

## Spaulding Rehabilitation Hospital Methods

### Research Fellows:

María Bellalta, FASLA  
Dean, School of Landscape Architecture  
Boston Architectural College

Hongbing Tang, ASLA, PLA  
Adjunct Faculty, School of  
Landscape Architecture  
Boston Architectural College

### Research Assistants:

Li Chen  
Master of Landscape Architecture, 3<sup>rd</sup> Year  
Boston Architectural College

Jason Kozikowski  
Master of Landscape Architecture, 3<sup>rd</sup> Year  
Boston Architectural College

### Firm Liaisons:

Sean Sanger  
Principal  
Copley Wolff Design Group (CWDG)

Fernando Sousa  
Landscape Designer  
Copley Wolff Design Group (CWDG)

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The full case study can be found at: <https://landscapeperformance.org/case-study-briefs/Spaulding-Rehabilitation-Hospital>

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## Acknowledgments

Spaulding Rehabilitation Hospital Boston is located on the ancestral territory of the Massachusetts Tribe, the original occupants of what is now known as Boston (hunap.harvard.edu n.d.). We pay our respects to the past and present Massachusetts Tribal members, as well as the land itself, which remains sacred to the Massachusetts People.

The team is grateful for the Copley Wolff Design Group (CWDG)'s great support in providing connections and resources for collecting information. Special thanks to Sean Sanger, lead designer of this project and principal of the firm, for his generous time and guidance. We would also like to remember Lynn Wolff, co-founder of CWDG and lead designer of Spaulding's ground-level landscape, who passed away from cancer in 2016.

Our work would not have been possible without the support of Mass General Brigham and Spaulding Rehabilitation Hospital Boston. The research team would like to thank David Burson, Senior Project Manager at Mass General Brigham, and various members of the leadership team at Spaulding Rehabilitation Hospital Boston, including Leslie S. Feinberg, Chief of Staff; Cara Brickley, Vice President of Operations and Director of Inpatient Rehabilitation Services; Timothy Sullivan, Director of Communications; and Aaron H. Moore, Outpatient Site Manager.

### Reference:

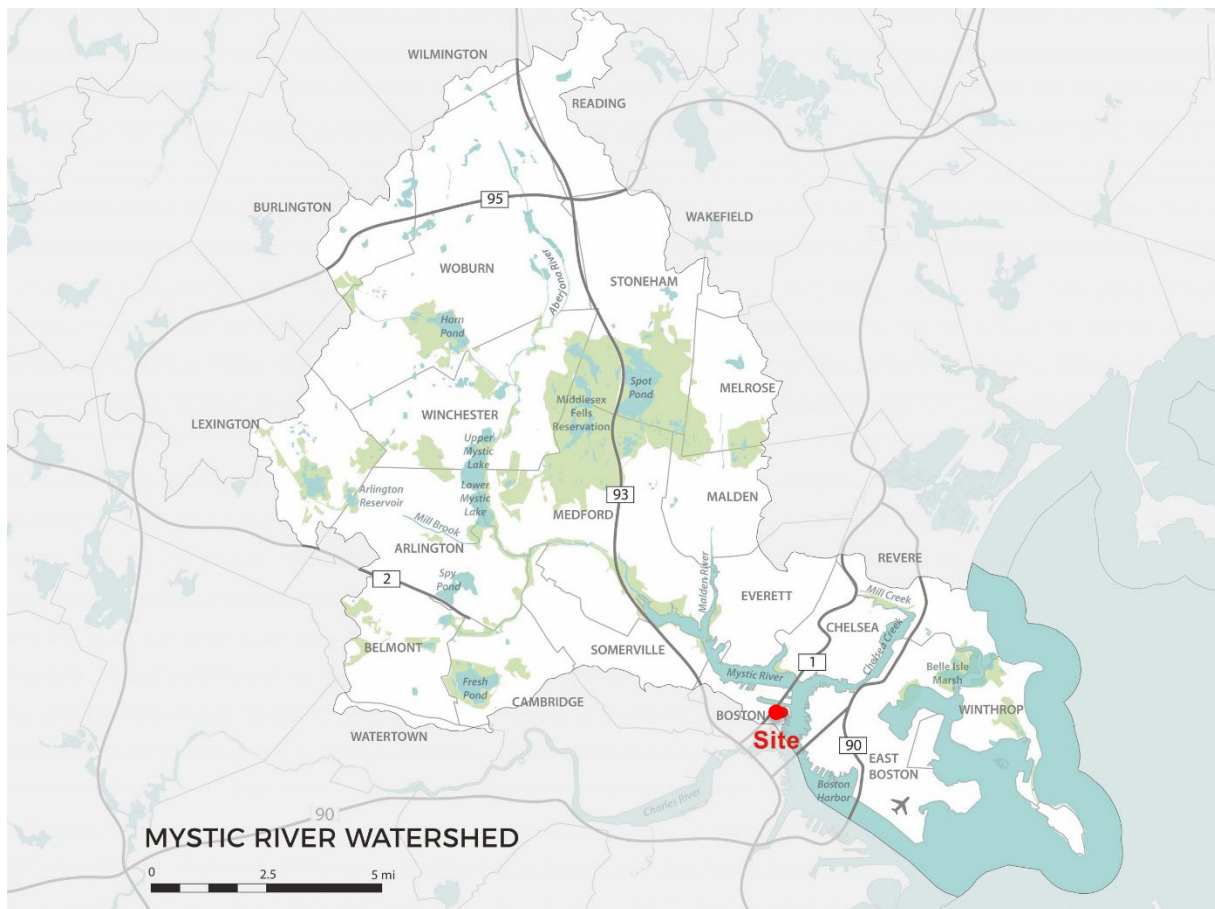
hunap.harvard.edu. n.d. "Acknowledgement of Land and People." Accessed August 1, 2023.  
<https://hunap.harvard.edu/land-acknowledgement>.

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## Context

### Context: Region

Spaulding Rehabilitation Hospital Boston is located at the confluence of the Mystic River and the Inner Harbor of Boston, Massachusetts. The Mystic River watershed encompasses 76 square miles or about 1% of Massachusetts' land area. Approximately 7 miles long, the Mystic River flows from the Lower Mystic Lake and travels through Arlington, Somerville, Medford, Everett, Chelsea, Charlestown, and East Boston before joining Boston Harbor (mysticriver.org n.d.), a 50-square-mile natural harbor and the estuary of Massachusetts Bay (nps.org. n.d.).

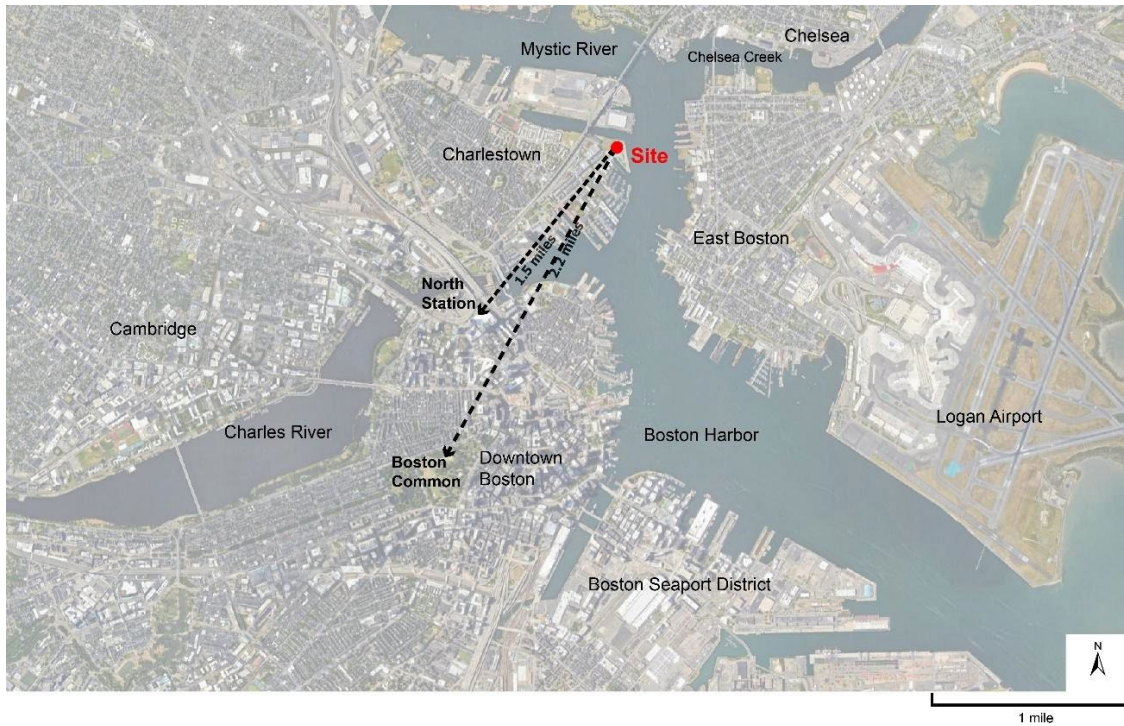


**Figure 1.1 Regional context in the Mystic River watershed**

Source: <https://mysticriver.org/maps>

### Context: City

Spaulding Rehabilitation Hospital Boston is located in the northeast of the city, about 1.5 miles from North Station and 2.2 miles from Boston Common.



**Figure 1.2. City context** Source: Google Maps

**Context: Neighborhood**

This 3-acre site is situated in Charlestown, the city’s oldest neighborhood. Located across the harbor and to the north of Boston’s North End, Charlestown is home to the Bunker Hill Monument and the historical Charlestown Navy Yard.

