Draft Report: Working & Natural Lands Working Group
Rivers Sub-Working Group

Acknowledgements

The Working and Natural Lands Rivers Sub-Working Group (WNLSWG-Rivers) would like to thank Governor Ned Lamont for his commitment to and efforts surrounding climate change in Connecticut. The work produced by this and other working groups will help Connecticut achieve its goals toward climate change mitigation and adaptation through the lens of Equity and Environmental Justice.

Throughout 2020 and the challenges that COVID-19 has presented, the WNLSWG-Rivers worked diligently to gather the information needed to understand the important roles that our inland waters (rivers, streams, lakes, ponds and groundwater) play in adaptation and mitigation of climate impacts. The work in this report would not have been possible without the participation of a broad membership committed to the work at hand.

Co-Chair **Alicea Charamut, Rivers Alliance of Connecticut** and DEEP staff support Peter Aarrestad**, CTDEEP, Fisheries Division** and **Susan Peterson, CT DEEP, Water Planning and Management Division,** would like to sincerely thank the following members of the WNLSWG-Rivers:

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Background and Context

The Working and Natural Lands Rivers Sub-Working Group is one of four sub-working groups of the Working and Natural Lands Workgroup of the Governor's Council on Climate Change. While this sub-working group is titled "Rivers," the group focused on inland surface (rivers, streams, lakes, ponds) and groundwater. Water must be considered and managed holistically if we are to meet the challenges brought about by a changing climate.

"Water rich" is a term often used to describe Connecticut. Our state is blessed with 5,830 river miles and 64,973 acres of lake[1]. Our groundwater resources are critical to recharge of our rivers, lakes and wetlands as well as an important source of supply for public health and economic development needs.

Water is, however, a limited resource. There are many laws, regulations and programs at the state and federal levels intended to manage the quality and quantity and balance the uses of this precious resource. The Connecticut Inland Wetlands and Watercourses Act, The Water Diversion Policy Act, and the Clean Water Act are just a few examples.

The concept of Ecosystem Services was utilized in identifying vulnerabilities of our inland waters and communities to climate change and in developing strategies for mitigation and adaptation. Ecosystem services refer to the many ways in which ecosystems support and benefit individuals and communities.

In the late summer of 2020, Connecticut teeters on its second drought in four years. Streamflow across the state and groundwater levels have been averaging below the 25th percentile for several months. There was a record number of days over 90 degrees Fahrenheit in July and that combined with the pandemic created public access and capacity issues/conflicts across the state as residents sought refuge in our water resources.

The recommended actions in this report are meant to be specific and actionable. If the expectation is to preserve all of the services our inland waters provide as our climate changes, we must act with greater urgency in the next decade than we have in the past few decades.

Importance of Inland Waters

HEALTHY WATERS = HEALTHY COMMUNITIES = HEALTHY ECONOMIES

Our inland waters provide us with a multitude of benefits. They offer us provisions through drinking water, as food source, irrigation, navigation, waste assimilation and energy generation. A riverine system in a more natural state will regulate flooding and keep our surface and groundwater clean and are self-supporting through soil formation and nutrient cycling. They act as wildlife and corridors and pollinator pathways. And last but not least, our inland waters provide numerous benefits as recreation destinations, spiritual inspiration and provide a sense of place.

[1] https://portal.ct.gov/-/media/DEEP/water/water_quality_management/305b/2018CTIntgratedWaterQualityReportpdf.pdf

Impact Assessment and Vulnerability

Changing precipitation patters through more frequent drought and an increase in short-duration, heavy precipitation events combined with warmer temperatures put our inland waters at significant risk. According to the Connecticut Physical Climate Science Assessment Report (2019), the observed and projected annual total precipitation in Connecticut is projected to increase by 4-5 inches by the midcentury and by 4.5-5.5 inches by the late century (2070-2099). In terms of water quantity, the section of the State Water Plan titled *Preparing for Change, Future Conditions and Opportunities*, it is predicted that, "there may be conditions that make it more difficult for a basin to satisfy all out-of-stream and instream needs" and "higher risk of flooding during winter months." In terms of water quality we face an increase in harmful algal blooms, a change in temperature regimes and increase in nutrient loads that will lead to a loss of high-quality headwater streams and cold-water habitat and further degradation of impaired waters. Those in vulnerable communities will be most impacted by the latter. A decline in water quality also has a negative impact on recreational use that often has an impact on local economies. We face the loss of viable native and migratory aquatic species that valuable not only to our ecosystems, but to our sense of place and culture.

This future need not be certain. There are factors that can be controlled such as extraction, diversion, loss of riparian/buffer zones, fragmentation of forests and loss of core forests, change in land use patterns, connectivity, and conservation that will reduce impacts on quality and quantity. We can adapt to shifting ranges in biota.

Progress since 2011 report

While we have made some progress on some of the actions in the 2011 report, there has not been enough urgency in making progress on specific actions that will lead us to ensure that our inland waters can continue to meet our many needs.

