

Barriers in Plain Sight: Pedestrian Accessibility, Safety, and Well-Being in Urban Green Space

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Abstract

Urban green spaces are extremely valuable in cities as they work to support environmental health, promote physical health, and mental well-being. As climate change, population growth, and urban density increase, urban green spaces such as parks, wetlands, and urban forests play a crucial role in providing valuable ecosystem functions, mitigating environmental stressors, and improving climate resilience. Having access to urban green space also supports human health through providing a place for physical activity and reducing stress. While the benefits of green urban spaces are widely recognized, access to them is shaped by social, structural, and mobility barriers. This influences who is willing or able to enter a space. Physical barriers that make access difficult or unsafe for the public include large and busy roadways, unsafe pedestrian crossings, and limited transit connectivity. Environmental and health benefits from urban green spaces can only be realized when users have equitable, safe access to them. This study focused on the Union Bay Natural Area (UBNA), a large urban green space in Seattle, Washington, to address how infrastructure and design influences accessibility, safety perceptions, and user behaviors in urban green spaces.

A survey of 131 respondents was conducted to evaluate user perceptions on accessibility, safety, visitation patterns and behaviors, and responses to a proposed pedestrian trail, connecting the UBNA with local transit infrastructure and pedestrian routes. Results show that when accessing the UBNA, travel time and distance (61.8%), indirect routes (23.7%), and roadway crossings (18.3%) were the most commonly reported barriers among respondents when accessing the site. Respondents also generally reported that they feel safer while within the UBNA as opposed to traveling to the site. Under the proposed trail scenario, 63% of the respondents reported they would be more likely to visit the UBNA, while only 4% reported feeling they would be less likely to visit. Survey responses varied with across locations taken at with majority of respondents having support for the trail being from online and University of Washington's campus and lowest among respondents already visiting the UBNA.

The result of these findings suggests that accessibility to urban green space is not only influenced by proximity but also by pedestrian connectivity and safety, transportation infrastructures, and site access. Reducing mobility barriers and improving pedestrian infrastructure improves equitable access to environmental, recreational, and public health benefits that green space provides while highlighting and considering user experience.

1. Introduction

Urban green space has become increasingly valuable in cities, supporting environmental health and promoting physical and mental well-being. As climate change, population growth, and urban density increase environmental stressors in cities, urban green spaces such as parks, wetlands, and urban forests play a crucial role in mitigating urban heat, enhancing climate resilience, and

improving air quality. They also provide valuable ecosystem functions such as managing stormwater runoff and sustaining ecological resilience (Shahmohamadi et al., 2011). Having access to urban green spaces supports human health through providing a place for physical activity and reducing stress. As current environmental impacts worsen, access to urban green space is increasingly recognized as a valuable feature in cities, helping improve environmental and public health outcomes (Proust et al., 2012). Environmental and health benefits from urban natural spaces can be realized, however, only when users have equitable, safe access to them.

While the benefits of green urban spaces are widely recognized, access to them is shaped by social, structural, and mobility barriers. This influences who is willing or able to enter the space. Physical barriers that make access difficult or unsafe for the public include urban infrastructure such as large, busy roadways, unsafe pedestrian crossings, and limited transit connectivity (Wolff M. et al., 2022). Car-oriented design can impose even greater restrictions on individuals who rely on walking, biking, and public transit. Social barriers, such as perceptions of safety, exclusionary design, and a lack of belonging and place attachment, can discourage certain users from visiting (Noël C et al., 2021). Addressing these barriers, both physical and social, requires not just improving infrastructure function but also listening to and understanding how different populations perceive and experience the landscape.

Current research on accessibility to urban green spaces has focused on proximity or distance metrics, such as transit time or the amount of green space within a given area. This research provides important insights into spatial relations; it may overlook other significant factors, such as perceived accessibility and behavioral patterns. Individuals can live in close proximity to urban green spaces yet still feel unable to visit them due to safety concerns, physical barriers, or mobility issues. Relying solely on distance-based metrics often does not account for more complex social and psychological barriers that shape how users interact with space. Understanding perceptions and behaviors is valuable for developing more equitable approaches to urban planning.

Infrastructure, including pedestrian crossings, trails, and connectivity corridors, is often used to improve site accessibility to green spaces. Trails function as more than just a recreational amenity but can become important to the space by supporting sustainable mobility, walkability, and strengthening connections between the community and natural environment (Kyriakopoulos, 2023). Research on urban design and public health has also emphasized the role of pedestrian-friendly infrastructure, encouraged physical activity, and increased the use of outdoor spaces (Jackson, 2003). By evaluating how proposed connectivity improvements impact user perceptions and behaviors, planners can better inform management strategies and infrastructure investments to promote a more inclusive and equitable urban environment.

Understanding how urban infrastructure affects accessibility and safety is crucial for equitable urban planning and understanding public health outcomes. Often, spaces meant for public use are designed in ways that exclude certain user groups. Design and planning interventions should be used to improve connectivity between communities and urban green spaces. This study recognizes the potential to expand equitable access and environmental benefits, while addressing disparities in those who are welcomed to these spaces.

The climate resilience, environmental services, and human health benefits that urban green spaces provide are highly valuable to cities. However, physical and perceived barriers, such as safety concerns and limited pedestrian access, can restrict equity and accessibility to these benefits. While much of existing research documents the ecological and health benefits of urban green spaces, there are limited studies examining how mobility barriers influence user experience, accessibility, perceived well-being, and willingness to visit. This project aims to address how infrastructure and design influence accessibility, safety perceptions, and user decisions in urban green spaces. The objective of this project is to:

1. Identify how different user groups experience and perceive accessibility, safety, and health benefits in green urban spaces.
2. Examine disparities across different demographic and user groups to identify equity gaps.
3. Assess how proposed pedestrian infrastructure improvements might change these behaviors and perceptions.

To examine these questions, this study focused on the Union Bay Natural Area (UBNA), a large urban green space in Seattle, Washington, to examine an existing barrier and its influence on accessibility for residents, students, and visitors.

2. Methods

Area of Study and Site Description

This study focused on the Union Bay Natural Area (UBNA), an urban nature area located adjacent to the University of Washington's campus in Seattle, Washington. The UBNA is an urban green space consisting of a restored wetland and shoreline that provides environmental education opportunities, ecological habitat, and recreational use for a diverse population, including University of Washington students, faculty, visitors, and residents. The site is surrounded by urban neighborhoods, including the University District and Laurelhurst, and major roadways such as Montlake Boulevard and NE 45th Street.

Despite its proximity to many local communities, pedestrian access to the UBNA is limited by physical barriers that affect its surrounding transit infrastructure. Currently, a mile-long fence separates the nature area from surrounding circulation routes, and nearby roadways create challenging routes for users traveling by foot or public transit. This limits access to recreational space and can discourage some individuals from visiting the site.

A trail connection has been proposed and discussed by stakeholders as a potential infrastructure improvement to increase public access and connectivity between the surrounding neighborhoods, transit routes, and the natural area. This study aims to evaluate how UBNA's current accessibility conditions and proposed trail scenario might influence users' perceptions of safety and accessibility, and their willingness or ability to visit the site.

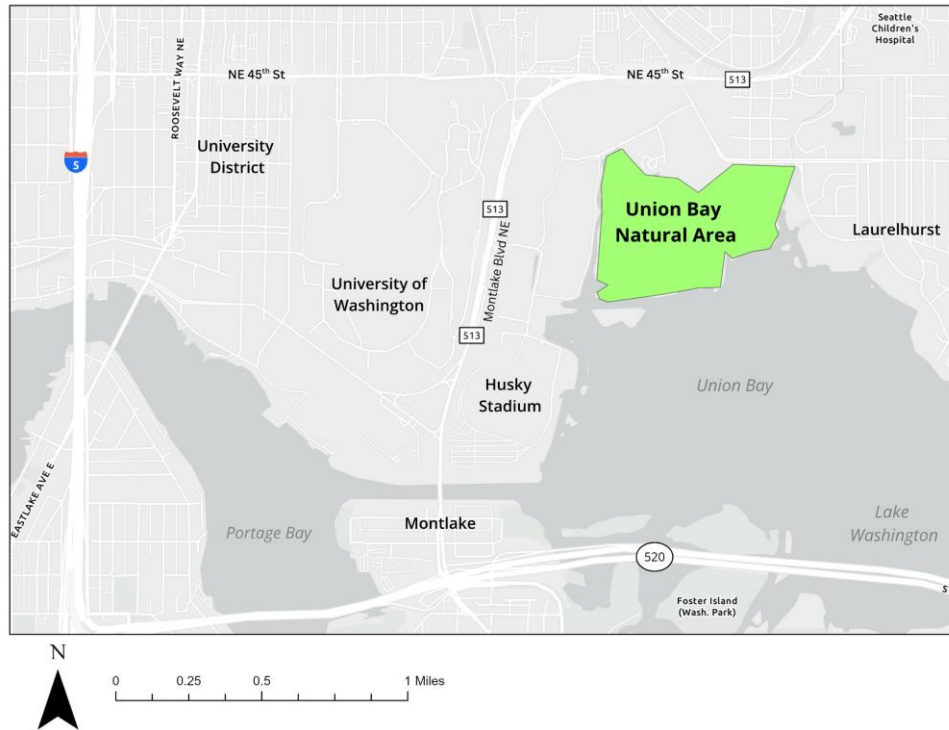


Figure 1. Study Site Map of Union Bay Natural Area, Seattle, WA and surrounding roadways, bodies of water, and neighborhoods.



