

Appendix C

Final Risk Matrix Results from the CRB Workshop

Community Resilience Building Risk Matrix



H-M-L priority for action over the Short or Long term (and Ongoing)

V = Vulnerability S = Strength

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Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Group	Features	Location	Ownership	V or S	Hazard	Flooding/ Heavy Rain	Ice/Snow Storms/Extreme Cold	Drought/Extreme Heat		Priority	Time
						Actions				H - M - L	Short Long Ongoing
						Infrastructural					
1	Combine Sewer - DCU Center (flooding)	City-center	City	V	Rain/Flooding	1. Betterment tax for properties along flooding route 2. Prioritized sewer separation program				M	L/O
1	Stormwater Drainage System (Worcester Diversion Project.) --> clogging catch basin --> culverts in water course	City-wide	City	V/S	Rain/Flooding	1. Examine stormwater utilities 2. Education program to residents 3. Revisit maintenance (asset management) 4. Evaluate heavily treed area, downtown w/ trash issue, city recycling program (education)				H	L/O
1	Road/Slope (potholes, steep street) --> Asphalt/Drainage	City-wide City-wide	City/State	V/S	ALL	1. Belmont Street - high friction pavement 2. Cambridge street - raise bridge, lower road				L M	L L
1	Built water reservoirs (drought)	Outside city	City	V	Heat/Drought Rain/Snow	1. Building permits, low flow fixtures 2. Public education on level conditions 3. Continue to acquire property in and around reservoirs				M	O
1	Dams (conditions School (aging facilities)	City-wide City-wide	City/private City	V/S	Rain/Flooding Cold/Heat	1. Continue to evaluate dams for assessment / elimination 2. Continue with school upgrade/replacement (yearly)				M H	O O
1	Power Lines (tree canopy / location / access)	City-wide	Utility	V	ALL	1. Continue with Right Tree, Right place, Worcester Tree Initiative 2. Continue coordination with National Grid 3. Combination of education and grant opportunity				H	O
1	Housing (public/residential), age of construction	City-wide	City/residential	V	ALL	Combination of education and grant opportunity				L	L
2	Retaining Walls	Uplands	Private/Public	V	Flooding/Drought	Inventory, zoning to prevent flattening of hills				M	O
2	Old bridge deterioration - freeze/thaw	City-wide	City/State	V	Heat/Cold	Assessment of undersized culverts, bridges restricting flow. (Southgate St bridge, Quinsig @ Cambridge street --> identify car safety)				H	O
2	Undersized / outdated stormwater infrastructure / pipes	City-wide	City	V	Flooding	Green infrastructure. Create stormwater bylaws --> stormwater utility fee. Incentives --> LI credit, high strength sewer discharge				H	S
2	Electricity Infrastructure	City-wide	National Grid / City	V/S	Flooding Ice/Heat	Hardening system (above / below ground) strategically, Battery Storage, solar ordinance, staff				M	L
2	Communication Infrastructure	City-wide	City	V	ALL	Study to identify community leaders to communicate without using cell phones, resiliency hub - social network map. --> Flash flood identification lights/signs				H	S
3	DCU Center (Could be a shelter)	50 Foster St	City	S/V	Flooding / Heat	Green infrastructure to address/mitigate flooding of public right of way. (would improve St Vincent hospital)				L	L
3	Worcester Technical High School (shelter) Primary city shelter	1 Skyline Drive (top of hill)	City	S	Snow/Ice	No action - skyline road already priority road				H	O
3	Railroad track and vehicular underpasses	City-wide	Private/City	V	Flood	1. City to advocate to MBTA for reliable contingency plan. 2. Develop a work in Worcester program so people work where they live				H	S
3	Combined Sewer	City-wide		V	Flood	Challenge is retrofitting to new standards and tap on new development				M/H	O
3	MBTA Commuter rail (regional issue) Worcester Transit WRTA Depot (Endicott street)		State / City	V	Snow flooding						
3	Wastewater treatment plant		State	S/ V	Flooding						
3	Medical Infrastructure (Amass campus, St. Vincent Hospital)		Private	V	Flooding						
3	Schools	City-wide	City	V	Extreme cold / heat	1. Proceed with vulnerability and risk assessment of buildings to identify most at risk / privatized. 2. Identify early actions 3. Develop guidelines for resilient facilities to integrate flooding and heat resilience				H	S

