Environmental Public Health Community Support in the Aftermath of Flooding and Other Natural Disasters

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Executive Summary

Washington is among the most flood-prone states west of the Mississippi River. In Washington, the costs of flood damages exceed the cost of all other natural hazards. The probability for 10 or more flooding events in a year is estimated as 81% based on data since 2000, and climate change will increase the frequency of these flood events, especially winter flooding for most rivers.[1]

Storms in late 2021 and early 2022 led to multiple flooding disasters that included several cascading impacts, such as stream channel migration, mudslides, and erosion, confirming that flooding is one of the most prevalent natural hazards in Washington and deserves our attention. [2]

As many Washington communities prepare for and respond to increased flooding and flood events, the effects on public health, especially the significant impacts to long term public health, are often overlooked. [3, 4]

Floodwaters can pick up contaminants like oil and other road dust and debris, animal waste, and fertilizers, before emptying into reservoirs or rivers or sinking into wells. This creates a long-lasting problem, even after flood waters recede. Contaminants can sink into houses and the ground, going undetected for months and giving people a false sense of safety.[5]

Severe storms and heavy rainfall can also leave behind another problem: polluted land, air, and water. Flooding associated with Hurricane Harvey, for example, flooded or damaged 13 Superfund sites, sending cancer-causing chemicals into the low-income, minority communities surrounding those sites. [6]

According to the Centers for Disease Control and Prevention, contaminated flood water cause a range of immediate and long term public health risks including: wound infections, skin rashes, gastrointestinal illness, tetanus, and in rare cases, a bacterial infection called lepttospirosis.

Due to policies like redlining, flooding and other disasters often disproportionately affect historically marginalized communities. Disasters bring economic hardship for families and businesses, as well as increased exposure to health hazards. To correct this trend, we must identify inequities in the flooding and disaster recovery policy landscape, amplify the voices of historically underserved populations, and ensure the equitable distribution of resources and assistance.[7]

This guide explores some of the primary ways that flooding threatens public health and provides guidance and resources for Local Public Health in partnership with community leaders to ensure better preparation and safer, more resilient communities.

What are Public Health Impacts of Flooding and Other Disasters?

Several types of floods occur across the state's diverse geography. In Western Washington, floods typically result from prolonged winter rains accompanying atmospheric rivers. In Eastern Washington and in the Cascades, spring snowmelt, rain-on-snow events, thunderstorms causing flash floods are the primary causes of these events. Coastal storm surges, overwhelmed storm drains, ice jam and debris blockages, and channel migration are also frequent sources flooding.[1, 2]

Health effects can be a direct or an indirect consequence of these increasingly common flooding events and felt immediately or experienced as medium to longer term impacts after a natural disaster. Recent research has categorized direct health impacts into four major categories: [8]

Weather-related morbidity and mortality

The immediate health impacts of floods most often include drowning, heart attacks, injuries, animal bites, and hypothermia. The indirect effects include, injuries and infections, water-borne infectious disease, mental health problems, respiratory disease and allergies in both the medium and longer term after a flood. [9] Complications from untreated chronic diseases such as diabetes, hypertension, and HIV are thought to have increased mortality in recent flood events due to an inability to access basic health care as well as added physical stress from hurricane-related stressors.[10]

Waterborne diseases and water-related illness

In the medium-term, infected wounds, complications of injury, poisoning, poor mental health, communicable diseases, and prolonged hunger are indirect effects of flooding. In the long-term, chronic disease, exposure to toxic and biological contaminants, carbon monoxide poisoning, disability, poor mental health, and poverty-related diseases including malnutrition are frequently seen. Health risks also are associated with the evacuation of patients, loss of health workers, and loss of health infrastructure and access to healthcare including essential drugs and supplies. [9, 11]

Vector-borne and zoonotic diseases

Other public health impacts include disruption of immunization and vector control programs, and destruction of existing safe water supplies and health and sanitation facilities. For example, data collected in major US flooding events over the past decade have documented that lack of shelter from damaged housing caused mosquito-biting rates to increase. Contamination of drinking water due to failures at water treatment plants and sewage system overloads can lead to outbreaks of diarrheal disease if clean water provisions are not prioritized. [4]