Below are Highest Priority Actions listed in the 2011 report that pertain specifically to inland waters and progress made to date:

***Priority Action*: Acquire land and conservation easements in riparian areas adjacent to coldwater streams**

Progress since 2011: Thanks to DEEP's Open Space and Watershed Land Acquisition Grant Program, some progress has been made in conserving land that protect our high-quality streams. It provided resources to land trusts and other land conservation groups to purchase lands that may otherwise be developed.

Local land-use decisions are still problematic. We must continue to take further action in ensuring that local land-use decisions result in further loss of coldwater habitat and degradation of high quality rivers and streams. Please see *Appendix A - Summary of the state's cold water resources relative to climate change threat* for information on efforts by DEEP to identify and map cold water resources.

***Priority Action*: Adopt regulations that provide stream flow levels necessary to ensure the resilience and ecological integrity of coldwater streams.**

Progress since 2011: Streamflow Standards and Regulations were adopted in December 2011 and the classification process was finalized in March of 2019.

The absence of groundwater withdrawals as a factor in streamflow and exclusion from streamflow standards and regulations mean that current regulations do not fully ensure the resilience and ecological integrity of coldwater streams.

***Priority Action*: Advance connectivity among habitats**

Progress since 2011: Progress has been made on dam removal and fish ladders based on resources available and a pro-active restoration program at DEEP and among conservation partners. There has also been progress in assessing culverts at road crossings in an effort to prioritize undersized and inadequate culverts for replacement.

Due to the age of our infrastructure in the northeast, connectivity remains a priority. To not only improve habitat connectivity, but to restore the natural ability of our rivers to mitigate the impacts of climate change on our communities.

Recommendations

The following recommendations are proposed for consideration in the 2020 GC3 report. They were assessed by the Rivers subgroup members as both high importance and areas where the Rivers subgroup will take a leading role in developing an implementation strategy. Each recommendation includes the specific implementation actions that need to be taken in order to achieve the broader goal of each recommendation.

2020.R.1: Protect the future ecosystem services value of inland waters.

Employ and mainstream nature-based solutions at scale	
Recommended Implementation Action Description	Nature-based solutions increase the resilience of freshwater systems including riverine and stormwater specific natural habitat conservation. Nature-based solutions include: Low Impact Development (LID), Green stormwater infrastructure (GI), Best Management Practices (BMPs), agricultural water use BMPs and drinking water treatment standards that ameliorate the effects of water availability (inundation and drought.) They can provide a cost-effective addition or alternative to gray infrastructure to improve water quality, reduce sewer overflows, and mitigate flooding while improving habitat and revitalizing communities, making them more resilient to the effects of climate change.
Targets, Indicators, and Completion Timeframe	Less than 2 years ● Establish and implement a science-driven process using The Nature Conservancy (TNC) guidance and other relevant data for identifying river systems with the most capacity for being resilient to extreme weather and climate and protecting the ecosystem services of inland waters. Indicator: Inventory, assessment and prioritized list ● Promote urban forestry and expansion of urban green spaces, including protection and/or re-establishment of riparian corridors; creation and expansion of public open spaces that incorporate, LID/GI, etc. such as tree box filters, rain gardens, etc. to reduce, capture and treat stormwater run-off . This also needs to include consideration of: "other" public institutions that may be associated with large open spaces (eg. - academic institutions; hospitals, museums, etc.), transportation and utility corridors; brownfields, etc. for protection and/or redevelopment and creation of green and clean open spaces, especially with regard to sites located adjacent to rivers, other waterbodies and wetlands. ● Maintain or increase funding for watershed planning through the existing Integrated Water Resource Management (IWRM) framework.

	Integrated watershed-based planning for water quality, flooding and climate resilience. 3 to 5 years ● Develop and adopt priority resiliency corridors and statewide riparian corridor regulations. ● Establish and fund a Connecticut-wide program to accelerate and expand the use of nature-based resilience solutions. Greater than 5 years ● Require or incentivize nature-based solutions for adaptation. o Indicator: percentage of runoff treated from impervious surfaces by green infrastructure. o Indicator: # of nature-based projects that reduce peak flows during rain events o Indicator: # of regulations requiring stormwater best management management practices o Indicator: Reservoir operational guidelines that better balance ecological flow requirements and water supply goals so as to mitigate climate impacts.
Implementation Entities	U.S. EPA, U.S. DOT, NRCS, USFS, CT DEEP, CT DPH, CT DECD, CT DOT, CIRCA, CGA, Sustainable CT, Municipalities, COGS, NGOs, Academic Institutions, etc. that may participate in the action.
Climate challenges addressed	Flood, drought, water quality degradation, habitat degradation, temperature shifts, sedimentation
Protection of vulnerable communities	• Provides for storm and flood mitigation • Ensures an adequate supply and quality of water for drinking, sanitation and recreation • Assists in temperature regulation • Enhances emotional, psychological and cognitive well-being
References for action	Connecticut Physical Climate Science Assessment Report (PCSAR): Observed trends and projections of temperature and precipitation; CT-PCSAR August 2019 https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/11/CTPCSAR-Aug2019.pdf CASE STUDY: HOWARD BEACH, QUEENS, NEW YORK | JULY 2015 https://www.nature.org/content/dam/tnc/nature/en/documents/urban-coastal-resilience.pdf EPA - Green Infrastructure https://www.epa.gov/green-infrastructure EPA Region 1 - Soak Up The Rain https://www.epa.gov/soakuptherain

