Disaster Preparedness Program and Plan (DP3) – 2017 Status

Introduction

Baltimore is highly vulnerable to a range of natural hazards, including coastal storms, flooding, extreme heat, and high winds. These types of extreme events are likely to increase in frequency and magnitude over the coming years. The increase in natural hazards, combined with climate change, create impacts that will affect the City's residents, businesses, infrastructure, and natural systems, and threaten regionally significant assets.

In 2013, the City of Baltimore developed an integrated All Hazards Mitigation Plan (AHMP) and Climate Adaptation Plan. This Plan, called the Disaster Preparedness Project and Plan (DP3), linked research, outreach, and actions that led directly to a comprehensive system for addressing existing and future climate impacts. The DP3 was approved by Planning Commission on October 3, 2013 and has served as the guiding document for all resiliency implementation since November 2013.

The DP3 outlines feasible and effective mitigation and adaptation recommendations for the below hazards, identified as posing the most significant threats for Baltimore:

- Flooding
- Coastal Hazards- Tropical Storms and Hurricanes, Nor'Easter, Sea Level Rise, and Storm Surge
- & Coastal Inundation
- Precipitation Variability- Precipitation, Winter Storms, Drought, Dam Failure
- Extreme Wind- Associated with Storms, Derechos, Tornados
- Extreme Heat
- Air Quality
- Additional Hazards- Earthquakes, Lightning and Hail, Tsunamis

The DP3 was developed with the assistance of a forty-two member DP3 Advisory Committee and working groups, which helped develop goals, strategies and actions based on detailed natural hazards inventory, risk assessment and vulnerability analysis. Since its adoption, significant progress has been made toward achieving the Plan recommendations. Progress reports on each of the fifty strategies and 231 actions in the DP3 have been prepared annually.

Status of the DP3 Action Items

In the past year, Baltimore City has made on progress on several recommendations and actions and continued previously reported work on others. Highlights of the past year include adoption of the new zoning code with an open space designation, progress toward creation of four pilot Resiliency Hubs, significant progress toward funding of needed stream restoration and other flood-minimizing projects, and the adoption of a Landscape Manual.

In general, three factors limited progress in the past year: availability of funding, the need to increase communication and engagement across government agencies and with the public, and staffing levels in the Office of Sustainability. For the latter, new staff have recently been hired and one more will be in place by early 2018.

A full list of the DP3 actions and the current implementation status is included in Appendix A. Specific work completed and milestones reached in the past year are summarized below:

<u>IN 9: "Encourage development of Green Streets in food prone areas and throughout the City"</u>

- A Green Streets technical assistance workshop was hosted by EPA and attended by Baltimore officials.
- A number of bioretention/bumpout projects were identified as part of the MS4 Permit project implementation.
- There have been new development projects using Green Streets techniques, including Anthem House in Locust Point and the new streetscape at the southern end of JHU campus.
- The Green Network Plan has identified Community Corridors, which should be prioritized for Green Streets and/or Complete Streets practices where feasible.

<u>IN 12: "Enhance and strengthen waterfront zoning and permitting"</u>

- The new zoning code, TRANSFORM, passed, which includes waterfront overlay districts in the Inner Harbor and Middle Branch that require more green/public space; specifically, it requires a 30 foot public pedestrian easement, including a 12 foot constructed promenade with the remaining area to be vegetated.

<u>IN16: "Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit" and "Preserve and protect natural drainage corridors"</u>

- The work to develop projects under the new MS4 permit is progressing, and numerous stream restoration projects are being constructed or will be constructed soon. In addition, the Green Network Plan identifies stream corridors as Nature Corridors for protection and enhancement.

IN 17: "Support existing stormwater requirements and continue to evaluate and improve Best Management Practices" and "Utilize water conservation elements such as green roofs, rain gardens, cisterns, and bioswales on residential, commercial, industrial, and City-owned properties to capture stormwater"

- The Landscape Manual was completed and adopted.
- There have been several redevelopment projects that have included green roofs and bioswales.
- MS4 Permit Implementation and 21st Century School projects are increasing the use of these techniques on City-owned properties.
- Critical Area code has a 10% nutrient reduction requirement for stormwater management, and developers typically met that through the practices listed within the DP3.

IN 19: "Encourage information sharing within the Chesapeake Bay community to assist in developing best management practices"

- Baltimore continues to participate in the Baltimore Urban Waters and Baltimore Wilderness groups, which promote information sharing among jurisdictions.

IN 20: "Expand and integrate existing programs to reduce or intercept debris before it gets into the streams and harbor"

- One new trash wheel has been implemented, with two additional planned.

IN 21: "Ensure Red Line planning incorporates adaptation strategies."

- Action no longer applicable, as Red Line currently cancelled/on hold.

BL 3: "Utilize open space category in zoning code to protect sensitive areas (e.g. stormwater sites, steep slopes, foodways, etc.)"

- The new zoning code, TRANSFORM, passed, which includes an Open Space category.

NS 1: "Evaluate green corridors and parks for possible improvements for foodplain management"

- As part of the Green Network Plan, Nature Corridors and Nature Nodes were identified along streams and in floodplain areas for potential to improve floodplain management.

NS 3: "Convert vacant land and row houses into meaningful and connected open space" and "Certify Baltimore as a Community Wildlife Habitat through the National Wildlife Foundation"

- The Green Network Plan identifies Nodes and Corridors in areas with high concentrations of vacancy to create new permanent green space and better connect neighborhoods and open spaces with each other.
- The National Wildlife Federation and the National Aquarium in Baltimore are working together to certify properties in Baltimore City as wildlife habitats. The City is close to certification and anticipates completion of the process by spring 2018.

PS 3: "Designate community leaders and organizations that can assist and provide support during hazard events"

As part of the effort to increase City's ability to respond to physical, social, and economic challenges, Baltimore City is developing Resiliency Hubs in some of our more vulnerable communities. Resiliency Hubs are a building or set of buildings and neighboring outdoor space that will provide a safe daytime location, access to fresh water, and resources such as food, ice and charging stations, etc. in the event of an emergency.

The main goal of this project is to increase the adaptive capacity and resiliency of neighborhoods most vulnerable to natural hazards, major community emergencies and the impacts of climate change. In addition to providing backup supplies and resources, Hubs will also serve as locations for incorporating energy efficiency, weatherization, solar installation and battery backup systems – all of which help reduce GHG emissions and meet goals identified in the City's Sustainability, Climate Action, and Disaster Preparedness Plans.