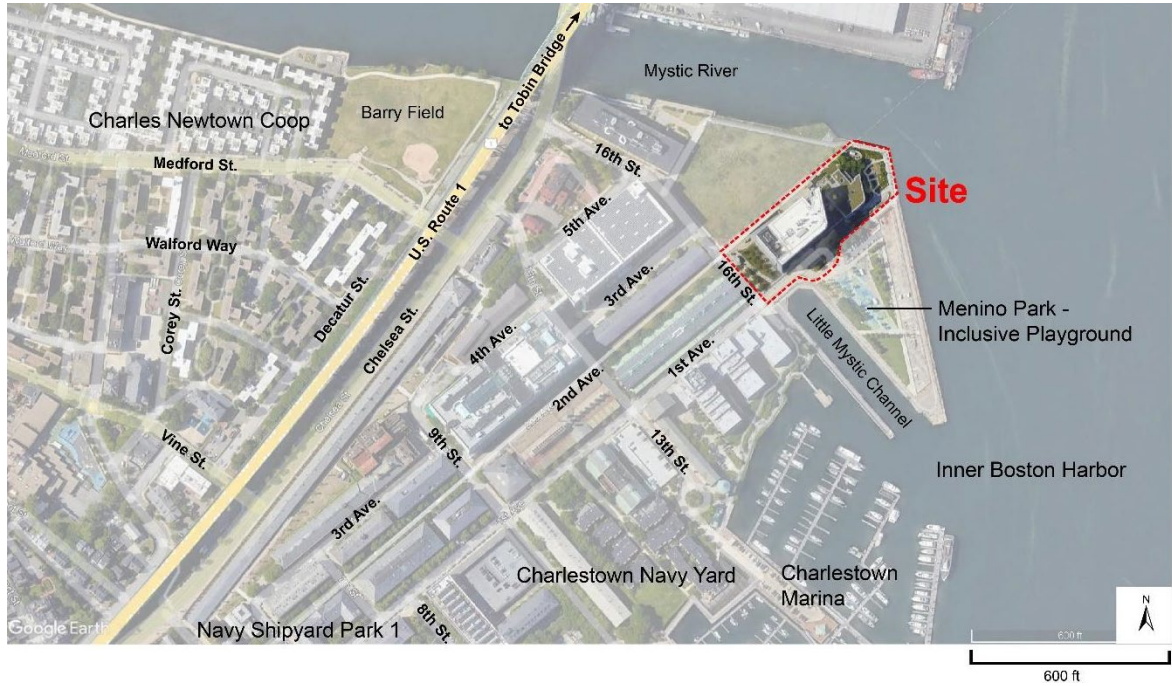


**Figure 1.3. Neighborhood context** Source: Google Maps

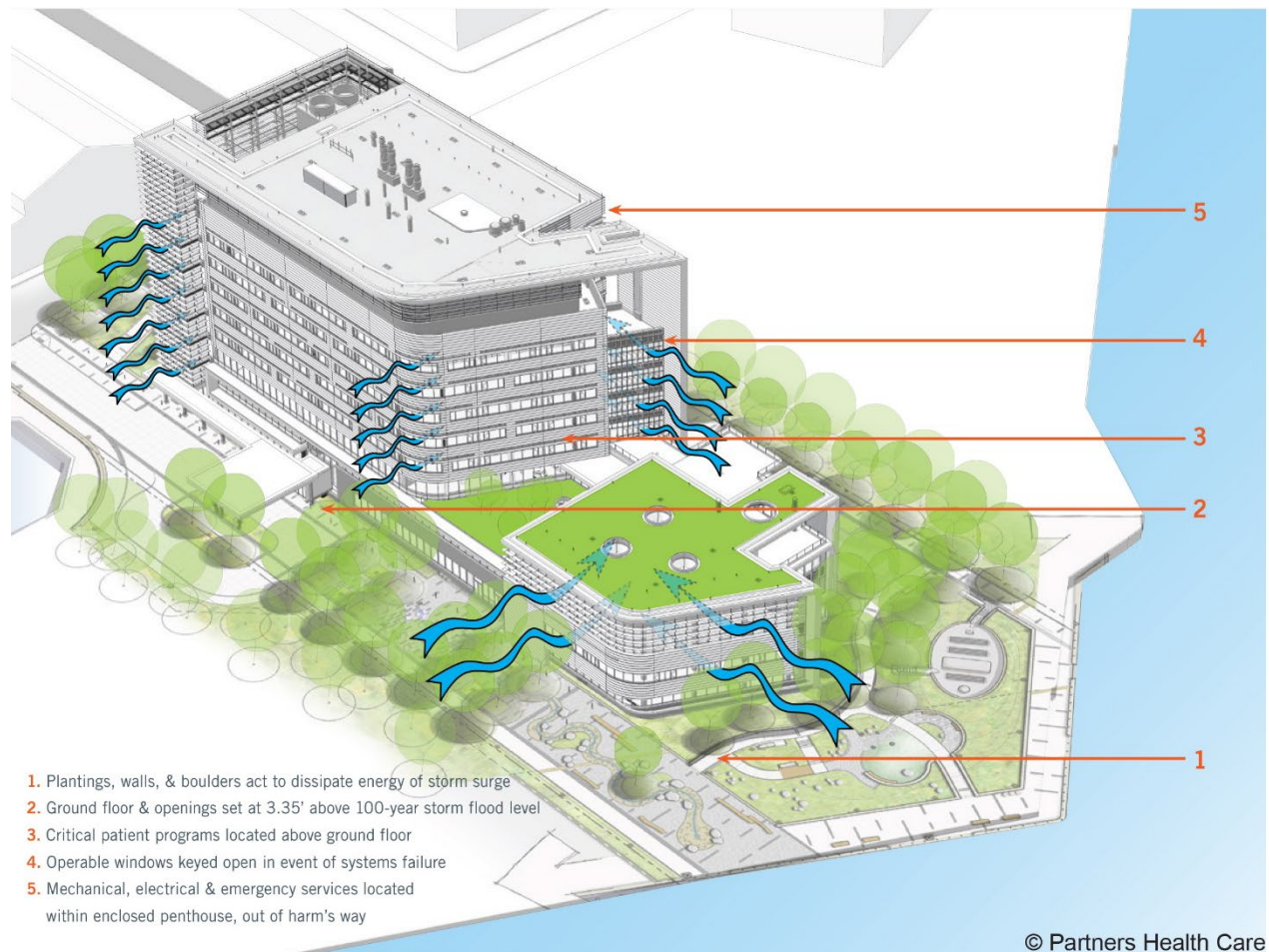


**Context: Street**

Located on the tip of the old Charlestown Navy Yard, the rehab hospital sits at the corner of 16th Street and First Ave. The Mayor Thomas M. Menino Park and Inclusive Playground is right next to the site. The surrounding land use is mixed with residential, commercial, and institutional buildings. Hundreds of families reside in nearby apartment complexes ranging from luxury condos to government-subsidized public housing.



**Figure 1.4: Street context** Source: Google Maps



**Figure 1.5: Site-scale resilience features** Source: Partners Health Care

**Sources and References:**

mysticriver.org. n.d. "Maps | Mystic River Watershed." Mystic River Watershed Association. Accessed July 29, 2023. <https://mysticriver.org/maps>.  
 nps.org. n.d. "Oceans - Boston Harbor Islands National Recreation Area (U.S. National Park Service)." Accessed July 8, 2023. <https://www.nps.gov/boha/learn/nature/oceans.htm>.

**Research Strategy**

The evaluation of Spaulding Rehab Hospital’s ground-level landscape performance adopted mixed methodologies to integrate qualitative and quantitative research methods to assess environmental, social, and economic benefits. Throughout the spring 2023 semester and the following summer months, the research team compiled a large collection of primary and secondary data to measure various benefits.

Our team conducted a total of 12 field trips to the project site. Primary data collected by the research team included 1) air/surface temperatures measured at 60 random spots across the site, as well as at 10 different spots in a comparable area adjacent to the site similar to the pre-



development conditions; 2) field observations of plant and wildlife species, as well as users behavior mapping at the ground-level outdoor gardens and open spaces; 3) responses from online and in-person post-occupancy evaluation surveys; and 4) recording of walk-along and photo-elicitation interviews with staff members, patients, and visitors.

Secondary data consisted of site plans and inventories of design elements, which were verified on site by the research team, as well as data shared by the design firm and the Spaulding Rehabilitation Network. Secondary data were also collected from reliable online sources, such as iNaturalist.org and websites of the City of Boston, Boston Planning & Development Agency (BPDA), Mystic River Watershed Association, and U.S. Green Building Council (USGBC), etc.



photos by J. Kozikowski

**Figure 1.6: Research Team conducting field measurements and walk-along interviews**

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## Environmental Benefits

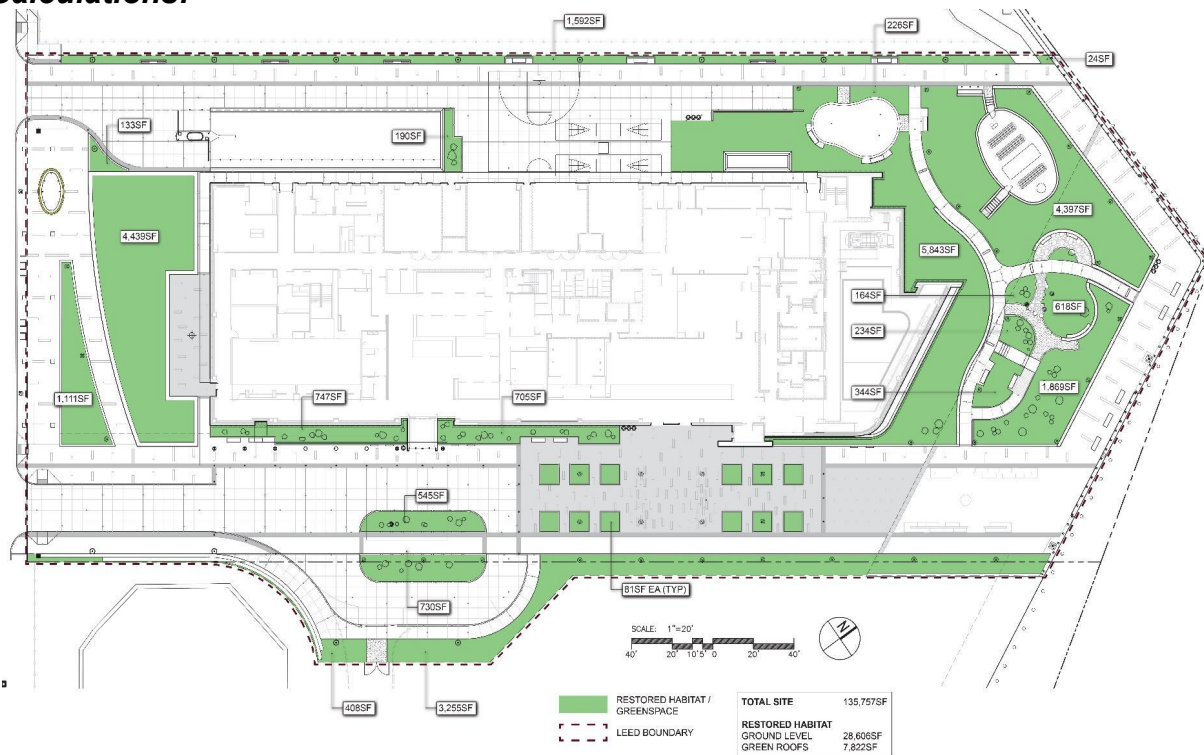
- ***Reduces peak runoff rate for a 100-year storm by an estimated 23% and reduces runoff volume by 98,915 gallons for a 100-year, 24-hour storm as compared to pre-development conditions.***

### ***Methods:***

Use historic satellite imagery of the site from 2002, and the implemented landscape plan provided by Copley Wolff Design Group (CWDG) to estimate the peak runoff rate for a 100-year storm (Time of Concentration  $T_c = 15$  min). AutoCAD was used to calculate the areas of each different surface cover. Modified Rational Method was adopted as it is a simplified model of the hydrologic process. It can be used to estimate the peak runoff rate for an area of less than 20 acres based on a design rainfall intensity.

The stormwater runoff volume comparison for pre- and post-development was calculated using the Natural Resources Conservation Service (NRCS) Method for a 100-year, 24-hour storm.

**Calculations:**



**Figure 2.1: Ground-Level Landscape Plan**  
 Source: CWDG (Environmental Plaza layout not included)

**Peak runoff rate reduction:**

**Modified Rational Method Formula:  $Q_p = CC_A i A$**

$Q_p$  = peak runoff rate, cubic feet per second (cfs)

C = runoff coefficient (unitless)

$C_A$  = antecedent precipitation factor (unitless)

i = rainfall intensity, inches per hour (iph), for storm duration = the time of concentration ( $T_c$ )

A = drainage area, acres (ac)

**Modified Rational Method assumptions:**

- The peak flow occurs when the entire watershed is contributing to the flow.
- The rainfall intensity is the same over the entire drainage area.
- The rainfall intensity is uniform over a time duration equal to the time of concentration

The pre- and post-development conditions were assessed. The post-development conditions are the result of the site design using LID techniques, which include rain gardens, street planters, perennial planting, and green roofs. The pre-development condition was 100% impervious concrete surface as part of the former shipyard.

• **Pre-Development Site Land Cover**

Shipyard surface material: concrete, 100% impervious

Runoff coefficient for concrete: C = 0.95

A = Total site area = 135,757 sf = 3.117 ac



- **Post-Development Site Land Cover**

Landcover	Area (sf)	Area (ac)	Runoff Coefficient C	Adjusted Area C*A
Lawn	618	0.014	0.1	0.001
Artificial Turf	840	0.019	1.0**	0.019
Rain gardens	2,891	0.066	0.05	0.003
Ground-level gardens	19,547	0.449	0.1	0.052
Garage-top gardens	5,550	0.127	0.3	0.038
Environmental plaza planting*	740	0.017	0.1	0.002
Environmental plaza stone paving*	1,110	0.025	0.7	0.018
Green roofs*	7,822	0.180	0.3	0.054
Regular roofs	32,655	0.750	0.95	0.713
Gravel path	273	0.006	0.3	0.002
Hardscape	65561	1.488	0.95	1.435
<b>Subtotal</b>	<b>135,757</b>	<b>3.117</b>		<b>2.284</b>

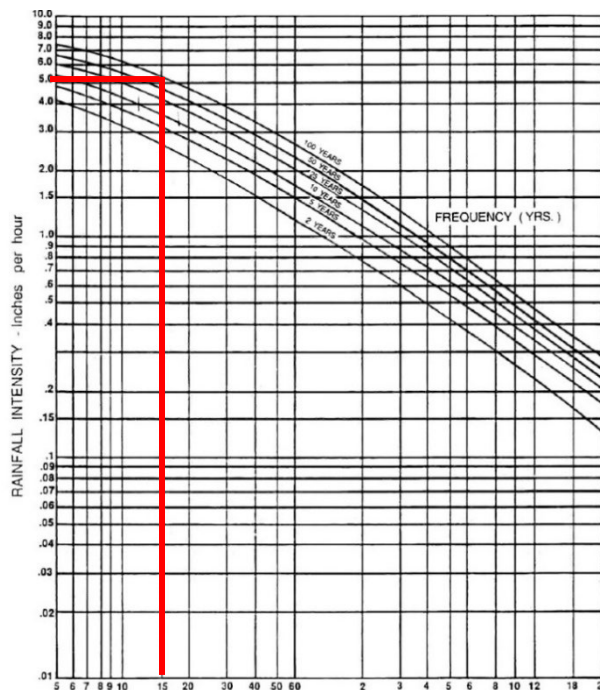
**Weighted Runoff Coefficient:**

$C_{weighted} = \text{Adjusted Area} / \text{Total Site Area} = 2.284 / 3.117 = 0.73$

Notes:

\* Large extensive green roof designed by CWDG; 3<sup>rd</sup> and 4<sup>th</sup>-floor rooftop gardens designed by Hoerr Schaudt; Environmental Plaza designed by Sterling McMurrin.

\*\*A runoff coefficient of 1.0 is commonly used in athletic field drainage system design. 100% of rainfall becomes discharge, collected by underground pipes.



**Figure 2.2: Rainfall intensity Chart for Boston, MA**  
Source: Mass. Highway Department 2006

## 100-year storm frequency

The rainfall intensity is 5.4 iph for a 100-year storm frequency from the Rainfall Intensity Chart for Boston, MA. We use 15 minutes for the time of concentration  $T_c$  based on the common practice noted in *Site Engineering for Landscape Architects* (Strom, Nathan, and Woland 2013): “Since it takes several minutes for rain to wet a surface thoroughly, many municipalities permit the use of minimum times of concentration, such as 10 or 15 minutes. This will reduce the intensity used for the computation of the runoff rate” (Strom, Nathan, and Woland 2013, 266).

Modified Rational Method formula was used with a recommended  $C_A$  antecedent precipitation factor = 1.25 for 100-year storm (Strom, Nathan, and Woland 2013, 218).