Group	Features	Location	Ownership	V or S	Hazard	Actions	H - M - L	Short Long Ongoing
4	Water filtration plant and reservoir	Holden / Worcester	Public	V/S	Drought	1. Reduce treated water consumption with LID solutions, monetize 2. Fix pipe leaks, increase water use costs, greywater, rationing during drought	H	L
4	Rear power lines and telephone poles	Residential Areas	City	V/S	Ice/Snow	1. Map grid inventory and make it public 2. City and utility company figure out a proactive plan	M	L
4	Transportation system (auto-focus)	City-wide	City	V/S	Cold/Heat/ Flooding	"Complete Streets Initiative" in MA, community education about transportation, Connection with upcoming master plan, and bicycle master plan, hire additional city planner for transportation	M	O
4	National Grid Electricity/Utilities System (Chandler St, Webster St, Lancaster St substations)	City-wide		V/S	Flooding/wind/ Heat	City to work with DPU and utility companies to develop a more effective plan, Public meetings about changes, FUTURE bill in legislature	H	L
4	Older Schools (Doherty and South) - there are lots	City-wide			Heat/Snow/Cold	New buildings are ideal to fix heating/cooling problems. Otherwise fix leaks in insulation, retrofit windows, keep a mind towards efficiency, regular maintenance, potential danger as emergency shelters	H/M	O
4	Aging building Infrastructure				Flooding / Heat / Cold	Help people utilize MassSave, aggregate services, energy efficient building score - initiative for homeowners	H/M	O
5	Water Distribution System	Regional	City	Both	Snow/Ice Extreme Heat	Education about frozen pipes, redundancy systems, public education on water use/reuse	M/H	L/O
5	School Buildings	City-wide	City	Both	ALL	Adaptive capacity (extreme temps.). Schools as neighborhood resilience hub. Green roofs, HVAC, Air quality	H	L
5	Emergency Response (Facilities and Systems)	Regional	Private	Both	ALL	Multi-lingual communications/messaging. (Reverse 911, etc.) Expand CERT to resilient neighborhood network	L/H	S/L
5	Utility Systems	Regional	Private	Both	ALL	Decentralization / Microgrids --> incentives Community / Neighborhood scale solutions	H	L
5	Transportation systems	Regional	ALL	Both	ALL	WRTA building --> Flood risk! Dual-use flood storage / infiltration / education / conveyance, Daylighting Blackstone Canal	H	L
5	Sewer / Stormwater Systems	Citywide	City	Both	Extreme Heat Flooding	Rain gardens, permeable pavement. On-site prevention vs. pipe replacements. Stormwater utility fee + incentives/credits for GI/LID		
6	Hospitals + community health centers + need for urgent care facilities	Various	Private	S	Floodplain	Use as showcase of LID (\$) best practices + accessibility to vulnerable populations	H	O
6	Highway access	West access	Local / State	S/V	All	1. Triage roadways and emergency routes and communication. 2. Identify plan to communicate, public campaign to know what to do	H	S/O
6	Water and Sewer (esp. CSO + Quinsig Ave)	Various		V	Precipitation	1. Wayfinding plan with real-time messaging 2. Shelter access, facilities, evacuation plan 3. Low tech solutions of where flooding occurs (Shore Dr, Harding St, Canal District)	H	S/O
6	Electric Transmission Lines (Old)			V	Wind	Put utilities underground, microgrids / decentralized infrastructure - flood resistant design	M	L/O
6	Reservoirs / Drinking water systems	Holden, Leicester	Local	V/S	Precipitation / drought	Increase water quality monitoring, both recreational and drinking water, including non-regulated sources, better public info campaign on water quality	M/L	L/O
6	Fire/Police/EMS (infrastructure)	Especially vulnerable locations at Route 20 and Amass	Local	V/S	All	High water capability, increase water training, plan and equipment		
6	Stormwater		Local	V	Precipitation	Alternative methods of treating excessive stormwater and keeping drinking water clean, especially as relates to contamination. (ex. Scaling living systems lab and locating GI in needed vulnerable areas to increase capacity of known hazards)	H	S/O
6	Roadway Triage and Management (especially ice and flooding), maintaining roadway network access (especially the west side of the city), develop emergency routes	City-wide, state-wide	Local / State	V	Snow/Ice	Triage roadways and emergency routes and communication? ID plan to communicate, public campaign to know what to do	H	S/O
6	Old housing stock (need retrofiting, health, efficiency)		Private / Local	V	All			
6	Schools K-12 (Sheltering regulations, efficiency --> A/C, etc.)		Private / Local	S	All			
6	Universities (Sheltering regulations, efficiency --> A/C, etc.)		Private / Local	S	All			