Figure 2. Physical barriers affecting pedestrian access to the Union Bay Natural Area. Image showing the fence adjacent to the U-Village bus stop and nearby roadway crossings that may contribute to indirect routes and accessibility challenges

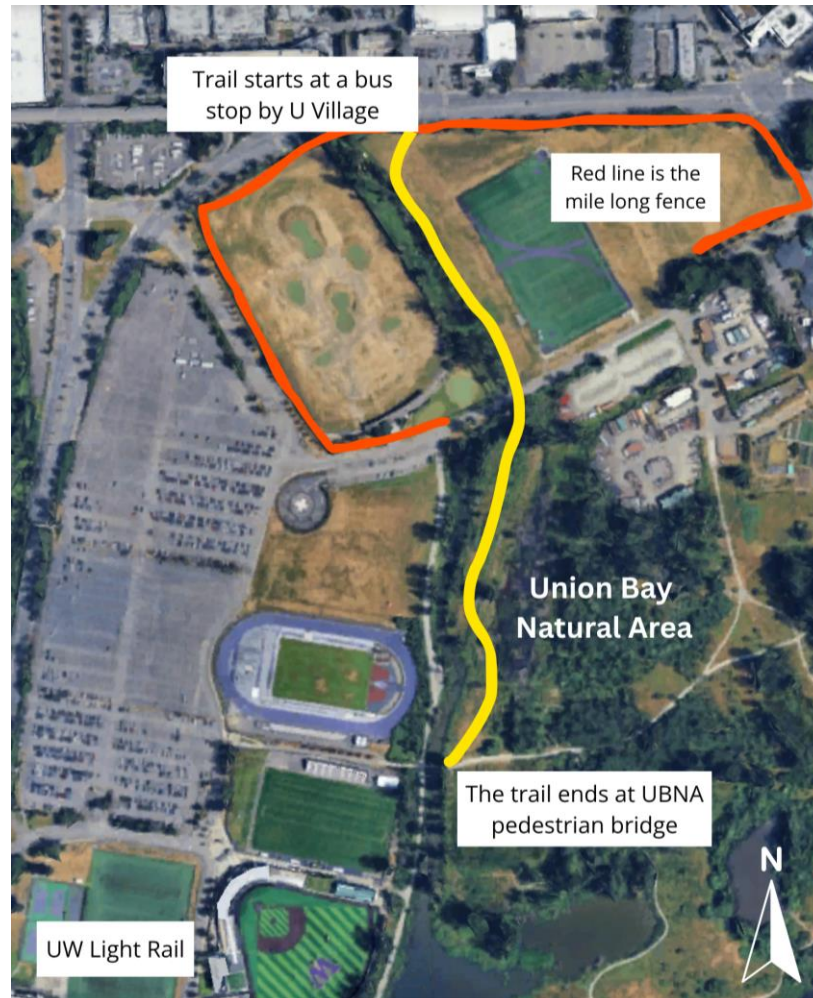


Figure 3. Proposed pedestrian trail connection between the U-Village area and the Union Bay Natural Area. The map shows the existing fence barrier and the proposed trail scenario intended to improve pedestrian connectivity.

2.1 Study Design

This project will use a survey-based case study to evaluate public perceptions of the UBNA site's current conditions and opinions on proposed trail scenarios. This survey is designed to be cross-sectional, collecting responses from individuals who currently visit the site, those who are unaware of the site, and those who may potentially use the space but face access barriers.

Survey participants were presented with a current site description and map to allow for insight into the area of study. This will be followed by a set of questions evaluating their current site's familiarity, mode of travel, and perceptions of the site's accessibility and safety. Participants will then be shown a description and map of the proposed pedestrian trail connection and will be asked to respond to a set of questions, gaining insight into how survey participants' willingness to visit the UBNA may change with improved pedestrian infrastructure. Prior to distribution, the survey will be pilot tested with small groups of students at the University of Washington to

identify issues with question clarity and survey flow. Feedback from this pilot test will be used to revise the questionnaire before being distributed to a wider audience.

This project involves voluntary participation through an anonymous survey and does not ask for or collect personally identifiable information. This is an educational research project conducted for a university capstone course. This project will follow the University of Washington's ethical guidelines and is expected to qualify for IRB exemption.

2.2 Population & Sampling

The target population for this survey will include people who live, visit, work, and study near and at the Union Bay Natural Area. Stakeholders include University of Washington staff, students, and faculty, as well as residents of the University District and Laurelhurst, neighborhoods near the natural area. Transit users and pedestrians traveling through the area, whether as visitors or nearby workers, are also considered important stakeholders in this study.

Participants will be identified through a combination of convenience sampling and targeted outreach. Survey distribution occurred through digital distribution in the university and local networks, community outreach events, and in-person on-site intercept surveying at the UBNA and transit stops. To avoid over-sampling UW affiliates, strong surveying off university grounds will aid in gathering information from a diverse range of communities.

The survey structure aims to collect responses from a wide range of participants representing diverse modes of transit (e.g., car and public transportation users), differing levels of site familiarity, and different demographic backgrounds. A target sample size of at least 100 responses will allow for basic comparative analysis across different user populations. Surveying is conducted between April and May 2026.

2.3 Survey Structure

The survey is a structured questionnaire that analyzes transportation, accessibility, perceived safety, and responses to new infrastructure at the UBNA. The survey will be distributed digitally through Google Forms and in paper format. The questionnaire will include a mix of multiple-choice questions, Likert scale questions (Likert, 1932), and open-ended questions. Several questions will use a 6-point Likert scale to measure safety perceptions and accessibility when traveling to and visiting the UBNA (e.g., very unsafe, somewhat unsafe, neutral, somewhat safe, very safe, not sure). Other questions assessing site familiarity, visitation frequency, mode of travel to the site, and reason for visiting the site will follow a multiple-choice format.

The survey questions are written and designed to be neutral and non-leading to avoid bias in response. Question responses will also include an 'I don't know' or 'not applicable' option to allow participants to share uncertainties.

2.4 Data Analysis Plan

Responses from the survey will be organized into a structured dataset for analysis using descriptive and comparative methods. The primary outcome of this study will be:

1. Scoring of perceived safety
2. Scoring of perceived accessibility, and

3. Change in willingness to visit the UBNA under the pedestrian trail proposal.

Statistics will summarize respondent demographics, modes of travel, familiarity, sampling location, and overall response patterns. Responses will be analyzed using percentages, frequencies, and cross-tabulation. These data analysis methods will help to identify any differences in perceptions across different user groups and evaluate whether the proposed access trail scenario is associated with a higher level of willingness to visit.

2.5 Interpretation

The results of this study will be used to evaluate whether the proposed pedestrian trail will improve public perceived safety and accessibility at the UBNA. Differences in response for the site's current condition compared to the proposed trail scenario are where we can identify indicators of meaningful change. A meaningful increase in perceptions will be defined by a shift of at least one point on the 6-point Likert scale for perceived safety and accessibility. Or, similarly, a notable increase in the number of survey respondents reporting a higher willingness to visit the site under the pedestrian trail scenario. Differences in responses across user groups may offer the opportunity to highlight which populations are currently facing the greatest barriers to accessing the UBNA and how infrastructure changes may influence those experiences.

Results will be viewed and analyzed with consideration of the study's limitations. In the survey, the proposed trail scenario is presented to the respondent hypothetically. Responses reflect stated perceptions rather than observable behavioral changes. The use of convenience sampling may limit the generalizability of results beyond the surveyed local populations.

Despite this, the results from this study provide valuable planning insights and decision-making for stakeholders. Scoring received safety can help shape equitable planning strategies, community engagement efforts, and infrastructure behavior. The results also support discussions between local stakeholders, urban planners, UBNA managers, and elected officials regarding pedestrian connectivity in the surrounding area.

3. Results

3.1 Respondent Demographics, Visitation Patterns, and Site Familiarity

In this study, there were a total of 131 survey responses from individuals who are from surrounding communities and are University of Washington (UW) affiliated individuals. Most respondents identified as UW students (84.0%, n=110), while the other respondents identified as UW faculty (6.1%, n=8) and University District residents (15.3%, n=20). Survey responses were collected on site at the University of Washington campus (66.4%, n=87), at transit stop locations (10.7%, n=14), through online outreach (9.9%, n=13), at the University District farmers market (6.9%, n=9), and on site at the Union Bay Natural Area (6.1%, n=8) (Table 1).

Category	Number of Respondents	Percent (%)
Affiliation		

UW Student	110	84%
UW Faculty/Staff	8	6.1%
U-District Resident	20	15.3%
Other	13	11.2%
Survey Source		
UW Campus	87	66.4%
UBNA On-Site	8	6.1%
University Village Bus Stops	14	10.7%
Online	13	9.9%
U District Farmers Market	9	6.9%

Table 1. Respondent Demographics and Survey Site Collection Sources (n = 131). Respondents were allowed to select multiple categories; therefore, percentages do not total 100%.

Survey respondents reported varying levels of familiarity with the UBNA (Figure 4). Around half of respondents identified as being very familiar with the site (44.3%), while 23.7% reported being moderately familiar. A smaller number of respondents indicated they were slightly familiar (13.0%) or not familiar at all (18.3%). Less than 1% of respondents reported being unsure about their familiarity with the site.