### Formula: $Q_p = C C_A i A$

$Q_{\text{pre-development}} = 0.95 \times 1.25 \times 5.4 \text{ iph} \times 3.117 \text{ ac} = 19.988 \text{ cfs}$

$Q_{\text{post-development}} = \text{Coverage} \times C_A \times i \times A = 0.73 \times 1.25 \times 5.4 \times 3.117 \text{ ac} = 15.359 \text{ cfs}$

Reduction rate:  $(19.988 - 15.359)/19.988 = 23.16\%$

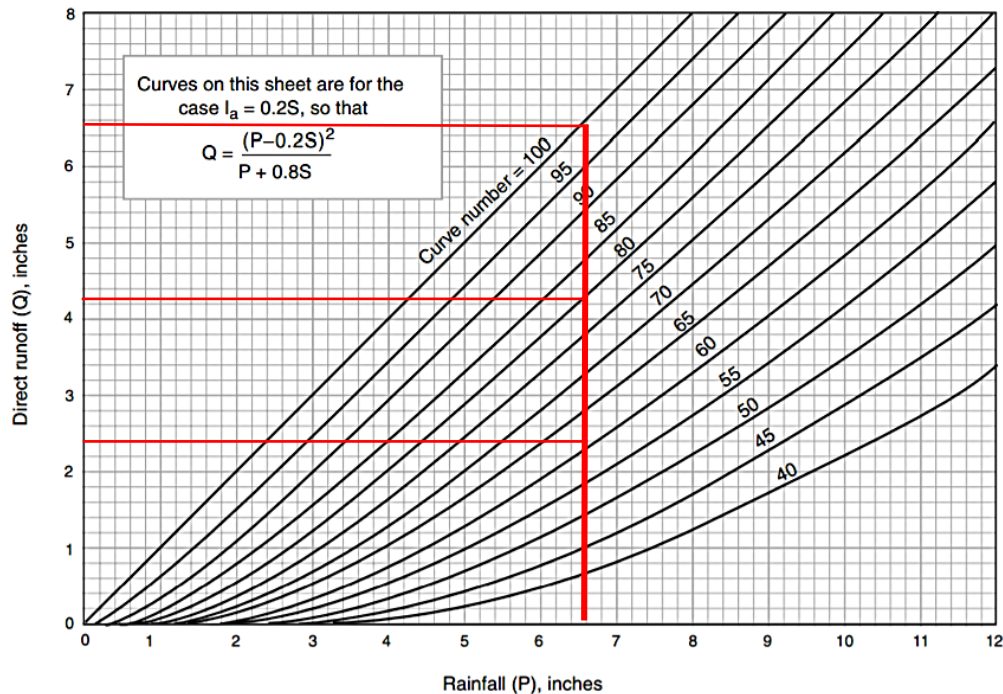
In Summary, 100-year design storm calculations show a 23.16% reduction in peak runoff rate comparing the pre- and post-development conditions.

## Reduction of runoff volumes for a 100-year, 24-hour storm

The NRCS method is used to determine the runoff volumes in a 100-year, 24-hour design storm event.

### A. Calculations of pre-development site runoff water in gallons:

The pre-project site was 100% impervious and covered with concrete (CN=98). Using the *WinTR-55* software developed by NRCS, when inputting the Rainfall Distribution Type (Type III for Massachusetts) and choosing Suffolk County where Boston is located, a table of storm data is shown. For the 100-year storm return period, the 24-hour rainfall amount is 6.6 inches.



**Figure 2.3: Relationship of CN to depth of runoff**  
 Source: 210-VI-TR-55; Strom, Nathan, Woland 2013, 228

Runoff from 6.6-in rainfall on surface with Runoff Curve Number (CN)=98 is 6.55-in (See Figure 2.2).

Pre-development Runoff Volume = 6.55in x 1 ft /12 in x 135,757 sf = 74,101 cf  
 74,101 cf x 7.48 gallons/cf = 554,275 gallons

**B. Calculation of post-development site stormwater runoff in gallons:**

Land Cover	Curved Number	Area (sf)	runoff generated (inch)
Impervious surfaces	98	97,206	6.55
Pervious surfaces	61	37,441	2.38
Environmental plaza rough stone paving	79	1,110	4.25

Post-development site (135,757 sf) is 71.60% impervious (97,206 sf).

Runoff Vol. = (6.55 in x 1 ft/ 12 in x 97,206 sf) + (2.38 in x 1 ft/12 in x 37,441 sf)  
 + (4.25 x 1 ft/12 in x 1,110) = 53,058+7,426 +393 = 60,877 cf

60,877 sf x 7.48 = 455,360 gallons

**Runoff volume reduction for a 100-year, 24-hour storm:**  
**554,275 – 455,360 = 98,915 gallons**



**Limitations:**

- Spaulding’s building structure and service areas occupy a large portion of the site, and all mechanicals are located on the roof or penthouse above the 8th floor in response to flooding risk. The amount of green open spaces to mitigate runoff is thus constrained.
- When doing stormwater runoff estimation, AutoCAD was used to trace and measure areas of various land covers based on the construction documents provided by the design firm and the client. Human errors were conceivable, limiting the accuracy of the calculations.

**Sources:**

Massachusetts Highway Department. 2006. “Chapter 8: Drainage and Erosion Control.” In *2006 Project Development and Design Guide*, 2006<sup>th</sup> edition, 8-1 to 8-144.

<https://www.mass.gov/lists/design-guides-and-manuals>.

Strom, Steven, Kurt Nathan, and Jake Woland. 2013. *Site Engineering for Landscape Architects*, 6<sup>th</sup> edition, 147–56. Hoboken, New Jersey: Wiley.

USDA. WinTR-55. <https://data.nal.usda.gov/dataset/small-watershed-hydrology-wintr-55>

- ***Provides habitat for at least 11 pollinator species, 9 bird species, and 1 canine species observed in the ground-level outdoor spaces and immediately adjacent areas.***

**Background:**

Spaulding Rehab Hospital is located in the lower Mystic River watershed, overlooking the Mystic River and Boston Harbor. People living along Boston's shoreline are frequently affected by the repercussions of climate change. Buildings, infrastructures, and open spaces are at risk due to rising sea levels, hotter days, and bigger storm events. Urban biodiversity supports ecosystem services and processes, many with direct benefits and value to human beings (Ahern 2013). Promoting biodiversity can help lessen the detrimental effects of climate change. Habitat conservation or restoration can help address climate change by removing carbon dioxide from the atmosphere (un.org n.d.). As part of the Charlestown Navy Yard, the former site of Spaulding Rehab Hospital was a brownfield with contaminated soil and insignificant biodiversity. There has been a significant increase in urban biodiversity since the project was built in 2013 with brownfield remediation and landscape design implementation.

**Methods:**

Three different methods were utilized to collect data on urban biodiversity.

**1. First-hand observations by the researchers**

We observed flora and fauna species and documented them with photographs using Sony ILCE-6000, Canon EOS 6D, Apple iPhone 13 Pro, iPhone 14 Pro, and Samsung phone cameras. Working with a digital camera is very convenient as all photos captured are recorded with the date and time, and some have geolocation information stored in the metadata of each file.

## 2. Second-hand observations from iNaturalist.org

One useful tool for studying biodiversity is [iNaturalist](https://www.inaturalist.org), a crowd-sourced and vetted community science project. The Mystic River Watershed Association created a community science project using *iNaturalist* called "[Mystic River Watershed Biodiversity](https://www.inaturalist.org/observations?nelat=42.3798252802915&nelng=-71.0477471697085&place_id=any&subview=map&swlat=42.3771273197085&swlng=-71.05044513029151)", a collection of "research grade" observations in the watershed with 4000+ flora and fauna species. Research grade observations have been verified by at least one other human observer. When zoomed in, observed species can be seen at the Spaulding Rehab site and in the surrounding areas. *iNaturalist* can also filter observations by defining a custom area around the site.

[https://www.inaturalist.org/observations?nelat=42.3798252802915&nelng=-71.0477471697085&place\\_id=any&subview=map&swlat=42.3771273197085&swlng=-71.05044513029151](https://www.inaturalist.org/observations?nelat=42.3798252802915&nelng=-71.0477471697085&place_id=any&subview=map&swlat=42.3771273197085&swlng=-71.05044513029151) Figure 3.1 shows total 27 observations with 22 plant and animal species identified by 19 observers within an approximate 600 x 900 ft area. Ten of them are in the immediately adjacent locations with date, location, common and Latin names provided.

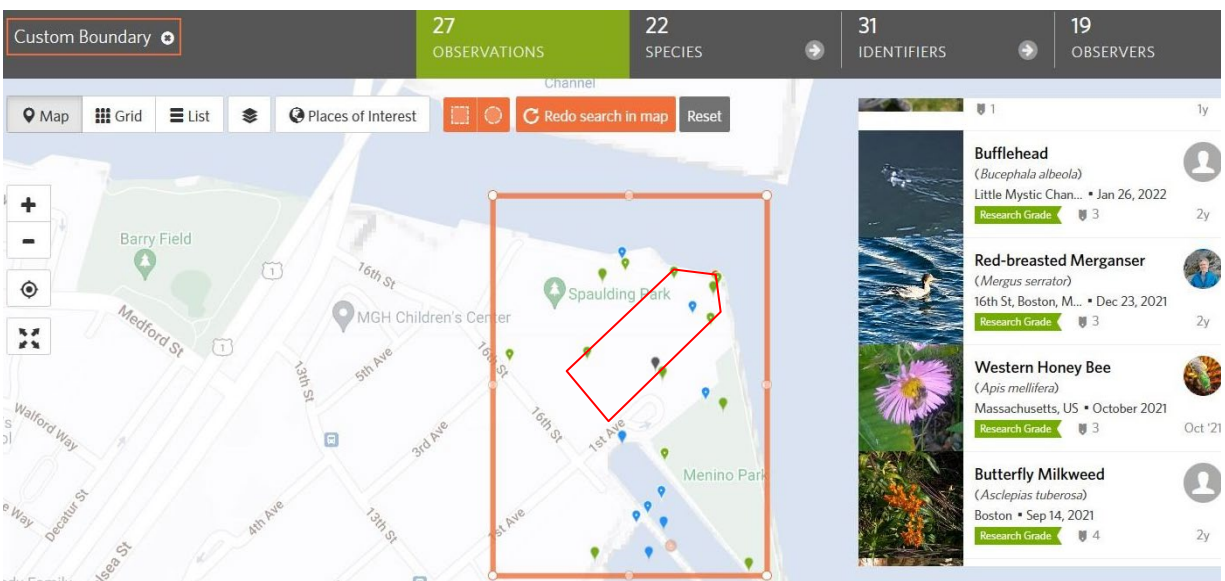


Figure 3.1: Filtered biodiversity observations Source: *iNaturalist*

## 3. Second-hand observations by the Spaulding staff

We also learned about wildlife species from Spaulding's staff members. Spaulding management team and Environmental Services staff informed us they had observed a variety of bird species, such as blue jays, American robins, sparrows, and seagulls. Other wildlife species observed by the staff include squirrels, chipmunks, rabbits, and a coyote.

**Calculations:**

**Pollinator species**



Red Admiral  
*Vanessa atalanta*  
photo by L. Chen



Small White Butterfly  
*Pieris rapae*  
photo by L. Chen



Monarch Butterfly  
*Danaus plexippus*  
photo by Ulysses M from iNaturalist



Common Darter  
*Sympetrum striolatum*  
photo by J. Kozikowski



Bumblebee  
*Bombus sp.*  
photo by J. Kozikowski



Miner Bee  
*Anthophora abrupta*  
photo by H. Tang



Honey Bee  
*Apis sp.*  
photo by H. Tang



Carpenter Bee  
*Xylocopa sp.*  
photo by J. Kozikowski



Flower Fly  
*Syrphus rectus*  
photo by H. Tang



Potter Wasp  
*Euodynerus sp*  
photo by H. Tang

**Bird species**



Herring Gull  
*Larus argentatus*  
photo by H. Tang



American Robin  
*Turdus migratorius*  
photo by H. Tang



American Robin chick  
*Turdus migratorius*  
photo by J. Kozikowski



Song Sparrow  
*Melospiza melodia*  
photo by H. Tang



Bufflehead  
*Bucephala albeola*  
photo by Rshoer from iNaturalist, observed on surrounding water 180' outside site boundary\*



Rock Pigeon  
*Columba livia*  
photo by J. Kozikowski



Black-capped chickadee  
*Poecile atricapillus*  
photo by J. Kozikowski



Northern Mockingbird\*  
*Mimus polyglottos*  
photo by vtabs from iNaturalist observed 20' outside site boundary\*



Red-breasted Merganser\*  
*Mergus serrator*  
photo by J. Myers from iNaturalist, observed on surrounding water 180' outside site boundary\*

**Rodent/Leporidae species**



Gray Squirrel  
*Sciurus carolinensis*  
photo by H. Tang



Eastern Cottontail Rabbit  
*Sylvilagus floridanus*  
photo by H. Tang

○ Native Species  
○ None-Native Species

**Figure 3.2: Selected wildlife species observed onsite or at immediately adjacent areas by the research team and iNaturalist observers**



Pollinator habitat is defined as an area with a diversity of flowering plants that provide food and nesting space for pollinators (Arathi, Davidson, and Mason 2018). Pollinator habitats were identified on-site through field observations. We used AutoCAD to draw closed polygons around each habitat in the site plan. The individual areas were calculated separately and then added together.

✚ **16<sup>th</sup> Street Plaza:**  $1,111 + 4,439 = 5,500$  sf

✚ **Therapy Trail & Garden:**  $3,580 + 4,397 + 60 + 618 + 1,869 + 344 + 234 + 164 = 11,266$  sf

✚ **Multi Sports Node:** 2154 sf

**Total pollinator habitat:**  $5,500 + 11,266 + 2154 = 18,920$  sf

### ***Limitations:***

- Our wildlife and plant inventories were limited due to the time constraints. Second-hand information came from the Spaulding staff and *iNaturalist*.
- We conducted our field observations in the month of July. However, diversity is maintained by seasonal variation in species abundance. Seasons are linked to some of the most noticeable temporal changes in species abundance (Shimadzu et al. 2013).
- The usefulness of the *iNaturalist* tool is limited by the number of observations people happen to submit from a given location. The absence of observations does not mean the absence of species.
- Some species may be considered invasive and/or displace native species, such as the cabbage white butterfly/small white butterfly.

### ***Sources and references:***

- Ahern, Jack. 2013. "Urban Landscape Sustainability and Resilience: The Promise and Challenges of Integrating Ecology with Urban Planning and Design." *Landscape Ecology* 28 (6): 1203–12. <https://doi.org/10.1007/s10980-012-9799-z>.
- Arathi, H.S., D. Davidson, and L. Mason. 2018. "Creating Pollinator Habitat - Factsheet 5.616." Extension. 2018. <https://extension.colostate.edu/topic-areas/insects/creating-pollinator-habitat-5-616/>.
- Shimadzu, Hideyasu, Maria Dornelas, Peter A Henderson, and Anne E Magurran. 2013. "Diversity Is Maintained by Seasonal Variation in Species Abundance." *BMC Biology* 11 (September): 98. <https://doi.org/10.1186/1741-7007-11-98>.
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- ***Reduces air temperatures by an average of 4.3°F and surface temperatures by 19°F as measured on two summer days, as compared to a nearby vacant lot resembling pre-development conditions.***

**Background:**

Spaulding Rehab Hospital Boston was awarded LEED BD+C: New Construction (v2.2) Sustainable Sites credits in the reduction of the heat island effect for both non-roof and roof (SSc7.1 and SSc7.2). The site's ground level consists of 60 mature trees (16 London Planes, 12 River birches, and 32 Honey Locusts), approx. 29,350-sf (21.6%) of green spaces and 65,100-sf (47.9%) hardscape including entry roads and service areas. Immediately adjacent to Spaulding is a 27,080-sf vacant area for adaptable sports storage with concrete pavement. Temperature measurements of this vacant lot were used as the best available proxy for understanding temperature reduction attributable to the former shipyard site with 100% concrete surface material.