	Green Infrastructure in Parks (2017) U.S. EPA https://www.epa.gov/sites/production/files/2017-05/documents/gi_parksplaybook_2017-05-01_508.pdf EPA Non-Point Source Pollution https://www.epa.gov/nps CIRCA - Inland Flooding https://circa.uconn.edu/inland-flooding/ 2004 Connecticut Stormwater Quality Manual (NOTE - THIS MANUAL TO BE UPDATED IN NEAR FUTURE - FUNDING FOR UPDATE SECURED) https://portal.ct.gov/DEEP/Water-Regulating-and-Discharges/Stormwater/Stormwater-Manual UConn CLEAR https://clear.uconn.edu/ UConn CLEAR NEMO https://nemo.uconn.edu/ UNH Stormwater Center https://www.unh.edu/unhsc/ Rutgers - NJ Agricultural Expt. Station - Keep the Rain from the Drain Program http://water.rutgers.edu/KeepTheRainFromTheDrain.html Harvard University - Harvard Forests - New England Landscape Futures Project https://harvardforest.fas.harvard.edu/other-tags/future-scenarios Greening up stormwater infrastructure: Measuring vegetation to establish context and promote cobenefits in a diverse set of US cities https://www.sciencedirect.com/science/article/abs/pii/S1618866719301657 Green Infrastructure and Health Guide (July 2018) Oregon Health & Outdoor Initiative https://willamettepartnership.org/wp-content/uploads/2018/07/Green-Infrastructure_final_7_12_18_sm.pdf Massachusetts Rivers Protection Act

Re-establish free-flowing character and connectivity of inland waters and hydrological connectivity	
Recommended Implementation Action Description	Reestablish aquatic connectivity in the river systems throughout Connecticut, by identifying and eliminating instream, coastal, and floodplain barriers, such as obsolete dams/embankments, and perched/undersized road crossings. Reestablishing connectivity will help ensure aquatic species population diversity; access to habitat for viable native species; additional geomorphic stability through the restoration of natural sediment transport processes; address aging infrastructure; and expand the range of movement for all

	aquatic species, such that they can more easily locate suitable habitat/refuge and adapt to climate change.
Targets, Indicators, and Completion Timeframes	Less than 2 Years: ● Establish a proactive state Barrier Removal Program, to include: ○ Access to funding for the removal of obsolete barriers ○ Coordinate with DOT and local municipalities regarding the design guidelines for and replacement of perched or undersized road crossings (culverts and bridge aprons). Assess economic benefits of replacing culverts with better-designed structures for new flow regimes. ○ Train and fund non-profit partners to assess in-stream barriers (e.g. inadequate culverts) across the state, using existing UMass/UConn modeling and system for data storage ○ Develop statewide climate resilience design guidance for building, replacing, or retrofitting road crossings ○ Initiate and find funding for projects to remove obsolete instream, coastal and floodplain barriers ○ Encourage nature-base adaptive restoration approaches for rivers, floodplains, and estuaries ○ Encourage use of living shorelines and other nature-based adaptation approaches over levees, hard armoring techniques, and tide gates ○ Educate Wetland Commission members and dam owners on options for dam removal. ○ At Minimum: Add a new position to CT DEEP Dam Safety focused on the removal of obsolete dams (which can also decrease the state's dam maintenance burden) ○ Alternative: Develop a State Program/Department to focus on restoration (similar to the MA Div. of Ecological Restoration or the soon to be developed Conservation Corridors Program in NY that looks to “reconnect or replant” 10,000 miles of fragmented and degraded stream habitat, restore floodplains, upgrade or remove obsolete dams, and fund “nature-based solutions to reduce flooding.” ● Incorporate high-priority culverts into hazard mitigation planning ● State regulations should require the use of aquatic organism passage (AOP) standards, similar to the revised ACOE regulations, when designing new or replacement culverts. If AOP standards cannot be met, a justification of why AOP standards cannot be met should be required. ● Incorporate replacements of high priority culverts into hazard mitigation plan to create eligibility for funding via FEMA and other sources. See "Supporting New England's Communities to Become River-Smart," (https://extension.umass.edu/riversmart/policy-report) UMASS Amherst, for public education ideas and incorporation into town practices (e.g., via Resilient CT).