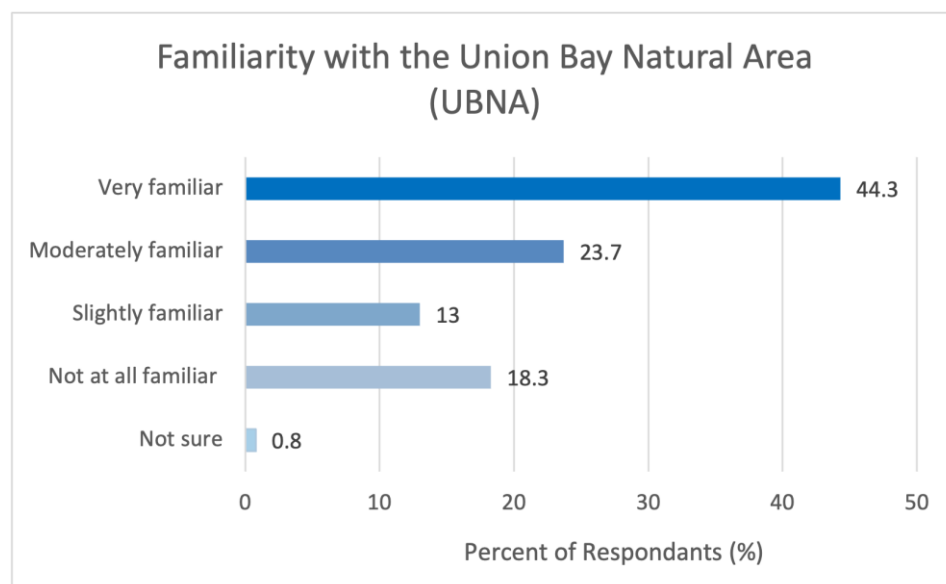


Figure 4: Respondent familiarity with the Union Bay Natural Area (n = 131). Most respondents reported being very familiar (44.3%) or moderately familiar (23.7%) with the site, while 18.3% reported no familiarity. Responses are reported as percentages.

Visitation frequency also varies among respondents (Figure 5). The largest number of respondents reported that they have not considered visiting the UBNA (26.0%). While others reported visiting the site a few times a year (16.8), wanting to visit but not yet having done so (16.0%), and having visited before, but not regularly (14.5%). Regular visitation was less

common, with 14.5% of respondents visiting weekly, 5.3% visiting monthly, and only 3.8% visiting daily. Additionally, 3.8% of respondents stated they do not visit the site.

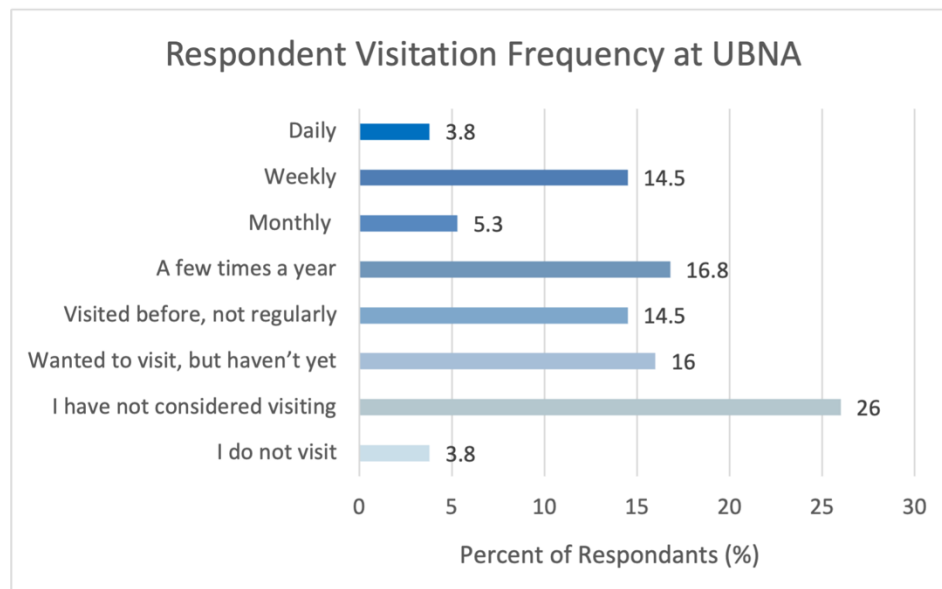


Figure 5. Respondents frequency of visitation at the UBNA (n = 131). The largest proportion of respondents reported not having considered visiting the UBNA (26.0%), while fewer respondents reported regular visitation. Responses are reported as percentages.

3.2 Current Accessibility and Safety Perceptions

Survey responses revealed that several accessibility barriers may be influencing how individuals' access and experience the UBNA. The most reported barrier by respondents was traveling time or distance (61.6%, n=81) (Table 2). Other frequently reported barriers include indirect routes or detours (23.7%, n = 31), road crossings or traffic (18.3%, n = 24), and difficulty locating entrances (16.0%, n = 21). A smaller number of respondents identified poor lighting conditions (9.2%, n = 12), or personal safety concerns (5.3%, n = 7) as barriers. Despite this, 19.1% of respondents reported they have experienced no barriers at the site (n=25)

Barrier	Number of Responses	Percent (%)
Travel time or distance	81	61.8%
Indirect routes or detours	31	23.7%
No barriers reported	25	19.1%
Road crossings or traffic	24	18.3%
Difficulty locating entrances	21	16.0%
Poor lighting	13	9.9%
Trail/surface conditions	12	9.2%

Other	11	8.4%
Personal safety concerns	7	5.3%

Table 2. Most frequently reported barriers (n = 131). Respondents were allowed to select multiple categories; therefore, percentages do not total 100%.

When respondents were asked about their perceptions of safety, responses differed between traveling to the UBNA and being within the site itself (Figure 6). Respondents reported feeling safer at the UBNA rather than traveling to it. About 66% of respondents felt the UBNA itself was very safe. In comparison, about 58% of respondents felt that traveling to the site was very safe. A larger proportion of respondents reported feeling unsafe or very unsafe then compared to being at the site.

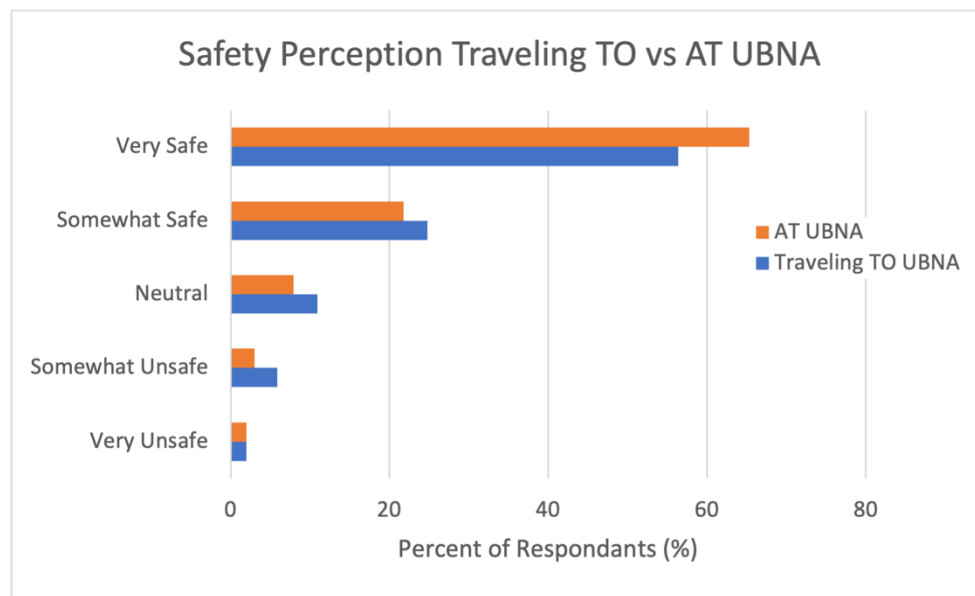


Figure 6. Perceived safety while traveling to versus being within the Union Bay Natural Area (n = 101). Respondents generally reported higher levels of safety within the UBNA than while traveling to the site, with a greater proportion indicating they felt “very safe” at the UBNA.

Reported accessibility barriers varied by respondents' familiarity with the site (Figure 7). Across all levels of familiarity, travel time or distance remained the most frequently identified barrier. Respondents who identified as slightly familiar with the UBNA reported having the highest number of concerns relating to travel distance and roadway crossings. While those who were very familiar with the site, more identified indirect routes and entrance location challenges as barriers. This suggests that perceptions of accessibility may vary depending on prior or no familiarity with the site.

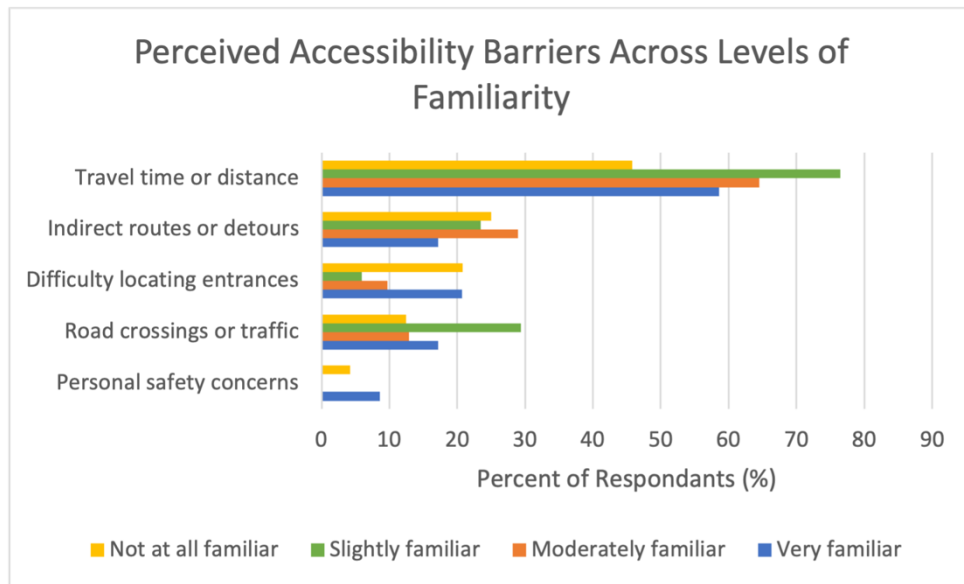


Figure 7. Perceived accessibility barriers across levels of familiarity with the Union Bay Natural Area. Travel time or distance was the most frequently reported barrier across all familiarity groups, while concerns related to roadway crossings, indirect routes, and entrance identification varied by familiarity level.