**Methods:**

ThermoPro InfraRed Thermometers (model TP30) were used for temperature measurement. Since our study area is focused on the ground level, we did temperature measurements on the ground level only. We divided the site into 6 zones and measured 60 spots for surface and air temperatures around noon time to minimize the shadow impact from the building.

**✚ To measure surface temperature:**

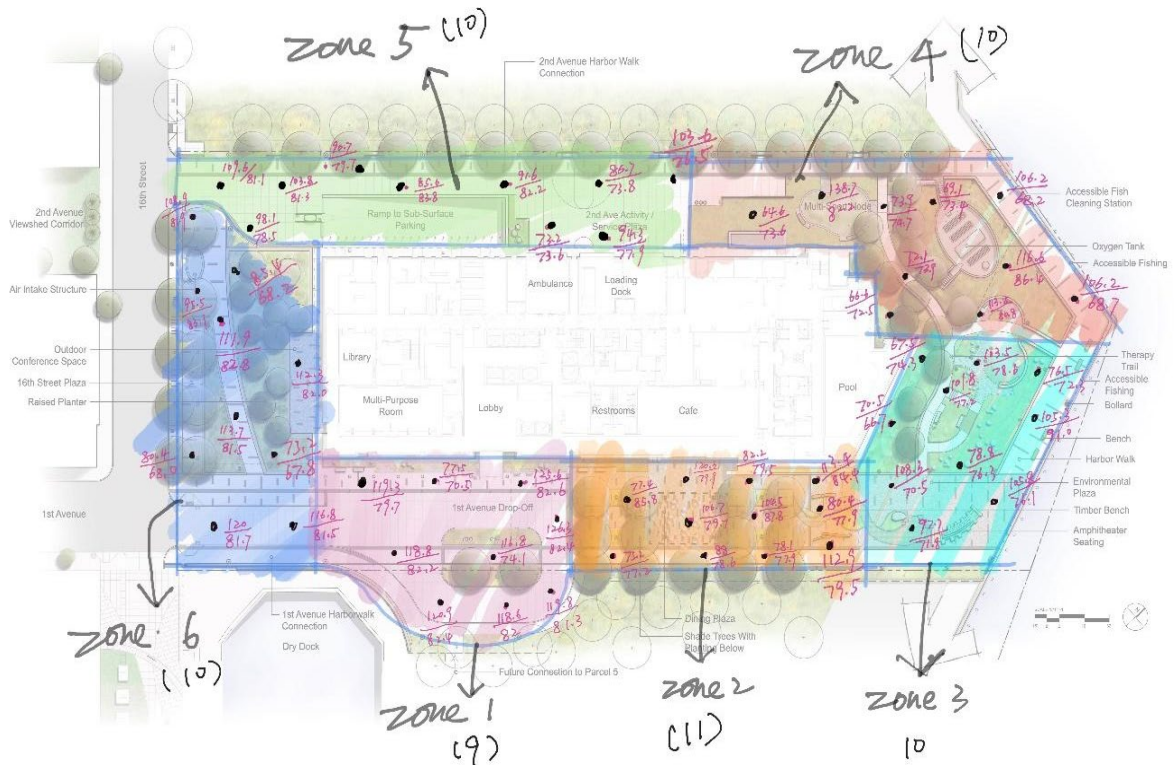
- In shaded areas: place the thermometer 8 in off the ground per the written instruction and at least 2 ft away from sun exposure, pointing the device directly to the surface;
- In sun areas: place the thermometer 8 in off the ground per the written instruction, pointing the device directly to the surface.

**✚ To measure air temperature:**

- In shaded areas: place the thermometer 3 ft off the ground and at least 2 ft away from sun exposure, holding the device parallel to the ground;
- In sun areas: place the thermometer 3 ft off the ground, holding the device parallel to the ground.

**Calculations:**

See figure 3.5.



**Figure 3.4: Temperature measuring zones and points marked on a site plan**

Measurements were taken at 60 different spots on-site in 6 zones on July 23 and July 31, 2023, at approximately noon. The measuring spots were located in both sunny and shady locations.



07/23/2023, Sun, 12:15-13:25, 83F° most cloudy, Air quality 36 Good, Wind 9.21 mp/h			07/31/2023, Mon, 12:08-13:27, 78F° most sunny, Air quality 29 Good, Wind 6.7 mp/h		
Zone	Surface Temperature	Air Temperature	Zone	Surface Temperature	Air Temperature
zone 1	119.3	79.7	zone 1	103.5	73.6
zone 1	118.8	82.2	zone 1	79.5	77.5
zone 1	120.9	82.4	zone 1	112.8	81.1
zone 1	118.6	82	zone 1	109.2	81.3
zone 1	119.8	81.3	zone 1	85.8	73.9
zone 1	116.8	74.1	zone 1	111.9	79.7
zone 1	126.3	82.4	zone 1	105.6	81.3
zone 1	125.6	82.6	zone 1	111	81.5
zone 1	77.5	70.5	zone 1	113.4	79.5
zone 2	77.4	85.8	zone 2	93.4	79.9
zone 2	75.2	77.2	zone 2	85.6	76.5
zone 2	120.6	79.9	zone 2	120.2	80.2
zone 2	106.7	79.7	zone 2	95.2	82.3
zone 2	88	78.6	zone 2	76.8	73.8
zone 2	82.2	79.5	zone 2	84.4	80.4
zone 2	104.5	87.8	zone 2	87.6	80.8
zone 2	78.1	77.9	zone 2	75.7	77.6
zone 2	113.4	84.4	zone 2	109.2	81.6
zone 2	77.9	80.4	zone 2	108.3	83.8
zone 2	112.9	79.5	zone 2	104.6	80.8
zone 3	97.7	71.8	zone 3	106	80.2
zone 3	108.3	70.5	zone 3	96.3	82.7
zone 3	70.5	66.7	zone 3	102.4	80
zone 3	67.5	74.3	zone 3	80.3	76.1
zone 3	101.8	77.2	zone 3	100.4	75.9
zone 3	103.5	78.6	zone 3	87.8	77.5
zone 3	76.5	72.3	zone 3	101.8	70.7
zone 3	105.3	91	zone 3	101.8	75.9
zone 3	78.8	76.3	zone 3	112.5	73.5
zone 3	105.8	76.1	zone 3	68.5	74.8
zone 4	64.6	73.6	zone 4	62.8	73.8
zone 4	138.7	82.2	zone 4	128.8	78.6
zone 4	73.9	74.7	zone 4	70.5	74.5
zone 4	69.1	73.4	zone 4	73.5	75.9
zone 4	106.2	68.2	zone 4	100.9	76.6
zone 4	72.1	73.9	zone 4	73.2	73
zone 4	116.6	86.4	zone 4	97.1	79.3
zone 4	113.5	80.8	zone 4	103.1	73
zone 4	106.2	68.7	zone 4	96.8	77.2
zone 4	66.6	72.5	zone 4	68.7	73.6
zone 5	109.6	81.1	zone 5	93.6	76.8
zone 5	103.8	81.3	zone 5	86.2	77.5
zone 5	90.7	79.7	zone 5	66.9	76.6
zone 5	85.6	83.8	zone 5	73	75
zone 5	91.6	82.2	zone 5	86.4	76.3
zone 5	86.7	73.8	zone 5	85.3	76.6
zone 5	103.6	76.5	zone 5	93.4	79.7
zone 5	94.3	77.9	zone 5	98.4	77.7
zone 5	73.2	73.6	zone 5	69.9	76.8
zone 5	98.1	78.5	zone 5	105.3	78.8
zone 6	108.9	81.9	zone 6	101.5	76.3
zone 6	85.4	68.2	zone 6	85.8	73.2
zone 6	95.5	83.1	zone 6	80.2	74.7
zone 6	111.9	82.8	zone 6	93.6	77.2
zone 6	112.3	82	zone 6	74.7	74.1
zone 6	113.7	81.5	zone 6	105.3	78.1
zone 6	80.4	68	zone 6	83.8	77.6
zone 6	75.2	67.8	zone 6	86.9	87.3
zone 6	120	81.7	zone 6	108	73.9
zone 6	116.8	81.5	zone 6	109	75.7
Average	98.01666667	78.06666667	Average	93.235	77.49666667
Area	Surface	Air	Area	Surface	Air
Off-site	117.9	83.8	Off-site	111.9	79
Off-site	117	82.8	Off-site	112.5	84.6
Off-site	115.3	82.4	Off-site	110.1	83.7
Off-site	115.7	85.9	Off-site	113	83.1
Off-site	116.1	85.2	Off-site	112.8	79.2
Off-site	116.4	82.8	Off-site	111.6	86.2
Off-site	116.8	81.7	Off-site	111	79
Off-site	118	82.5	Off-site	112.6	83.1
Off-site	117.3	82.6	Off-site	115.3	79.9
Off-site	116.2	82.2	Off-site	115.7	79.2
Average	116.67	83.19	Average	112.65	81.7
Site Average	98.02	78.07	Site Average	93.24	77.5
Differ	18.65	5.12	Differ	19.41	4.2
Differ Average	Surface/ F°	Air/ F°			
	19.03	4.66			

Figure 3.5: Field record of temperature measuring points sheets

**Sources:**

Temperature readings were conducted on-site by the research team.

**Limitations:**

- A large part of the site is the building, entry roads, and service areas. Landscape green spaces occupy approximately 22% of the ground level.
- The thermometer has a basic accuracy of +/- 2° F. Human error may occur when measuring surface and air temperatures. The wind conditions at the waterfront may also affect the accuracy of air temperature measurement.

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## Social Benefits

**Overall Methods:****✚ Field Observations**

Field observation is a type of field research method that involves collecting data by observing the behavior, actions, or interactions of people or animals in a natural setting. The researcher does not interfere with the subjects or manipulate any variables but simply records what they see and hear.



photo by H. Tang



photo by L. Chen

**Figure 4.1: Research Assistants Li Chen and Jason Kozikowski conducting field observations on-site**

**✚ Behavior Mapping**

Behavior mapping, also known as activity mapping, is a type of field observation method. In this process, the researcher observes who (a particular user type) is acting in a certain way (behavior), when (certain times of the year/month/day), and where (certain locations in space) (Sachs, 2017). Behavior mapping entails the research team observing users onsite and recording their behavior on a site map.

The research team performed behavior mapping across 6 site visits over 6 different days to estimate organic use of the site by staff, patients, and visitors.

## Surveys

Surveys are a common and simple research method. Surveys have the advantage of having a larger sample size and thus providing more statistical power (Jones, Baxter, and Khanduja 2013). Surveys were conducted with the same set of questions as interview questions (Appendix 1). To reach staff and patients, an online survey link was sent to the hospital admin team. The hospital distributed it internally and posted the survey link on social media. The research team conducted most in-person paper surveys on site during multiple field trips in July. The hospital's management team also assisted in the administration of paper surveys to the patients and staff.

To reach out to the local communities, we contacted Jason Ruggiero, the community engagement manager for Charlestown, East Boston, the North End and the West End at BPDA, Mystic River Watershed Association (MRWA), Navy Yard Garden and Art, Friends of the Charlestown Navy Yard, Friends of the Charlestown Elderly, and Charles Newtown Coop. We also attended the *Help Design your Harborwalk Open House* event in August at Charles Newtown Coop's waterfront, about 0.5 miles from Spaulding. Thanks to the help from the hospital and local organizations, the research team was able to collect and compile 190 survey responses. Among them 77 were online surveys and 113 were paper surveys.

<b>Participants</b>	<b>Online Surveys</b>	<b>Paper Surveys</b>
Staff	36	37
Patient	12	40
Visitor	24	27
Unidentified	5	9
<b>Subtotal</b>	<b>77</b>	<b>113</b>

## Interviews

Interviews can provide more in-depth, qualitative data than a survey can offer. The research team conducted a total of 30 interviews. 60% of the interviews were done with the “walk-along” method and 40% with the “photo elicitation” method to explore the usage of the ground-level garden spaces as well as users’ perceptions and attitudes. During walk-along interviews, participants answered questions as they walked along and experienced the outdoor spaces. When walk-along interviews were not possible, photo-elicitation methodology was employed. Participants answered questions as they viewed photos of the outdoor spaces. The interviews were performed with a list of semi-structured questions (Appendix 2) identical to the survey questions. Appendix 3 shows the photo boards used in the photo-elicitation interviews. Our interviewees included staff members, patients, and visitors. Most staff interviewees were recruited by the hospital management team based on their work schedule and availability. The research team also recruited and interviewed staff members randomly at the ground-level gardens, outdoor and indoor café areas. For local community members, we targeted residents living nearby within walking distance in Charlestown.