This project includes collaboration with other city agencies, nonprofits and members of the community with a focus on neighborhoods. We are engaging community members around energy efficiency and climate preparedness. These also happen to be areas most vulnerable to community shocks and stresses and with the majority of inhabitants being of people of color.

Resiliency Hubs will demonstrate impact through community access to a safe daytime location, a few days of electricity, heating and cooling in the event of an emergency; access to food access to fresh water; better coordination with partner organizations and City resources; utilization of surrounding vacant lots for food generation or shade and cooling through tree plantings; communication center and development of better relationships with members of the community; and access to limited back-up medical supplies.

Accomplishments to Date

- Three (3) pilot locations (Sandtown-Winchester, Pleasant View Gardens and The C.A.R.E.S. Community) identified.
- Initial purchases of supplies – ongoing.
- CERT training on basic disaster response skills being provided to pilot locations.

- Conversations with partners, especially about best practices for acting as a Hub – ongoing
- Communication resources (e.g., banners and flyers) are being created.
- Formalization of Resiliency Hub status through MOU – being created.

PS 8 and PS 9: "Conduct climate, resiliency, and emergency planning education and outreach" and "Improve awareness and education about the importance of flood insurance and preparation for Baltimore citizens"

The Baltimore Office of Sustainability's Floodplain Management Program has been conducting outreach as a public service to educate residents about local flood hazards and flood preparedness. We have on-going partnerships with local housing organizations that allow us to engage prospective home owners. We inform prospective home buyers about the mandatory insurance requirements, then educate them on how to determine their flood risks using local mapping tools. We're also partnering with the Mayor's Office of Emergency Management and the Department of Health distributing hazard preparedness literature in communities located in the Special Flood Hazard Area (SFHA). Mailers describing flood risk, various ways to prepare for a flood, and how to contact the City for assistance have also been sent to every property in the SFHA. Additional mailers were sent to properties in repetitive loss areas.

PS 10: "Incorporate Baltimore's food policy initiative into planning efforts" and "Develop a food security plan for Baltimore"

- The Emergency Food Working Group convened in 2015-16 to assess and develop recommendations related to reducing food insecurity for vulnerable populations during times of emergency. An appendix to the City emergency planning documents for ESF-6 has been drafted, and a Food Resilience Planner now participates in the EOC during relevant emergencies.
- The Johns Hopkins Center for a Livable Future collaborated with the Baltimore Food Policy Initiative to release a Food System Resilience Assessment that appraised current strengths and vulnerabilities and assessed how 14 types of emergencies could impact the city's food supply.

Capital Improvements Process

The City of Baltimore has incorporated resiliency into the capital improvements process. The guidelines and training for the program calls out example recommendations where capital projects are needed to achieve the goals of the DP3 (see box). In addition, agency staff are invited to meet with the City's Climate and Resilience Planner to discuss their projects and identify how they can address current and future hazard conditions.

***EXCERPT:* GUIDELINES FOR THE CAPITAL IMPROVEMENT PROJECT REQUEST PROCESS FY 2019 – 2024**

Disaster Preparedness and Resiliency: In order for Baltimore to succeed in reducing risk and vulnerability and becoming a more resilient city, the strategies and actions of the Disaster Preparedness Project and Plan (DP3) must be considered and integrated into the CIP. Each department has a responsibility to consider how their projects will address future climate impacts, reduce risk, and make Baltimore more resilient. Projects must integrate consideration for increased precipitation events including heavier precipitation in shorter durations of time; higher heat including weeks of 90+ degree temperatures; stronger storms including hurricanes and strong winds; and rising sea levels which will lead to increased tidal flooding and storm surge. Sample recommendations from the plan that impact capital projects include:

- IN-7, A4- Design bridges expansion joints for longer periods of high heat and heavy precipitation events, and develop a more robust inspection and maintenance process
- IN-9, A1- Prioritize infrastructure upgrades for roads identified at risk of flooding through the use of elevation data and Sea, Lake and Overland Surges from Hurricanes (SLOSH) model results
- IN-1, A7- Install external generator hookups for critical facilities that depend on mobile generators for backup power
- BL-8, A1- Install energy-efficient and low-water-use equipment during renovations in all City-owned buildings
- IN-15, A1- Replace old and malfunctioning pipes with new pipes or retrofit existing pipes with new lining prioritizing areas with reoccurring flooding
- IN-16, A3- Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk

Program for Public Information

Flood preparedness in Baltimore has traditionally been directed by the Baltimore Department of Planning in collaboration with the Office of Emergency Management, Department of Public Works, and Department of Health. The Department of Planning is responsible for the floodplain management program including floodplain permits, mapping and analysis, communications efforts, the Community Assistance Visit, Hazard Mitigation Planning, and the Community Rating

System. Through this work, the Department of Planning made efforts to develop a Program for Public Information (PPI) to better direct floodplain outreach efforts.

Baltimore City's PPI is an ongoing local effort to identify, prepare, implement, and monitor a range of floodplain-related public information activities that meet specific local needs. This committee focuses primarily on outreach projects and how those projects are delivered to the public. Members are asked to share their expertise, observations and suggestions for floodplain communications efforts and to approve floodplain outreach materials and presentations.

Baltimore City's PPI met once in 2017 and plans to meet again before the end of the calendar year. In the meeting held this calendar year, the PPI identified the best way to announce the CRS Class 5 rating to members of the community and how to conduct better outreach with Repetitive Loss Properties.

Priority Work for 2018

The City of Baltimore has already begun work to update and expand the DP3, in advance of the October 2018 deadline to renew. As part of that effort, partial grant funding has been secured to initiate work on areas not previously included. The update will include the latest science and most recent climate impacts. In an effort to more fully engage communities in increasing adaptive capacity and improving neighborhood resiliency, the City will develop an equity frame for the DP3 update and develop a format for 'community-district' resilience plans and implementation guidelines, including one pilot community. In addition, tidal and non-tidal flooding continues to be a major issue in Baltimore City. Planners will conduct an assessment of the City's small watershed actions plans (SWAPs) as well as the regions Watershed Implementation Plan (WIP) and develop a framework for watershed adaptation implementation that will address current shortcomings and identify strategic actions moving forward. In addition, the City will conduct a risk assessment to identify high priority historic areas and buildings that are most significantly impacted by flooding and identify best practices for mitigation actions that protect vulnerable historic structures.

