Hydro-Sustainable Cool Bus Stop for Ashburton

Authored by:
Erica C. Pinket, MPS-EDM
Baltimore City Office of Sustainability

Brooke Burgess, MPH
Baltimore City and Meharry Medical College
Community Data Health Initiative Fellow

Terris King II
Temple X Academic Collaborative

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Abstract

The Liberty Grace Church of God is a long-standing Baltimore City faith institution and a designated Baltimore City Community Resiliency Hub (CRH) that serves the Ashburton neighborhood of West Baltimore. Grounded in its pillars of safety, health, and education, the church hub provides frontline resources during emergencies and activates as a cooling center when the Baltimore City Health Department issues Code Red warnings for extreme heat. As part of the city's hazard mitigation plan, (DP3-Disaster Preparedness and Planning Project), Liberty Grace Church of God recognized that heat exposure extends beyond indoor spaces and that transit users in Ashburton face prolonged environmental exposure due to limited shade, long walking routes, and bus wait times. With 11.5% of Baltimore residents relying on public transportation and Ashburton serving approximately 3,000 residents, the need for pedestrian-centered heat mitigation infrastructure is demonstrably critical.

To address this gap in extreme heat exposure, Liberty Grace Church of God in partnership with the affiliated Temple X Schools, expanded its community resilience role through the development of a hydro-sustainable cool bus stop project, known as the "Garden of Eden" with funding from the Leon Lowenstein Foundation and the Urban Sustainability Directors Network (USDN). Located at a heavily used bus stop in front of the church property, the hydro-sustainable cool bus stop project integrates a solar-supported water filtration station, fruit tree canopy, misting infrastructure, and digital crisis messaging to provide clean water, shade, food access, and trusted information.

Community involvement in the project was captured by youth-led community surveys that assessed residents' perceptions of water quality, public trust, and usability. The community was also informed of the independent water testing verified system performance against city-requested methods to align community assessment and outreach capabilities in one effort. Results from the community surveys indicate strong willingness to use the hydration station when water quality information is transparent, supporting both technical reliability and social trust. This initiative demonstrates how faith-based resilience hubs can extend climate adaptation infrastructure into public spaces, offering a replicable, equity-centered model for extreme heat mitigation in historically underserved communities.

Contents

Introduction

In the case of extreme heat mitigation in West Baltimore, the Liberty Grace Church of God serves as a Baltimore City Community Resiliency Hub (CRH) that activates during Code Red days, providing an air-conditioned environment for residents in need of management support of their personal heat thresholds. The Baltimore City Office of Emergency Management provides Maryland Foodbank donated water bottles to Baltimore hubs which can only be distributed on Code Red activated days that are declared by the Health Commissioner.

As an active CRH, Liberty Grace Church of God recognized an immediate need of shade canopy at the bus stop in front view of the church grounds and imagined a more sustainable way to distribute water on non-Code Red days. With hotter days occurring in Baltimore City's Urban Heat Island (UHI), Liberty Grace Church of God developed a solution for the residents struggling at the exposed bus stop presenting in need of water, shade, and an open invitation for hub use. The city does not have the capacity to increase the water supply for excessively hot days and has experienced 23 Code Red days in 2024 (Baltimore City Health Department). The increase of Code Red days has stretched the water supply available for distribution to become an additional challenge.

To solve this growing problem of water scarcity, water quality, shade deficiency, and limited communication, Liberty Grace Church of God hub proposed a hydro-panel project to extract moisture from the air for conversion into drinkable water at the frequented Ashburton bus stop. The need for planted fruit tree canopy to improve air quality, shade deficiency, and food scarcity, as well as a need for a misting station tent became aligned into a hydro-sustainable cool bus stop effort. The additional feature of the installment of a digital sign capable of solar connectivity, allows for Code Red days to be announced to those with limited social media and traditional messaging sources, and provides additional city-issued crisis messaging disseminated by a trusted resource in the community.

With the Ashburton community serving a population of 3,000, according to the U.S. Census Bureau, those who depend on public transportation are in need of extreme heat infrastructure support for residents without direct transport; as 11.5% of Baltimore residents use public transportation. Residents and pedestrians who walk long distances on Liberty Avenue experience little shade or extreme heat exposure relief as both directions are central areas of conducting community affairs. Walking, using public transportation, recreational cycling, and other physical modes of transport require thoughtful infrastructure to alleviate the extreme heat burdens of the city's Urban Heat Island effect, especially in the Black Butterfly.

Extreme Heat in the Ashburton community affects a wide range of vulnerable populations inclusive of able-bodied individuals with no adverse health conditions. Water consumption is critical to Baltimore's heat mitigation strategy as guidance from all City Hall issued notices include water consumption as a priority for extreme heat conditions and Code Red days. With water quality concerns in the community, the Liberty Grace Church of God hub addressed a cross section of community concerns into one solution-based effort. The first concern of an exposed bus stop, the

second concern of water scarcity, and the third concern of limited use of the hub space on Code Red days were applied through a lens of lived experience and a solution was provided.

This white paper discusses the process of building a hydro-sustainable cool bus stop, the community perspective of the endeavor, and best practices and guidance for replicability of hydro-sustainable cool bus stops in neighborhoods of similar social and infrastructural design.

Background / Literature Review

The Liberty Grace Church of God hub seeks to address interconnected community challenges that are deeply rooted in historical racism, structural inequity, and infrastructure disinvestment. Baltimore's hazard mitigation plan, the Disaster Preparedness and Planning Project (DP3), identifies extreme heat as a rapidly intensifying climate hazard with wide-ranging implications for infrastructure, public health, and urban resilience. Extended periods of temperatures exceeding 90°F are increasing in frequency and are projected to rise dramatically by the end of the century. These conditions place strain on energy systems, increase the risk of blackouts, and heighten danger for vulnerable populations, particularly older adults and individuals without reliable air conditioning. The City's vulnerability analysis highlights that neighborhood with low tree canopy and high impervious surface coverage—often low-income communities shaped by historic segregation experience amplified heat burdens and have fewer adaptive resources.

While Baltimore's Code Red Extreme Heat Plan activates cooling centers and emergency communication when heat indices exceed 105°F, the DP3 emphasizes that emergency response effectiveness depends on the strength of underlying social and physical infrastructure. Gaps in vegetation, outdated infrastructure, and inequitable access to cooling resources limit long-term resilience. Research further shows that extreme heat impacts are shaped by social determinants such as energy insecurity, housing quality, and disinvestment, meaning that exposure is not random but socially patterned. Within this context, cooling bus stops represent a resilience intervention that disrupts inequitable systems by embedding adaptation resources directly in high-exposure public spaces.

Understanding these dynamics requires a systems approach. Five priority domains—Transportation Access, Environmental Justice, Local Economy, Food and Water Access, and Education Access interact to shape vulnerability and opportunity.

Transportation Access

Public transportation plays a significant role in urban mobility, with approximately 10% of adults nationally and 11.5% of Baltimore residents relying on transit. In Ashburton, this reliance intersects with historic redlining and infrastructure disinvestment, which have left gaps in transit-adjacent amenities such as shade, shelter, and hydration infrastructure. First- and last-mile walking, combined with wait times, increases environmental exposure for transit users. As heat events intensify, bus stops become extended exposure environments rather than neutral transit spaces. Improving transit-adjacent infrastructure is therefore both a mobility and public health priority.

Environmental Justice

Extreme heat, air quality degradation, and urban heat island effects disproportionately burden historically underserved neighborhoods. The DP3 notes that areas with limited tree canopy and high impervious surfaces face greater exposure and reduced adaptive capacity. Health impacts include dehydration, heat stress, and worsening mental health conditions. Research demonstrates that increasing tree canopy and shade infrastructure can reduce localized temperatures, particularly in socially vulnerable communities. Environmental justice thus spans transportation, economic conditions, and housing systems, as the same neighborhoods facing environmental burdens also experience limited access to cooling resources and infrastructure upgrades.