Overall, respondents reported mostly positive perceptions of safety within the UBNA itself, while accessibility concerns surrounding transportation routes, travel distance, and pedestrian infrastructure were commonly reported barriers faced while traveling to the site, causing a slightly greater concern for safety.

3.3 Trail Proposal Scenario Responses

Survey participants were presented with a prompt for a proposed pedestrian trail connection that would link nearby transit infrastructure and pedestrian routes to the Union Bay Natural Area. Respondents were asked how the proposed trail might influence their visitation behaviors.

Many respondents indicated that they would be more likely to visit the UBNA if the proposed trail were to be constructed (Figure 8). Fifty-seven respondents stated that they would be more likely to visit, and an additional twenty-five respondents showed they would be more likely to visit. In comparison, under the proposed trail scenario, only five total respondents reported that they would be less likely to visit. Forty-two reported that the proposed trail scenario would not change their likelihood of visiting the UBNA.

Overall, 63% of respondents indicated that the trail scenario would increase their willingness to visit the site.

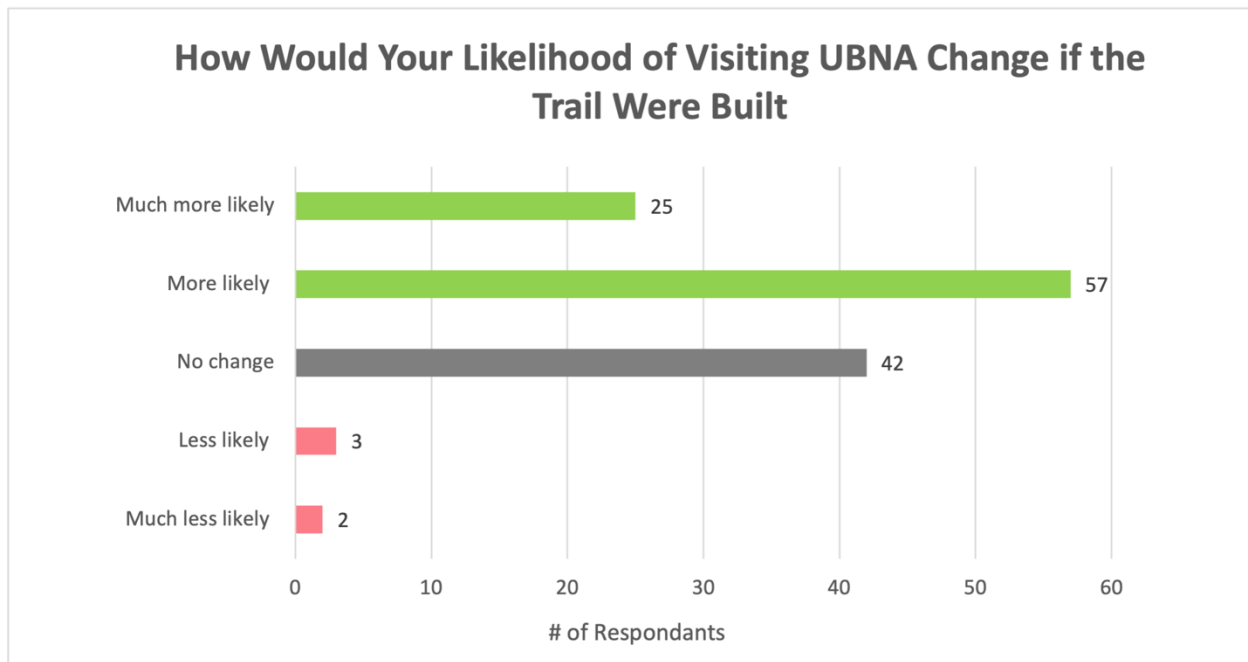


Figure 8. Change in willingness to visit the Union Bay Natural Area under the proposed trail scenario (n = 131). Most respondents indicated they would be more likely or much more likely to visit the UBNA if the proposed pedestrian connection was constructed.

Responses in the likelihood of visiting the UBNA also varied according to site familiarity. Respondents who were already very familiar with the site were most likely to report no change in visitation. Respondents who were moderately familiar, slightly familiar, or not familiar generally reported an increase in willingness to visit under the proposed trail scenario. This suggests that the trail may have a larger influence on those who are less familiar with the UBNA or those who are experiencing barriers around site accessibility.

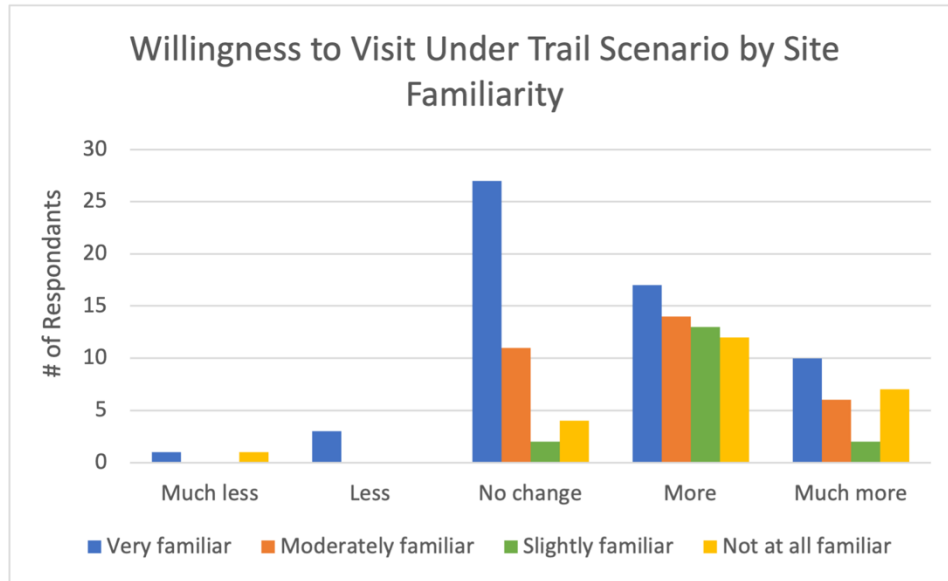


Figure 9. Willingness to visit the Union Bay Natural Area under the proposed trail scenario by familiarity level. Respondents with lower familiarity generally reported increased willingness to visit under the trail scenario, while those already very familiar with the site most often reported no change.

The proposed trail scenario was also associated with changes around anticipated mode of transportation to the site (Figure 10). Walking remained the most reported mode of travel before and after the trail proposal. Biking and running increased substantially after the proposed trail scenario. In contrast, the respondents reported that usage of cars and public transit decreased under the trail proposal. This suggests that improved pedestrian connectivity may encourage more active modes of transportation to the UBNA.

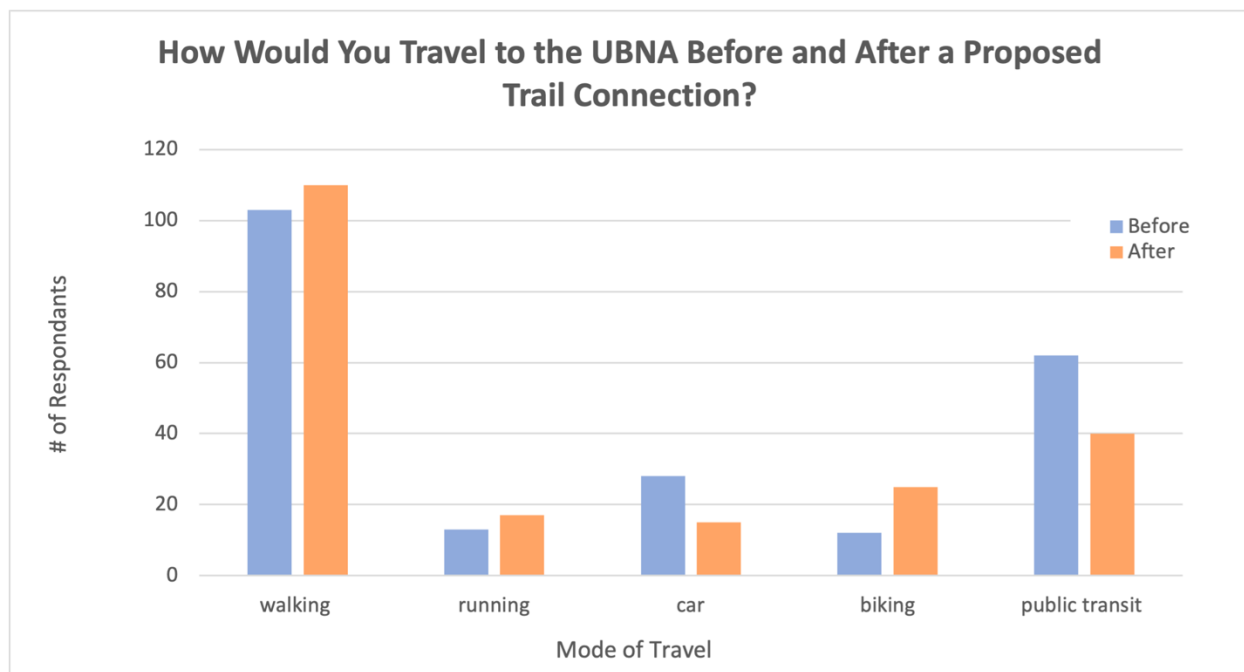


Figure 10. Transportation modes before and after the proposed trail connection. Walking remained the most common travel mode, biking and running increased and automobile and public transit use decreased under the proposed trail scenario.