	● Enhance the inventory and assess vulnerable state and municipal road-stream crossings in flood-prone areas. Upgrade priority state and municipal road-stream crossings based on risk of flooding-related failure and risk tolerance.
	● Discourage new, small traditional hydropower development and instead incentivize use of existing hydropower facilities where facility removal is unlikely. Require assessment of the tradeoffs between continuing existing hydroelectric facilities and ecosystem restoration goals.
	● Consider hydroelectric not generated by dams (e.g., free-standing hydrokinetic turbines and in-pipe turbines)
	● Adopt statewide riparian/river corridor regulations like the Rivers Protection Act in Massachusetts (https://www.mass.gov/guides/rivers-protection-act-questions-answers)
	
	3 to 5 Years:
	
	● Create a "one stop shopping" destination for instream, coastal and floodplain barriers that identifies which are obsolete
	● Define resiliency corridors to protect and discourage development in coastal flood hazard areas, floodplains, and within the dynamic geomorphically defined bounds of a river, to manage a responsible retreat. Look toward the Vermont Fluvial Hazards Corridor Program as an example of how to integrate this concept with local planning and zoning. These may also consider headwater areas, aquifers, and recharge zones.
	● Incentivize additional municipal regulation of floodplains
	  ○ Establish modifications to zoning and subdivision ordinances/regulations to go beyond the minimum National Flood Insurace Program standards.
	  ○ Incorporate the Association of State Floodplain Managers (ASFPM) "No Adverse Impact Floodplain Management (NAIFM)" policy into local floodplain management programs and municipal plans. (However, ensure that NAIFM does not apply to one snapshot in time and limit the ability to restore rivers. Must be able to account for the dynamic nature of the river system.)
	  ○ Increase participation by the watershed communities in the National Flood Insurance Program Community Rating System.
	● Require inspection and maintenance plans for ALL existing dams, not just state registered dams

Implementation Entities	FEMA, ACOE, USFWS, FERC, U.S. EPA, U.S. DOT, NRCS, CGA, CT DEEP, CT DOT, COGs, Municipalities, NGOs
Climate challenges addressed	● Disruption to connectivity ● Shifts in geographic ranges of species ● Warming water temps ● Changes in flow regimes and precipitation patterns

	○ Increased frequency and intensity of heavy precipitation, runoff, and peak streamflow ○ Increased frequency and intensity of droughts and flooding. ○ Disturbances to the geomorphic stability of rivers through the disruption of natural sediment processes ● Impacts to the migration of fish and wildlife species ● Sea level rise combined with increased frequency and intensity of storm surges and hurricanes ● Habitat loss for viable native species
Protection of vulnerable communities	● Restoration of free-flowing rivers through the removal of barriers has been shown to play an economic revitalization role in former economically distressed industrial regions within communities. ● Identify most vulnerable communities-- regarding hazard and socioeconomic risks relating to dam and levee failure. Identify sustainable long-term solutions to reduce risk.
References for action	North Atlantic Aquatic Connectivity Collaborative https://streamcontinuity.org/naacc The Stream Continuity Portal https://streamcontinuity.org/ Natural Floodplain Function Alliance https://www.aswm.org/watersheds/natural-floodplain-function-alliance

Create safe, equitable opportunities for people of diverse backgrounds to access and enjoy water resources	
Recommended Implementation Action Description	Adaptation and resilience to climate change will require ensuring safe and equitable access to, and benefits from, water resources for all Connecticut residents but especially for underserved and vulnerable communities. As it stands now, climate change will worsen existing racial, social, economic, and geographic inequities around the many significant benefits that natural resources – such as rivers and lakes – can provide to all people and communities. This harmful climate trend needs to be countered with freshwater-related adaptation and resilience actions that intentionally prioritize and enhance the safety, health, and prosperity of underserved and vulnerable communities. Increased feelings of safety in the outdoors and inclusive access that fosters greater enjoyment and better understanding of natural resources will also foster greater community support for climate change measures that protect and enhance water resources. Over time, these actions will also lead to greater natural resource stewardship and produce more natural resource and environmental professionals and leaders of diverse backgrounds who will participate in planning and decision-making on climate change and related issues.

Completion Timeframe	Less than 2 years ● Begin prioritizing underserved and vulnerable communities in state agency existing grantmaking and project work relating to inland waters – for example, through existing efforts such as Section 319 NPS grants or Open Space and Watershed Land Acquisition grants. ● Begin monitoring and evaluating state agency program results on basis of impact in underserved and vulnerable communities. ● Ensure that access information and signage is accessible to all communities. Better utilize technology for improved communication beyond English language signage. ● Foster greater level of comfort with freshwater resource activities (e.g., swimming lessons, paddling and fishing instruction, etc., especially for underserved populations). ● Ensure all state agency staff receive training in handling issues around equity, inclusion, and diversity, including for access, recreation, and safety issues around inland waters. ● Increase state agency staff and program funding for Environmental Justice and Public Outreach (environmental education) to support both internal and external needs for guidance, information and programming. Provide greater support to the Office of Diversity and Equity to recruit more diverse staff for positions within environmental conservation and environmental quality sectors. ● Develop programs that will help outdoor recreation, natural resource partners, and municipalities engage with diverse communities. 3 to 5 years ● Develop and implement criteria across all DEEP inland waters programs that prioritizes underserved and vulnerable communities for program efforts, protections, and resources, especially for any new climate adaptation and resilience programs and funds. ● Ensure early equity, inclusion, and diversity efforts for freshwater resources implemented in first two years (listed above) are placed on a long-term, sustainable footing within DEEP. Greater than 5 years ● Ensure that equity, inclusion, and diversity are core, long-term strategic priorities of DEEP and have been incorporated into DEEP's governing statutes, major policies and programs, planning, regulations, and practices relating to freshwater resources.
Implementation Entities	U.S EPA, U.S DOT, USFWS, USFS, NRCS, CGA, CT DEEP, CEQ, CT DPH, CT DOT, CT DMHAS, DCF, CT Office of Tourism, COGs, Municipalities, NGOs
Climate challenges addressed	Climate change will degrade, impair, and otherwise reduce the availability of freshwater resources that impacts recreation, public health, and sustenance provisioning to CT communities through the following:

	• More frequent and heavier downpours, resulting in more polluted stormwater runoff • More frequent, intense, and longer-lasting periods of drought • More frequent and severe episodes of harmful algal blooms in lakes, ponds, and reservoirs • More frequent, intense, and longer-lasting heat waves, which can harm watershed ecosystems • Enabling the spread of invasive species to the detriment of culturally-significant native species, such as coldwater fisheries. These climate harms will reduce the adaptive capacity and climate resilience of the freshwater resources crucial to the sustainability and prosperity of many CT communities. Will help to create a more diverse group of natural resource and environmental stewards, professional and leaders who will play a role in climate change planning, actions and decision-making.
Protection of vulnerable communities	Freshwater resources – our many rivers and lakes – play a key role in supporting and enhancing public health in CT's communities, among other important benefits. They offer respite from high heat, opportunities for recreation and exercise, and support culturally-significant ecosystems and species that are central to the cultural identity and well-being of diverse communities. Prioritizing equity, inclusion, and diversity considerations in protecting and restoring CT's freshwater resources will help ensure that already vulnerable communities receive the climate protections they urgently need, while also strengthening CT's overall adaptive capacity and resilience. Greater access and safer opportunities to enjoy these natural resources will also inspire more people of diverse backgrounds to become natural resource and environmental stewards, professionals and leaders who will add their voices to climate change discussions, and reflect other points of view about climate change impacts and solutions with regard to vulnerable communities.
References for action	CT DCF Wilderness School https://portal.ct.gov/DCF/Wilderness-School/Home Anti-racism in the Outdoors: Resources related to inclusion, diversity, equity and access of black, indigenous a people of color in parks and greenspaces (Google Doc - Compiled by Don Rakow - Cornell University & Laura Brown - University of Connecticut) https://docs.google.com/document/d/1i1nsirpyAFOTTTnjLP2LJtiewL-Y6sUERCxKepJBhDo/edit Green Infrastructure and Health Guide (July 2018) Oregon Health & Outdoor Initiative https://willamettepartnership.org/wp-content/uploads/2018/07/Green-Infrastructure_final_7_12_18_sm.pdf

Recommendation 2020.R.2: Safeguard water quantity for both "fish and faucet" through more balanced water use decisions

Promote demand-side water conservation and water reuse	
Recommended Implementation Action Description	Adopt and implement a state water hierarchy that includes water conservation, capture, storage and re-use, to reduce demand on rivers and inland waters such that enough water is available during droughts **without causing** low-or-no flows in inland water bodies.
Targets, Indicators, and Completion Timeframe	Less than 2 years ● Provide resources for the Implementation of the State Water Plan as many of the recommendations in this section mirror consensus recommendations in the Plan. ● Apply climate change projections to stream flow regulations, diversion regulations, and all related state policies/programs ● Require new commercial and government building construction to include capture and re-use of greywater for use in toilets. ● Eliminate decision-making bias toward economic development, and equalize ecologic needs of waterways (which is actually an economic need in CT – tourism etc.) ● Re-assess grandfathered diversions in vulnerable areas ● Accommodate dual systems for re-use by having all new construction framed to accommodate purple pipes (pipes that carry reclaimed water.) ● Implement recommendations in State Water Plan, and create a new position to help the Water Planning Council implement and update the plan in response to climate change ● Reduce transmission losses by expanding leak detection and maintenance programs. ● Create and implement a comprehensive education program to educate the public as to where their drinking water comes from, the connection between a clean environment and clean drinking water. 3 to 5 years ● Promote year-round conservation and reductions in peak water use. ● Reduce or eliminate grandfathered diversions. ● Locate wastewater treatment facilities near nurseries, greenhouses, agri-businesses, and wetland creation areas to enable use of reclaimed water ● Promote innovations for water conservation and re-use on farms, nurseries, green houses, golf courses, office and retail campuses ● Reduce use of treated drinking water for non-drinking uses. On-going: ● Educate residents about in-home water conservation and implement the 40-gallon challenge

	• Educate public to reduce outdoor water use and encourage xeriscape plantings • Promote greater understanding and educate public about where their drinking water comes from and where their wastewater goes.
Implementation Entities	U.S. EPA, NRCS, CT DPH, CT DEEP, CT DoAG, Water Companies, Agricultural Operations, CBIA/Businesses and Industries, Sustainable CT, Municipalities, Sustainable CT, COGs, NGOs
Climate challenges addressed	• Changes in precipitation (too much and too little) patterns • Flashier stream flows • Lack of public understanding of relationship between their actions (eg. - use of drinking water and discharge of wastewater) and climate change
Protection of vulnerable communities	• Rate recovery mechanisms and rate setting that will allow utilities to generate enough revenue for infrastructure maintenance and operations must keep low income households in mind. Pilots for water and wastewater utility bill assistance exist in Connecticut and should be expanded. • Reduction in out-of-stream water uses through conservation programs and an emphasis on year-round conservation mean healthier rivers, lakes, ponds and streams for recreation as well as fewer instances of restrictions on drinking water.
References for action	EPA - Water Sense - https://www.epa.gov/watersense Home WaterWorks - https://www.home-water-works.org/