Local Economy

Economic conditions influence both exposure to heat risk and the ability to adapt. Energy insecurity can prevent residents from using air conditioning even when available, as seen in research from other U.S. cities, where fear of high energy bills leads to dangerous indoor temperatures. Housing affordability, poverty, and limited public investment shape infrastructure needs and mobility patterns. Liberty Grace Church of God hub serves as a community anchor with land, trusted leadership, and established relationships, allowing localized resilience solutions to operate with lower ongoing costs. As a Community Resiliency Hub, the church can convert social capital into sustained infrastructure, reducing reliance on external emergency response systems and promoting long-term economic resilience.

Food and Water Access

Equitable access to food and safe drinking water remains a challenge in many Baltimore neighborhoods. A significant portion of residents live in areas with limited access to quality food, and historical disinvestment has contributed to deficits in water trust and infrastructure equity. Integrating hydration stations and fruit tree canopy into transit spaces addresses both immediate and long-term needs by providing clean drinking water, shade, and localized food resources. This approach links environmental adaptation with food system resilience and supports daily mobility to additional resources.

Education Access

Education and transparent information sharing are critical to resilience. Youth engagement and partnerships with local schools strengthen community capacity and ensure solutions reflect lived experiences. Research shows that residents prefer user-centered, easy-to-understand communication about water quality and environmental conditions. By sharing real-time data and emergency messaging at the bus stop, the project builds trust, empowers residents, and reclaims community agency. Education access therefore supports both behavioral adoption of infrastructure and long-term social resilience.

Together, these domains illustrate how the hydro-sustainable cool bus stop functions as integrated social and environmental infrastructure. By addressing transportation exposure, environmental

justice, economic vulnerability, food and water access, and education simultaneously, the model advances equitable, community-embedded climate adaptation aligned with Baltimore's resilience planning goals.

Methods / Project Description

The objectives for this project were to develop a hydro-sustainable cool bus stop from inception to completion with community support of a high-quality water source at no cost to anyone. To test the community's perception of the technology used in the solar filtration system and the associated Q-Code access capacity for the public facing benefits of a real-time water tested system at the hydration station. The hydration station consists of a water fountain that has two options for water dissemination. The system used is a CYCLEAU filtration unit that includes a water testing capacity which the public can see the water quality prior to their consumption. To test this perception, the Liberty Grace Church of God youth workers canvassed the area with a community survey collecting data on residents' willingness to use and trust the water, as well as to collect data on residents' ability to use Q-Codes.

Once the hydration station was fully installed, a city provided test was conducted on the water to determine if the unit's real time data is in alignment with city testing results. The method used was water testing. Once the two results were determined suitable for public use, and the stakeholders can track how many times the Q-Code was accessed to measure the full scope of public usage.

Data

Survey Data

The data recovered by the Liberty Grace Church of God youth workers include the responses to the following prompts:

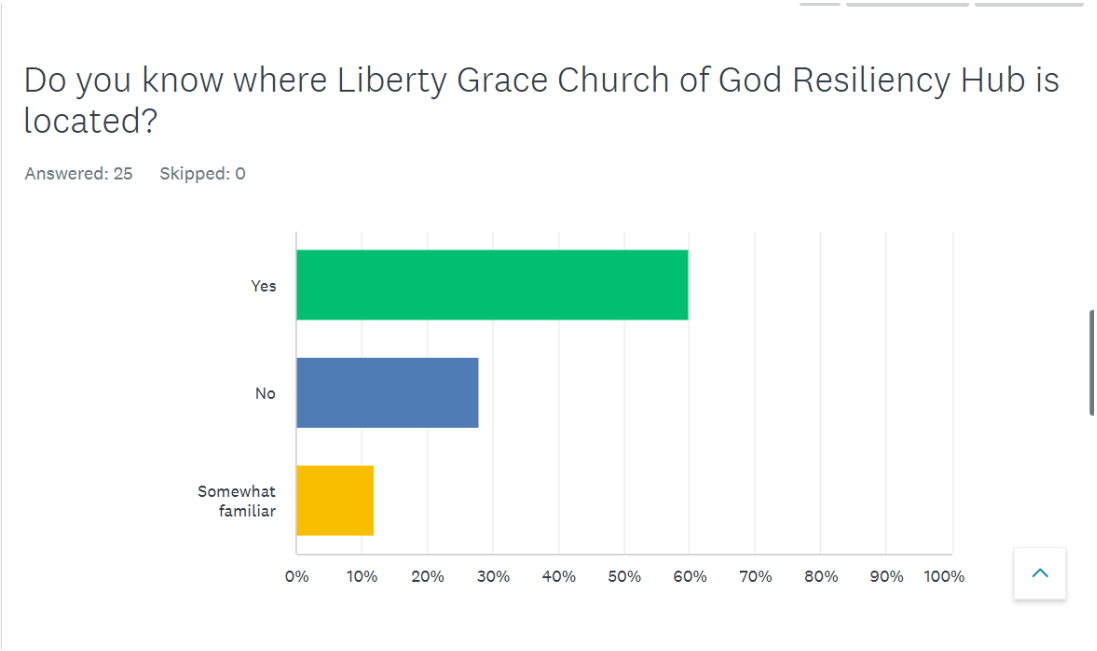


Figure 1: Ashburton Neighborhood Survey Question and Response

The survey results indicate that most respondents are knowledgeable about the location of the Liberty Grace Church of God Resiliency Hub, with approximately 60% selecting "Yes." Meanwhile, a notable portion of participants reported lacking awareness, and a smaller segment expressed only partial familiarity, suggesting opportunities for improved community outreach and visibility.

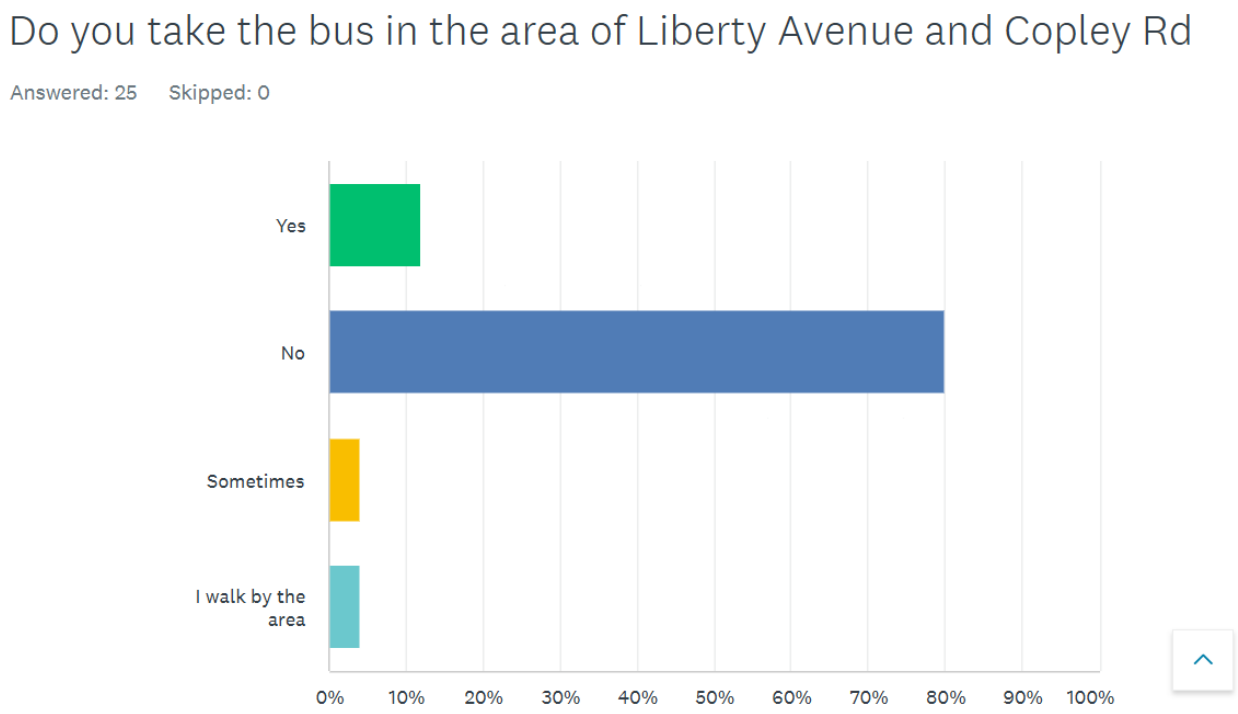


Figure 2: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
Yes	12.00%	3
No	80.00%	20
Sometimes	4.00%	1
I walk by the area	4.00%	1
TOTAL		25