These new elements will provide a stronger and more robust resiliency plan and increase Baltimore's ability to implement portion of the project with both neighborhood partners and regional partners. We intend to also focus on continued implementation of high priority actions identified in the DP3.

Materials and Outreach

Disaster preparedness materials and floodplain materials are available and maintained at the City's library and at City permitting centers including the Abell Wolman building and Benton building. Additionally, materials are available 24 hours a day at the Office of Sustainability website.

Information Documents Provided Year-Round:

FEMA and NFIP Flood Insurance Brochures:

1. Why You Need Flood Insurance	FEMA F-683
2. Por Que Usted Necesita Seguro De Inundacion	FEMA F-683S
3. Flood Preparation and Safety	FEMA F-684
4. Top Ten Facts for Consumers	FEMA F-301
5. FloodSmart.gov Know Your Risk	NFIP
6. FloodSmart.gov Conozca su Riesgo	NFIP Spanish
7. How the NFIP Works	FEMA F-025
8. Answers to Questions About the NFIP	FEMA F-084
9. Flood Insurance Claims Handbook	FEMA F-687
10. Manual de Reclamacion para Seguros Contra Inundaciones	FEMA F-687S
11. NFIP Summary of Coverage	FEMA F-679
12. FEMA Prepare for Emergencies Now	FEMA R-6
13. FEMA Preparing Makes Sense for Older	FEMA R-5
14. FEMA Emergency Supply List	FEMA R-8
15. FEMA What is Risk Map	

Other Brochures:

16. Americas Preparathon for Community Based Organizations	
17. Maryland Natural Hazards Preparedness Guide	
18. Quick Series Tsunami Preparedness	NOAA and MEMA
19. What is Freeboard? Raise your home, lower your payments MD DNR CoastSmart	
20. CoastSmart Recovery	MD DNR CoastSmart
21. Family First- Buddy Says "Be Ready"	MEMA and MD Citizen Corps

City Brochures:

22. About Mandatory Flood Insurance (1 pager) -- Distributed by the Department of Planning
23. B'more Prepared Plan 9: A Simple Guide to the nine essential items to help you shelter-in-place in the event of an emergency -- Distributed by the Baltimore City Health Department
24. Baltimore Health Information Card: Follow your emergency plan and instructions -- Distributed by the Baltimore City Health Department, the Department of Planning and the Mayor's Office of Emergency Management

Websites:

- City of Baltimore Main Website

http://www.baltimorecity.gov/answers/sustainability-resiliency-floodplain

- City of Baltimore, Office of Sustainability

www.baltimoresustainability.org/floodplain

- City of Baltimore, Department of Planning
  www.archive.baltimorecity.gov/Government/AgenciesDepartments/Planning.aspx
- City of Baltimore, Office of Emergency Management

http://emergency.baltimorecity.gov/PublicInformation/DisasterReliefInformation.aspx
http://emergency.baltimorecity.gov/PublicInformation/Resources.aspx

- City of Baltimore, Health Department

http://health.baltimorecity.gov/programs/emergency-preparedness-response

- Enoch Pratt Library Floodplain Page

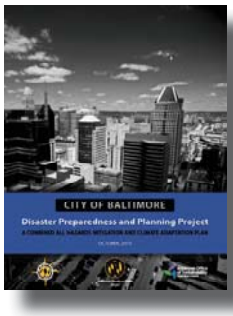
www.prattlibrary.org/research/tools/index.aspx?cat=19952&id=84511

- Inundation Zone Maps

http://cityview.baltimorecity.gov/maps/map.html?webmap=a43dd492035746ccb6887abde9b5419b

- Evacuation Routes and Shelters

http://cityview.baltimorecity.gov/maps/map.html?webmap=ba0afd2d413840198e934655eccece82



The **Disaster Preparedness Project and Plan (DP3)** was approved in 2014. There are four primary sectors— Infrastructure (IN), Buildings (BL), Natural Systems (NS), and Public Services (PS)—that provide the structure for the plan's 50 strategies and 231 additional actions.

Starting with the 2014 Annual Report, the City began reporting on the implementation status of each DP3 action.

DP3 INFRASTRUCTURE

		Still Pending	Very Early Stages	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
IN 1 | Protect and enhance the resiliency and redundancy of electricity system							
1	Work with the Maryland Public Service Commission (PSC) to minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities and located within the City	○	●	○	○	○	✓
2	Evaluate the City of Baltimore utility distribution system, and identify "underground utility districts" using BGE's May 2014 short term reliability improvement plan	○	●	○	○	○	✓
3	Support BGE's collaboration with the Maryland Public Service Commission to implement various smart grid solutions that will provide the City with real-time access to data during events	○	●	○	○	○	✓
4	Identify, harden, and water seal critical infrastructure relative to electrical, heating, and ventilation hardware within the flood plain	○	●	○	○	○	✓
5	Increase resiliency in our energy generation system by encouraging the development of decentralized power generation and developing fuel flexibility capabilities	○	●	○	○	○	✓
6	Develop a comprehensive maintenance and training program for City employees at facilities with backup generators to ensure proper placement, hook-up and function during hazard events.	●	○	○	○	○	✓
7	Install external generator hookups for critical City facilities that depend on mobile generators for backup power	●	○	○	○	○	✓
8	Partner with utility to evaluate protecting power and utility lines from all hazards	○	○	●	○	○	✓
9	Determine low-laying substation vulnerability and outline options for adaptation and mitigation	○	○	●	○	○	✓
10	Evaluate and protect low laying infrastructure - switching vaults, conduit and transformers	○	●	○	○	○	✓
IN 2 | Increase energy conservation efforts							
1	Increase energy efficiency across all sectors through education, efficiency retrofits, and building management systems	○	○	○	○	○	✓
2	Encourage critical facilities and institutions to connect to existing cogeneration systems, or develop new cogeneration systems	○	●	○	○	○	✓
3	Continue the City's electricity demand-response program during peak usage or pre-blackout periods	○	○	○	○	○	✓
IN 3 | Ensure backup power generation for critical facilities and identified key infrastructure during power outages							
1	Investigate off-grid, on-site renewable energy systems, generators, and technologies for critical facilities to ensure redundancy of energy systems	○	○	○	●	○	✓
2	Seek funding to purchase and install generators for all city building designated as critical to agency functions	○	●	○	○	○	✓