Explore water rights options that protect fish and wildlife	
Recommended Implementation Action Description	Elevate and mainstream the protection of healthy river systems that can support fish and wildlife as competition among water uses increase with climate change.
Targets, Indicators, and Completion Timeframe	Two years: • Ensure that fish, wildlife and ecological needs are met when balancing economic and social needs in decision-making processes. • Establish minimum flow releases for ecological and biological support below dams • Re-evaluate grandfathered diversions • Compile all studies and data or commission a study on the economic value of healthy river ecosystems, fish and wildlife to the state's economy • Focus state land conservation plans and funding on conservation lands around cold water streams and resilient river systems • Discourage new small traditional hydropower development and instead incentivize existing hydropower facilities where facility removal is unlikely. Five years: • Reduce and/or eliminate grandfathered diversions

	● Create a State Office of Ecological Restoration within DEEP ● Adopt statewide riparian/river protection regulations ● Improve current floodplain regulations to reflect both the ecological values and flood storage values of floodplains.
Implementation Entities	USFWS, NRCS, CT DEEP, CT DPH, CT DoAG, Sustainable CT, Water Companies, Agricultural Operations, CBIA/Businesses and Industries, COGs, Muncipalities, NGO's,
Climate challenges addressed	● Promotes accounting for climate change risks, including warming temps; changes in flow regimes and precipitation patterns; migrating fish and wildlife species; and changes in land use patterns, when initiating any new development.
Protection of vulnerable communities	• Maintain or increase the opportunity for recreation and sustenance fishing • Healthier waters and natural areas bring healthier local economies and a higher quality of life.
References for action	Natural Floodplain Function Alliance https://www.aswm.org/watersheds/natural-floodplain-function-alliance

Recommendation 2020.R.3: Further develop policies, education/outreach, research, and funding opportunities that encourage protections for inland waters

Fund and enhance stormwater management programs	
Recommended Implementation Action Description	Based on Connecticut Physical Climate Science Assessment Report (2019), the observed and projected annual total precipitation in CT is projected to increase by 4-5 inches (approximately 8.5%) by the midcentury (2040-2069) and by 4.5-5.5 inches (approximately 10%) by the late century (2070-2099).
Targets, Indicators, and Completion Timeframe	Less than 2 years ● Establish and secure adequate and sustained funding for stormwater infrastructure and Nature Based stormwater management ○ Adopt enabling legislation for stormwater utilities ○ Increase number of municipalities with stormwater utility ○ Secure dedicated funding mechanisms ○ Update of Stormwater Quality Manual, Erosion and Sediment Control Guidelines, Post construction provisions in CT Stormwater General Permits for erosion and sediment control

	account for projected and observed changes in frequency of intense precipitation. 3 to 5 years ● Support regional collaboration and clear barriers to improved stormwater management ○ Update manuals and guidelines to reflect climate change conditions (listed in the longer categorization list) ○ Set strong but realistic goals and establish performance metrics e ○ Review and update state laws and regulations ● Protect all inland waters as well as the potability of public and private drinking water supplies from impacts of road salt and encourage "Green Snow Pro" techniques Greater than 5 years ● Create enabling conditions that reduce climate driven stormwater impacts to infrastructure, public transportation, commerce, and community/public health services and ecosystems. ○ Establish government structures, policies and incentives ○ Indicator: # Municipalities should establish zoning requirements/incentives for redevelopment and infilling, disconnection, buffers ○ Indicator: % disconnection of existing hard surfaces % nrew development disconnected ○ Indicator: % Municipalities requiring/incentivizing nature-based solutions for adaptation
Implementation Entities	CT DEEP, EPA, CIRCA, CLEAR, CGA, Municipalities, COGS, NGOs,
Climate challenges addressed	Flood, drought, water quality degradation, habitat degradation, temperature shifts, sedimentation
Protection of vulnerable communities	Water quality improvements to surface waters Reduction or elimination in combined sewer overflows Flood Mitigation
References for action	Connecticut Physical Climate Science Assessment Report (PCSAR): Observed trends and projections of temperature and precipitation; CT-PCSAR August 2019 https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/11/CTPCSAR-Aug2019.pdf One Water for America State Policy Makers Toolkit http://uswateralliance.org/sites/uswateralliance.org/files/publications/State%20Policymakers%27%20Toolkit.pdf 2004 Connecticut Stormwater Quality Manual (NOTE - THIS MANUAL TO BE UPDATED IN NEAR FUTURE - FUNDING FOR UPDATE

	SECURED) https://portal.ct.gov/DEEP/Water-Regulating-and-Discharges/Stormwater/Stormwater-Manual