Figure 3: Ashburton Neighborhood Survey Results by Percentages

The survey findings indicate that the majority of respondents do not regularly use the bus in the Liberty Avenue and Copley Road area, with 80% selecting "No." A smaller proportion reported consistent use (12%), while minimal shares indicated occasional use or simply walking through the area, suggesting that direct bus ridership at this location may be limited among the surveyed group.

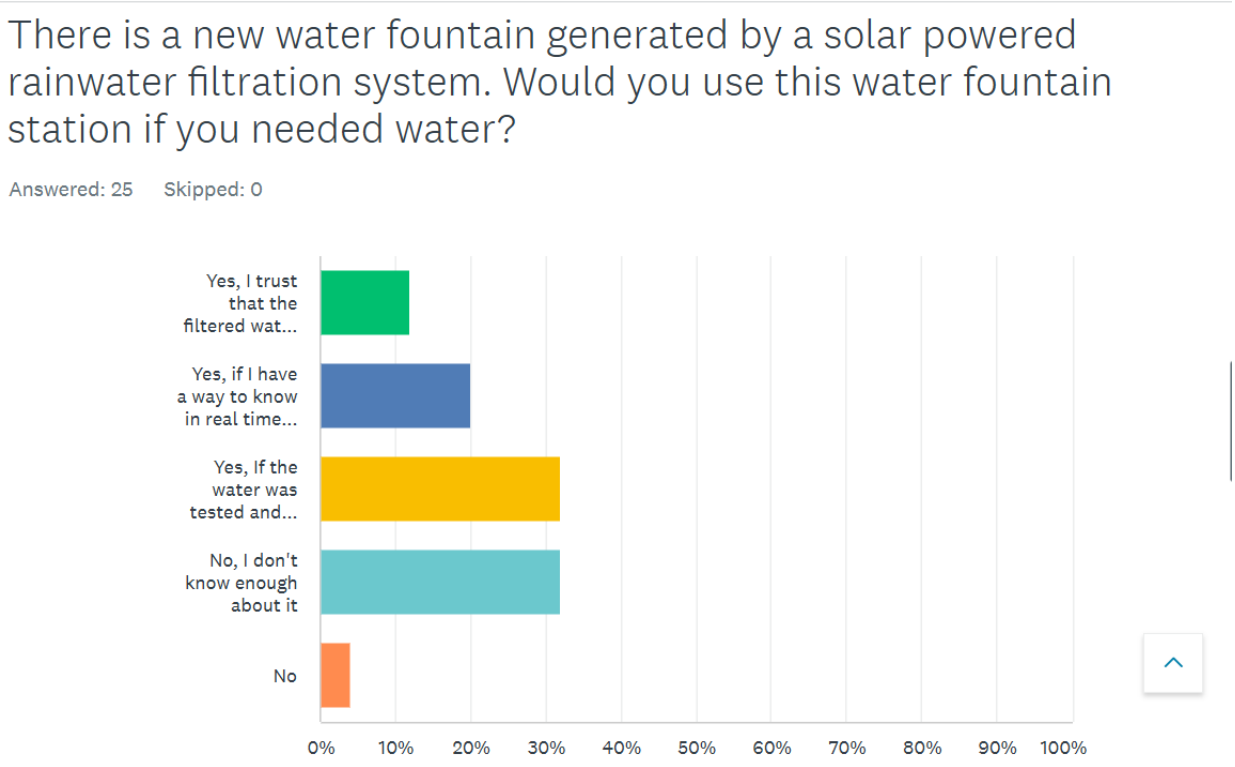


Figure 4: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
Yes, I trust that the filtered water will be good	12.00%	3
Yes, if I have a way to know in real time that the water is ready to drink	20.00%	5
Yes, If the water was tested and approved by an authorized agency	32.00%	8
No, I don't know enough about it	32.00%	8
No	4.00%	1
TOTAL		25

Figure 5: Ashburton Neighborhood Survey Response Percentages

The survey results suggest that willingness to use the solar-powered water fountain is strongly influenced by transparency and trust in water quality. A substantial portion of respondents indicated they would use the station if the water were tested and approved by an authorized agency or if real-time information confirmed its safety, while another large share expressed uncertainty due to limited knowledge about the system. Only a small minority reported unconditional trust or outright refusal, highlighting the importance of clear communication and visible water quality verification to encourage use.

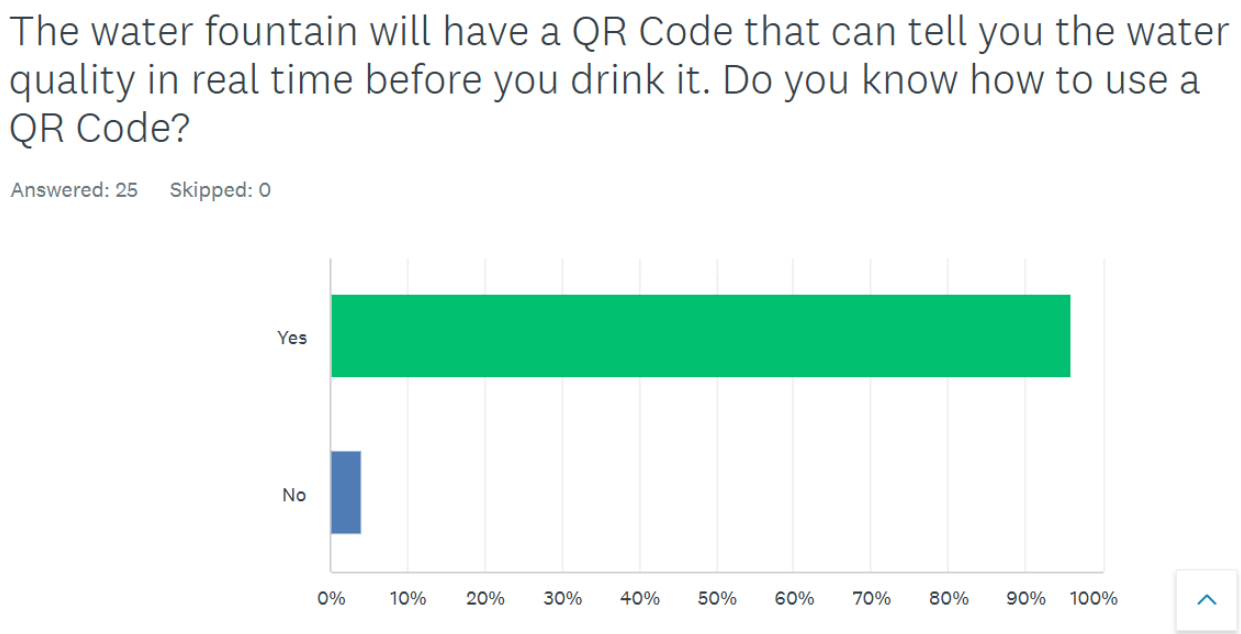


Figure 6: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
Yes	96.00%	24
No	4.00%	1
TOTAL		25

Figure 7: Ashburton Neighborhood Survey Question Response Percentages

The survey findings indicate that QR code literacy is nearly universal among respondents, with 96% reporting that they know how to use a QR code. Only a small minority expressed unfamiliarity, suggesting that QR-based real-time water quality communication would be broadly accessible to the community.