3	Develop Combined Heat and Power (CHP) co-generation plants at identified critical facilities	○	●	○	○	○	✓
4	**Evaluate and ensure backup power generation is available to healthcare facilities (nursing homes, critical care facilities, hospitals, etc.)**	○	●	○	○	○	✓

IN 4 | Protect and manage compressed liquefied natural gas sites and (city) fueling stations before and during hazard eventsduring power outages

1	Work with BGE to ensure existing preparedness plans for Spring Gardens liquefied natural gas site incorporate its vulnerability to present and predicted flooding, storm surge and sea level rise	○	●	○	○	○	✓
2	Adopt building code that requires anchoring of 50 gallon storage tanks or larger	●	○	○	○	○	✓
3	Support the Maryland Public Service Commission's effort to accelerate replacement of aging natural gas infrastructure which will harden the system against flooding	●	○	○	○	○	✓

IN 5 | Evaluate and improve resiliency of liquid fuels infrastructure

1	Design and implement a generator program that assists private gas stations in securing backup generators, especially those stations along major evacuation routes	●	○	○	○	○	✓
2	Increase and ensure fuel availability during distribution disruptions	●	○	○	○	○	✓
3	Ensure fuel for generators and delivery priority is given to critical facilities and emergency responders.	●	○	○	○	○	✓

IN 6 | Evaluate and improve resiliency of communication systems that are in place for sudden extreme weather events

1	Utilize new technologies such as fiber optics, external hook-ups, and mobile generators to improve resiliency	○	○	●	○	○	✓
2	Build redundancy into all public and inter-agency warning and communication systems	○	○	●	○	○	✓
3	Identify best practices for the installation and management of flood proofing of all communications infrastructure at risk of water damage	○	●	○	○	○	✓
4	Implement additional nurse triage phone lines and community health centers to reduce medical surge on hospitals	○	●	○	○	○	✓
5	Evaluate and improve early warning systems for hazard events	○	○	○	●	○	✓
6	Ensure continued operation of city governments various computer mainframes for email, control systems, and internet service by having stand-by batteries for each with a capacity sufficient for backup generation to operate	○	○	●	○	○	✓
7	Identify shared communication technology for emergency responders and government agencies to ensure continued and coordinated communication during emergency events	○	○	●	○	○	✓

IN 7 | Integrate climate change into transportation design, building and maintenance

1	Determine the coastal storm vulnerability and complete an exposure assessment of City transportation assets	○	●	○	○	○	✓
2	Improve stormwater management, operations and maintenance for stream flooding that erodes away bridge supports	○	●	○	○	○	✓
3	Incorporate compliance with earthquake standards to withstand a magnitude eight earthquake for all new, improved and rebuilt bridges	●	○	○	○	○	✓
4	Design bridges expansion joints for longer periods of high heat and develop a more robust inspection and maintenance process	●	○	○	○	○	✓
5	Research utilizing existing and new rating systems for all new infrastructure and road projects	●	○	○	○	○	✓

6	Identify, investigate, and incorporate Best Management Practices as they relate to transportation design, construction and maintenance	○	●	○	○	○	✓
7	Require that backup solar powered street lights and signals be integrated along evacuation routes and high traffic areas	●	○	○	○	○	✓

IN 8 | Identify additional alternative routes and modes for effective transport and evacuation efforts during emergency situations

1	Evaluate existing systems and develop a comprehensive evacuation plan	○	●	○	○	○	✓
2	Coordinate evacuation plans with regional partners	○	○	●	○	○	✓
3	Develop and prioritize clearance of specified transportation routes for delivery of emergency response supplies	●	○	○	○	○	✓
4	Educate the public on the dangers of driving through flooded roads	○	●	○	○	○	✓
5	Make available a network of dedicated pedestrian and bicycle transportation routes leading into and throughout the City	○	●	○	○	○	✓
6	Identify and collaborate with bicycle groups and repair shops to assist in emergency response and accommodate alternate transportation needs	●	○	○	○	○	✓

IN 9 | Alter transportation systems in flood-prone areas in order to effectively manage stormwater

1	Prioritize infrastructure upgrades for roads identified at risk of flooding through the use of elevation data and Sea, Lake and Overland Surges from Hurricanes (SLOSH) model results	●	○	○	○	○	✓
2	Raise streets in identified flood prone areas as they are redeveloped	●	○	○	○	○	✓
3	Encourage development of Green Streets in flood prone areas and throughout the City	○	○	●	○	○	✓
4	Encourage use of permeable pavement in non-critical areas – low-use roadways, sidewalks, parking lots and alleys where soils permit proper drainage	○	●	○	○	○	✓
5	Add pumps or other mitigation alternatives to streets as they are redeveloped (if needed)	●	○	○	○	○	✓
6	Assess need for new culvert capacity and identify where upgrades are needed	●	○	○	○	○	✓
7	Conduct an in-depth analysis of the impacts of drain fields that feed the harbor	○	●	○	○	○	✓
8	Expand and reinforce existing stormwater education programs	○	○	●	○	○	✓
9	Design and implement floodgates and barriers in transportation tunnels	●	○	○	○	○	✓
10	Encourage Federal and State Government to design and install floodgates and barriers at vulnerable transportation tunnels	○	●	○	○	○	✓
11	Upgrade existing floodgate hardware and mechanisms to control rise rate of water into all city tunnels	●	○	○	○	○	✓

IN 10 | Ensure structural stability of all transportation tunnels to reduce impact from seismic activity

1	Repair cracks and leaks in all tunnels to reduce impact of seismic activity	●	○	○	○	○	✓
2	Follow Federal, State and Local criteria for the stabilization of Historic transportation tunnels (e.g. Howard Street)	●	○	○	○	○	✓
3	Install a seismically resistant fire standpipe, air monitoring, and automatic valve system in all tunnels to provide a fully automated and monitored fire suppression system	●	○	○	○	○	✓

IN 11 | Evaluate changes to road maintenance and construction materials based on anticipated changes in climate