Group	Features	Location	Ownership	V or S	Hazard	Actions	H - M - L	Short Long Ongoing	
	Societal								
S	1	Community Action (engagement) Municipal Involvement	City-wide City-wide	Community Community	S S	Heat/Drought ALL	Engage neighborhood communities with educational info	H	O
S	1	Diversity (broadly) Emergency communication	City-wide City-wide	Community Community	S V	ALL	1. Flashing light system for communication hazard / emergencies (educational) 2. Planning work to include diversity form the city (community engagement/outreach) 3. Educate transient population on climate related precautions	H	O
S	1	Displaced populations/housing Mobility of Vulnerable population (especially elderly)	City-wide City-wide	Community Community	V V	Heat / ALL			
S	1	Population distribution / living (access to services)	City-wide	City	V	ALL	WRTA to serve greater community	M	S
S	1	Availability of emergency response staff	City-wide	Community	V/S	ALL	1. Preparing residents to shelter in place 2. Continue collaboration with neighboring communities / agencies 3. Consider engaging emergency volunteers (National Guard)	M	S
S	1	Portion of city may be susceptible to mobility, communication and access issues (especially vulnerable populations)	City-Center	Community	V	ALL	1. Consider utilize ride-share/taxis for emergency transport 2. Tweak building code to be more stringent in flood areas	M	L
S	2	Bus Ops Center / Maintenance Garage	Green Island	WRTA	V	Flooding	Plan for alternative maintenance during flooding events	L	S
S	2	Age of Building Stock	City-wide	Private	V	ALL	Tenant/Owner Education	H	S/O
S	2	Designated storm shelters	City-wide	City	V	Snow / Flood	More robust study of storm shelters overlaid w/hazards (ex: light green = open, red = closed)	H	S
S	2	Vulnerable population at risk (gentrification, lack of education, lack of resources)	City-wide	City	V	Flood Heat	Education (multilingual), Displaced people --> resettlement specialist connected to city	H	O
S	2	Overstressed health providers	City-wide	City/Private	V	Heat	Health Department can facilitate continuity of operations plans for regular hazards	M	S
S	2	Absentee Landlords	City-wide	City	V	ALL	Rental registration - including climate considerations	H	S/O
S	2	Translation / Access to important info	City-wide	City	V	All			
S	2	Green island neighborhood --> social services		private	V	Flooding			
S	3	The Village Family Homeless Shelter (150 Residents, 80 households)	Cambridge Road	Private, OMHA operated	V	Flooding	1. Make sure population at risk know about services available - define and identify population at risk and building trust 2. Building needs to be significantly upgraded and made resilient - challenge is funding. (governance issue) 3. Be more inclusive of population that is disproportionately impacted - broader representation/broader means of communication	H	O
S	3	St. John (temporary shelter, hotel grace over shelter)	44 Temple Street	Private	S	Flooding (Green Island)	Gap between population in need and resources & communication in time of stress		
S	3	People relying on T for jobs in Boston		City	V	Heat		H	S
S	3	Healthy Buildings / Schools		City	V	Wintry Mix (flooding)			
S	3	Affordable Housing (Worcester Housing Authority)		City	V	Wintry Mix (flooding)			
S	3	Senior Centers (Assisted Living)	Mt. Vernon / Multiple	City	V	Flooding / Heat	1. Make sure that they have emergency plans coordinating with public health department and first responders. 2. Assess vulnerability and develop a plan	H L	O L
S	3	Areas for growth/economic development	Downtown	Mixed	V	Flooding / Heat	1. Work with developers on implementing resilient infrastructure 2. Explore ideas for the city to enforce or encourage resiliency measures in new buildings or renovations 3. Advocate for building code to be updated for resiliency regulations 4. The new baseball stadium presents and opportunity for water management/storage in area vulnerable to flooding and UHI and opportunity to join stakeholders in common projects	H	O
S	4	Foreign Language Speaking Populations	City-wide		V/S	Cold/Heat	More engagement and outreach, sustainability focus, information accessibility	H	L
S	4	Leaf Disposal Practices	City-wide		V/S	Flooding/ snow removal	Boost composting programs and education, take leaves/debris to community garden	M	S
S	4	Homeless Population/Shelters				Cold/Heat			
S	4	School Closings / Busing Issues	City-wide			Heat/Cold Snow/Ice	City is working hard on the busing problem, fewer car drop-offs and more effective busing system. Need more data on students/parents routines. Why drop-off?	L	O