Under the proposed trail scenario, safety perceptions showed a mixed pattern (Figure 11). Several respondents reported feeling very safe traveling to the UBNA, which decreased under the proposed trail scenario. Respondents who reported feeling somewhat safe and neutral responses increased under the trail proposal. Reports stating that feeling somewhat unsafe and very unsafe remained low and declined slightly.

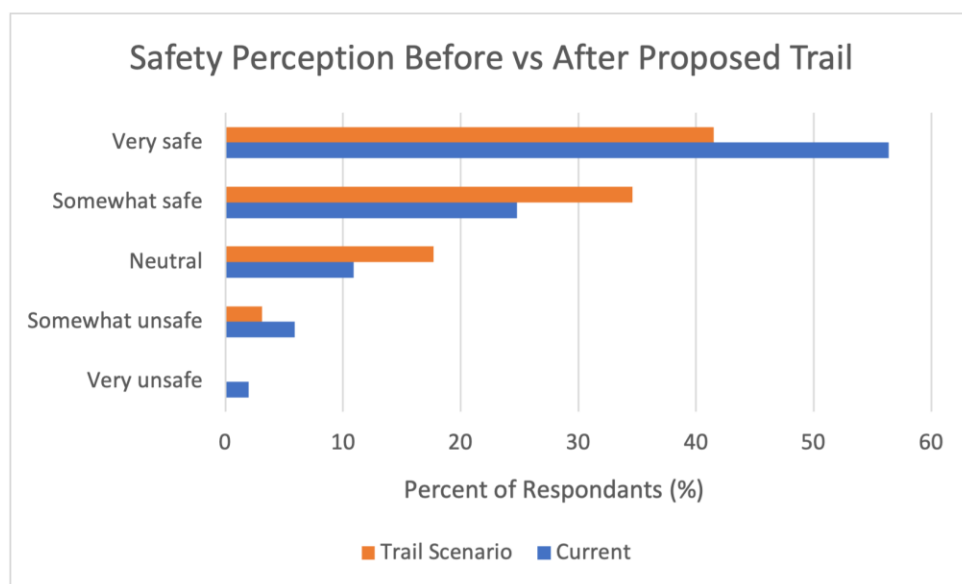


Figure 11. Perceived safety before and after the proposed trail scenario. Respondents continued to report generally positive perceptions of safety under both scenarios, although responses shifted from “very safe” toward “somewhat safe” under the proposed trail scenario.

Overall, respondents continuously reported positive perceptions of safety. However, the trail proposal scenario did not produce a clear increase in safety; rather, responses were more concentrated in moderate safety categories. This suggests, for now, the proposed trail may influence access and visitation more strongly than user safety perceptions.

3.4 Variation in Results and Survey Location

Responses varied across collection locations, which suggests that the users' site familiarity and access might influence the respondents' perceptions of the proposed trail prompt. Support for the proposed trail was the highest among online (92.3%) and UW campus respondents (72.2%), showing an increase in willingness to visit the UBNA. Among respondents surveyed at transit stops (58.3%) and the U District Farmers Market (44.4%), the willingness to visit was lower. Respondents who were surveyed within the UBNA reported the lowest change in willingness to visit for the proposed trail and indicated a 50% chance of no change in willingness to visit under the proposed trail scenario.

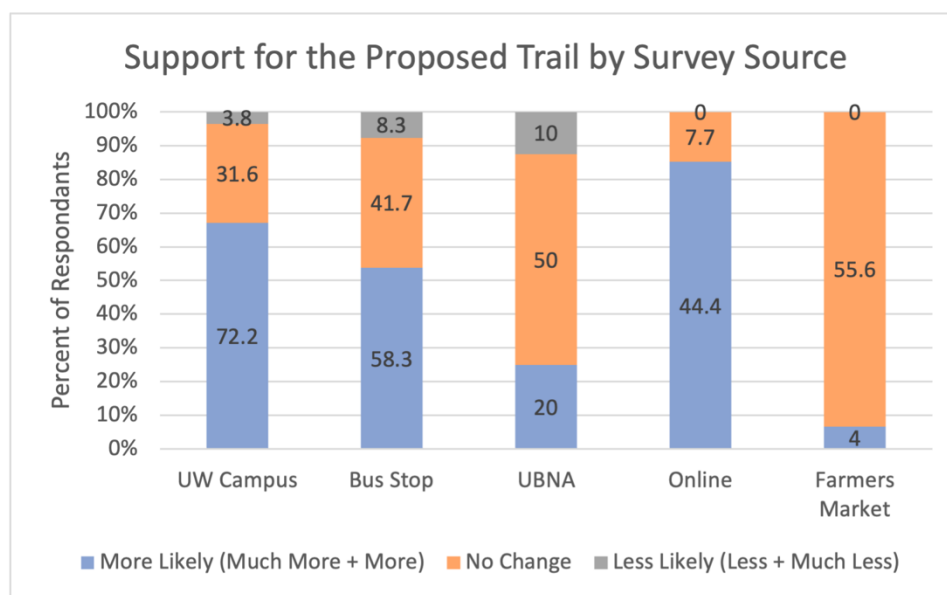


Figure 12. Support for the proposed trail by survey collection location. Support was defined as respondents reporting they would be more likely or much more likely to visit the UBNA under the trail scenario. Support was highest among online and UW campus respondents, while respondents surveyed within the UBNA most frequently reported no change in visitation

3.5 Open-Ended Responses

Open-ended survey responses have provided additional insights into how respondents are currently experiencing accessibility to the site and how future infrastructure challenges answer or raise concerns. Several themes around road crossings, transit access, trail infrastructure, wildlife impacts, and entrance identification impact future trail development (Table 3).

Concerns around roadway crossings were frequently mentioned. Respondents reported challenges in crossing busy roadways with high volume and fast-moving traffic, poor visibility, and lack of safe pedestrian infrastructure.

Transit accessibility was another theme as several respondents expressed support for improving connectivity between public transit lines and the UBNA. Respondents emphasized this with the coming parking policy changes around UW and the UBNA making access by car more difficult.

Comments on trail's infrastructure focused on how existing accessibility is limited due to regular flooding in wetter months. These responses raise concerns regarding trail maintenance and year-round accessibility.

While many respondents expressed support for the improved infrastructure, there were also concerns surrounding potential environmental impacts of a new trail connection. These comments highlighted possible disturbances to wildlife habitats, vegetation, and Ravenna Creek. Respondents emphasized that there should be a balance between accessibility improvements and protection of ecological habitat.

Theme	Respondent Quote
Road crossing concerns	"I access the area from the Burke Gilman at 36th Ave NE. Crossing NE 41st St. can be difficult because of fast vehicles and poor sight lines. At minimum there should be a painted crosswalk there."
Transit access	"Closer transit access than the current situation would be great! Especially with upcoming changes to parking policy."
Trail infrastructure	"The trail around one of the ponds at Union Bay is not very accessible in the spring as it floods and is covered by this huge puddle."

Trail infrastructure	“Some paths at UBNA tend to flood, forcing one to either turn back or use sticks/planks/etc. to step over. There needs to be a solution for this.”
Entrance identification	“Signage on the street showing access and closer bus stops to the entrance would be nice”
Environmental impacts	“My main concern with a pedestrian/bike path to UBNA would be about whether the path obstructs or disrupts wildlife in the area.”
Environmental impacts	“I would like to know more about how this potential path would impact the environment; would trees or habitat have to be removed? What would the impact be to Ravenna Creek?”

Table 3. Recurring qualitative themes and quotes from respondents.

4. Discussion

This study examined how accessibility, perceived safety, and urban infrastructures influences user experiences and behaviors with the Union Bay Natural Area (UBNA). This research specifically identifies how user groups experience barriers that may limit equitable access to urban green spaces, while evaluating how a proposed pedestrian trail could influence user access and willingness to visit.

Survey results suggest that accessibility to urban green space goes beyond physical proximity. The UBNA is located closely to dense residential neighborhoods, the University of Washington campus, and major transit routes. Despite this, respondents frequently identified barriers related to travel time and distance, indirect routes, and entrance accessibility. Survey respondents also reported feeling generally safe within the UBNA but felt greater safety concerns while traveling to the site itself. Additionally, several reported that they would be more likely to visit the UBNA under the proposed trail scenario, suggesting that current pedestrian and transit infrastructure may influence user experience and access to urban green space.

These findings suggest that barriers around mobility and access play an important role in user visitation behaviors. While urban green spaces provide valuable environmental and public health benefits, these benefits can only be experienced when individuals are able to access them safely and equally.

4.1 Accessibility Beyond Physical Distance

One of the most significant findings from survey responses is that physical proximity does not guarantee access to urban green space. The UBNA is in close proximity to transit routes, neighborhoods, and the UW campus. Many respondents reported that they experience barriers when reaching the site. Travel time and distance were the most frequently reported barrier, while road crossings, indirect routes, and difficulty finding entrances were also commonly identified. Open-ended responses from respondents also highlighted concerns around unsafe pedestrian infrastructure and confusion around site entry points. These findings support that traditional measures of accessibility such as distance can fail to capture how people experience urban green spaces. Schindler et al. (2022) found that the visitation of urban green spaces is more influenced by factors such as travel routes, mobility options, and perceived accessibility rather than site proximity. Similarly, in this study, despite the UBNA's proximity, survey respondents were able to identify challenges associated with traveling to the site.