1	Implement a repaving strategy that reduces heat-related damage to asphalt and incorporates maintenance and operations that extend the life of the road surface	●	○	○	○	○	✓

2	Develop a reconstruction and repair strategy that reduces damage to concrete and incorporates better maintenance and operations	●	○	○	○	○	✓
3	Develop deicing strategies and materials that are effective in extreme cold temperatures and prolonged events to stabilize roadway and bridge surfaces	○	●	○	○	○	✓
4	Design pavement sections and materials that withstand longer periods of extreme heat events	●	○	○	○	○	✓

IN 12 | Enhance the resiliency of the City's waterfront to better adapt to impacts from hazard events and climate change

1	Raise bulkhead height along shoreline areas most at risk	●	○	○	○	○	✓
2	Utilize vegetation and stone to stabilize and armor unprotected shorelines	○	●	○	○	○	✓
3	Encourage the development of integrated flood protection systems that use structural (engineering) and non-structural (wetlands) measures	○	○	●	○	○	✓
4	Review and enhance coastal area design guidelines to better mitigate the impacts of flooding	○	○	●	○	○	✓
5	Enhance and strengthen waterfront zoning and permitting	○	○	●	○	○	✓

IN 13 | Increase the resilience of all wastewater systems and protect them from current and projected extreme weather events

1	Ensure all water and wastewater pumping stations have off-grid, on-site energy sources and/or reliable backup power sources by increasing the number of backups and pulling electricity from different grids	○	●	○	○	○	✓
2	Evaluate the sewer system to identify and develop key areas for prevention of raw sewage overflows	○	●	○	○	○	✓
3	Develop and adopt increased level of protection for construction, redevelopment, and design of all water and wastewater facilities that incorporate future climate projections	●	○	○	○	○	✓
4	Retrofit and harden low-laying pumping stations and treatment plants in flood hazard areas	●	○	○	○	○	✓
5	Ensure effective operations and security for wastewater treatment plants if facilities are overwhelmed by hazard event	●	○	○	○	○	✓
6	Establish the capability of wastewater treatment plants to function during large storm events and establish protocols for storms that overwhelm the system	●	○	○	○	○	✓
7	Increase stormwater recharge areas and quantity management to prevent flooding from overflows	○	●	○	○	○	✓
8	Conduct an assessment of the City's current water system to identify age, condition of infrastructure, capacity, weaknesses and areas for priority upgrades	○	●	○	○	○	✓
9	Conduct and utilize a detailed risk assessment to determine vulnerability of the sewage treatment plant to prevent overflows from extreme storm events	●	○	○	○	○	✓
10	Determine the elevation of sewage treatment buildings, tank construction details, and if the plant is at risk of back flow, for improvements to withstand coastal storm events	○	●	○	○	○	✓
11	Retrofit wastewater treatment facility and methane gas storage system to withstand seismic activity to protect against earthquakes. Design facility to exceed current building codes	●	○	○	○	○	✓

IN 14 | Integrate resiliency, redundancy, and structural stability into the City's drinking and water system to ensure safe and reliable water storage and distribution

1	Repair leaks and improve connection from all City reservoirs and the Susquehanna River	○	●	○	○	○	✓
2	Provide water conservation education, and continue to protect our watersheds to assist in maintaining water quality	○	●	○	○	○	✓

3	Ensure dam emergency plans account for impacts of climate change	○	●	○	○	○	✓
4	Identify and document post damage responsibilities in memorandums of understanding as addendums to Reservoir Watershed Management Agreement	●	○	○	○	○	✓
5	Review dam capacity, load and failure points and review them against 1,000 year and 10,000 year precipitation events	○	●	○	○	○	✓
6	Conduct a study to determine seismic design standards and seismic resiliency of drinking water distribution system (tunnels, piping, clean water pump stations, dams, shafts, and tanks)	●	○	○	○	○	✓
7	Increase stormwater recharge areas and quantity management	○	●	○	○	○	✓
8	Evaluate the impacts of sediment loading on reservoir capacity	○	●	○	○	○	✓
9	Manage watershed forests to provide maximum benefits for water quality and to maintain resiliency during extreme weather events	●	○	○	○	○	✓
10	Adopt new policies on salt application to prevent high salinization on drinking water supplies	●	○	○	○	○	✓
11	Establish a structured Firming Program to maintain adequate storage and water quality in the source-water reservoirs during drought conditions	○	●	○	○	○	✓
12	Maintain appropriate agreements with Susquehanna River Basin Commission (SRBC) and the Exelon Power Company to ensure adequate water withdraws from the Susquehanna River during drought emergency	○	●	○	○	○	✓

IN 15 | Conduct an assessment that evaluates and improves all pipes' ability to withstand extreme heat and cold

1	Replace old and malfunctioning pipes with new pipes or retrofit existing pipes with new lining	○	○	●	○	○	✓
2	Evaluate and utilize new technology that allows for greater flexibility in pipes as they are replaced	○	○	●	○	○	✓

IN 16 | Enhance and expand stormwater infrastructure and systems

1	Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit	○	○	○	●	○	✓
2	Prioritize storm drain upgrades and replacement in areas with reoccurring flooding	○	●	○	○	○	✓
3	Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk	○	●	○	○	○	✓
4	Preserve and protect natural drainage corridors	○	○	●	○	○	✓
5	Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall	●	○	○	○	○	✓

IN 17 | Modify urban landscaping requirements and increase permeable surfaces to reduce stormwater runoff

1	Support existing stormwater requirements and continue to evaluate and improve Best Management Practices	○	○	○	●	○	✓
2	Encourage urban landscaping requirements and permeable surfaces into community managed open spaces	○	○	●	○	○	✓
3	Utilize water conservation elements such as green roofs, rain gardens, cisterns, and bioswales on residential, commercial, industrial, and City-owned properties to capture stormwater	○	○	●	○	○	✓
4	Encourage permeable paving on low-use pathways	○	●	○	○	○	✓

IN 18 | Evaluate and support DPW's stream maintenance program

1	Review and improve status of standing maintenance requirements	○	●	○	○	○	✓
2	Ensure adequate funding is in place to support stream maintenance	○	○	●	○	○	✓
3	Identify opportunities where stream restoration efforts will off-set maintenance costs	○	●	○	○	○	✓
4	Identify interdependencies and benefits of stream maintenance with other transportation programs	●	○	○	○	○	✓
5	Clear streams on a regular basis, prioritize dredging the stream beds, and increase inspection and cleaning of culverts and storm drains to prevent flooding	○	●	○	○	○	✓