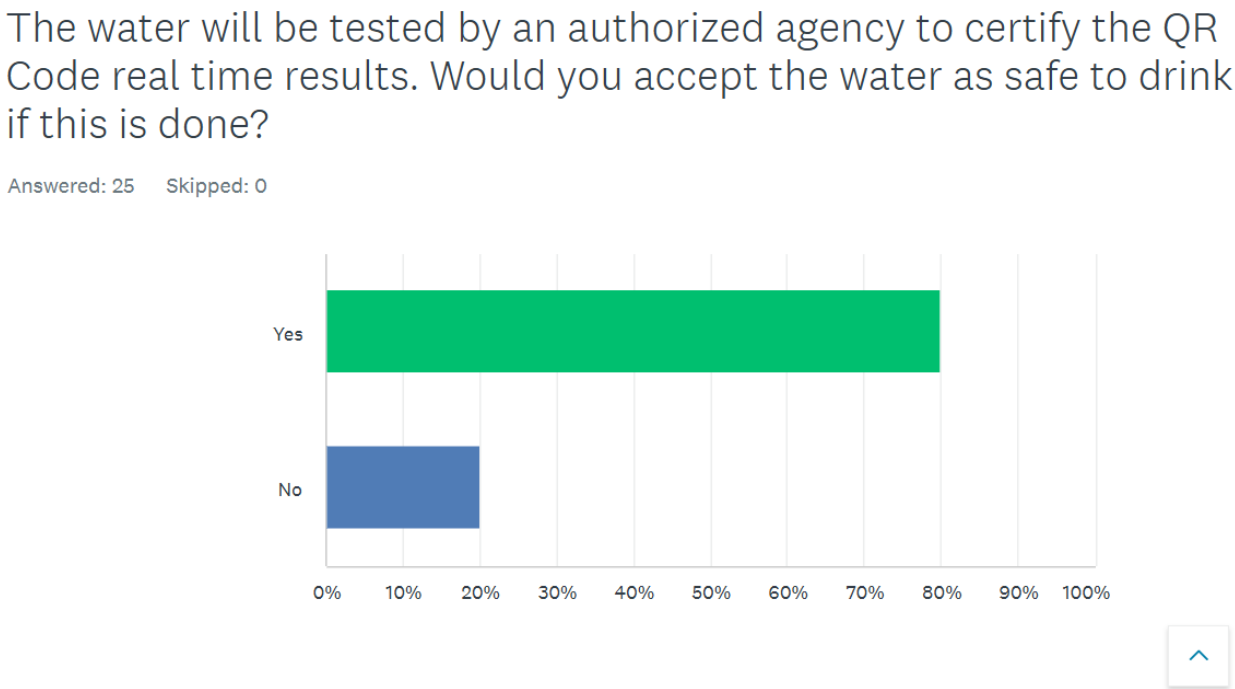


Figure 8: Ashburton Neighborhood Survey Question and Response

The survey results indicate a strong level of trust in the water system when independent verification is provided, with a clear majority of respondents stating they would consider the water safe to drink if it were tested and certified by an authorized agency. A smaller but notable portion remained hesitant, suggesting that while third-party validation significantly increases confidence, continued education and transparency may further strengthen community acceptance.

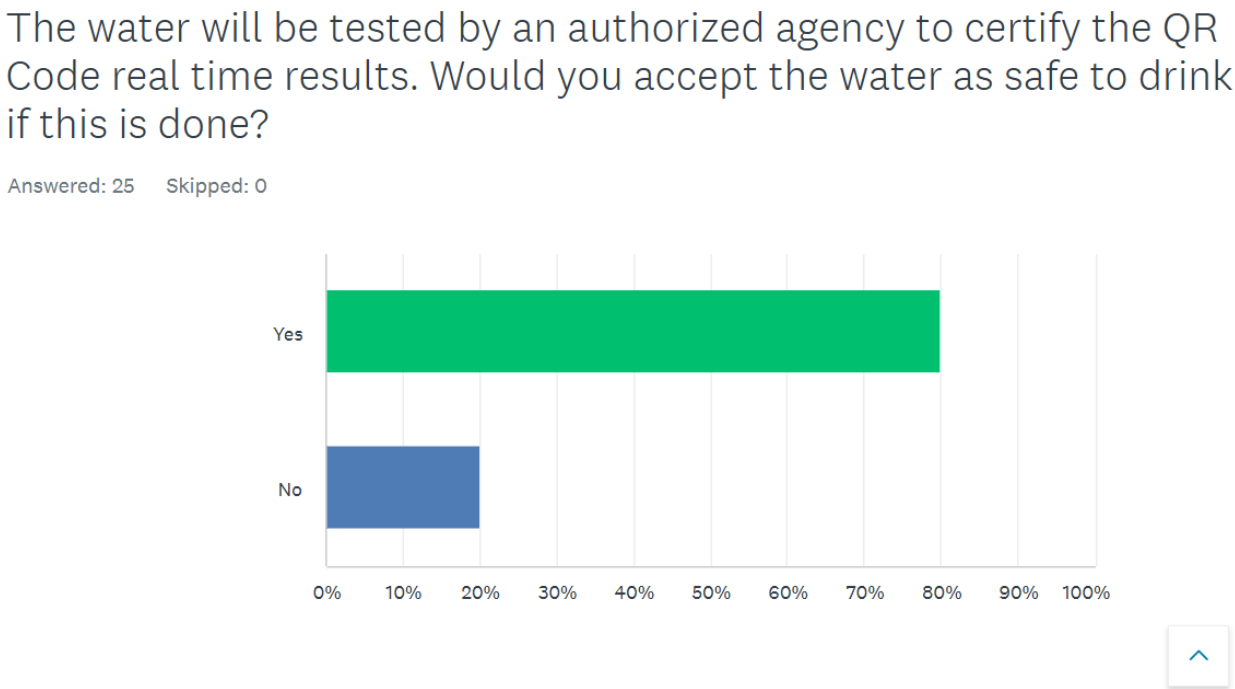


Figure 9: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
Yes	80.00%	20
No	20.00%	5
TOTAL		25

Figure 10: Ashburton Neighborhood Survey Responses by Percentages

The survey findings show that a substantial majority of respondents would consider the water safe to drink if it were tested and certified by an authorized agency, with 80% indicating acceptance. A smaller segment remained hesitant, suggesting that while third-party verification significantly increases confidence, continued communication and trust-building efforts may help address remaining concerns.