Participants	Walk-along Interviews	Photo Elicitation Interviews
Staff	16	0
Patient	0	9
Visitor	2	3
<b>Subtotal</b>	<b>18</b>	<b>12</b>



photo by L. Chen

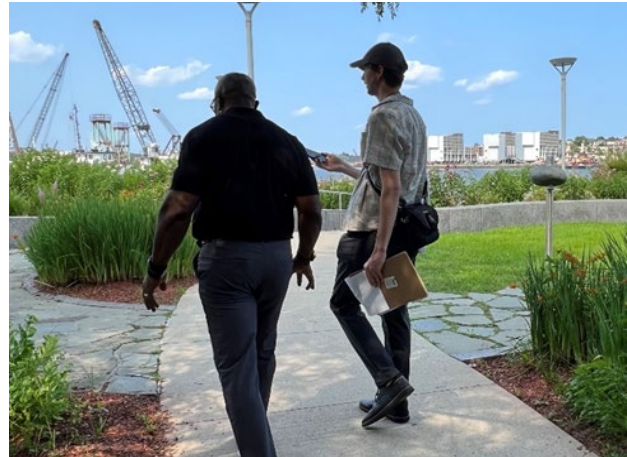


photo by H. Tang

**Figure 4.2:** Research Fellow Hongbing Tang conducting a photo-elicitation interview with a local resident (left). Research Assistant Jason Kozikowski conducting a walk-along interview with a staff member (right).

### **References:**

- Jones, TL, MAJ Baxter, and V Khanduja. 2013. "A Quick Guide to Survey Research." *Annals of The Royal College of Surgeons of England* 95 (1): 5–7.  
<https://doi.org/10.1308/003588413X13511609956372>.
- Kvale, Steinar. 2007. *Doing Interviews*. SAGE Publications, Ltd.  
<https://doi.org/10.4135/9781849208963>.

### **Limitations:**

- Field observations conducted in natural settings are not controlled by the researcher. The researcher might not be able to capture everything that is happening and there is the risk of losing information.
- Surveys can suffer from low response rates, which can affect the representativeness and generalizability of the results. On a voluntary basis, people may skip certain questions. Some answers may contain false or incomplete information. This can introduce bias and errors in data collection.
- Similarly, interviews can be biased, inaccurate, and incomplete. It is also time-consuming to conduct interviews and process data.

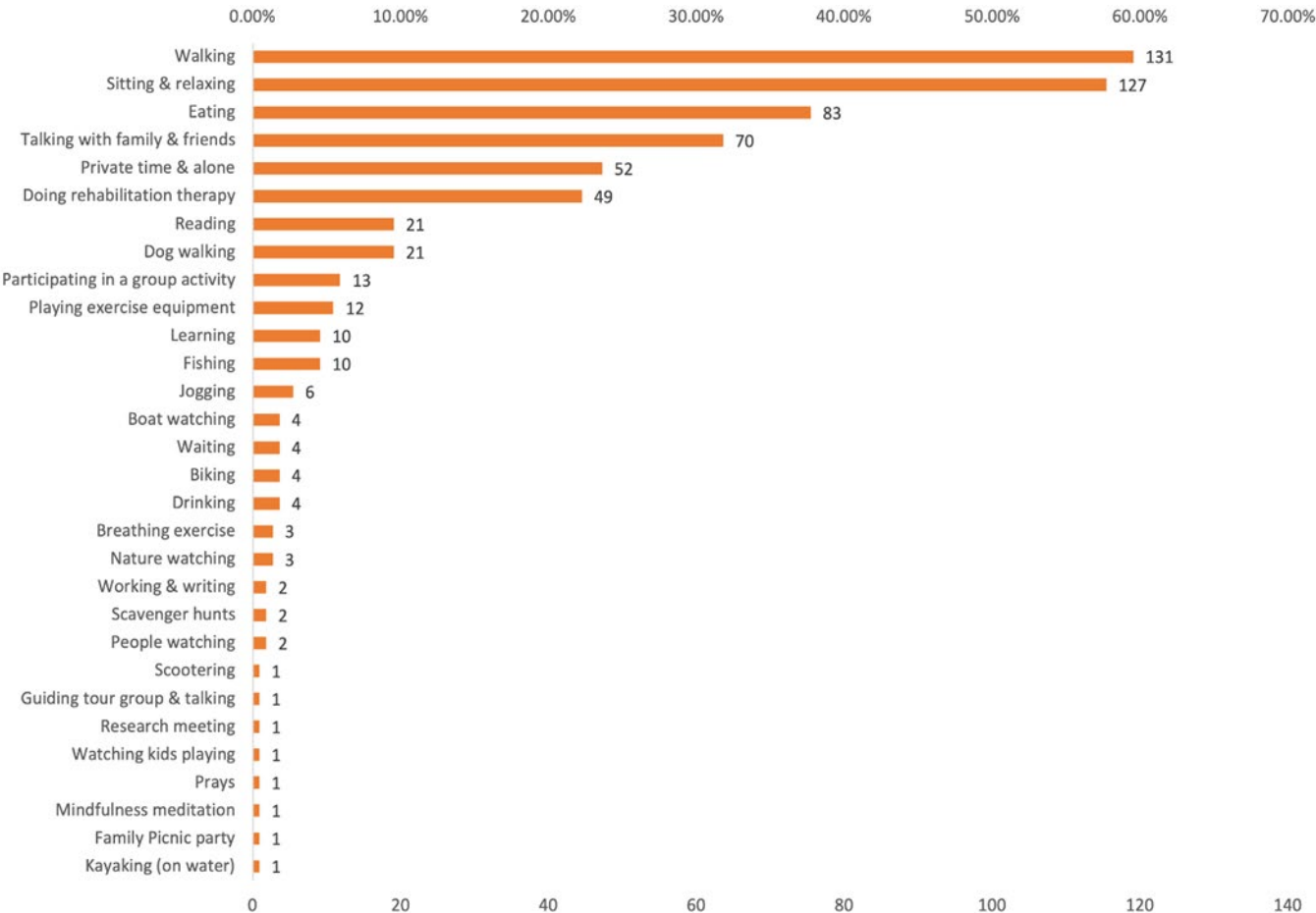


- **Provides a range of activity spaces, with 19 activity types observed on-site in the summer and 30 activity types reported by users through 190 surveys and 30 interviews. Most common activities include walking (60% of 220 surveyed and interviewed users), sitting and relaxing (58%), and eating outside (38%).**

**Calculations:**

**Activities learned from the interview and survey data**

The ground-level landscape areas provide space for a variety of activities - a total of 30 activity types reported by our survey and interview participants. The most significant activities include walking (60%), sitting and relaxing (58%). Additionally, 38% of individuals used outdoor spaces for eating, 31% engaged in outdoor conversations with family and friends, while 22% prefer private time of thinking and being alone. 21% of people use outdoor open spaces and gardens for rehabilitative exercises.



**Figure 4.3: Activity types and percentages compiled from surveys and interview results**

In summary, the ground-level outdoor areas provide a venue for healing and relaxation, improving physical and mental well-being while fostering social interactions and advancing general community health.

- **Behavior Mapping**

The researchers performed 6 behavior mapping activities at the therapy trail and garden on 5 weekdays and 1 Sunday in the morning, lunchtime, and afternoon. 19 different activity types were recorded. The trajectory of people's activities was manually documented on a site plan and 6 mapping diagrams were created (Figures 4.4 - 4.6). Each observation session lasted approximately 30 minutes and focused on identifying recurring activities as well as the direction of movement across the site. When possible, activities of staff, visitors, or patients were recorded by identifying factors such as staff badges, uniforms, patient attire, and wheelchair usage.

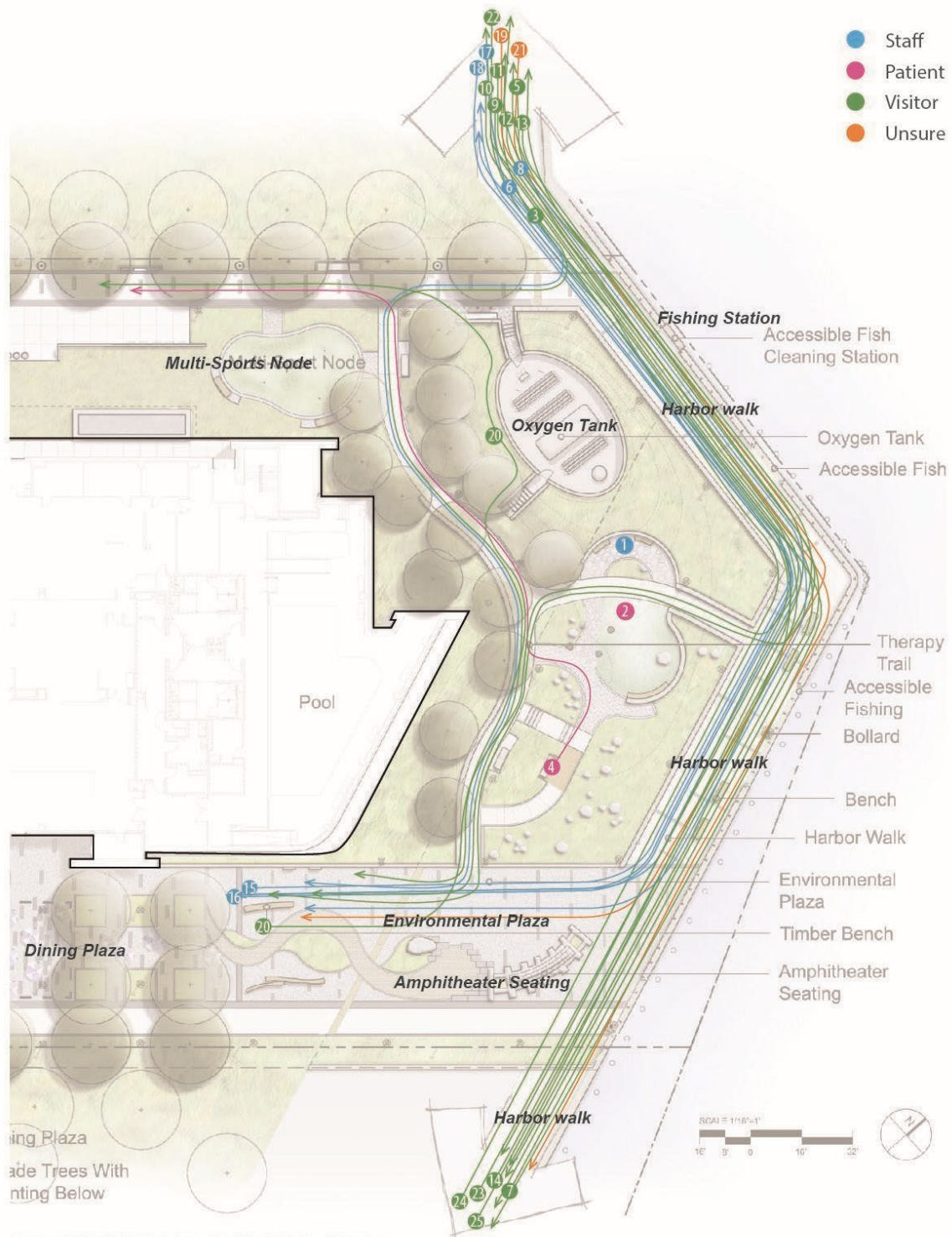
The diagrams below illustrate the activity trajectory patterns that occurred at the therapy trail and garden as well as near Harborwalk during the observation periods. Activities observed included walking, dog walking, jogging, baby strolling, wheelchair riding, exercising, sitting and relaxing, eating, reading, being alone thinking, taking pictures, talking with family and friends, engaging in rehabilitation therapy, making phone calls, taking a nap, resting (on a roller bed for patients), fishing, boat watching, and biking on the Harborwalk. The Harborwalk section had the highest foot traffic, largely from visitors taking solitary walks, jogging, dog walking, chatting or relaxing on the Harborwalk benches with family members. Following that, the therapy garden saw considerable activity, with staff guiding patients in rehabilitative exercises, engaging in conversations while sitting and relaxing, and even sunbathing. Many staff members also moved through the therapy garden during lunch break.

**Sources:**

Data came from the research team's field observations, survey and interviews.

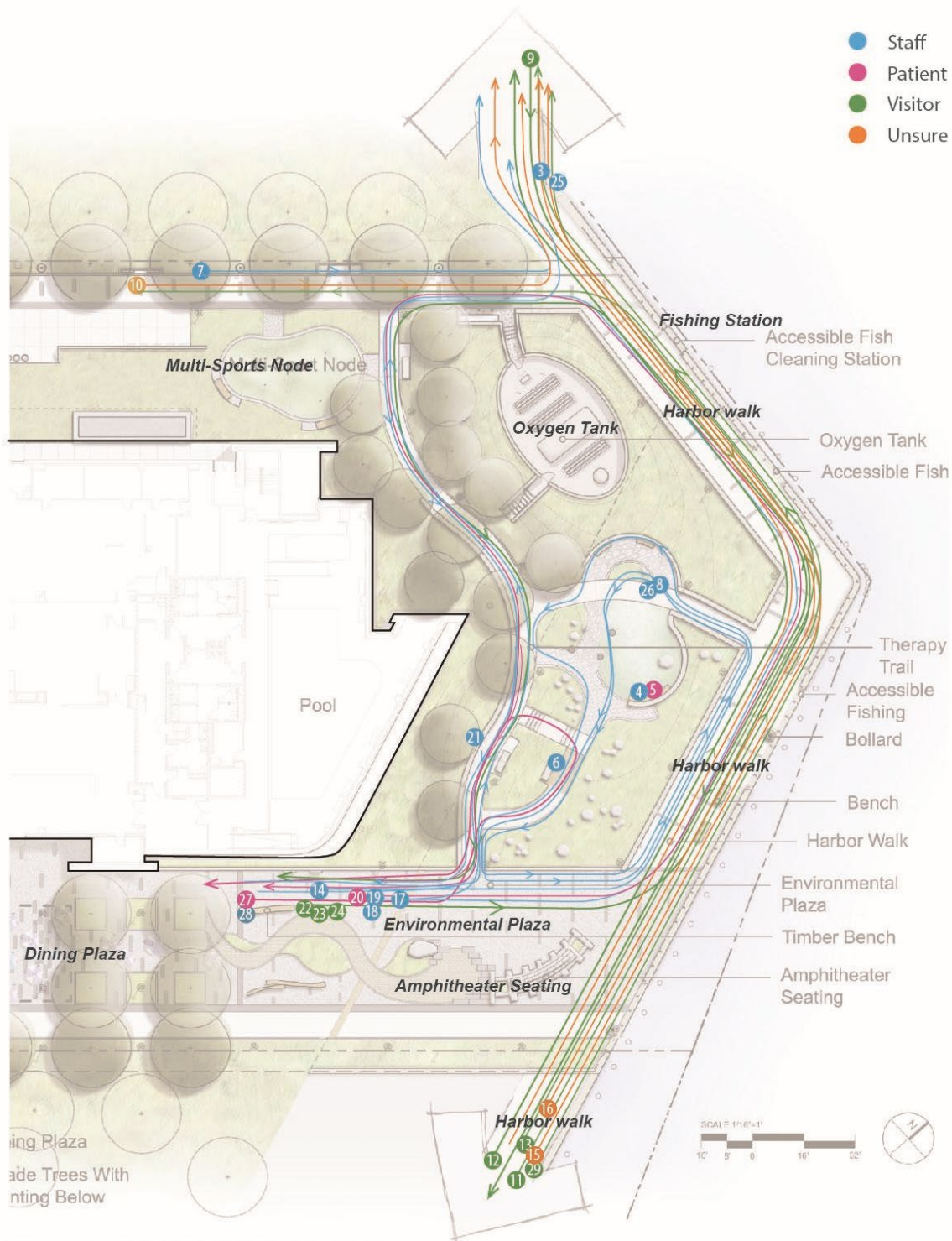
**Limitations:**

Our behavior mappings were carried out on non-rainy days in July. Weather influences people's outdoor activities. Different activities might have been recorded during other seasons and weather conditions.