Recognizing the distinction between being physically close to urban green space and feeling that the site is accessible is important. An important finding from this study is that users may be feeling safe when within the UBNA but feeling unsafe while traveling to it. Although survey respondents indicated a mostly positive feeling of safety once in the UBNA, when considering traveling to the site, perceptions of safety declined. Accessibility theory has grown to recognize that barriers like roadways, poor crossing conditions, connectivity, and perceived safety influence whether individuals are willing or able to access a space. Wolff et al. (2022) state that urban green space accessibility is not just shaped by distance but by physical, perceptual, and social barriers. These findings suggest that when looking to improve access to urban green spaces, it requires planners to look at not just the site itself but also the pedestrian environment that connects the surrounding communities and area.

The existing fence surrounding a large portion of the UBNA may likely be contributing to the access barriers identified by survey respondents. The fence was not directly evaluated in the survey, but it creates a physical barrier that separates transit stops, pedestrian routes, and the natural area, forcing users to navigate indirect routes. As a result, users might perceive the UBNA as less accessible than its geographic location would suggest.

Survey respondents reported feeling safe once inside the UBNA, yet many showed concern around safety when reaching the site. This suggests that barriers existing outside the urban green space, such as roadway infrastructure, wayfinding signage, and pedestrian connectivity, can have a large impact on visitation behaviors. The qualitative responses from the survey reinforce this information. Several respondents described experiencing difficulties when crossing major roadways, finding entrances, and navigating existing pedestrians and transit routes to the UBNA. These comments show there are psychological and mobility barriers that can influence willingness to visit, meaning that accessibility is not just a measure of distance but also a person's ability to comfortably and safely travel to a site.

Together, these findings suggest that improving access to urban green space may require more than just creating the space itself, but equitable access depends on external factors such as transit and other connectivity infrastructure. Understanding access through user experience can help planners identify barriers that are often overlooked by distance-based metrics.

4.2 Transportation Equity and User Experience

Findings from the survey suggest that accessibility is not experienced equally by all users. While some respondents may have direct access to the Union Bay Natural Area (UBNA), others may face challenges depending on their mode of transportation. Survey responses and respondent comments indicate that users who walk, bike, and take public transit may experience greater barriers related to crossing, indirect routes, and entrance identification than those who drive. Many barriers identified by respondents reflect characteristics of the roadway system surrounding the UBNA that prioritizes automobile travel. Heavy traffic, limited pedestrian crossings, and location of access points create challenges for individuals traveling without a car. These barriers disproportionately affect users who rely on walking, biking, and public transit.

Survey responses on the proposed trail scenario provide additional insight into how trail infrastructure may shape user experiences. Most respondents report that they would be more likely to visit the UBNA with the addition of the pedestrian trail. Respondents indicated that their walking and biking would increase, while car usage would decrease. Increased walking and biking further suggest that current infrastructure may discourage active transit to the site. The decrease in automobile use under the proposed trail scenario indicated that some respondents might currently rely on driving to reach the UBNA because current transit networks are less convenient.

An unexpected finding under the proposed trail scenario was the decreased use of public transit as a mode of travel. Improved access from the trail was thought to increase visitation and public transit usage with the improved connection between transit stops. The proposed trail may reduce the need for public transit during an individual's trip to the UBNA by providing improved pedestrian safety and access. The barriers most reported in the survey that impact users' access were travel time, indirect routes, and roadway crossings. Individuals who currently rely on public transit or automobiles to navigate around the site's existing fence and major roadways may now prefer to walk or bike under safer pathway infrastructure. Research suggests that more pedestrian friendly infrastructures and encourage more usage of active transportation and increases use of outdoor spaces (Jackson, 2003)

Looking at the survey location data, we can see that access barriers are not experienced equally. Survey respondents who responded within the UBNA were more likely to report that the proposed trail would not change their visitation behaviors. Respondents that surveyed at transit stops, UW campus, and through online outreach forms expressed a stronger likelihood of visiting

under the proposed trail. This information suggests that those users who are already visiting the site have most likely overcome access barriers and no longer impact their visitation. Those who are less familiar with the UBNA and rely on surrounding transportation infrastructure may believe that they will gain more benefit from the improved pedestrian infrastructure.

This data supports larger discussions around environmental justice and transportation equity. How urban infrastructures are designed influences who are willing or able to access public urban green space, and who benefits from the environmental and physical health benefits they provide. When roadway access is designed to prioritize automotive vehicles, it creates barriers for other modes of transportation and the opportunity to experience urban green space becomes unevenly distributed. This can influence perceptions around a sense of belonging and willingness to visit.

These findings suggest that improving transportation equity is an important step to take in expanding public access, enhancing pedestrian access, and making sure environmental and public health benefits are distributed more equitably to a wide range of users.

4.3 Public Health and Community Implications

Reducing barriers that impact accessibility to urban green space has the potential to further support public health, community well-being, and sustainable transit goals. One notable finding among responses was the increase in reported walking and biking under the proposed trail scenario. Respondents indicated a greater likelihood of using active transit when a direct connection to the UBNA was presented. This suggests that pedestrian infrastructure would not only improve site access but also encourage physical activity. Research has shown that walkability and accessibility of green space can promote exercise, recreation, and healthier lifestyles (Jackson, 2023). Creating a more direct trail route can support physical activity opportunities for students, visitors, and residents.

Improved public access may also strengthen connections between communities and nature. Most respondents indicated that they would be more likely to visit the site if a pedestrian trail were constructed. Increased use of urban green spaces has been associated with a wide range of mental health benefits such as reduced stress, improved mood, and greater overall well-being. In a dense urban environment such as the U District in Seattle, access to natural areas is valuable in providing recreational and relaxation opportunities. The proposed trail may also support broader sustainable transportation goals by improving connectivity between transit stops, pedestrian routes, the University of Washington Link Station, and the UBNA. Based on survey responses of increased walking and biking, more use of active transportation contributes to reduced vehicle dependency, lower emissions, and improved sustainability.

Increased engagement with urban green spaces such as the UBNA increases community connection to local environments, community awareness around ecological value, and community stewardship of urban nature. As cities' populations grow and address climate change,

ensuring there is equitable access to urban green space is extremely important in environmental planning and public health strategies.

4.4 Management and Planning Implications

The results from this study provide insight into how modest infrastructure improvements can have a meaningful impact on communities and how they access and experience urban green space. Most respondents reported that they would be more likely to visit the UBNA under the proposed trail, indicating that there may be barriers currently limiting user engagement with the site. Changes in modes of transit also suggest that improved pedestrian connectivity supports both site recreational and surrounding transportation functions. The potential value of the proposed trail is more than just a recreational amenity but would serve as a connection between neighborhoods, the University of Washington, transportation, and the UBNA.

Findings from the survey suggest several opportunities for planners, transportation agencies, and site management to improve site access and experience. Firstly, improving pedestrian safety around roadway crossings should be a valued priority. Many respondents indicated road crossings as barriers when accessing the UBNA. In an open-ended response, the respondent emphasized concerns around vehicle speeds, visibility, and marked crosswalks. Improved crossing signals, pedestrian refuge islands, or traffic calming measures may help to address these user concerns and improve experience.

Secondly, respondents brought up concerns around locating entrances and navigating routes to the site. Improved wayfinding signage, clear entrance identification, and more directional information to connect nearby transit stops to the UBNA may help in reducing user confusion and improving access for first-time visitors.

Lastly, stakeholders may want to consider public transit access improvements. Existing fence barriers limit ease of access to transit stops and UBNA entrances. Evaluating opportunities to improve connectivity between these areas can help improve access for users who rely on walking, biking, or public transportation.

While future infrastructure improvements require stakeholder collaboration and careful environmental review to protect ecological habitats within the UBNA, the results of this study suggest that improving pedestrian infrastructure strengthens connection between surrounding communities and the Union Bay Natural Area.

4.5 Limitations of the Study

Several limitations should be considered in interpreting the results of this study. Firstly, survey respondents were recruited through convenience sampling using online distribution, community outreach, and on-site surveying. As a result of this, the sample of respondents may not fully

represent all potential users of the UBNA or broader Seattle populations. As a result, percentages being reported should be interpreted as descriptive of the survey sample as opposed to the precise estimate of a broader population.

Secondly, this study relies on self-reported perceptions and stated intentions rather than observed behavior. Respondents self-reported their experience with accessibility, safety, and willingness to visit, which may differ from behavior observed in a setting. Additionally, the proposed trail scenario was hypothetical, meaning respondents had to reflect on how they believe they would respond to improved connectivity.

This study was conducted within a limited timeframe and reflects conditions and perceptions from a single season. Perceptions on accessibility, safety, and visitation behaviors may vary throughout the year due to changes in weather conditions, vegetation, daylight, and seasonal flooding. Finally, the sample size may have limited the ability to conduct a more detailed analysis across different demographic and transportation groups. Future research could expand data collection and more closely evaluate behavioral changes.

Despite these limitations, the study still provides meaningful insight into how users perceive accessibility, safety, and transportation barriers at the Union Bay Natural Area. This study highlights possible opportunities for improved infrastructure connections between urban green spaces and surrounding communities.

4.7 Conclusions

This study was conducted to examine how accessibility, safety perceptions, and urban infrastructures influence experiences with urban green spaces. Findings from this research suggest that access to urban green space is shaped by physical and social barriers, including limited connectivity and perceptions of accessibility. The result of this study recognizes the importance of understanding urban green space accessibly through user experience rather than just spatial proximity. Equitable accessibility depends on how infrastructure connects people to urban nature. By improving pedestrian connectivity and addressing barriers identified by users, planners and stakeholders may be able to expand and improve public access to the environmental, recreational, and public health benefits the urban green spaces can provide. As cities continue to grow and learn to adapt to environmental challenges, investments in accessible and safe urban green spaces may be extremely valuable in supporting health and climate resilient communities.