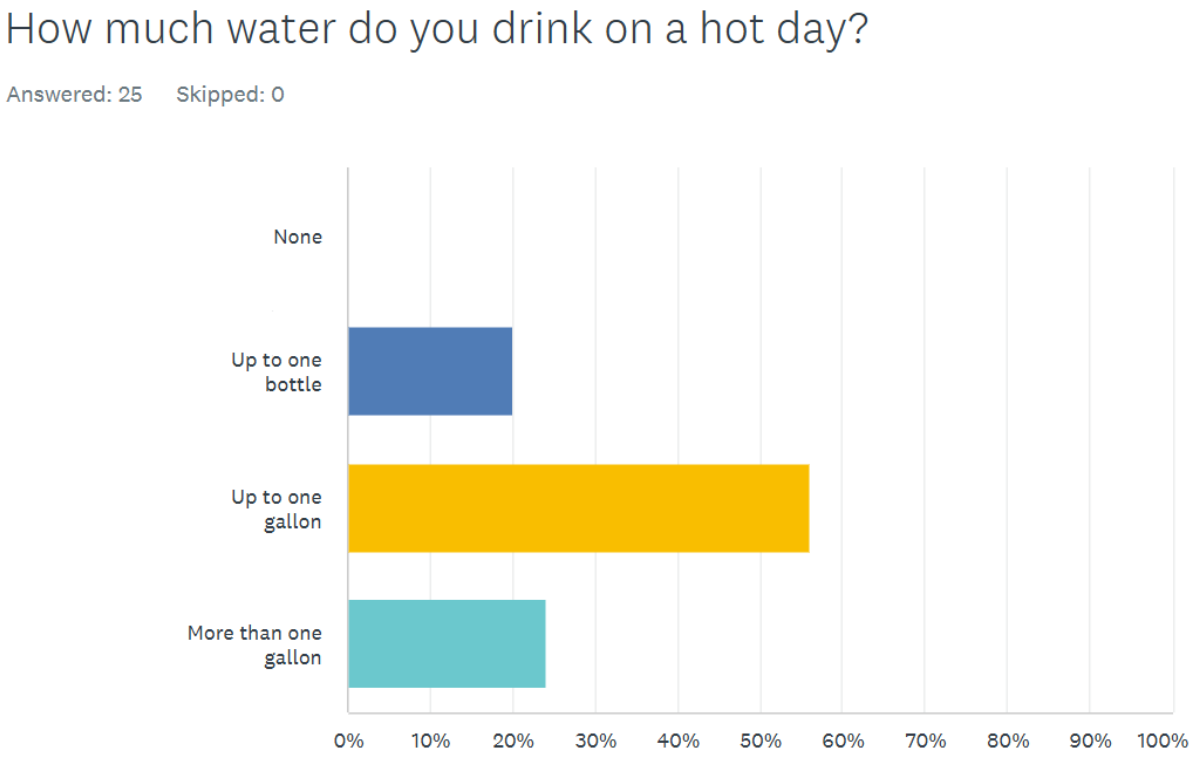


Figure 11: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
None	0.00%	0
Up to one bottle	20.00%	5
Up to one gallon	56.00%	14
More than one gallon	24.00%	6
TOTAL		25

Figure 12: Ashburton Neighborhood Survey Question Response by Percentages

The survey indicates that most respondents increase their water intake during hot weather, with a majority reporting consumption of up to a gallon per day and a notable share drinking even more. A smaller portion reported drinking only minimal amounts, while none indicated consuming no water, suggesting general awareness of hydration needs during high-heat conditions.

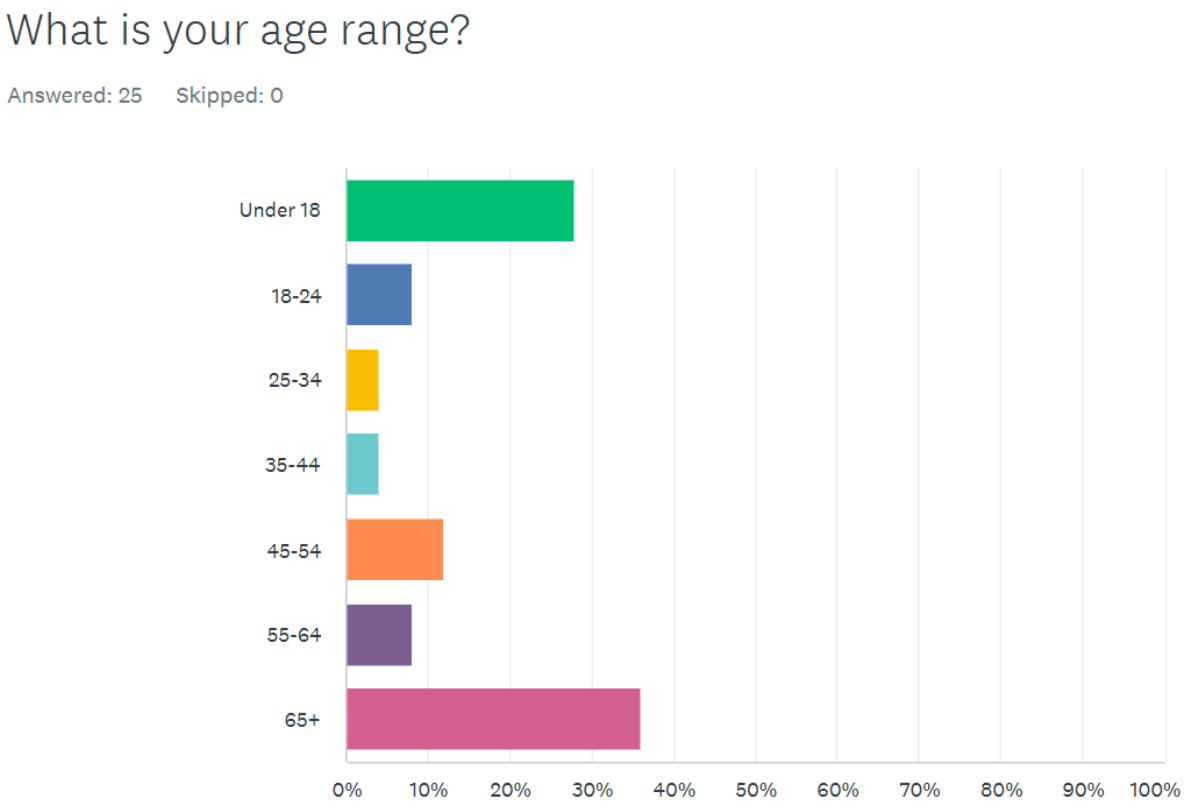


Figure 13: Ashburton Neighborhood Survey Question and Response

ANSWER CHOICES	RESPONSES	
Under 18	28.00%	7
18-24	8.00%	2
25-34	4.00%	1
35-44	4.00%	1
45-54	12.00%	3
55-64	8.00%	2
65+	36.00%	9
TOTAL		25

Figure 14: Ashburton Survey Demographic Responses by Percentages

The respondent pool reflects a diverse age distribution, with the largest share represented by adults aged 65 and older, followed by a substantial proportion of youth under 18. Smaller segments span middle-aged and young adult groups, indicating that perspectives were gathered across multiple generations, including both populations particularly vulnerable to extreme heat and those engaged in community youth networks.

Independent Water Quality Testing and Results

A water sample captured from the fountain installed at Liberty Grace Church of God (3400 Copley Rd, Baltimore MD 21215) was tested for contaminants including total coliform, e. coli, fecal coliform, salmonella, staphylococcus aureus, and pseudomonas aeruginosa by MidAtlantic Laboratories, Inc, an EPA-certified laboratory located in Port Royal, Virginia. The contaminants selected for analysis were deemed to be at medium- to high-risk of presence in untreated rainwater for their origins in bacterial sources including bird/animal feces and organic matter which may accumulate in gutters.

The test results overwhelmingly indicated minimal or undetected levels of bacterial contamination, particularly concerning the more dangerous and highly-regulated strains of total coliform, including E. Coli. In addition to coliform bacteria, three bacterial strains — which are unregulated for their limited risk to human health but may be high in concentration in untreated rainwater — were also analyzed. The test results captured are compared below to drinking water regulatory standards in the City of Baltimore:

Contaminant	Regulatory Standard/ Maximum Contaminant Level	Water Quality Test Result
Total coliform	0	<1/Not Detected
E. coli	0	<1/Not Detected
Fecal coliform	0	<1/Not Detected
Staphylococcus aureus	None	<1/Not Detected
Salmonella	None	Negative
Pseudomonas aeruginosa	None	9,000 cfu/ml

Table 1: Mid-Atlantic Water Quality Test Results (Florea, 2026)

All test results demonstrated negative or undetected levels of contaminants, with one exception being an outlier result for 90,000 cfu/ml of pseudomonas aeruginosa.