Date: 07/11/2023, Tue, 13:50-14:20\_ 30min  
 Weather: Sunny High 84°F  
 Air Quality:68 (Moderate)  
 Total: 25 people

Figure 4.4: Behavior mapping diagram 1



Date: 07/13/2023, Thur, 11:15-11:45\_ 30min  
 Weather: Most cloudy High 85°F  
 Air Quality: 33 (Good)  
 Total: 29 people

Figure 4.5: Behavior mapping diagram 2



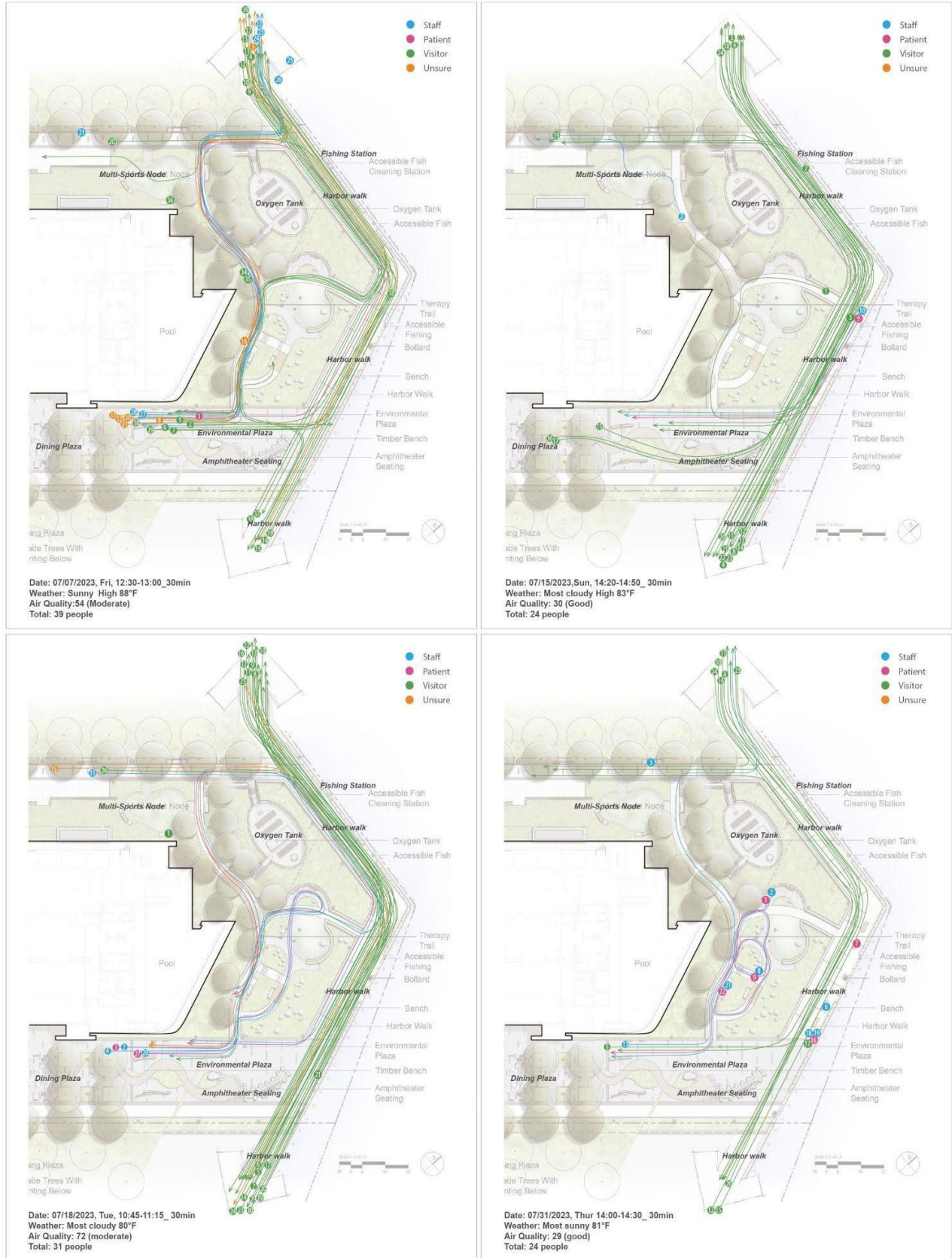


Figure 4.6: Behavior mapping diagrams 3-6

- **Positively impacts patients' rehabilitation experience according to 85% of 61 surveyed and interviewed patients.**

**Calculations:**

52 patients in total were surveyed and 9 were interviewed, including 36 inpatients and 25 outpatients. Spaulding Rehab Hospital Boston has 132 inpatients and 50,000 outpatient visits total annually. Our inpatient sample accounts for 27% of the entire inpatient population. Among the 61 patient participants, 12 of them responded to our online survey. Due to our limited access to patients, especially to inpatients, the hospital staff conducted 24 paper surveys with their patients on the research team's behalf. The research team conducted 16 paper surveys with random patients on-site. The hospital arranged 2 inpatients for interviews while the research team recruited 7 patients randomly, who were willing to participate. One of the outpatients we met and interviewed is over 100 years old!

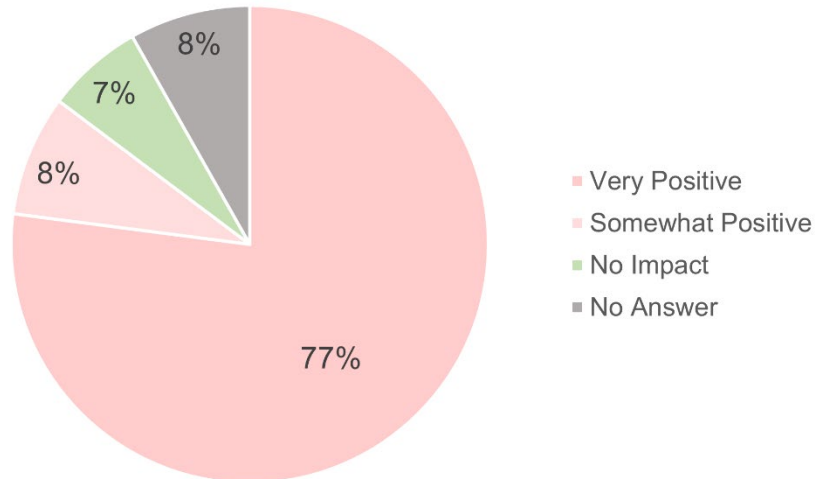
The patients were asked the following question:

*For patients: what is the impact of the facility's ground-level outdoor gardens and open spaces on your rehabilitation experience?*

- A. Very negative
- B. Somewhat negative
- C. No impact
- D. Somewhat positive
- E. Very positive

The following table and chart show the results. 77% of the total patients reported the impact was very positive while 8% said the impact was somewhat positive.

<b>Patient Responses</b>					
	<b>Very Positive</b>	<b>Somewhat Positive</b>	<b>No Impact</b>	<b>No Answer</b>	<b>Total</b>
Online Survey	5	2	3	2	12
Paper Survey	33	3	1	3	40
Interview	9	0	0	0	9
<b>Subtotal</b>	<b>47</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>61</b>
<b>Percentage</b>	<b>77%</b>	<b>8%</b>	<b>7%</b>	<b>8%</b>	<b>100%</b>



**Figure 4.7: Survey & interview results of the impact on patients' rehabilitation experience**

Patients expressed gratitude regarding the ground-level outdoor gardens and the positive impact on their rehabilitation experience and overall well-being.

"It's really healing, and I like seeing the transitions every time." – outpatient

"I like special activities much better every morning (in the therapy garden). It is like a therapy for the mind." - inpatient

"Very beautiful. We like it very much. The flowers and the plants are so mixed on purpose, making it nice with different varieties of flowers." - outpatient

"Just being outside and just my view is part of the therapy. It makes you feel good when you wake up and see something like this. It's not depressing. This is not a view that everybody gets, you know, and a lot of patients get. So this is, I mean, this is part of therapy. I feel like the aesthetics outside is part of the therapy." - inpatient

"I don't use the grounds for my appointment, but it is nice to start my appointments with just being in the garden for a little bit to mentally ground myself." – outpatient

"It's very important to have this outdoor space and to make it as usable as you can (for everyone). Wouldn't it be amazing if we make it so user-friendly that others could reimagine their spaces in the same way? Maybe finding community help so that we can make sure it stays clean and usable. Scouts might be interested." - inpatient

"Very positive. We'll come here for sure. We do aquatic therapy once a week. We don't use the garden but we like to come out to look around, to have lunch and relax." - outpatient

Most of the patients at Spaulding Rehab are on wheelchairs and could not conduct walk-along interviews. Photo elicitation interviews were conducted. Three interviewees shared photos of their favorite spots.



**Figure 4.8: Patients' favorite spot photos**

When viewing our photo boards during the photo-elicitation interviews, most patients expressed the Harborwalk as their top favorite place, followed by the Therapy Trail and Garden, and the Dining Plaza. The garage entrance area is an undesirable spot because there are too many cars passing by, which makes people want to stay away from it. The outdoor conference space is a least favorite spot to many because no one used that space.

Patients also commented on the outdoor environments that they found undesirable and offered suggestions for potential improvement:

“More resting areas and better access to aqua therapy (boating, kayaking, etc); more shrubs or barriers between benches for opportunities for patient privacy.” - outpatient

“Need to find a way to decrease the amount of wind. Also, the different types of pavement made it uncomfortable if in a wheelchair and dying to recover.” - inpatient

“Asphalt patch therapy garden so I can see what it's like in the real world.” - outpatient

“More accessible parking.” - outpatient

“Food vendor, ice cream, ice soda, hamburgers, hot dogs outdoor push cars. I know they have a café inside. It is nice to have food outside. People could come and tourists too.” - outpatient

“I did find that the landscaped areas were looking neglected this year and am happy to see that the hospital leadership commissioned a firm to clean out the overgrown areas. The diversity of the Therapy Garden was being threatened by overgrowth. I am also happy that the canopies on the Harborwalk were replaced.” - outpatient



### Sources:

Data came from the surveys and interviews.

### Limitations:

- According to the Spaulding management team, Spaulding Rehab Hospital Boston sees 4,000 to 5,000 outpatient visits on a monthly basis. Our outpatient sample is 25, which accounts for less than 1% of the active outpatient population.
- Most of the patients at Spaulding Rehab are on wheelchairs and could not conduct walk-along interviews. Photo-elicitation interviews were conducted but they were less engaging.

- 
- ***Positively impacts work performance and satisfaction with the work environment according to 90% of 89 surveyed and interviewed staff members.***

### Calculations:

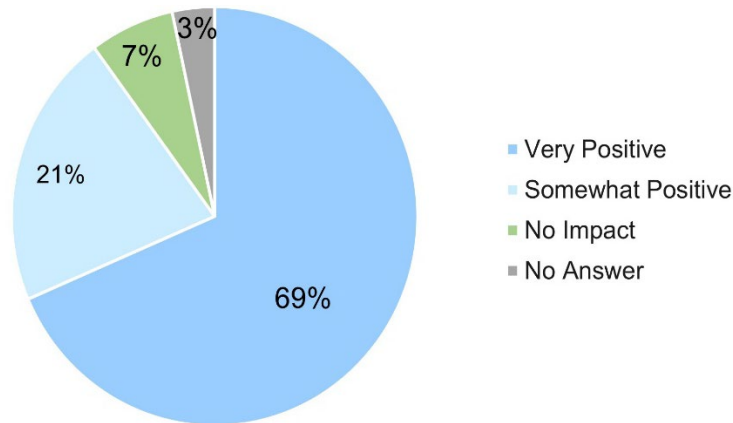
Spaulding Rehab Hospital has about 1,000 staff members. During the month of July, the research team surveyed 73 and interviewed 16 staff members, including doctors, nurses, therapists, social workers, researchers, interns, adaptive sports specialists, and management team members. This represents approximately 9% of the total staff working at Spaulding. The staff members were asked the following question:

*For staff: what is the impact of the ground-level outdoor gardens and open spaces on your work performance and satisfaction?*

- A. Very negative
- B. Somewhat negative
- C. No impact
- D. Somewhat positive
- E. Very positive

Out of the 89 staff participants, 69% reported the outdoor gardens and open spaces provided a very positive impact on their work performance and job satisfaction, while 21% reported the impact was somewhat positive, 7% said no impact, and 3% did not provide an answer.