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6. Appendices

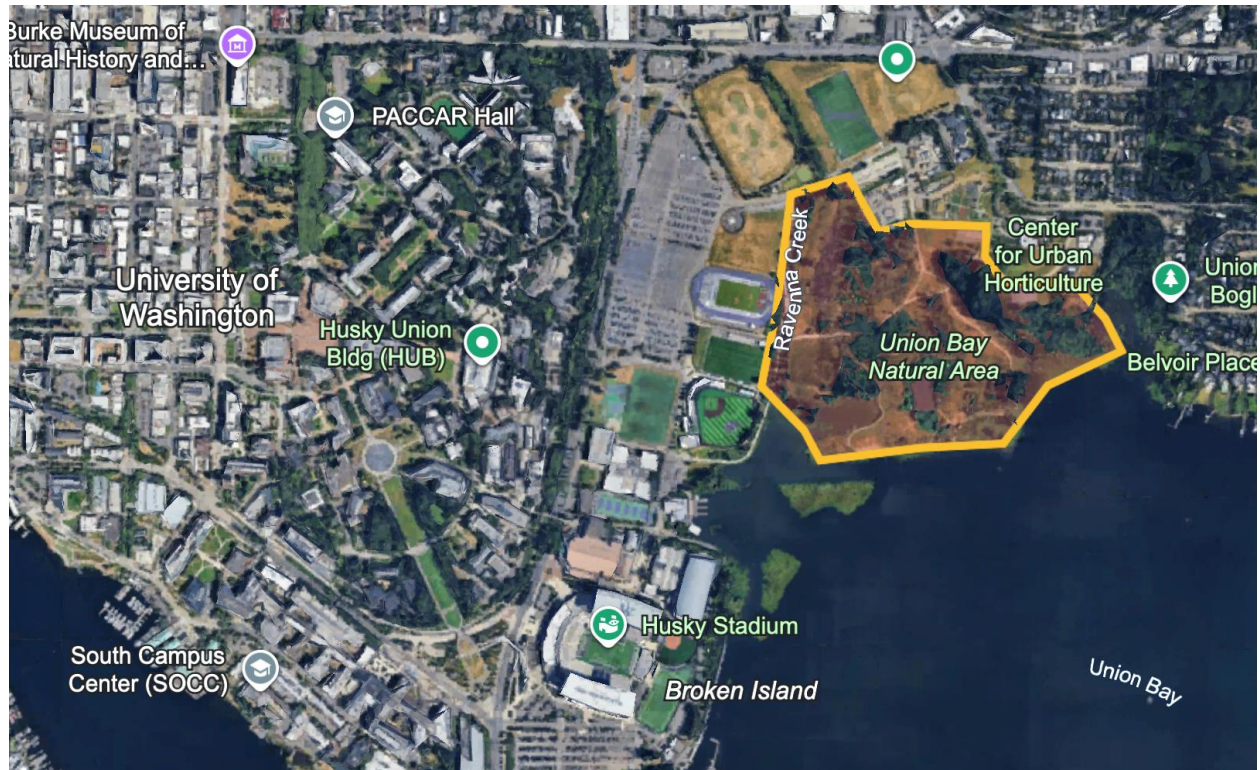
Appendix A: Survey Questions

Union Bay Natural Area Access & Experience Survey

This survey is part of a University of Washington student capstone project examining access, safety, and user experiences at Union Bay Natural Area (UBNA). Your response is anonymous and will only be reported in summary form. The survey takes approximately 3 minutes. You may skip any questions.

The Union Bay Natural Area (UBNA), an urban nature area located adjacent to the University of Washington's campus (shown in red on the map) in Seattle, Washington. The UBNA is a restored wetland and shoreline providing environmental education opportunities, ecological habitat, and recreational use for a diverse population. The site is in close proximity to University District and Laurelhurst, and major roadways like Montlake Boulevard and NE 45th Street.

You do not need to be a frequent visitor to participate. We are interested in both visitors and non-visitors. Thank you for helping us better understand access and experiences at UBNA.



1. How familiar are you with Union Bay Natural Area (UBNA)?

- Not at all familiar
- Slightly familiar
- Moderately familiar
- Very familiar
- Not sure

2. What describes you best?

- I have not considered visiting
- I have tried to visit but found it difficult
- I have wanted to visit but haven't yet
- I prefer other parks

- I don't know
- Other:

3. What barriers, if any, influence whether you visit Union Bay Natural Area (UBNA)? (Select all that apply)

- Travel time or distance
- Difficulty locating entrances
- Indirect routes or detours
- Road crossings or traffic
- Poor or limited public lighting
- Trail or surface conditions (gravel, stairs, etc.)
- Personal safety concerns
- I have not experienced any barriers
- I don't know
- Other:

4. How easy would it be for you to travel to UBNA from where you are?

- Very difficult
- Somewhat difficult
- Neutral
- Somewhat easy
- Very easy
- Unsure

5. How interested would you be visiting UBNA in the future?

- Not interested
- Slightly interested
- Neutral
- Moderately interested
- Very interested
- Unsure

6. If you were to visit UBNA, how would you travel there?

- Walking
- Running
- Biking
- Car
- Public transit
- I don't know
- Other:

A potential pedestrian connection has been discussed. The trail would link the U-Village area to the UW Stadium Link Station through Union Bay Natural Area (UBNA) and include an opening in the mile-long fence highlighted in red.

Please review the map and answer the following questions about how this scenario might influence your perceptions and travel decisions.



7. If a more direct pedestrian and bicycle connection were added between U-Village and the UW Stadium Link Station through UBNA, how would your likelihood of visiting change?
 - Much less likely
 - Less likely
 - No change
 - More likely
 - Much more likely
 - Not sure

8. If this connection existed, how safe would you feel traveling along this route?
 - Very unsafe
 - Somewhat unsafe
 - Neutral
 - Somewhat safe
 - Very safe
 - Not sure

9. If this connection existed, how would you travel to UBNA?

- Walking
- Running
- Biking
- Car
- Public transit
- I don't visit
- Other:

10. If this connection existed, what would you use it for? (Select all that apply)

- Birdwatching or nature viewing
- Walking, running, or biking
- Commuting between destinations
- Exercise
- Socializing
- I would not use it
- Other:

11. How often would you use this connection?

- Daily
- Weekly
- Monthly
- A few times a year
- not regularly
- I do not visit

12. Overall, how accessible do you feel the UBNA is?

- Very inaccessible
- Somewhat inaccessible
- Neutral
- Somewhat accessible
- Very accessible
- I don't know

13. Which best describes you?

- UW Student
- UW faculty/staff
- Volunteer
- U-District resident
- Laurelhurst resident

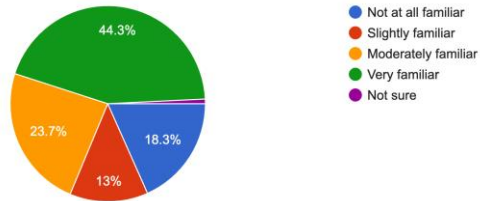
- Visitor
- Other:

14. Is there anything else you would like to share?

Appendix B: Figures and Data Tables

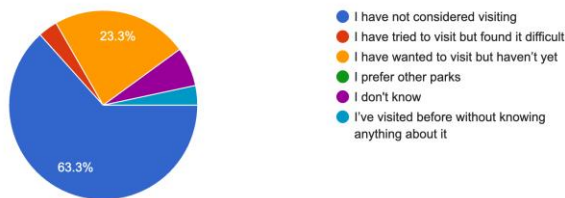
How familiar are you with Union Bay Natural Area (UBNA)?

131 responses



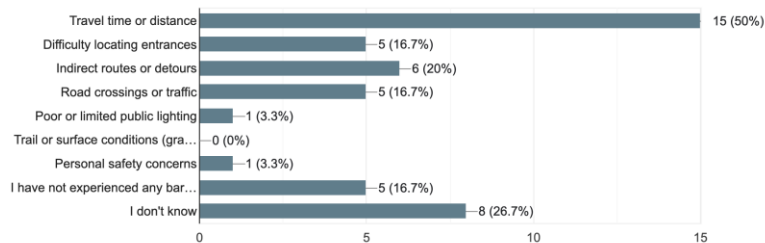
What describes you best?

30 responses



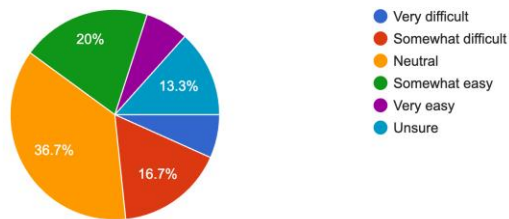
What barriers, if any, influence whether you visit Union Bay Natural Area (UBNA)? (Select all that apply)

30 responses



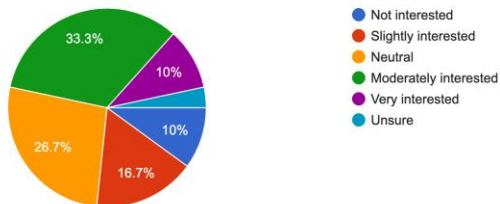
How easy would it be for you to travel to the UBNA from where you are?

30 responses



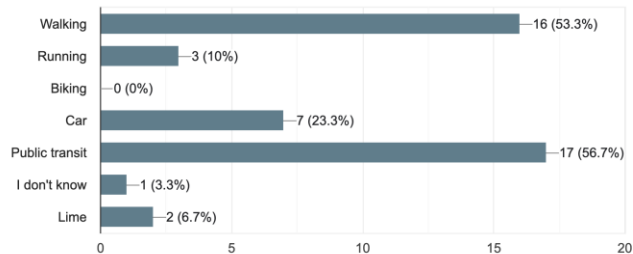
How interested would you be in visiting UBNA in the future?