Pseudomonas aeruginosa is a bacterial strain commonly found in stored water sources including tap water and bottled water sources which remain stagnant for multiple days. There is presently no regulatory standard or recommendation for pseudomonas aeruginosa as it generally does not create risk for healthy people, though may impact immuno-compromised individuals. The outlier result indicating a high concentration of pseudomonas aeruginosa is expected to be a result of delayed shipping processes during the holiday season which caused the water samples to remain stagnant for up to 11 days prior to analysis. Pseudomonas aeruginosa is one of only a few contaminants

which can develop and multiple in highly filtered and distilled water sources, particularly when left stagnant. It can appear as a visible biofilm which may be yellow or green on the water's surface.

As the water samples otherwise indicate no bacterial contamination and as no biofilm or discoloration was noted in the sample at time of collection, the outlier result concerning a high concentration of pseudomonas aeruginosa is expected to be a false positive which does not reflect real-time water quality at the point of source.

Re-testing for pseudomonas aeruginosa in March 2026 at the time of the fountain's restoration (following the winter season) is recommended to re-evaluate actual potential concentrations of this bacteria as they reflect actual fountain water quality. Expedited/overnight delivery options for water samples should also be pursued insofar as the contaminant of concern is known to develop in filtered water sources which remain stagnant.

Moving forward, periodic testing is still recommended, particularly for coliform bacteria, as is expanding the number of parameters under assessment. Based on these results, the drinking water fountain installed at Liberty Grace Church of God is considered safe for consumption from a human health and regulatory standpoint, with the single outlier result considered a false positive caused by improper analysis protocol, namely shipping delays between the site and the lab during the holiday season.

Mid-Atlantic Laboratories, Inc.
State-Certified Environmental Laboratory.
224 Main St., Suite 1, Port Royal, Virginia 22535
804-742-5577 www.midatlanticlaboratories.com
Lab certifications: VA00215, WV #9926, MD #215, NC #51704

Certificate of Analysis

Client: LAERO LLC 11404 Crownwood Lane, Rockville, MD 20850
Report Date: January 21, 2026
Project #: PR18235
Sample Location: LCGOD SAMPLES

Date/Time Collected	Sample Location	Analyte	Lab Results	Units	RL	DF	Method	Date/Time Analyzed	Analyst
12/30/25 0500	LCGOD-1	Pseudomonas aeruginosa	90000	cfu/ml	1		FLOR-BART	01/10/2026 1230	JS
12/30/25 0500	LCGOD-2	Total Coliform	<1	MPN/100 mL	1	1	SM 9223 COLILERT	01/07/2026 1230	CE
12/30/25 0500	LCGOD-2	E. Coli	<1	MPN/100 mL		1	SM 9223 COLILERT	01/07/2026 1230	CE
12/30/25 0500	LCGOD-3	SALMONELLA (P/A)	Negative	Pos/Neg		1	AOAC 2011.03	01/09/2026 1519	CMF1
12/30/25 0500	LCGOD-4	Fecal Coliform	<1	MPN/100 mL	1	1	Colilert 18 QT	01/08/2026 0900	CE
12/30/25 0500	LCGOD-5	STAPHYLOCOCCUS AUREUS	<1	cfu/mL	1	1	BAM-12	01/14/2026 1452	CMF1

Waypoint Analytical - VELAP 460181
DF = Dilution Factor
RL = Reporting Limit
< less than = Not detected
Pos/Neg = Positive/Negative
MPN/100 mL= Most Probable Number Per 100 Milliliters
cfu/mL = colony forming units per milliliter

Mid Atlantic Labs, Inc
VA 00215
WV 9426
MD 215
NC 51704
Certified Analysis

Reviewed by:

KS Storke, Quality Control Officer

Comprehensive Overview

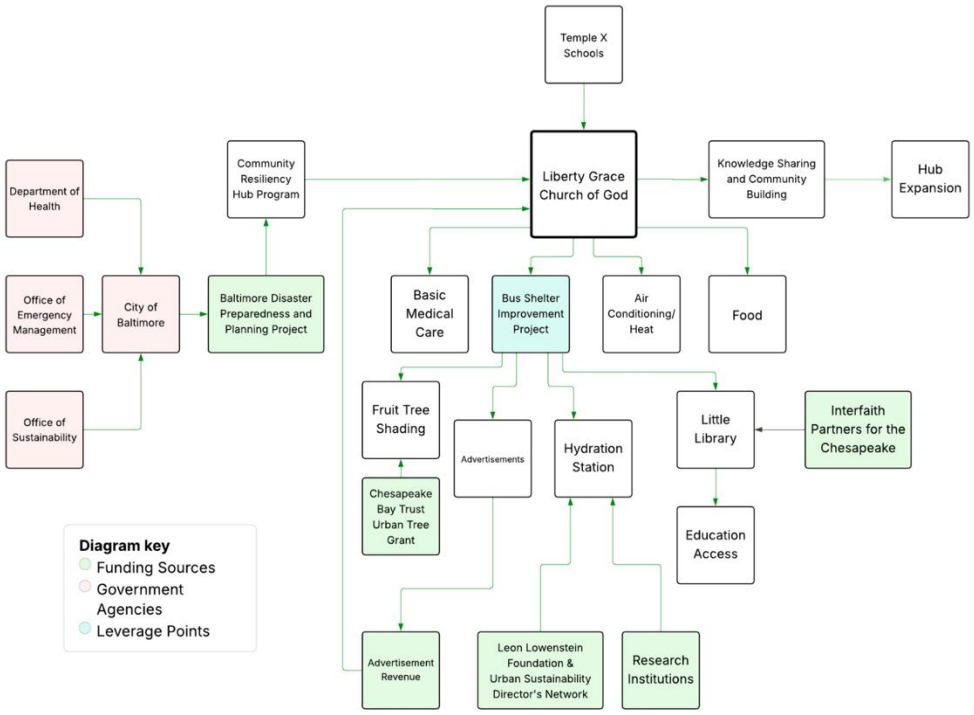


Figure 15: Liberty Grace Organizational Chart

The above diagram shows how Liberty Grace Church is functioning as a central leader in a broader socio-ecological mosaic of parts and levers that enabled the existence of the initial Cool Bus Stop project.

The central actor of this diagram is Liberty Grace Church itself, which functions as a Community Resilience hub and a faith institution trusted by the Ashburton community. The church itself is the vessel through which life-saving interventions like cooling, hydration, education, and health services can be delivered. The central actor acts as the primary decision maker and is anchored in community voice.

Moving to the left of the diagram, Baltimore City agencies create and curate the policy environment in which the Cool bus Stop operates. This includes emergency protocols and operations through the Baltimore Disaster Preparedness and Planning Project (DP3), which also provides the heat mitigation goals for which the project aims to reach.

Along the bottom of the diagram are multiple different sources of funding for the Cool Bus Stop project, with each source highlighting a particular component. The Leon Lowenstein Foundation and the Urban Sustainability Director's Network finance the hydrological systems and renewable energy aspects of the project. Meanwhile, the Chesapeake Bay Trust's Urban Tree Grant helps support increased tree canopy for shade. Advertisement revenue represents the future efforts of the

project to become self-sustaining and shift reliance on external grants and partners– a value emphasized by Liberty Grace Church representatives as central to the vision of the project.

Directly beneath Liberty Grace Church are the tangible components of its resiliency efforts: fruit tree shading, basic medical care, bus shelter improvement project, air conditioning/heat relief inside hubs, hydration stations. And little libraries and education access. Each of the components patch together different parts of the larger urban mosaic through forms of social and environmental infrastructure.

Towards the right of the diagram, community partners such as Temple X Schools, Interfaith Partners for the Chesapeake and research institutions contribute to the project with their capacity for knowledge and expertise. These knowledge hubs help expand Liberty Grace Church's ability to collect meaning data whilst engaging the youth.