Fund and enhance education, outreach and research	
Recommended Implementation Action Description	Articulate goals, incentivize participation, and provide training and data management, for monitoring and research projects that can detect climate change impacts on inland waters. Community engagement in monitoring and research will foster a greater level of stewardship.
Targets, Indicators, and Completion Timeframe	Less than 2 years • Establish a funding mechanism similar to Massachusetts' Water Quality Grant Program to provide resources to NGOs to supplement DEEP's ambient monitoring program to reduce the number of streams that are unassessed or do not have sufficient data for each Water Quality Report cycle. • Establish ongoing forums for participants to coordinate effort, share data (take advantage of existing conference, event, or network opportunities). • Develop educational campaigns for climate change adaptation awareness in CT targeted at multiple sectors • Standardized, funded support and training for citizen participants in monitoring—schools, non-profits, & other. 3 to 5 years • Develop and maintain accessible, up-to-date, long-term database for tracking and visualizing climate-change impacts on inland waters. (perhaps built upon CT Integrated Water Quality Report or other pre-existing tracking system)
Implementation Entities	CT DEEP, WPC and it's working groups, DPH, CIRCA, CLEAR, NGOs, Community Groups
Climate challenges addressed	• Climate-driven changes in: species composition of aquatic communities; water chemistry; nutrient cycling; sedimentation; invasive aquatic plants; toxic algal blooms; bacteria; other. • Impacts on recreational uses of inland waters (fishing, swimming, boating, other). • Impacts on ecosystem services of inland waters (pollutant detoxification, water purification, primary productivity, aerobic decomposition). • Public health risks posed by climate change on inland waters.
Protection of vulnerable communities	• Monitor condition/protect water quality of waterbodies used for recreation and fishing. • Enable/empower communities to do their own water quality monitoring and apply best management practices at the local level. • Invest in programs that will help outdoor recreation and natural resource partners engage and incorporate diversity and equity.

References for action	Massachusetts Water Quality Monitoring Grant Program

Address funding deficiencies for wastewater infrastructure and barriers to wastewater solutions	
Recommended Implementation Action Description	Conveyance and treatment of wastewater so it can be assimilated into our rivers and streams so that aquatic life and recreation can be supported without causing impairments to receiving waters and Long Island Sound has long been a high priority for Connecticut in meeting water quality goals. Connecticut is already experiencing the impacts of climate change in more intense precipitation and frequent droughts that are already impacting water quality. Addressing funding of important infrastructure projects (such as combined sewer overflow elimination and reduction), refining discharge limits, and addressing regulatory and oversight barriers to traditional and alternative septic are critical.
Targets, Indicators, and Completion Timeframe	Less than two years ● Advocate for an increase in federal funding for wastewater infrastructure and wastewater solutions. ● Maintain/Increase funding for Clean Water Fund. ● Evaluate enhanced nitrogen and phosphorus wastewater treatment technologies ● Evaluate barriers to implementing alternative treatment waste systems (ATS) and integrate and coordinate permitting across DPH and DEEP to enable use and oversight of high performing ATS. ● Improve effectiveness of existing regulatory, planning and funding framework for wastewater treatment and disposal in unsewered areas (CT DEEP and CT DPH Workgroup) ● Maintain high standards for Combined Sewer Overflow (CSO) reduction in CSO communities. 3 to 5 years ● More stringent/uniform criteria and oversight for traditional septic. ● Incorporate TMDL waste load allocations and water quality effluent based limits into discharge permits ● Provide funding to municipalities to address water quality impairments due to septic systems Greater than 5 years ● Relocate or increase elevations of wastewater treatment plants and subsurface groundwater separation
Implementation Entities	CT DEEP, DPH, OPM, CGA, Municipalities, COGS, NGOs, Connecticut Water Pollution Abatement Association

Climate challenges addressed	● Warming air and water temperatures increase nutrients, pathogens, pollutant concentrations and algal growth and decrease levels of dissolved oxygen. ● Increased frequency and intensity of heavy precipitation, runoff, peak streamflow and inland flooding triggers untreated sewage discharge ● Increased and more intense coastal storms, waves and flooding threaten wastewater treatment plant operations, particularly in coastal and tidal areas. ● Increased pollutant transport to water bodies during high flow events (urban runoff, combined sewer overflows, treated wastewater discharges, groundwater levels encourage sump pump of untreated sewage discharges to sanitary sewers (inflow) and exacerbate collection pipe leakage (infiltration) ● Decreased low flow volume during periods of drought (less dilution) ● Rising groundwater levels Increase risks of septic system failure malfunction or inadequate effluent treatment, particularly in coastal and tidal areas.
Protection of vulnerable communities	● The bills coming due for capital improvements for community and municipal wastewater systems cannot be put entirely on the backs of ratepayers as this will negatively impact economically disadvantaged households and communities. Increased investment in wastewater infrastructure at the federal and state level will ease the financial burden on households. ● Weakening of Combined Sewer Overflow reduction requirements will impact vulnerable communities.
References for action	

APPENDIX A – SUMMARY OF THE STATE'S COLD WATER RESOURCES RELATIVE TO CLIMATE CHANGE THREAT

The Connecticut DEEP has classified over 4,000 miles of streams as cold water habitat through methods using both fish species and direct water temperature measurements. The research defined important water temperature thresholds, providing the ability to identify and classify areas of cold water stream habitat[2].