Psychiatric and mental health effects

The most lingering health hazard that is not well planned is the mental and emotional trauma sustained after surviving the floods. Some residents enduring major floods face displacement, poverty, and unemployment. Natural disasters are known to leave many survivors with acute post-traumatic stress disorder (PTSD), including children [12]. Recent studies find the prevalence of serious mental illnesses doubled when compared to results from surveys of the same census divisions prior to flooding, and flooding in particular has been found to affect people of all ages for prolonged periods of time, with the mental health effects encompassing anxiety and depression in addition to PTSD. [11, 12]

A recent review of 35 epidemiological studies finds that public health impacts are also inter-related and associated with social vulnerability. Mortality rates were found to increase by up to 50% in the first year post-flood. Immediately after floods, there is an increased risk of disease outbreaks such as hepatitis E, gastrointestinal disease and leptospirosis, particularly in areas with poor hygiene and displaced populations. Psychological distress in survivors (prevalence 8.6% to 53% two years post-flood) can also exacerbate their physical illness. [3]

There is a clear need for effective, multi-disciplinary planning, policies, and programs focused on preventing flood-related morbidity and mortality hinging on increasing the public understanding of potential health impacts of floods. Future efforts should integrate health preparedness and prevention measures into emergency flood plans and hydrological warning systems.

Ensuring Flood Preparation and Response Prioritize Public Health

Communities with the right preparation can avoid some of the worst public health risks associated with flooding and other disasters by prioritizing public health. Washington State Department of Health is expanding resources in several priority areas to support local health partners and communities with flood preparation and response efforts including:

1. **Coordinating planning, public communication, and education to reach the most vulnerable**
2. **Protecting access to healthcare facilities**
3. **Improving flood mapping and warning systems by including public health data**
4. **Prioritizing public health in post-disaster building assessments**

#1 - Coordinating planning, public communication, and education

Washington State Department of Health also supports the efficiency and effectiveness to be gained through multi-disciplinary coordination and integration of local Comprehensive Plans and Hazard Mitigation Plans. Local Environmental Public Health can help ensure community engagement in resilience planning; ensure emergency managers and health experts are helping develop the Comprehensive Plan, and planners and public health experts help develop the Hazard Mitigation Plan.

Ensuring that comprehensive plans and Hazard Mitigation Plans are integrated and consistent with each other creates a more complete assessment of risks and ensures that public health is prioritized in preparation and response. FEMA Region 10's **Integrating Hazard Mitigation Into Local Planning, Case Studies and Tools for Community Officials** provides information about how to integrate hazard mitigation activities into local planning efforts. Part of this integrated planning includes engagement of the most vulnerable populations and educating the public about dangers of wading into flood water.

Elected officials and community leaders have a responsibility to incorporate public health considerations in their messages around flooding.

#2 - Protecting access to healthcare facilities

Facing flood disasters, communities must protect facilities that are essential to a community's health and safety, such as healthcare facilities and wastewater treatment plants. Weakened health care infrastructures during natural disasters make seeking care for these immediate injuries and infectious diseases even more difficult.

Local Public Health in partnership with planners, emergency managers and communities can establish priorities for healthcare access an focus efforts mitigate flood impacts through combined preparation, response, and funding efforts. For example, When Hurricane Harvey flooded acres of parks and properties in Houston, even though they were outside the floodplains mapped out by FEMA, volunteers responding to the emergency collected data on flooded areas and uploaded it to an online map. The data gave first responders and emergency managers real-time flood information about for miles of flooded area that was excluded on established flood maps. [13] Charleston, South Carolina, recently completed nearly a dozen projects totaling over a half billion dollars to improve stormwater drainage in its medical district. [14] In St. Augustine, Florida, Local Public Health in partnership with the community surrounded a wastewater plant with portable flood barriers, which can be quickly installed ahead of a storm. [15]

#3 - Updating flood maps and data to include public health risk

Public health should be a key part of any community's flood preparation, response, and recovery. We can do this by ensuring much of our existing flood work complements public health efforts, using many resources that already exist, combined with efforts to educate and engage the general public.

Public health maps, when combined with flood risk maps, let governments identify and assist vulnerable populations and neighborhoods including the young, aging populations, people experiencing homelessness, and those who are dependent on electrically powered medical equipment and devises.

This combined public health and flood risk information can help target warning messages before extreme weather events, locate unstable infrastructure that may collapse from flooding, and support emergency responders during a disaster.