IN 19 | Support and increase coordination and information sharing across jurisdictions to better enable mitigation of cross-border impacts on the regions watersheds (e.g., understanding flood conditions upstream in the County)

1	Partner with local counties to evaluate major tributaries in all watersheds to determine best management practices for capturing run-off and slowly releasing it (stormwater quantity management)	○	○	●	○	○	✓
2	Encourage information sharing within the Chesapeake Bay community to assist in developing best management practices	○	○	●	○	○	✓

IN 20 | Reevaluate and support a comprehensive debris management plan for hazard events

1	Investigate best practices for managing and disposing of downed trees, yard waste, building debris, as well as additional household garbage	○	●	○	○	○	✓
2	Expand and integrate existing programs to reduce or intercept debris before it gets into the streams and harbor	○	●	○	○	○	✓
3	Develop and promote solid waste management actions for citizens to implement before a hazard event	○	●	○	○	○	✓

IN 21| Encourage the integration of climate change and natural hazards into private and State planning documents, systems, operations, and maintenance

1	Incorporate consideration of hazards and climate adaptation efforts into all plans, systems, operations, and maintenance	○	○	●	○	○	✓
2	Ensure Red Line planning incorporates adaptation strategies	●	○	○	○	○	✓
3	Ensure hazard scenarios, utilized in vulnerability assessments, are at a minimum 25% greater in intensity and impact than historical record events to date	●	○	○	○	○	✓
4	Develop guidelines for hospital, health care facilities and other institutional entities (e.g. Universities)	●	○	○	○	○	✓
5	Partner with regional air quality institutions to integrate air quality measures and messaging into City climate change policy efforts	○	●	○	○	○	✓

IN 22 | Develop City policy which requires new city government capital improvement projects to incorporate hazard mitigation principles

1	Discourage new public projects in hazard-prone areas such as floodplains or the coastal high hazard areas	○	○	○	●	○	✓
2	Utilize hazard mitigation design requirements that exceed minimum standards for critical facilities	○	○	●	○	○	✓
3	Use comprehensive infrastructure assessments to identify infrastructure in need of replacement and prioritize funding for those projects	○	●	○	○	○	✓

DP3 BUILDINGS

	BL 1 | Develop and implement hazard protections for critical facilities including hospitals, fire stations, police stations, hazardous material storage sites, etc.	Still Pending	Very Early Stages	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
1	Conduct educational outreach for city-owned, residential, commercial, and industrial buildings about proper storage and disposal of hazardous materials and heating oil	●	○	○	○	○	✓
2	Require hazardous materials stored in city-owned, residential, commercial, and industrial buildings within the floodplain to be elevated a minimum of three feet above the freeboard	○	○	○	○	○	✓
3	Require new critical facilities to be designed with redundant operating systems	○	○	●	○	○	✓
4	Require pre-wiring for generators at all facilities designated critical to agency operations and hazard response	●	○	○	○	○	✓
5	Develop stricter flood regulations for critical facilities	○	○	○	○	○	✓
6	Develop partnership with private fueling stations to provide backup generators in exchange for a commitment to fueling emergency response vehicles during a hazard event	●	○	○	○	○	✓
7	Ensure storage of and access to fuel for generators in critical facilities	●	○	○	○	○	✓

	BL 2 | Enhance City building codes that regulate building within a floodplain or near the waterfront						
1	Design new projects to be resilient to a mid-century sea level rise projection and adaptable to longer-term impacts	○	●	○	○	○	✓
2	Incorporate climate change and coastal hazard considerations into building codes by increasing freeboard requirements to two feet as buildings are redeveloped and renovated	○	○	○	○	○	✓
3	Continue to regulate to the existing tidal floodplain delineation as adopted 2 February, 2012	○	○	○	○	○	✓
4	Incorporate outfall elevation regulations	○	●	○	○	○	✓
5	Develop Construction Best Practices for development within floodplains	○	○	●	○	○	✓
6	Train all code enforcement and building inspectors about flood proofing techniques and the local floodplain ordinance	○	○	●	○	○	✓
7	Encourage green roof installations to include vegetative and reflective technologies for all new commercial, industrial, multifamily, and city-owned development	●	○	○	○	○	✓

	BL 3 | Strengthen City zoning, floodplain and construction codes to integrate anticipated changes in climate						
1	Review zoning and strengthen language (where necessary) in order to better protect citizens and increase resiliency in buildings	○	○	●	○	○	✓
2	Review and amend existing building and floodplain regulations to require more flood resistant new and existing structures when located in the floodplain	○	○	○	○	○	✓
3	Utilize open space category in zoning code to protect sensitive areas (e.g. stormwater sites, steep slopes, floodways, etc.)	○	○	○	○	○	✓
4	Review and increase Flood Protection Elevation (Base Flood Elevation + Freeboard) standards to the highest available State, Federal or local elevation level	○	○	○	○	○	✓
5	Evaluate and update stormwater management regulations to avoid increases in downstream flooding	○	○	●	○	○	✓
6	Adopt design requirements that include wet and dry flood proofing techniques	○	○	○	●	○	✓
7	Review and consider adoption of the International Green Construction code	○	○	○	○	○	✓

BL 4 | Update a list of flood prone and repetitive loss buildings to consider for acquisition

1	Continue to acquire property (including repetitive loss properties) in the special flood hazard areas where feasible and appropriate	○	○	○	●	○	✓
2	Prioritize Hazard Mitigation Assistance funding for mitigation of repetitive loss properties and severe repetitive loss properties	○	○	●	○	○	✓
3	Develop a creative financing program for flood resiliency in industrial buildings	○	●	○	○	○	✓

BL 5 | Improve wind resiliency of new and existing structures

1	Review local building codes to determine if revisions are needed to improve the structures ability to withstand greater wind velocities and storm impacts	●	○	○	○	○	✓
2	Retrofit emergency shelter windows to withstand winds associated with coastal storm events	●	○	○	○	○	✓

BL 6 | Evaluate various seismic design enhancements using prototypical Baltimore City building types