- Brook trout and slimy sculpin are important cold water stream habitat indicator species in Connecticut. The presence of either in healthy populations indicates cold water stream habitat. Brook trout have been previously described as sentinel species for small, healthy least disturbed streams in Connecticut[3].
- An average summer (June-August) stream water temperature less than 18.3 degree C (64.9 degrees F) can also be used to classify cold water stream habitat.

Where is Connecticut's Cold Water Stream Habitat?

With the knowledge gained from the compilation of recent Connecticut based studies, identification and subsequent classification of cold water habitat can be made with data from either fish or stream water temperature. To catalog cold water habitat DEEP analyzed all available fish and water temperature data to identify cold water rivers and streams. The analysis to date includes years 1988 – 2019 and identified 1,182 samples and 692 sites indicating cold water habitat from both fish community and temperature logger data. Sixty-six sites include cold water measurements from both temperature logger and fish community samples. If a site was measured to have cold water habitat with either fish community or water temperature using the June-August metric at any time during our surveys, it was considered cold water stream habitat. To present these data in a readily accessible and usable format, DEEP developed a web-based mapping application[4]. The mapping application is easily updated as new or updated information is collected and analyzed.

- Data used in the **Cold Water Stream Habitat Web based map application** can be downloaded through the web application.
- Nearly 4,000 stream miles support cold water habitat in Connecticut.
- The information contained in the cold water map is not a model. Rather, the map is based on measurements in the field collected by many dedicated biologists and volunteers over several years.

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[2] Mike Beauchene, Mary Becker, Christopher J. Bellucci, Neal Hagstrom & Yoichiro Kanno. 2014. *Summer Thermal Thresholds of Fish Community Transitions in Connecticut Streams*, North American Journal of Fisheries Management, 34:1, 119-131, doi:10.1080/02755947.2013.855280

[3] Christopher J. Bellucci, Mary Becker, & Mike Beauchene. 2011. *Characteristics of macroinvertebrate and fish communities from 30 least disturbed small streams in Connecticut*. Northeastern Naturalist 18:411-444, doi.org/10.1656/045.018.0402.

[4] https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Cold-Water-Stream-Habitat-Map

APPENDIX B – URBAN WATERSHED PILOT PROJECT PROPOSAL (Submitted by Mary Pelletier, Park Watershed)

A. Identify Pilot 'Green Zone' Project Areas: *select 4-6 urban/suburban (coastal and inland) watersheds:*
What State agency properties and State programs (such as Sustainable CT, or municipal Plans of Conservation & Development) can be utilized to fulfill GC3 recommendations?

Coastal communities

New Haven – West River *or* Quinnipiac River watershed
Bridgeport – Housatonic River watershed or other, smaller river/watershed)
New London – Mystic River watershed

Inland communities

Hartford – North Branch Park River watershed
Waterbury – *Naugatuck River watershed*
Willimantic – Thames Basin Partnership

B. Begin an integrated planning process by synthesizing recommendations from GC3 groups:
Develop a spreadsheet/list of placed-based opportunities to implement GC3 recommendations urban-suburban watersheds:
What planning conditions need to change in order to eliminate pollutants that damage public health in urban areas?
What designed relationships between healthy ecosystems and development will support desirable, resilient economically sustainable high-density communities?
What ecosystem service benefits are provided by existing forests (such as mitigating urban heat islands) along urban-suburban riparian corridors, and how can revitalization of damaged landscapes further increase resiliency?
How can expansion of urban-suburban corridors mitigate the increased volatility of urban-suburban tributaries volatile, projected due to increased heavy precipitation?
How will increased heat and prolonged drought impact riparian corridors, and how can conservation planning and revitalization increase resiliency of riparian corridor biodiversity?
How can increased can expansion of the riparian corridors support avian, mammal and aquatic habitat as well as design new symbiotic relationships between human communities and urban wilds?
How can increased connectivity along urban-suburban riparian corridors support wildlife, birds, avian insects (pollinator pathways) and aquatic migration so as to strengthen established habitat within the context of urban development?

C. Engage in a comprehensive planning process *of the pilot watersheds*
Have this process managed by design professionals who have experience with large scale urban design, landscape/ecosystem restoration and regional planning implementation processes. Include biologists, public health experts, cultural historians, ecosystem restoration landscape architecture and urban designers as well as engineers and

transportation planners.

Comprehensive planning ought to address and include:

1) Revise urban economic conventions and design assumptions so as to recognize the need for high-density communities that minimize suburban sprawl, yet also *support community health pods and social distancing*. Through design with respect to public and environmental health, future high-density development can increase walkability, access healthy natural resources, and connectivity to community.

2) Generate new green economy jobs through conservation and revitalization of damaged natural resources in urban areas that is conducive to symbiotic economic programming, such as a native plant nursery or bicycle shop.

3) Complete the comprehensive planning process within 1 year. Set 3-5-10-15-year timelines/deadlines for implementation along with future community vision goals.