Washington State Department of Health (DOH), as part of our effort to expand health capacity related to flood risk resources has expanded health disparity mapping and social vulnerability mapping and data to incorporate the most current flood risk data, in conjunction with health care facilities and resources for identifying populations dependent on electrical medical equipment. Washington State DOH continues to work to model flood risk among vulnerable populations as part of our Washington Tracking Network, Information By Location mapping program available on our website at: **https://fortress.wa.gov/doh/wtn/WTNIBL/**

#4 - Public health focus in post-disaster building assessments

Under Washington laws, Voluntary assessments for flood control or stormwater control are required and generally focus on building and design standards. Many cities and counties across the state have well established emergency management policies, plans and ordinances, and much important work has been done by the ***Washington Association of Building Officials (WABO) and Washington Safety Assessment of Facilities Evaluators (WASAFE)*** establishing building assessments, training programs, and procedures meeting state and federal requirements to help ensure public, health, safety and welfare in major flood events and other natural disasters.

Given damaged public health infrastructure, alongside contaminated floodwaters, injuries, and disease in Washington State that is consistent with national experiences, WA DOH recognizes that a single flood can overwhelm communities' healthcare systems and cause long-term health crises. [16, 17] Washington State DOH also recognizes an opportunity to increase community resilience and reduce health disparities by increasing the focus on public health in all flood and natural disaster planning, communications, education and especially in post-disaster building assessments. This guidance contains a sample building assessment and several examples from other states focusing on public health. We also encourage preparation and response efforts that focus on health and health equity recognizing a history of resource eligibility restrictions that leave out lower income homeowners and communities, allow renters and non-English speakers to fall through the cracks, and follow complex procedures that make processes more costly and challenging for rural and remote communities.

What Additional Public Health Resources are Available?

WAserv

WAserv stands for the Washington State Emergency Registry of Volunteers. It allows local administrators and volunteer managers to efficiently identify, activate, and deploy medical and support volunteers. It also provides information about training and exercises.

WAserv is part of the Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP). It is a national network of state-based programs used to verify the identity, licenses, and credentials of trained health care, public health, and support professionals before an emergency happens.

Public Health Flood Checklist

In addition to establishing a process and procedures for conducing environmental public health focused building assessments and reviews, as well as preparation and planning, a number of national and international public health agencies and organizations have developed and published checklists, operational guidelines and websites designed to assist the public in the aftermath of flooding or other natural disasters. Some of these resources have been compiled here to assist Local Health Jurisdiction as well as Washington State DOH in expanding our resources.

Common themes in Public Health Flood Checklists include:

- Mitigating for Mold
- Avoiding Gas-Powered Generators Indoors
- Disinfecting Flooded Drinking Water Wells
- Emergency water supply

    - Consult with local authorities to organize the emergency water supply and technical options for sources, treatment, disinfection, storage and distribution.
    - Emergency water supplies can consist of packaged water, tanker water, direct use of alternative water sources or on-site production of drinking-water.
    - If circumstances allow, separate emergency supplies (including both materials and human resources) are encouraged for health care facilities and the general public.
    - Prevent access of unauthorized people to the emergency water supply and storage system.

- Identifying and Addressing Flooded Private Sewage Systems

- Needs Assessment for Toilets, Waste Handling and Disposal

- Addressing Flooded Heating Systems (air ducts/indoor air quality)

- Residential Oil Spills

- Hazardous Household Materials (including lead)

- Rapid Review for Vulnerable Populations
    - accommodation of people with medical needs in temporary shelter;
    - ensuring that chronically sick people have a list of medications required at hand;
    - availability of short and clear instructions on what to do – for example, in text suitable for children;
    - training of first aid workers to work with vulnerable groups;
    - business continuity plans for primary health care;
    - integration of factors related to race, culture and language in communication strategies;
    - integration of specific needs of ethnic and racial groups in programs for health sector surge capacity, emergency shelter and quarantine.

- Any additions to routine vaccination should only be considered for vulnerable population groups under certain specific circumstances.

