new way:** In my project, exploring the preliminary design of Olmsted revealed ideas that were critical for the neighborhood. The historical research of the site showed why the designs were not incorporated and how the site degraded over time. Through my design, I took into account for the history and site conditions.

**Critical analysis of historic examples and re-interpretation:** Through careful analysis of historical examples and observations, we can interpret new ideas that can enable innovative explorations. This allows contemporary expressions that reflect a part of history and enrich a design giving it a new meaning. For example, in my project, A. E. Bye’s designs enabled beautiful snow patterns. My analysis of why that happens projected new ideas about how difference in textures, materials and aspect can affect snow patterns. Using these ideas, my exploration further helped in envisioning and imagining various possible snow display patterns in the landscape with the help of structures and topography.
Chapter 7

FUTURE WORK
My graduate project explored aspect and winter sun patterns as factors that affect the snow melt. In this section, I will describe directions for future work along four dimensions: (i) causal factors that influence the snow melt, (ii) temporal aspect determining the rate of the snow melt, (iii) improving quality of snow melt, and (iv) snow melts on different vegetative land covers.

Other causal factors for snow melt: It would be very interesting to explore other factors such as wind, temperature and humidity and their relationship with the sun and slope that could improve the accuracy of predictable snow patterns in the landscapes.

Temporal aspect determining rate of snow melt: Another aspect is to understand ways that control the rate of snow melt – specifically, those that can enable long versus short spanned snow melt patterns. An idea would be to combine the design with the urban snow melt systems that are used to speed up the process of snow melt.

Improving quality of snow melt: The snow from the roads that eventually melts and flows into the stream undoubtedly has number of impurities including salt, metal, etc. An important aspect of research that needs to be conducted is to find ways to purify the water from the snow melt as it flows into the stream.

Snow melt on different vegetative land covers: Observing the snow melt patterns formed on different textures of the vegetative land cover would provide interesting insights into creating more versatile snow patterns and adding another layer of meaning to the subject.

Exploring these factors at different geographic locations would produce different results and thus it remains an interesting avenue for further research.
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Figure 7. Western Stream Corridor, Cadwalader Park, NJ (image reproduced from Google Earth).


Figure 12. 1891: The Preliminary Plan for Cadwalader Park, Trenton (The Olmsted Archives, Brookline Massachusetts)


Figure 14. Neighborhood Plan, Cadwalader Park, Trenton, NJ (Parcels traced from Google Earth. GIS Data Sources: 10-meter Digital Elevation Grid of the Central Delaware Watershed Management Area (WMA 11), 2002, NJDEP.


Figure 18. Back Bay Fens before Design. (Fens area marked with dotted red line. Original image from Frederick Law Olmsted and the Boston Park System by Cynthia Zaitzevsky. Massachusetts: The Belknap press of Harvard University Press, 1982, 10)

Figure 19. 1887: Back Bay Fens Plan by Olmsted. Winding formed traced in blue color. (Original image without the traced winding from is from The Olmsted Archives, Brookline, Massachusetts).

Figure 20. Detail of the Engineered Topography along the stream corridor (The Olmsted Archives, Brookline, Massachusetts).

Figure 21. Image of a Bridge at Back Bay Fens, Boston (The Olmsted Archives, Brookline, Massachusetts).

Figure 22. View of the Biltmore Mansion located at a high elevation, overlooking the River (The Olmsted Archives, Brookline, Massachusetts).

Figure 23. 20 foot dam at Biltmore Estate (The Olmsted Archives, Brookline, Massachusetts).

Figure 24. Stone Bridge blending with the topography at Biltmore Estate (The Olmsted Archives, Brookline Massachusetts).

Figure 25. Stone embankments along steep slopes (The Olmsted Archives, Brookline, Massachusetts).

Figure 26. Image showing placement of Stone embankments to prevent erosion (The Olmsted Archives, Brookline, Massachusetts).

Figure 27. View of the Approach Road (The Olmsted Archives, Brookline, Massachusetts).

Figure 28. Winter Sun Pattern Analysis (Image modified and reproduced from Art in Landscape, Landscape in Art by A.E.Bye).

Figure 29. Grading Plan of the Soros Residency ((Image modified and reproduced from Art in Landscape, Landscape in Art by A.E.Bye).

Figure 30. View of the Ha Ha wall during winter (Image modified and reproduced from Art in Landscape, Landscape in Art by A.E.Bye).
Figure 31. Plan of the Gainesway Farm Project (Image modified and reproduced from Art in Landscape Landscape in Art by A.E.Bye).

Figure 33. Stone Embankment Diagram (diagram created was based on the landscape drawings of the Dell project acquired from the Facility Resource Center at University of Virginia during Archival Research).


Figure 35. Plan of The Dell, University of Virginia (image reproduced by Google Maps, acquired April 1, 2013).


Figure 47. Drainage Diagram Illustrating swales, ridges and high points. (Contours traced from Existing Conditions Viewshed Map by March Associates. Existing Water and Sewer City lines data based on drawings provided by City of Trenton, County of Mercer, State of New Jersey, during Archival Research. Parcels traced from Google Earth. 2010 TIGER/Line Shapefiles: Roads (tl_2010_34021_roads.shp), U. S. Census Bureau. http://www.census.gov/cgi-bin/geo/shapefiles2010/file-download. Created February 15, 2013).


Figure 49. Shadows caste during the lowest sun angle in January. (Contours and trees traced from Existing Conditions Viewshed Map by March Associates. Existing Water and Sewer City lines data based on drawings provided by City of Trenton, County of Mercer, State of New Jersey, during Archival Research. Parcels traced from Google Earth. 2010 TIGER/Line Shapefiles: Roads (tl_2010_34021_roads.shp), U. S. Census Bureau. http://www.census.gov/cgi-bin/geo/shapefiles2010/file-download. Created April 15, 2013).

Figure 50. Aspect Analysis. (Contours traced from Existing Conditions Viewshed Map by March Associates. NJDEP 10-meter Digital Elevation Grid of the Central Delaware Watershed Management Area (WMA 11), 2002, NJDEP. http://www.state.nj.us/dep/gis/digidownload/zips/wmalattice/wma11lat.zip. Created March 5, 2013).

Figure 51. Selected Sites for Intervention. (Contours and trees traced from Existing Conditions Viewshed Map by March Associates. Existing Water and Sewer City lines data based on drawings provided by City of Trenton, County of Mercer, State of New Jersey, during Archival Research. Parcels traced from Google Earth. 2010 TIGER/Line Shapefiles: Roads (tl_2010_34021_roads), U. S. Census Bureau. http://www.census.gov/cgi-bin/geo/shapefiles2010/file-download. Created March 5, 2013).
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