Group	Features	Location	Ownership	V or S	Hazard	Actions	H - M - L	Short Long Ongoing	
S	4	Homeowner/Renter disconnect (EJ population)	city-wide		All				
S	4	Poor Populations	City-wide		ALL	More engagement and outreach, sustainability focus	H	L	
S	4	Seasonal Populations	City-wide	V/S	Snow/Ice Flooding	Integrate campuses with sidewalks, bike paths, safe pedestrian walkways, utilize college student energy with internships, research opportunities and summer programs, orientation information	M	L	
S	5	Transportation Fleet / Mobility	Regional	ALL	Both	ALL	Use school buses to address mobility limitations during emergencies Privatize transit system / redevelop	H	L
S	5	Health / Medical Access	Regional/State	Regional/State	S	All	Decrease hospital visits / reliability as 1st resort (hubs, onsite, shelters/schools) Tap into medical resource corps (underused) Alternative treatment options	M	O
S	5	Student Population	Citywide	Public/Private	Both	All	Emerging resource / problem solvers Require unique / specific preparedness / response measures (EOP, etc.)	L	O
S	5	Vulnerable Populations (Seniors, special needs, immigrants, disabled, low/limited income, etc.)	City-wide		V	All	Property protection / personal preparedness (education / outreach) Empower renters / incentivize landlords + property managers to retrofit, adapt, invest in resilience)	H	L
S	5	Inclusive / Collaborative Culture	Citywide		S	All	Build coalitions / resilience hubs --> connect with other social service organizations, demonstrate and replicate	H	L
S	6	Community centers, connections		Private / Local	S/V	All	1. Sheltering plan, public info to be accessible, communication plan, invest in emergency management planning and clear regulations, build CERC team, better interdepartmental cooperation and collaboration 2. Work with state to increase needs and benefits of unifying administrative collaboration. Needed in all municipalities 3. Enhance partnership with other municipalities for regional emergency management	H	S/O
S	6	Fire / Safety Communications		Local	S/V	All			
S	6	Emergency Sheltering and Communication		Private / Local	V	All	1. Sheltering plan, public info to be accessible, communication plan, invest in emergency management planning and clear regulations, build CERC team, better interdepartmental cooperation and collaboration 2. Work with state to increase needs and benefits of unifying administrative collaboration. Needed in all municipalities 3. Enhance partnership with other municipalities for regional emergency management	H	S
S	6	Homeless populations (especially sheltering during extreme weather events, caring for mental health / addicted groups)			V	All	Training program for municipal staff to understand resources available and advisory council (informed by representatives from the community), marketing and outreach (website to reduce language barriers and improve access to services), multidisciplinary training for non-profits, religious organizations etc.	H	L
S	6	Public knowledge / awareness vs. existing conditions of hazards			V	All	Create coding of hazards (ex. flag colors) of water quality and drought to eliminate language barriers and improve communications. Create phone tree to get messages out to neighborhood groups and homeless population by name/list	H	S/O
S	6	Nonprofits (legal, language, housing, and religious organizations)			S	All	Training program for municipal staff to understand resources available and advisory council (informed by representatives from the community), marketing and outreach (website to reduce language barriers and improve access to services), multidisciplinary training for non-profits, religious organizations etc.		
S	6	Public Transportation		Local	S/V	All	Smaller buses - run more frequently, walkable neighborhoods, bikeable streets, city transportation plan, hire transportation planner	H	S/O
S	6	Recreation - waterways, trail system		Local / State	S	All	Campaign for increased use, make inviting	M	L/O
Environmental									
E	1	Topography (7 hills in Worcester) - impact to weather microclimate	City-wide		V	ALL	1. Revisit zoning with respect to microclimates 2. Limit the slope of driveways, stormwater management requirements	M	L
E	1	Residential / Forested brush fires (land use)	City-wide		V	Heat	Right Tree, Right Place	L	O
E	1	Wetlands Conservation Areas	City-wide City-wide	State City/Private/State	S/V S	Rain/Flood	1. Continue with protection and maintenance/inspection, ordinance 2. Provide public education	M	O
E	1	Invasive species (lake organisms, aquatic species, beetles, etc.)	City-wide City-wide		V V	Heat/Flood Flooding	1. Consider implementing pervious pavement 2. City could require landscape buffer	H	O/S
E	1	Air Quality			V	Heat	1. Focus on increased enforcement/compliance (school retrofits) 2. Expand reporting, implement carbon tax	H	L
E	1	Open Space Recreation / Waterways			S/V	Flooding	1. City to evaluate vacant/unused lots for green infrastructure (Park aver, Mill stop/shop)	H	S
E	2	Hills	City-wide	City	S/V	Flooding/Heat	Wind power, improving pedestrian network	L/H	L/S/O