1	Determine engineering effectiveness and cost-benefit of various earthquake mitigation measures using computer modeling	●	○	○	○	○	✓

BL 7 | Retrofit existing buildings in the designated Flood Area to increase resiliency

1	Target and encourage flood resiliency retrofits for buildings in the designated Flood Area	○	○	●	○	○	✓
2	Prioritize retrofitting and increasing resiliency of Public Housing units in the designated Flood Area and other high risk areas	○	○	●	○	○	✓
3	Educate building owners within the floodplain to ensure that all electrical, mechanical, and key building systems are above the base flood elevation and meet existing codes	○	○	○	●	○	✓

BL 8 | Improve resource conservation practices in all city owned buildings

1	Install energy-efficient and low-water-use equipment during renovations in all City-owned buildings	○	○	●	○	○	✓
2	Support energy efficiency and weatherization as part of Baltimore City schools ten-year plan	○	○	○	●	○	✓
3	Update Baltimore green building standards by offering multiple compliance paths for new and substantially renovated construction	○	○	○	○	●	✓

BL 9 | Conduct educational outreach to increase resource conservation practices in private buildings

1	Conduct educational outreach and provide information about savings related to reduced water use	○	●	○	○	○	✓
2	Educate and provide resources and information about utility rebate programs	○	○	○	○	●	✓
3	Provide energy efficiency education to include information on conserving electrical power. Emphasize reductions during summer peak demand hours	○	○	○	●	○	✓

BL 10 | Use HAZUS-MH computer modeling to determine losses generated by coastal storms

1	Utilize engineering studies and cost-benefit analyses to identify additional mitigation needs and actions	○	○	●	○	○	✓
2	Evaluate various building design enhancements to reduce losses generated by earthquakes, floods, and storm surge	○	●	○	○	○	✓

DP3 NATURAL SYSTEMS

		Still Pending	Very Early Stages	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
NS 1 | Utilize green corridors and parks to help protect surrounding communities from the impacts of hazard events							
1	Evaluate green corridors and parks for possible improvements for floodplain management	○	○	●	○	○	✓
2	Increase the resiliency of park facilities and buildings	○	●	○	○	○	✓
NS 2 | Increase and enhance the resilience and health of Baltimore's urban forest							
1	Anticipate the impacts of future changes in temperature and weather on the urban forest by developing a comprehensive list of plant and tree species known to have a broad range of environmental tolerances	○	○	○	○	●	✓
2	Establish and routinely update a comprehensive tree inventory to anticipate insect and forest structural impacts of climate change	○	○	○	●	○	✓
3	Establish a comprehensive maintenance program that includes pruning for sound structure and the removal of hazardous limbs and trees. First focus on areas where vulnerable infrastructure is nearby such as energy supply and roads	○	●	○	○	○	✓
4	Continually adjust and modify planting details and specifications to assure the health and longevity of trees	○	○	○	●	○	✓
5	Increase the urban tree canopy and target areas with urban heat island impacts	○	○	●	○	○	✓
NS 3 | Create an interconnected network of green spaces to support biodiversity and watershed based water quality management							
1	Utilize the Growing Green Initiative to increase green spaces in areas where there is available vacant land in order to reduce the heat island effect	○	○	○	○	●	✓
2	Convert vacant land and row houses into meaningful and connected open space	○	○	●	○	○	✓
3	Complete a habitat analysis and plan for the City	○	●	○	○	○	✓
4	Create a strategic plan that identifies areas of focus for tree planting, stormwater management, and forest preservation	○	○	●	○	○	✓
5	Certify Baltimore as a Community Wildlife Habitat through the National Wildlife Foundation (NWF)	○	○	○	○	●	✓
NS 4 | Expand, protect and restore riparian areas in the city							
1	Conduct regular maintenance of stream restoration projects and stormwater quality facilities	○	○	●	○	○	✓
2	Evaluate current regulations regarding stream buffers and floodplains and modify them (if appropriate) to assure they adequately protect perennial stream corridors	○	○	○	●	○	✓
NS 5 | Preserve and create new coastal buffer efforts and support creating more wetlands and soft shoreline along coastal areas							
1	Integrate natural buffer requirements, such as wetlands and soft shorelines, into new development or redevelopment	○	○	○	●	○	✓
2	Complete stream restoration projects in Baltimore City and County stream valleys that lead into the coastal wetlands so as to increase habitat and reduce sedimentation	○	○	●	○	○	✓
3	Identify and evaluate areas in the Critical Area buffer to prioritize ecological buffer restoration efforts	○	○	○	●	○	✓
NS 6 | Require the City's drought management plan to account for changes in climate							
1	Map drought risks and water availability via climate change scenarios	●	○	○	○	○	✓

		Still Pending	Very Early Stages	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
2	Update drought management plans to recognize changing conditions	●	○	○	○	○	✓

NS 7 | Integrate climate change and natural hazards planning into small watershed action plans (SWAPs)

1	Review existing watershed management plans and identify future actions to address climate impacts	○	○	●	○	○	✓

NS 8 | Conduct detailed ongoing analysis of climate information, trends in storm events and hydrology to support policy changes responding to climate change

1	Expand the use of climate information (e.g. seasonal forecasts) in water resources planning and management.	○	●	○	○	○	✓
2	Research and actively monitor trends in storm events, stream flow and other conditions affecting hydrology and water	○	○	●	○	○	✓
3	Update flood maps to reflect changing risk associated with climate change.	○	○	○	○	○	✓
4	Continuously improve and enhance flood vulnerability data.	○	○	○	●	○	✓

DP3 PUBLIC SERVICES

PS 1 | Strengthen emergency preparedness coordination between local government, NGOs, and private entities by updates to the City Emergency Operations Plan (EOP) and related Emergency Support Functions (ESF)