Finally, the top-right area of the diagram paves the way for future growth, with the intention to expand the Cool Bus Stop model across the city of Baltimore through other faith-based institutions and stewards of community trust. In this way, Liberty Grace Church has the potential to act as a trailblazer and offer insights for new potential sites and partnerships for the continuation of Cool Bus Stops.

Financial Breakdown

Instating infrastructure that considers social networks and enhances community resilience represents sustainable investment into the future of the neighborhood. Instead of spending funds on emergency responses, the Cool Bus Stop offers tangible, durable, and preventative solutions by working within the existing social fabric– in this case, with faith institutions trusted in the community. For Liberty Grace Church, approximately $25k in grant funds were spent on the water infrastructure alone for the Cool Bus Stops. This upfront cost is juxtaposed by the lower costs of long-term operation due to community oversight, renewable energy sources, and less reliance on emergency measures.

Cool Bus Stop Replicability Tiers:

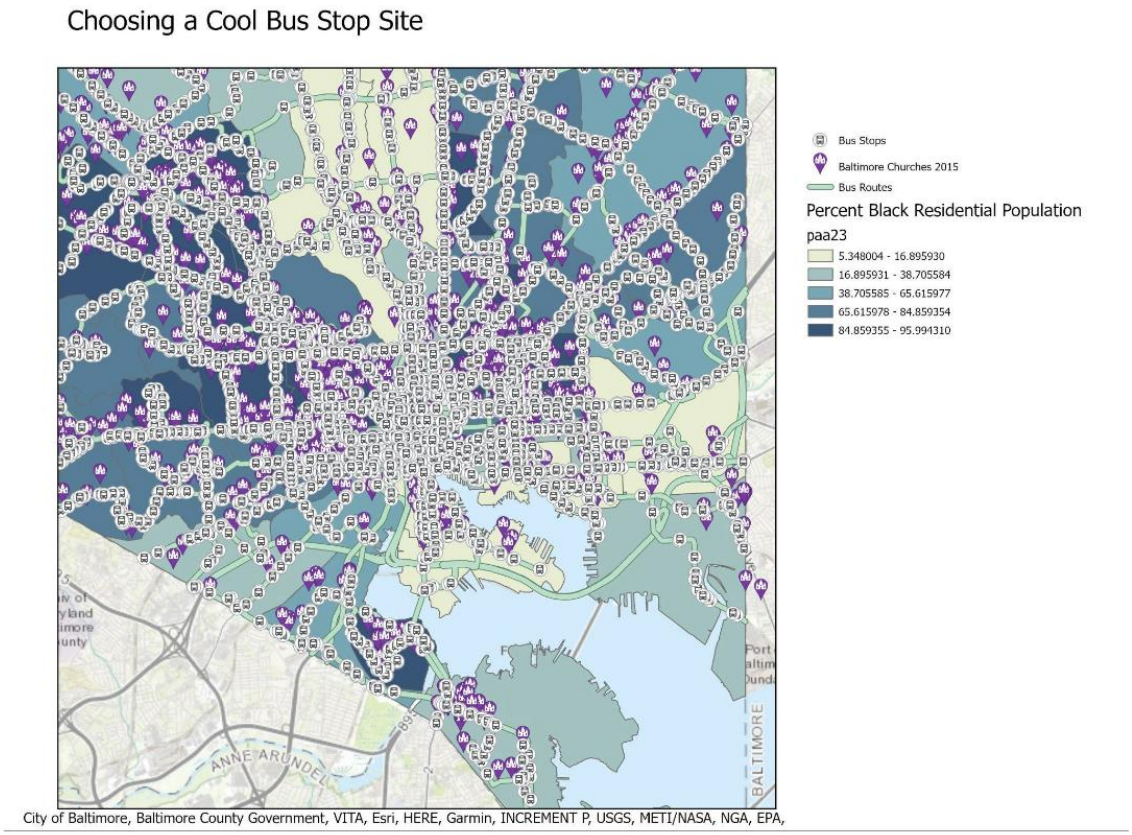
Tier	Included Components	Approximate Cost	Site Insights
Tier 1: Heat Relief	Shade infrastructure, digital alerts, seating	$5,000 - $10,000	Faith institutions near bus stops, moderate foot traffic
Tier 2: Water-Access Site	Tier 1 + water fountain	$10,000- $15,000	High foot traffic, existing infrastructure
Tier 3: Hydro- Hub	Tier 2 + solar-powered filtration, storage tank, QR code engagement Gauge	-$25,000	High heat vulnerability, strong church leadership and stewardship

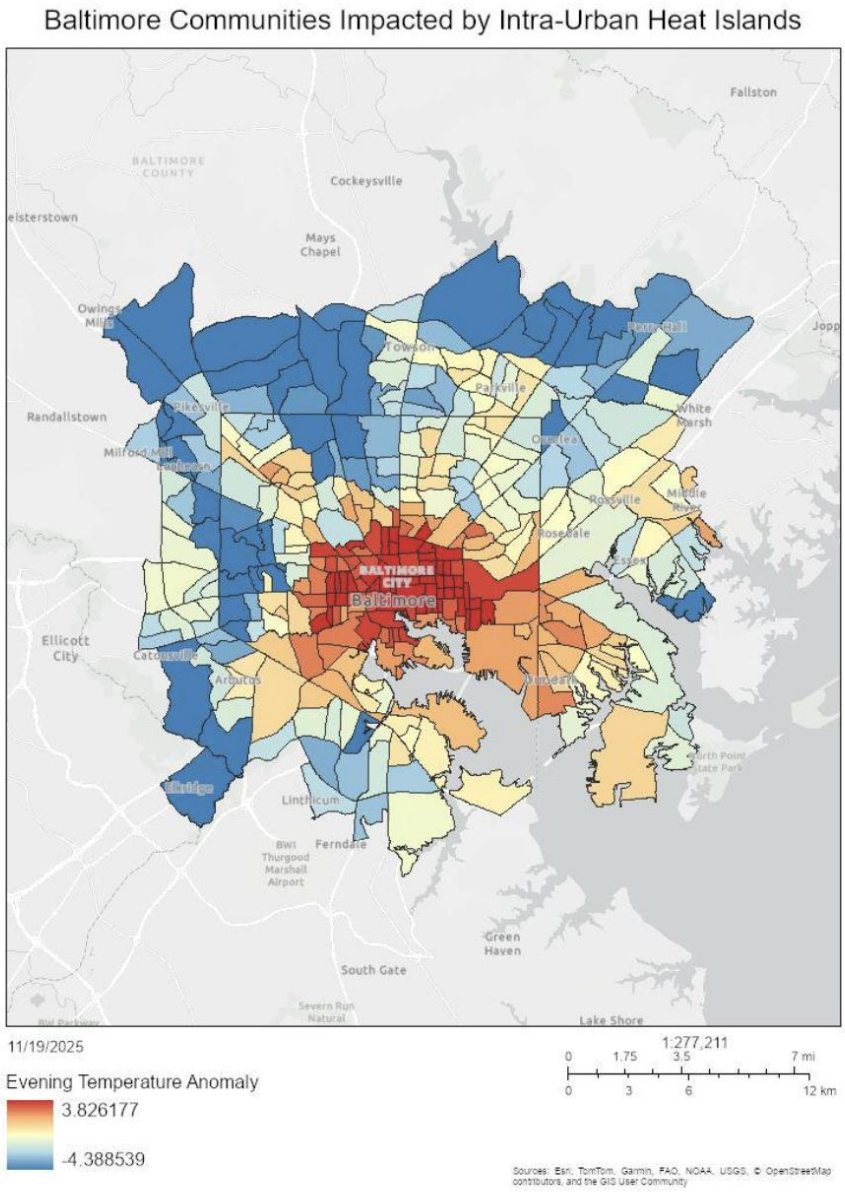
Table 2: Tiered Costs for Replicability

Note: These cost estimates are ordered by magnitude and are approximations used to demonstrate differences in tiers for planning and replication purposes and not strictly for finalized budgets.