	<b>Very Positive</b>	<b>Somewhat Positive</b>	<b>No Impact</b>	<b>No Answer</b>	<b>Total</b>
Online Survey	20	12	3	1	36
Paper Survey	28	6	2	1	37
Interview	13	1	1	1	16
<b>Subtotal</b>	<b>61</b>	<b>19</b>	<b>6</b>	<b>3</b>	<b>89</b>
<b>Percentage</b>	<b>69%</b>	<b>21%</b>	<b>7%</b>	<b>3%</b>	<b>100%</b>



**Figure 4.9: Survey & interview results of the impact on staff’s work performance & satisfaction**  
 All 16 staff interviews were walk-along. Participants were asked to show their favorite and least favorite spots and take photos on-site while walking with the researchers. Figure 4.11 is a photo collage of staff members’ favorite spots. Their top favorite areas include the waterfront therapy trail and garden, the Harborwalk, the environmental plaza with timber benches, and the outdoor dining area.



photos by H. Tang

**Figure 4.10: Walk-along interviews with staff members**

Positive attitudes toward the ground-level gardens and open spaces were primarily focused on the perceptions and reflections associated with the landscape design, which integrated natural light, views, native plants, and oceanfront settings in order to create a soothing rehabilitative and restorative environment. Staff remarks state:

“I love the landscaping. It’s very relaxing and nice.”

“Yeah, it’s amazing. It can help make your day brighter by being able to go outside. It also helps us with our jobs for getting our patients better to be able to go back to the community because there’s a lot of practice-simulated environments. The patients want to go outside because it is nice. So, I think it’s beneficial to the staff personally and it’s also beneficial to our patients.”

"If you look at other hospitals, they are just buildings. It is so ugly. Having this in the foreground changes the feeling. They did the best they could. You need that green space. I think it was a very good choice."

"It's extremely attractive. I love everything. It's natural. They look natural because nothing is kept like a French garden. I'm talking about colors, fragrances, shapes and sizes, everything (with) diversity."

"it just enhances what I can do with patients, and it's just pleasant for everyone."

"So many of the plants are native. They're drought tolerant and they work in this area. They can also give you ideas like something you could do at home... I prefer the more native look. I think it ties into the area better, more ecologically, consistent with the area too. So, you know, native butterflies have a place to pollinate and exist. I think that's kind of cool."

"I will say that being a supervisor, it is a huge component for my staff to have accessibility to that (outdoor gardens and open spaces) and the ability to come out and take a break, especially during COVID. Obviously, everything during COVID was stressful, but that was one of the biggest differences. Come out and just walk around or they eat their lunch - just have that little break from treating patients."

"Very satisfied. It is a helper. It gives you a sense of positivity. The kind of activities and events that happen bring people together. Some of us really do miss out on being out here as often as we should."

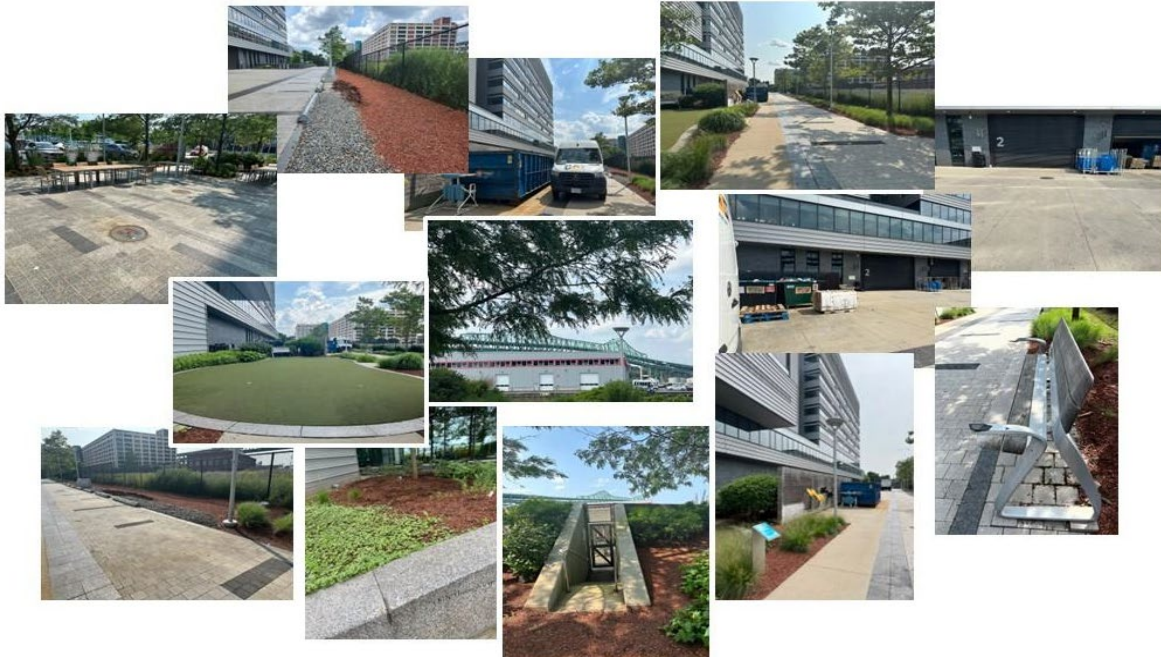
"Having this whole area so that you could sit, you could be with your colleagues, you could be friendly and see all especially in the spring and summer, when all the boats are active and just the life, I think it brings a lot. It just makes you feel very privileged to be able to have a spot like this that you can go through."



**Figure 4.11: Staff's favorite spots**  
photos taken and provided by the staff participants

Figure 4.12 shows some of the staff' least favorite spots. Feedback from staff was mainly focused on 6 areas that could have potential improvement: 1) the middle of the dining plaza with no shade; 2) the unattractive service area at the back side of the building; 3) the putting green, which is not in a great shape and seldom used; 4) the shady building corner outside the indoor pool; 5) unappealing views to the entrance of the oxygen tank; and 6) rusted site furniture as a result of the ocean climate and time.





**Figure 4.12: Staff's least favorite spots**  
 Source: Staff photos taken during the interview

The follow is a list of suggestions staff provided for potential landscape improvement:

- Provide shade and vegetation at the wide open area in the center of the dining plaza;
- Add some cover for outdoor use during rainy days;
- Maintain clear egress area next to the building. Currently it is blocked by tables and chairs, which is not compliant to code;
- Add a water fountain in the therapy garden for people's convenience in drinking water;
- Improve the putting green area with better maintenance and trees to block noise and undesirable views;
- Improve the exercise area at the backside of the building. Currently, there is a dumpster block in a part of the space;
- Provide truncated or cane travel ground guided to each area with braille description posts;
- Add more screen planting at the shady area outside the indoor pool;
- Extend the green space to the surrounding areas beyond fence with more flowers;

- More rich green and less wispy wild planting

### **Sources:**

Data came from the surveys and interviews.

### **Limitations:**

- Staff at Spaulding Rehab tend to have a busy work schedule. A lot of them are too busy to spend time enjoying the outdoor environment. Many people stay less than 10 minutes at a time in the ground-level gardens and open spaces.
  - Boston's winter at the waterfront is harsh with wind, snow, rain, and ice. The weather is very unpredictable, limiting the usage of outdoor spaces in winter.
- 

- ***Positively impacts the surrounding communities according to 98% of 45 surveyed and interviewed residents.***

Our research team surveyed and interviewed a total of 56 visitors during the summer months of 2023. There was a total of 45 local residents, 1 in-state visitor, 4 out-of-state visitors and 6 others from unknown locations.

To access the impact on the local communities, we targeted local residents living nearby within walking distance in Charlestown. We recruited interviewees from our professional network and with the help from the Mystic River Watershed Association. We also used the snowball sampling technique to get more survey and interview participants. Among the 5 visitors we interviewed, 3 were local residents. There were 23 local residents who participated in our online survey. We also conducted 19 paper surveys with local residents.

### **Calculations:**

The following question was asked in our surveys and interviews.

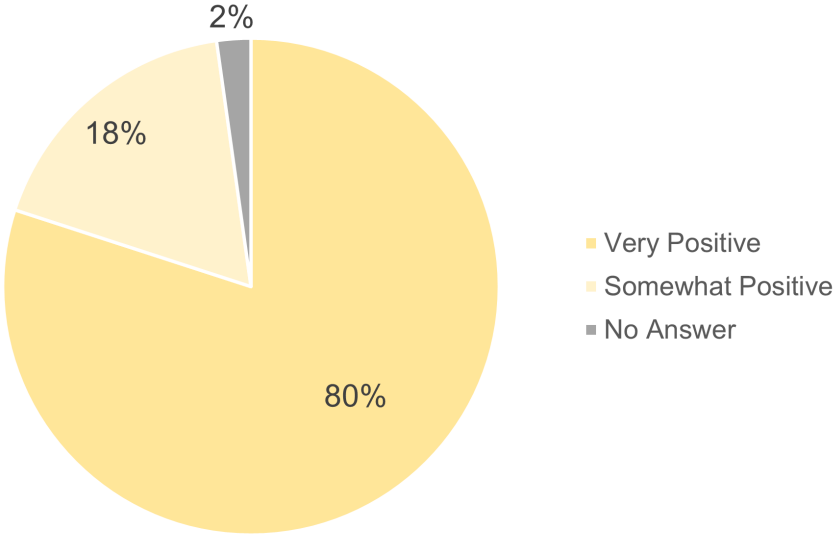
*For local residents: what is the impact of the ground-level outdoor gardens and open spaces on the surrounding communities?*

- A. Very negative
- B. Somewhat negative
- C. No impact
- D. Somewhat positive
- E. Very positive

The following table and chart show the results.

	<b>Very Positive</b>	<b>Somewhat Positive</b>	<b>No Answer</b>	<b>Total</b>
Online Survey	18	5	0	23
Paper Survey	15	3	1	19
Interview	3	0	0	3
<b>Subtotal</b>	<b>36</b>	<b>8</b>	<b>1</b>	<b>45</b>
<b>Percentage</b>	<b>80%</b>	<b>18%</b>	<b>2%</b>	<b>100%</b>

Out of the 45 local residents, 80% reported the outdoor gardens and open spaces provided a very positive impact on the surrounding communities, while 18% reported the impact was somewhat positive. 2% provided no answer.



**Figure 4.13: Survey & interview results of the impact on the local community**

The research team conducted walk-along interviews with 2 local residents. We met a senior citizen with a walking cane at the site randomly. He is a local resident and was willing to engage. We sat down and conducted a photo-elicitation interview with him.



**Figure 4.14: Local residents' favorite spot photos taken during interviews**

Figure 4.14 shows photos of local residents' favorite spots taken during the interviews. Our survey and interview data revealed that the local residents' No. 1 favorite area is the Harborwalk, followed by the Therapy Trail and Garden, Dining Plaza, Environmental Plaza, and the Amphitheater area. People also appreciated the exercise equipment at the backside of the building, 16th Street Plaza and the fishing station. Their least favorite spot was the service area at the backside of the building, which is "somewhat cluttered and untidy looking".

The following are some positive remarks from the local residents in the surveys and interviews regarding the landscape design and the impact on the surrounding communities.

"I visit the landscape in the Navy Yard both morning and evening. Everyday all year long. It humanizes me. I feel serene, peaceful, grounded, connected and introspective in the landscape. I feel that way for 1-2 hours...it is an essential part of my day."

"The impact is very positive. It's a big bonus for a one-square-mile, high-density population. Very small area. Spaulding came and opened this whole thing up. It's a big plus for the community. It's a wonderful thing. This area right in front of us is used by just everybody in Charlestown. They come here at six o'clock, seven o'clock in the evening. There will be dozens of people walking after dinner."

"Positive. It provides a good environment. If you are my friend from Canada or somewhere, I will invite you all here."



“I think (the impact) is high. People like to come here. They like to walk. The undeveloped space is really quite nice. I understand that’s probably future expansion, which is terrific. It gives you a sort of lightened area.”

“The landscaping - flowers, bushes, trees - is beautiful. I feel peaceful, educated, entertained, and gainfully distracted from the busy city and my work. I admire the little bronzes.”

“Great use of perennials, peaking at different times with varied height, color, and foliage.”

“Plant selection is very appropriate for the environment.”

“Proud. Pleased. Hopeful (that more places could be this nice.)”

“Almost always kept clean and attractive.”

“I think the grounds are great and good places if you need a break and time away.”

Local residents and non-local visitors also commented on the more undesirable areas and offered suggestions for potential improvement:

- Extend the landscape and connect it more to the surrounding neighborhood, a larger pedestrian system through the Navy Yard. Right now there is Spaulding and then there is the neighborhood. It would be great if the two could be stitched together;
- Regulate the playground area parking so it won’t block the hospital’s driveway and access. The playground park is a very popular place and many people in Charlestown bring their kids here. While this is positive, some people often drive over and park on the Spaulding side. This makes it difficult for patients and visitors to navigate out and results in inconvenient traffic and potential safety concerns;
- The tables and chairs are very convenient, but the chairs at the dining plaza have no back support (back area is hollow due to the furniture design). Suggest providing chairs with better back support so senior people can sit for a while without a sore back;
- Add umbrellas to outdoor tables and chairs;
- Suggest adding more exercise equipment like the yellow ones on the wall at the backside of the building. Some local residents really love them;
- The conference area is a lost opportunity to some degree. Not a place that anybody would ever come to use. It probably could be improved;
- The planting at the 16th Street plaza looks a bit overgrown, taking over the native grass. It feels it should be pruned for maintenance;

- Utilize the dry dock area for future rehabilitation needs;
- It is very nice to not have bees, wasps, and hornets.

**Sources:**

Data came from the surveys and interviews.

**Limitations:**

- Most of the participants in the local resident group were 50-64 years old or 65+. Only 9% of the participants were in the 18-29 age group, and 20% in the 30-49 age group. Younger visitors tend to be very active on site, like biking, walking, jogging, dog walking, or busy chatting with friends. It was difficult to interact with them.
- We contacted several local organizations in Charlestown after our project got IRB approval at the beginning of July. They responded slowly due to people's summer schedules.