30 responses



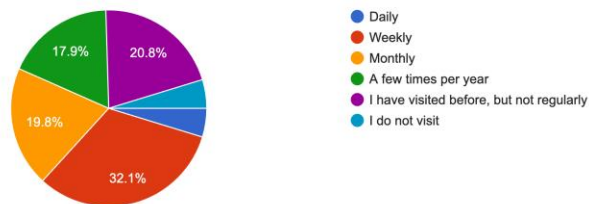
If you were to visit UBNA, how would travel there?

30 responses



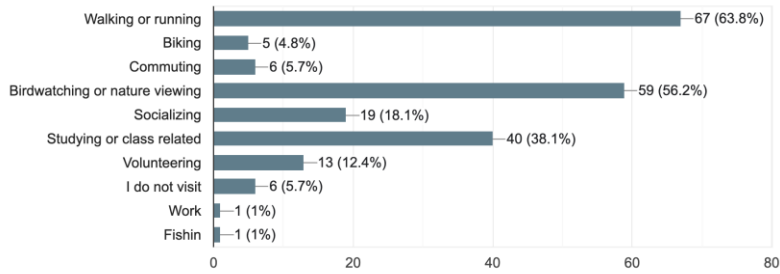
How often do you visit UBNA?

106 responses



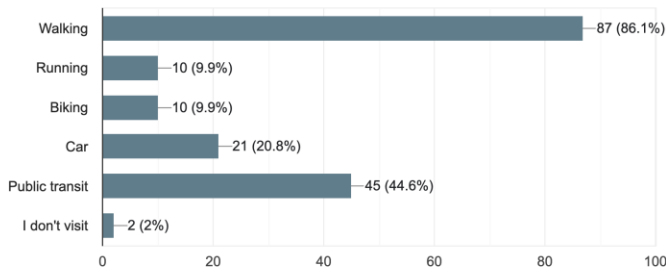
What are your usual reasons for visiting? (Select all that apply)

105 responses



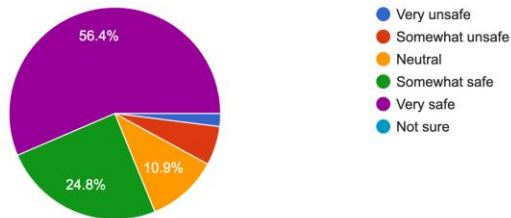
How do you travel to the UBNA? (select all that apply)

101 responses



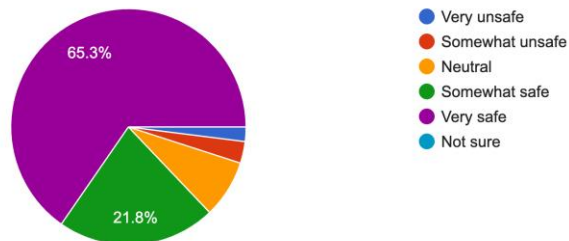
How safe do you feel traveling to UBNA?

101 responses



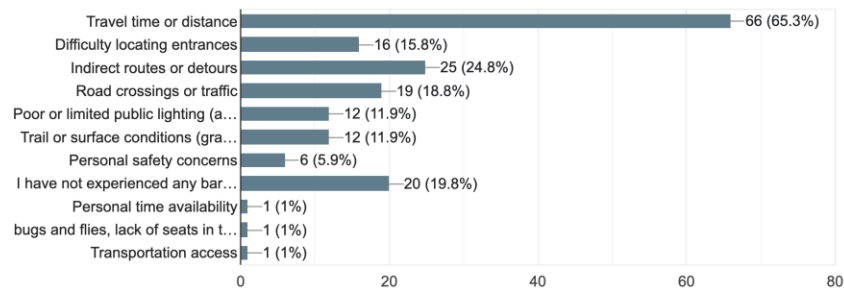
How safe do you feel while at the UBNA?

101 responses



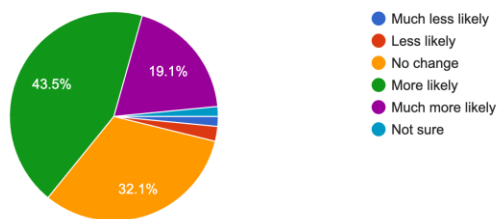
What barriers, if any, influence your visit to the UBNA? (Select all that apply)

101 responses



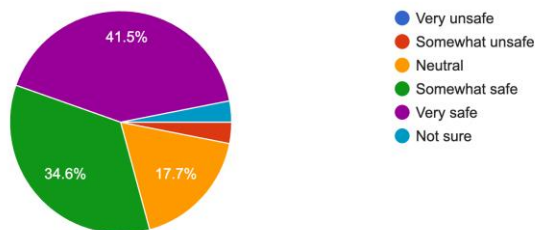
If a more direct pedestrian and bicycle connection were added between U-Village and the UW Stadium Link Station through UBNA, how would your likelihood of visiting change?

131 responses



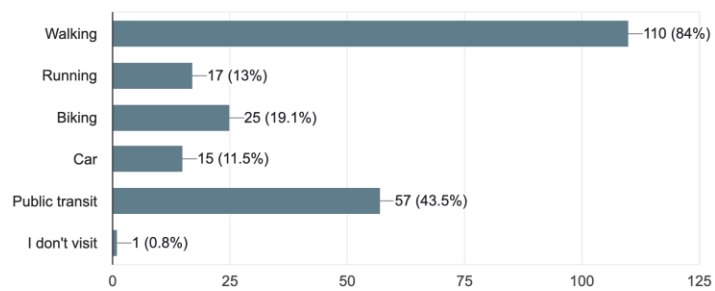
If this connection existed, how safe would you feel traveling along this route?

130 responses



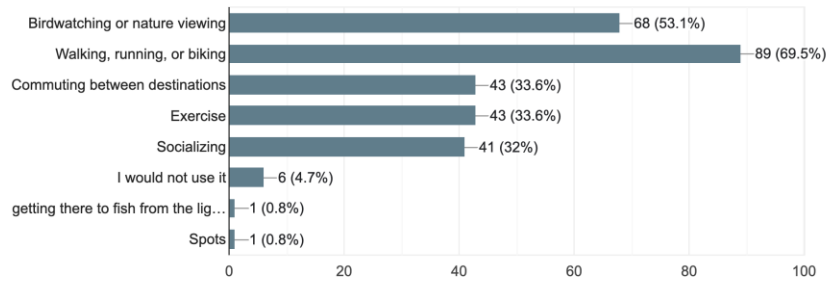
If this connection existed, how would you travel to the UBNA?

131 responses



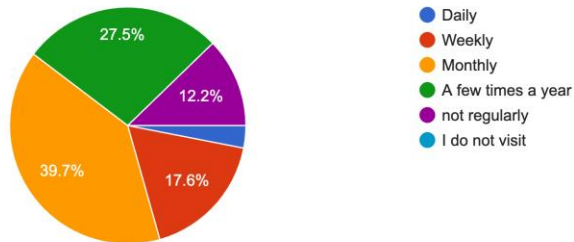
If this connection existed, what would you use it for? (Select all that apply)

128 responses



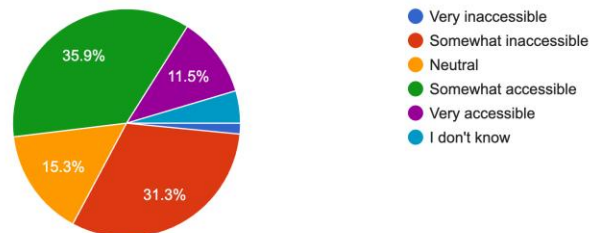
How often would you use this connection?

131 responses



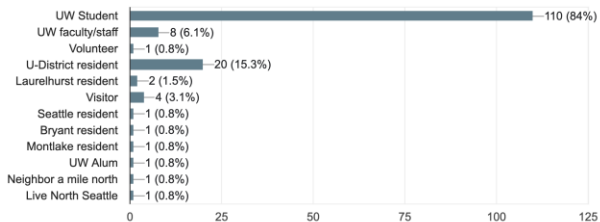
Overall, how accessible do you feel the UBNA is?

131 responses



Which best describes you?

131 responses



Union Bay Natural Area Access & Experience Survey Short Responses

- Preserving nature is the most important to me when it comes to the UBNA. Please consider wildlife and native plants when you build new trails.
- I would prefer that a pedestrian/biking connection is not built THROUGH the ubna but instead around it. The ubna is an important place for wildlife and a commuter route may increase traffic and displace wildlife near the proposed trail. Having the ubna be a destination where people go to respectfully engage with nature and wildlife is much better than it being a through route for commuters
- I love this nature area for its true feel of a nature area. It would be nice to have a gate to leave the park toward U Village at the north end versus needing to walk all the way around the northern field. I do not find this park unsafe.
- My main concern with a pedestrian/bike path to UBNA would be about whether the path obstructs or disrupts wildlife in the area.
- I would like to know more about how this potential bike path would impact the environment; would trees or other habitat have to be removed? What would the impact be to Ravenna Creek? Etc.
- Some paths at UBNA tend to flood, forcing one to either turn back or use sticks/planks/etc to step over. There needs to be a solution for this.
- Accessibility wise, I feel UBNA is very safe and accessible, however, I'm never opposed to making it more so. An additional suggestion I have is adding a boardwalk section (or something else?) to the portions that flood and have planks that act as "puddle avoiders" when the water is high. While I personally don't have mobility issues, I have struggled to cross the planks at times due to the planks being unsteady and/or floating slightly. While I'm sure this is a known issue, it's another accessibility challenge that may be worth adding to the list. I assume UBNA has things to keep tabs on.
- I access the area from the Burke Gilman at 36th Ave NE. Crossing NE 41st St. can be difficult because of fast vehicles and poor sight lines. At minimum there should be a painted crosswalk there. Even better- an all-way stop.

Appendix C: Site Maps