GIS Spatial Models

Coupled with our tiered approach, our team also used GIS to help identify where such replication efforts would be socially meaningful and meet the "site insights" for each tier. Churches and bus stops across Baltimore were spatially mapped and overlaid with race population data to help determine likely Black faith institutions. We realize that Liberty Grace Church has existing connections and can likely forego this step in using the map for determining potential sites. The map can also be compared alongside the existing Baltimore intra-urban heat island from the NOAA Urban Heat Island Mapping Campaign (National Oceanic and Atmospheric Administration [NOAA], n.d.) to determine which areas have high heat vulnerability.





By mapping historically Black churches against urban heat island effect intensity as well as transit infrastructure, the GIS analysis proves that resources distributed based on structural vulnerability– such as exposure to redlining and disinvestment– shapes the needs of a community. By visualizing the replication process, Liberty Grace Church of God hub can remain transparent with its stakeholders and community members about how investments are prioritized. By integrating social infrastructure into spatial analysis in this way, the site selection process can become data driven as well as rooted in lived experiences of the community.

Discussion

This project is innovative as it pioneered three major ingenuities. The first is implementing the CYCLEAU unit in Baltimore with a customized build to provide a public facing unit with the technology protected and embedded in the hub property. The solar panels, water collection tanks, and CYCLEAU filtration unit was positioned in the rear of the property, and pipelines were installed to connect the filtered water source and the public facing hydration station. This partnership of private land use for a public good with no cost to any entity other than the initial investment award, has demonstrated the expediency of development when there is a no burden partnership.

The second cause for ingenuity explores deeper into the city partnership with community-based organizations to develop within capacity and utilize the best use of each entity to expedite project development. The partnership between the city and hub permitted for the opportunity from the Leon Lowenstein Foundation through the city's Office of Sustainability's membership with the USDN to directly impact the Ashburton community without the civic processes that can hinder time efficient expenditures. This project was given six months to complete and due to the hub receiving and expending independently, the project was made possible by direct payments from awardee to the vendors.

The third point of ingenuity is the customized technology used for the Ashburton community specifically. Initially, the project was intended to implement a hydro-panel which takes moisture from the air and converts into portable drinking water. The climate of Baltimore of harsh winters and insufficient dry air was not conducive to the needs for available technology now for hydro-panels. The next option was for rain collection water that uses the same CYCLEAU filtration capacity to purify gray water, hydro-panel water, or any water source in need of a process prior to consumption. The amount of water produced from hydro-panels is an insufficient amount of water for the population of the neighborhood. A goal was set to provide a gallon of water per day (rain permitting), per resident. For that, two 5,000-gallon tanks were secured. The CYCLEAU unit uses NSF-certified technology which ensures accuracy of assembly and processes which is shared in real-time with anyone with access to the QR-Code. This allows for a sustainable, no effort, and free water supply for a community with multiple lanes of vulnerability.

Planting fruit tree serves two objectives of the project which is shading at the public bus stop and nourishment. While the trees were planted on Liberty Grace Church of God property, their maturity is insufficient to offer the requisite shade for the many bus users at this location. To mitigate the lag in benefit, a purchase of a misting tent was secured to be managed on Code Red days by the activated hub.

With the fruit tree canopy, misting tent, and hydration station sits the digital signs for community crisis messaging. This addition at a highly traversed area by motorists as well as pedestrians allows for the hub to announce activations and community support messaging through a direct partnership with the city and the Office of Emergency Management CRH lead.

The ability to address a community level need with a community-based organization demonstrated a mutually beneficial relationship that required minimal exertion of resources, time, and stakeholder reluctance.

Lessons Learned and Best Practices

Lessons learned include the following takeaways:

1. Check availability of new technology at the time of development as new options became available and customization that were not available during the time of the proposal writing process of the grant award. The hydro-panel concept has been growing with interest and use of hydrogels have improved water extraction methodologies as cited by the MIT Review, *Bubbles' turn air into drinkable water* (Chu, 2025).
2. Utilize underground land use for water storage tanks. The water tanks could be efficiently stored beneath ground which frees up space that can be used for other above ground use.
3. Have a weatherization plan for the solar panels as they can be toxic to the environment if airborne during a storm or wind event.
4. When utilizing piping to transport water, ensure that there are flow and elevation considerations being made to avoid pressure and flow issues to the connected station.
5. Conceive of all potential uses for water connectivity in advance of the installation. With the misting tent and the digital signs, the solar panels could have been connected to the Digital Signs and the water lines could have been developed for irrigation of the canopy, the misting station as well as the fountain.
6. Consider an over supply of water. The pilot project planned for one gallon of water per resident a day. With larger investments in tanks, this could be increased substantially. If placing the water tanks below ground, this will support water sustainability at micro and hyper local levels in a no-cost, no burden endeavor.

Recommendations

We offer the following recommendations to Liberty Grace Church that focus on enhancing the longevity and replicability of Cool Bus Stops across the city of Baltimore. These recommendations are an extension of the "what, where, how, and by whom" framework that is used throughout this paper and focuses heavily on how to translate what we know in theory into direct action.

First, Liberty Grace Church expressed to us their desire to keep funding power within the church, in the hands of Black people. To do this, we believe that securing diversified streams of funding would be in the church's best interest. Combining public grants with philanthropic support and city partnerships that keeps the church's wealth of knowledge and social autonomy at the center is what matters for financial stability and reducing reliance on any single outside entity or stream of funding.

Next, we identified a prime opportunity to formalize youth engagement as a part of the program infrastructure. Liberty Grace Church has already implemented youth engagement through the

distribution of youth-led surveys. By emphasizing youth engagement as a part of the core infrastructure of Cool Bus Stops– perhaps through paid positions, training, and school partnerships– local capacity and longevity can be built while also ensuring that solutions are booted in the community.

Lastly, recognizing that today's socio-ecological mosaic is shaped by the policy decisions of the past (Roman et al., 2018); by partnering with policy makers, Liberty Grace Church can cement their cool bus stop strategy as a part of Baltimore's long-standing infrastructure. Liberty Grace Church is already identified as a Community Resilience Hub, so there is potential for Cool Bus Stops to be included in the integration of city resilience planning– formalizing implementation across the landscape of the city. Exploring the quantification of public health improvements of the bus stop's modifications can provide critical evidence in support for these proposals.

Conclusion

In conclusion, the goal of addressing a multi-pronged challenge of extreme heat in an urban heat island, with an exposed bus stop with no shade, and community dealing with food and water scarcity, the Liberty Grace Church of God maximized their partnership with the city of Baltimore's Community Resiliency Hub program to implement a solution in a more efficient timeline. The community was provided with a two-way outreach opportunity conducted by the youth workers of the hub, and a data analysis report was developed. The data identified any hesitancy and overall public trust in the water issued from the CYCLEAU solar filtration system which yielded favorable responses across the age groups. The water was also tested by Mid Atlantic Laboratory to ensure that the results were in alignment with the real-time water quality analysis provided by the hydration station QR-Code technology. The results include that the community is prepared, willing, and ready for the hydration station and has already served as a benefit in the community. The digital signs permit the emergency response capacity to address offline communication scenarios and information sharing in an age of mis/disinformation. The reliability of digital crisis messaging assists forthcoming systems tests address communication opportunities through the CRH program.

The replicability of hydro-sustainable bus stops is encouraged based on the facilitated install capacity, the no-cost and no-burden to any entities involved other than the initial investment award, and the lessons learned support the next implementation process for a more hydro-sustainable Baltimore.

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