Group	Features	Location	Ownership	V or S	Hazard	Actions	H - M - L	Short Long Ongoing	
E	2	Parks + Open Space	City-wide	City	S	Heat	1. Open space under I90 near Indian lake 2. Upland stormwater detention 3. Bike infrastructure --> complete streets	M M H	L L S
E	2	Trees	City-wide	City	S/V	ALL	Urban forest master plan	M	S
E	2	Water Bodies	City-wide	City	S/V	All	1. Study Beaver Brook daylighting 2. Purchase repetitive loss properties for stormwater retention / storage 3. Wetland migration / growth plan	L L M	L L L
E	2	Soil Contamination	City-wide	City/EPA	V	Flooding	LID zoning requirement for new parking, education on upland fertilizer use, city could set a % of GI funds relative to grey infrastructure	H	S
E	2	Waste/Trash/Garbage/Water	City-wide	City	V	Drought / Flood	City food composting --> commercial and residential. Study or policy. Cost benefit analysis of waste bin practices	H	S
E	3	Water Reservoirs	Holden	City	V	Drought	There is a plan B to purchase		
E	3	Waterway - Water Quality	System	City	V	Flood	1. Continue sewer separation - proceed with feasibility study. 2. Timing opportunity with new development for integrated approach (GI)	M/H	O
E	4	Gas Leaks and Methane Emission	Near Schools			Heat	Fix gas leaks, FUTURE bill in legislature	H	O
E	4	Tree Canopy	Downtown		V	Drought/Heat	Plant trees in urban areas of the city, Worcester Tree Initiative, more funding, trees on the street should be default, not homeowner choice.	M	O
E	4	City Parks	Not near downtown			Drought/Heat	MVP Plan should dovetail with Worcester Open Space plan, pocket parks, converting parking lots / unused space to public parks downtown	H	S
E	4	Recreational Water Bodies	Indian Lake, Coen Pond, Quinsig Lake			Heat/ Flooding			
E	4	Pathogens	City-wide			Heat/Drought flooding	Assess and collect data to define problem, align solution with existing community health improvement plan, get college students involved in research (could be an add-on to community gardening)	H	L/S
E	5	Tree Cover	City-wide	All	S/V	Flooding Snow/Ice/ Extreme Heat	Expand Worcester Tree Initiative (replace plantings, preserve), Incentives for private land owners, drought resistant landscaping	H	O
E	5	Waterways / Wetlands	City-wide	All	Both	Flooding	Expand, enhance, protect existing resources (lakes and ponds) Stormwater improvements	H	O
E	5	Hills	City-wide	All	Both	Snow/Ice Flooding	Power generation, LID (restrictions?), Snow melt / stormwater retention? Deicing / Road treatment	L	L
E	5	Brownfield Sites	Mostly CBD (but elsewhere)	All	V	Flood	Cap / prevent infiltration but full redevelop in a resilient way	L	O
E	5	Green / Open Space	City-wide	All	S	Flood			
E	5	Soil Contamination	City-wide	City	S	All			
E	6	Blue Space	V/S	Local	S/V	Drought / Precipitation	Maintain and market as a resource, especially drought and temperature. Increase role of blue space as a park. Integrate blue/green interface and work with nonprofits and schools to foster environmental	M	L/O
E	6	Watershed and Forest Management		Local	S/V	Heat, wind			
E	6	Urban tree canopy - downed power lines and GI	V/S	Local	S/V	Wind	1. Management - Identify dead trees, regular pruning / maintenance 2. Identify heat islands for planting locations. 3. Urban tree inventory (work with universities) 4. Create program for private investment to plant 5. Tree replacement program and regulations.	H	S/O
E	6	Planning for drought resistant species		Local / State	V	Drought / Precipitation	Improve local and state design standards to increase open space, LID, decrease flooding with pervious surfaces and adopt LID. Tree replacement program and regulations	H	S
E	6	Increase bioretention area, decrease impervious projects		Local / State	V	Drought / Precipitation	Improve local and state design standards to increase open space, LID, decrease flooding with pervious surfaces and adopt LID. Tree replacement program and regulations	H	S
E	6	Biophilic design, sustainable development, landscape principles, living landscape		Local / State	V	Drought / Precipitation	Improve local and state design standards to increase open space, LID, decrease flooding with pervious surfaces and adopt LID. Tree replacement program and regulations	H	S
E	6	Planning for GI/LID incorporation		Local / State	V	Drought / Precipitation	Improve local and state design standards to increase open space, LID, decrease flooding with pervious surfaces and adopt LID. Tree replacement program and regulations	H	S
E	6	Blackstone River and National Park		Local / State	V	Drought / Precipitation	Headwaters of Narragansett Bay, have National Park be example of LID at headwaters		