		Still Pending	Very Early Stages	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
1	Identify and develop a common database that all city government agencies and departments should utilize for hazard information, preparedness and response	○	●	○	○	○	✓
2	Ensure consistency and integration with existing and future response plans within and between agencies	○	○	○	●	○	✓
3	Continue to identify and improve coordination with Key Partners including private sector, State partners, Federal partners, community, universities and industry leaders through Local Emergency Planning Committee	○	○	○	●	○	✓
4	Coordinate outreach efforts of the Mayor's Office of Emergency Management, Mayor's Office of Neighborhood and Constituent Services and Baltimore City Health Department to leverage messages related to all-hazards emergency preparedness	○	○	○	○	●	✓
5	Develop strong working relationships with local experts to provide technical assistance to refine and improve city government emergency preparation	○	○	○	●	○	✓
6	Review and improve specific response plans contained in the EOP and related ESFs that relate to extreme weather events (snow, heat, flood, wind, electrical outages, and other hazard events)	○	○	○	●	○	✓
7	Ensure equipment purchases and communication systems are compatible across agencies and jurisdictions	○	●	○	○	○	✓
8	Encourage all animal rescue and care shelters to further develop their internal plans for animal's health and safety during and after a hazard event	○	●	○	○	○	✓
9	Ensure all animal rescue and care shelters located within the floodplain are provided the support to apply for and obtain funds to relocate	●	○	○	○	○	✓
10	Develop and implement a case study of hospital-based practices that foster community resilience to climate change	●	○	○	○	○	✓

PS 2 | Develop a Hazard Awareness Program

1	Create a standardized early warning system for members of the public	○	○	●	○	○	✓
2	Evaluate and improve community health center strategies for communicating with patients during an emergency	●	○	○	○	○	✓

3	Educate citizens about the existing early warning systems and actions they should take when alarms sound	○	○	●	○	○	✓
4	Prepare and integrate occupational health and safety messages and instructions for first responders	○	●	○	○	○	✓
5	Hold climate specific seminars, in partnership with MDH2E and MHA, for hospital emergency and sustainability managers	○	●	○	○	○	✓

PS 3 | Designate community leaders and organizations that can assist and provide support during hazard events

1	Prior to a hazard event, identify lead contacts serving vulnerable populations and coordinate actions to maximize safety and information sharing	○	○	●	○	○	✓
2	Develop a community group coordination plan and implementation guide	○	●	○	○	○	✓
3	Identify and evaluate plans already in place and work to improve utilization of community based leaders to assist in preparedness and response	○	○	●	○	○	✓

PS 4 | Integrate climate change and natural hazards planning into all City and community plans

1	Develop guidelines to include proactive resilience planning into plan development process	○	●	○	○	○	✓
2	Incorporate language that strengthens the ability of city government officials to enforce rules and restrictions that support public health, safety and welfare related to hazard events and conditions	●	○	○	○	○	✓
3	Partner with Maryland Department of Health and Mental Hygiene or other pertinent entity to develop institutional checklist and materials for health care specific resilience plans	●	○	○	○	○	✓

PS 5 | Better equip emergency workers for natural hazards.

1	Research and identify personal protective equipment (PPE) needs based on specific hazards	○	●	○	○	○	✓

PS 6 | Anticipate and address potential disease outbreaks caused by extreme weather events and changing climatic conditions

1	Support studies of heat and flood related vector borne diseases in the Baltimore the region based on changing temperature and moisture	○	○	●	○	○	✓
2	Evaluate existing programs that detect disease outbreaks to determine their flexibility to respond to new conditions	●	○	○	○	○	✓

PS 7 | Protect Baltimore residents from the effects of hazard events and plan for more frequent hazard instances

1	Re-evaluate and update existing heat alerts, advisories, and updates to healthcare and emergency service providers	○	○	●	○	○	✓
2	Ensure that residents and visitors have access and transportation to cooling centers during extreme heat events	○	○	●	○	○	✓
3	Evaluate code red plans to ensure all agencies adequately protect their own workers	○	○	●	○	○	✓
4	Consider extending hours for public wading pools during extreme heat events	○	○	●	○	○	✓
5	Include information about Code Red in the event permitting process, and incorporate language that allows BCHD to cancel outdoor events	●	○	○	○	○	✓
6	Work with Regional, State and Local partners to improve air quality and reduce respiratory illnesses	○	○	●	○	○	✓
7	Create and implement programs to manage combined health impacts of heat and air pollution	○	○	●	○	○	✓

PS 8 | Conduct climate, resiliency, and emergency planning education and outreach

1	Incorporate environmental health and climate change into curriculum at schools, universities and health care facilities	●	○	○	○	○	✓
2	Educate communities on how city agencies respond to hazard events, their role in an event, and how agencies work together	○	○	●	○	○	✓
3	Educate and train community groups to participate in responding to hazards	○	○	○	●	○	✓
4	Generate a comprehensive community-specific all hazards outreach campaign	○	○	●	○	○	✓
5	Develop and communicate a simplified process for Baltimore residents to follow after a hazard event	○	●	○	○	○	✓
6	Create curriculum for hospitals to teach communities about climate change as part of hospital community benefits programs	●	○	○	○	○	✓
7	Utilize existing preparedness messaging to include information on universal precautions to insect-borne and other infectious diseases	○	●	○	○	○	✓

PS 9 | Improve awareness and education about the importance of flood insurance and preparation for Baltimore citizens

1	Create an educational program centered on flood hazards, coastal construction practices and evacuation procedures	○	○	●	○	○	✓
2	Encourage owners of properties to purchase flood insurance and improve policyholder awareness at time of sale or renewal	○	○	○	●	○	✓
3	Inform property owners who have paid off their mortgage that flood insurance is still necessary	○	○	●	○	○	✓
4	Identify programs and grants that assist citizens in purchasing flood insurance and making flood proofing changes	○	●	○	○	○	✓
5	Develop an annual newsletter to inform and remind owners of property in the floodplain about flood insurance and flood proofing activities they should undertake	○	●	○	○	○	✓
6	Provide information on how to file for reimbursement for impacts of hazards	○	●	○	○	○	✓
7	Require a flood disclosure form, and educational information as part of lease agreements for commercial and residential properties	●	○	○	○	○	✓
8	Develop floodplain awareness information for rental tenants and ensure distribution as tenants change	●	○	○	○	○	✓

PS 10 | Increase Baltimore's Food Security

1	Double the size and number of food producing community gardens by 2025	○	○	●	○	○	✓
2	Link Jessup, Maryland Food Hub, and regional/local food producers to local distributors	○	●	○	○	○	✓
3	Incorporate Baltimore's food policy initiative into planning efforts	○	○	○	○	●	✓
4	Develop a food security plan for Baltimore	○	○	○	●	○	✓
5	Increase land under cultivation for commercial urban agriculture	○	○	●	○	○	✓