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## Economic Benefits

- ***Created an estimated 64 jobs associated with ground-level landscape construction.***

**Methods:**

The Bureau of Economic Analysis's (BEA) Regional Industrial Multiplier System II (RIMS II) economic input-output model was used to estimate the number of jobs created by project construction, specifically site and landscape construction.

The quantity of jobs produced per million dollars of real final demand is known as the employment multiplier. Using Massachusetts as the final demand region, the BEA RIMS II multiplier for construction in 2013 was 13.6 for employment. This means that for every \$1 million increase in final demand for construction in Massachusetts, the total employment generated was 13.6 jobs.

Multipliers are based on regional data in 2013 provided by BEA.

**Calculations:**

The Spaulding Rehab Hospital's landscape construction cost: \$4.7 million (in 2013 USD).

Landscape Construction Job Estimation:

Total employment = construction cost as final demand × employment multiplier

$$= 4.7 \times 13.6 = 63.92 \approx 64$$

Therefore,

Total estimated number of jobs associated with the project construction = 64

**Sources:**

Construction cost info provided by CWDG.

The regional employment multiplier created by the Bureau of Economic Analysis (BEA)

<https://www.bea.gov/help/glossary/rims-ii-multipliers>

**Limitations:**

- The \$4.7 million landscape construction cost does not include the site interpretive element installation cost. The jobs associated with landscape construction only reflects CWDG's scope of work. Rooftop gardens designed by Hoerr Schaudt were under a separate contract.
- Since this is just a rough estimation using a simple economic model for general information, the level of accuracy is limited.

- 
- ***Created 4 year-round jobs and 8 seasonal jobs directly associated with the standard maintenance of the hospital's outdoor landscape and grounds.***

**Methods:**

Secondary information was obtained via email from the hospital admin team.

Spaulding Rehabilitation Network provided this information upon request by email on June 28, 2023. According to the information we obtained, standard maintenance is performed by 4 external landscapers, and seasonal maintenance by up to 8 external landscapers.

**Limitations:**

- The maintenance jobs generated by the landscape design include both ground-level and rooftop gardens, designed by CWDG and other designers.
- We have no data for the workers' operation hours and the landscape work contract value. Thus, the economic benefit is difficult to quantify.

## Appendix 1

### ***Survey Questions on Spaulding Rehab Hospital's Ground-Level Outdoor Gardens and Open Spaces***

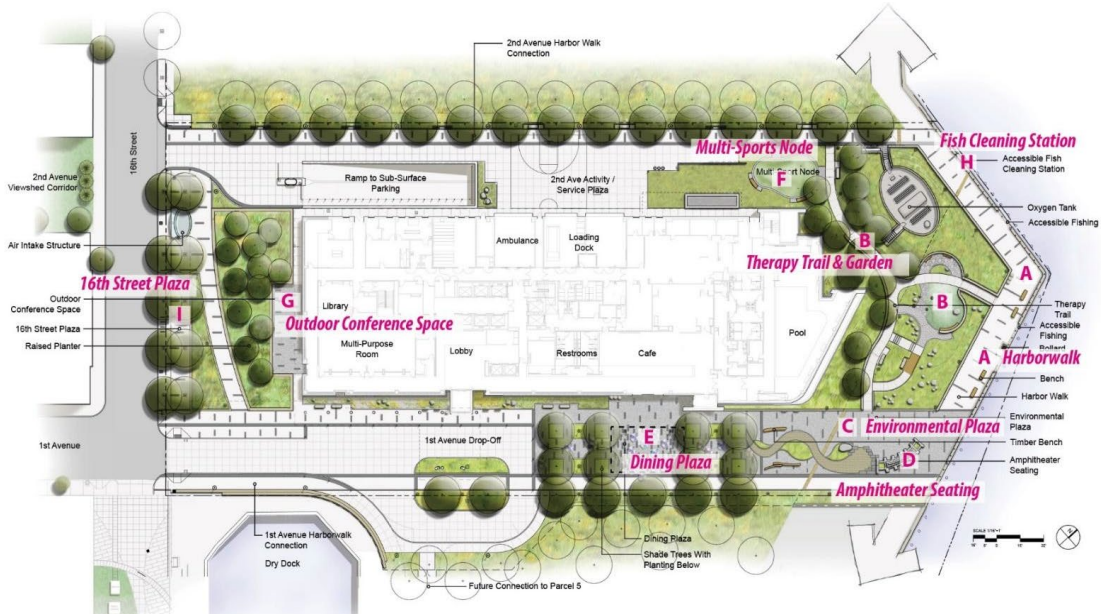
#### **Part 1: Questions on the Usage of Spaulding Rehab Hospital Boston's Ground-Level Outdoor Gardens and Open Spaces**

- 1. How often do you use (not just simply pass through) the facility's ground-level outdoor gardens and open spaces?**
  - A. Less than once per week
  - B. Once per week
  - C. Several times per week
  - D. Daily
  - E. More than once daily
  
- 2. When you use (not just simply pass through) the ground-level outdoor gardens and open spaces, how long do you usually stay?**
  - A. Less than 10 minutes
  - B. 10-19 minutes
  - C. 20-29 minutes
  - D. 30-59 minutes
  - E. 1 hour +
  
- 3. How do you use (not just simply pass through) the facility's ground-level outdoor gardens and open spaces? Mark all that apply.**
  - A. Walking
  - B. Jogging
  - C. Dog walking
  - D. Fishing
  - E. Sitting and relaxing
  - F. Doing rehabilitation therapy (physical therapy, cognitive-behavior therapy, etc.)
  - G. Eating
  - H. Talking with family and friends
  - I. Reading
  - J. Learning (from interpretive signage, etc.)
  - K. Participating in a group activity
  - L. Playing with on-site exercise equipment
  - M. Private time for thinking and being alone
  - N. Other \_\_\_\_\_
  
- 4. What are the feelings or emotional status when and after you use the facility's outdoor gardens and open spaces? Try to use 3-5 adjectives to describe the feelings.**

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- 5. What is your favorite spot(s) of the facility's ground-level outdoor gardens and open spaces? Mark all that apply.**
  - A. Harborwalk
  - B. Therapy Trail and Garden
  - C. Environmental Plaza



- D. Amphitheater Seating
- E. Dining Plaza
- F. Multi-Sports Node
- G. Outdoor Conference Space
- H. Fishing Station
- I. 16<sup>th</sup> Street Plaza
- J. Other \_\_\_\_\_



6. What is your LEAST favorite spot(s) of ground-level outdoor gardens and open spaces and why?

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7. How accessible do you find the facility's ground-level outdoor gardens and open spaces?
  - A. Poor
  - B. Fair
  - C. Satisfactory
  - D. Good
  - E. Excellent
8. What do you think of the aesthetic value of the facility's outdoor gardens and open spaces?
  - A. Extremely low
  - B. Low
  - C. Average
  - D. High
  - E. Extremely high
- 9a. For patients: what is the impact of the facility's ground-level outdoor gardens and open spaces on your rehabilitation experience?
  - F. Very negative
  - G. Somewhat negative
  - H. No impact
  - I. Somewhat positive

J. Very positive

**9b. For staff: what is the impact of the ground-level outdoor gardens and open spaces on your work performance and satisfaction?**

- A. Very negative
- B. Somewhat negative
- C. No impact
- D. Somewhat positive
- E. Very positive

**9c. For local residents: what is the impact of the ground-level outdoor gardens and open spaces on the surrounding communities?**

- A. Very negative
- B. Somewhat negative
- C. No impact
- D. Somewhat positive
- E. Very positive

**10. Any comments/suggestions on the landscape design and/or maintenance of the facility's ground-level outdoor gardens and open spaces?**

**Part 2: Demographic Information**

**1. Which age group do you belong to?**

- A. 18-29 years old
- B. 30-49 years old
- C. 50-64 years old
- D. 65 years old and above

**2. What is your gender?**

\_\_\_\_\_

**3. What is your role associated with Spaulding Rehab Hospital Boston?**

- A. Inpatient
- B. Outpatient
- C. Local resident (visitor living in Boston)
- D. In-state visitor (visitor living anywhere outside Boston but within Massachusetts)
- E. Out-of-state visitor
- F. Hospital Staff
- G. Other \_\_\_\_\_

**4. If you are a staff member, what is your professional background?**

- A. Doctor
- B. Nurse
- C. Therapist
- D. Social worker
- E. Administrator/manager
- F. Ground keeper
- G. Other \_\_\_\_\_

**5. If you are a staff member, how many years have you worked in this health facility?**

\_\_\_\_\_

## Appendix 2

### *Interview Questions on Spaulding Rehab Hospital's Ground-Level Outdoor Spaces and Landscape*

#### **Part 1: Questions on the Usage of Spaulding Rehab Hospital Boston's Ground-Level Outdoor Gardens and Open Spaces**

The interview is intended to be “walk along” on-site if possible. The researchers will walk along with the participants to conduct a semi-structured interview with open-ended questions. A site map will be provided to each participant.

**1. How often do you use (not just simply pass through) the facility's ground-level outdoor gardens and open spaces?**

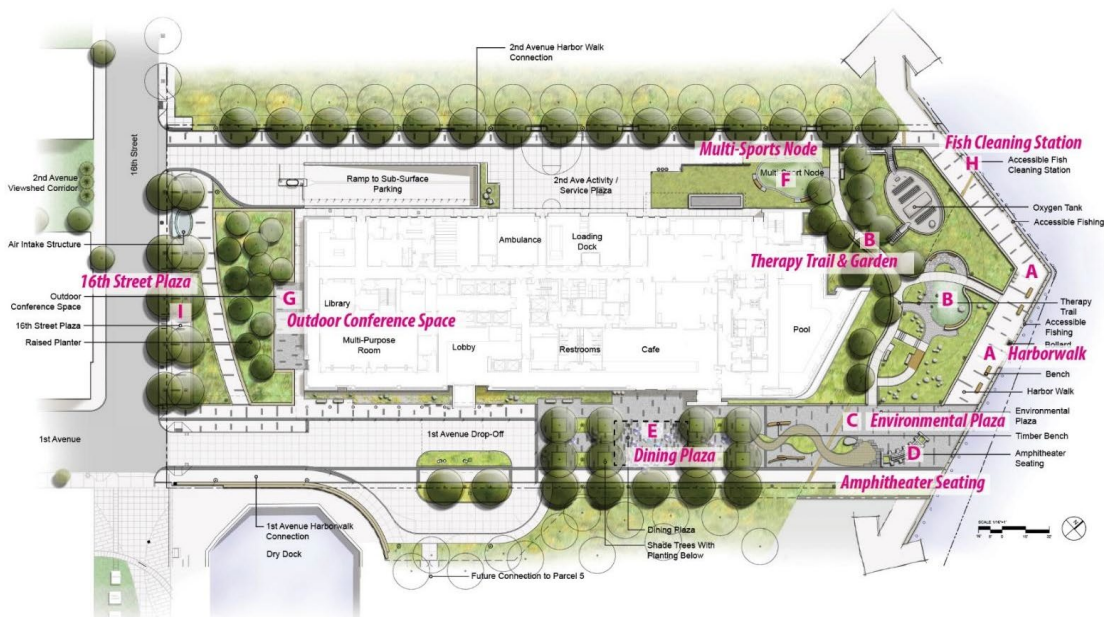
**2. When you use (not just simply pass through) the ground-level outdoor gardens and open spaces, how long do you usually stay?**

**3. How do you use (not just simply pass through) the facility's ground-level outdoor gardens and open spaces?**

**4. What are the feelings or emotional status when and after you use the facility's outdoor gardens and open spaces? Try to use 3-5 adjectives to describe the feelings.**

**5. What is your favorite spot(s) of ground-level outdoor gardens and open spaces? Please provide a photo(s).**

**6. What is your LEAST favorite spot(s) of ground-level outdoor gardens and open spaces and why? Please provide a photo(s).**



**7. How accessible do you find the facility's outdoor gardens and open spaces?**

**8. What do you think of the aesthetic value of the facility's outdoor gardens and open spaces?**

**9a. For patients: what is the impact of the facility's ground-level outdoor gardens and open spaces on your rehabilitation experience?**

**9b. For staff: what is the impact of the facility's ground-level outdoor gardens and open spaces on your work performance and satisfaction?**

**9c. For local residents: what is the impact of the facility's ground-level outdoor gardens and open spaces on the surrounding communities?**

**10. Any comments/suggestions on the landscape design and/or maintenance of the facility's ground-level outdoor gardens and open spaces?**

**11. Are there any people you think we should talk to about the facility's ground-level outdoor gardens and open spaces?**

## **Part 2: Demographic Information**

**1. Which age group do you belong to?**

- 18-29 years old
- 30-49 years old
- 50-64 years old
- 65 years old and above

**2. What is your gender?**

**3. What is your role associated with Spaulding Rehab Hospital Boston?**

- Inpatient
- Outpatient
- Local resident (non-patient resident living within Boston)
- In-state visitor (visitor from anywhere outside Boston but within Massachusetts)
- Out of state visitor
- Hospital Staff
- Other

**4. If you are a staff member, what is your professional background?**

**5. If you are a staff member, how many years have you worked in this health facility?**

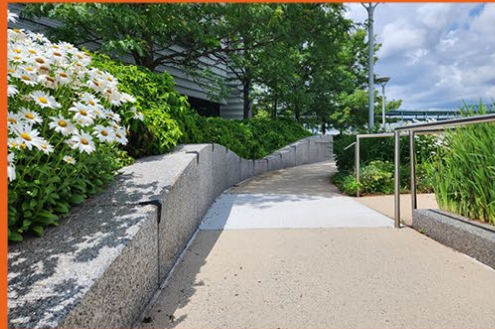


Appendix 3 *Photo boards for photo-elicitation interviews*

A. Harborwalk



B. Therapy Trail and Garden



C. Environmental Plaza



D. Amphitheater Seating





**E. Dining Plaza**



**F. Multi-Sports Node**



**G. Outdoor Conference Space**



**H. Fish Cleaning Station**



**I. 16th Street Plaza**