- Food safety concerns include:
    - increased risk of outbreaks of foodborne disease, including diarrhea, dysentery, hepatitis A;
    - increased likelihood of using contaminated water for food handling and preparation;
    - population displacement forcing people to have fewer food choices and use more risky food handling practices;
    - contaminated fruit and vegetables;
    - poor sanitation, including lack of safe water and toilet facilities;
    - impairment of the cold chain and proper heat-treatment of foods because of problems with the electricity supply. Avoid communicable disease outbreaks by advising people to follow the five keys to safer food:
    - keep hands and utensils clean
    - separate raw and cooked food
    - cook food thoroughly

- keep food at a safe temperature
- choose to use safe water and raw materials

Understanding the Legal Framework

The 2018 Disaster Recovery Reform Act, Section 1241(a) (*P.L.* 115-254), requires post disaster building safety assessments to be coordinated with federal, state and local governments and organizations representing design professionals, such as architects and engineers, to develop guidance, including best practices, for post-disaster assessment of buildings by licensed architects and engineers to ensure the design professionals properly analyze the structural integrity and livability of buildings and structures.

This is established recognizing that the federal and state governments have limited resources to deploy in the aftermath of a disaster and local agencies may be immediately on the scene to implement procedures and conduct post-disaster building assessments quickly and effectively.

Authority Under Washington State Laws

A. RCW 36.40.180 Emergencies subject to hearing—Nondebatable emergencies.

In response to an emergency or for the immediate preservation of order or public health or to restore public property that has been destroyed by accident, or for the relief of a community overtaken by a calamity, or in settlement of approved claims for personal injuries or property damages, exclusive of claims arising from the operation of any public utility owned by the county, or to meet mandatory expenditures required by any law, the Board of County Commissioners (BOCC) may, upon the adoption of a resolution, make the expenditures necessary to meet such emergency without further notice or hearing.

B. RCW 38.52.070 Local organizations and joint local organizations authorized – Establishment, operation – Emergency powers, procedures – Communication Plans.

A political subdivision in which a disaster occurs has the power to enter into contracts and incur obligations necessary to combat the disaster, protecting the health and safety of persons and property, and providing emergency assistance to the victims of such disaster. The political subdivision is authorized to exercise the powers vested under RCW 38.52 in the light of the exigencies of an extreme emergency situation without regard to time-consuming procedures and formalities prescribed by law (exception: mandatory constitutional requirements). This includes, but is not limited to, budget law limitations, requirements of competitive bidding and publication of notices, provisions pertaining to the performance of public work, entering into contracts, the

incurring of obligations, the employment of temporary workers, the rental of equipment, the purchase of supplies and materials, the levying of taxes, and the appropriation and expenditures of public funds.

C. RCW 38.52.110 Use of existing services and facilities – Impressment of citizenry

1. In responding to a disaster, the BOCC are directed to utilize the services, equipment, supplies, and facilities of existing departments, offices, and agencies of the state, political subdivisions, and all other municipal corporations thereof including but not limited to districts and quasi municipal corporations organized under the laws of Washington State to the maximum extent practicable. Officers and personnel of these departments, offices, and agencies are directed to cooperate and extend services and facilities upon request, notwithstanding any other provision of law.

2. In the event of a state-declared disaster, the BOCC have the power to command necessary service and equipment from citizens, provided during the period of service, the citizens are entitled to all privileges, benefits and immunities provided by RCW 38.52 and federal and state emergency management regulations for registered emergency workers.

D. RCW 38.52.310 and WAC 118-04 Emergency Worker Program

Washington State established the Emergency Worker Program to provide protection and benefits to volunteers deployed on state-approved incidents and training events. Registered emergency workers are provided liability, medical, and personal property coverage as well as reimbursement for some incidental expenses. There are 18 classes of emergency workers and the scope of duties of each class is detailed in WAC 118-04-100. Local emergency management agencies are authorized and responsible for registering emergency workers for their jurisdiction. Permanent workers such as search and rescue or medical reserve corps volunteers are registered in advance. When emergency situations require immediate or on-scene volunteer recruiting, temporary registration is authorized.

E. RCW 39.04.020 Plans and specifications – Estimates – Publication - Emergencies

When an emergency requires the immediate execution of a public work, the publication of its description and estimate may be made within seven days after the commencement of the work.

F. RCW 39.04.280 Competitive bidding requirements - Exemptions

If an emergency exists, the person or persons designated by the governing body of the municipality to act in the event of an emergency may declare an emergency situation exists, waive competitive bidding requirements, and award all necessary contracts on behalf of the municipality to address the emergency situation. If a contract is awarded without competitive bidding due to an emergency, a written finding of the existence of an emergency must be made by the governing body or its designee and duly entered of record no later than two weeks following the award of the contract.

APPENDIX A: Sample Environmental Public Health Building Assessment

Date_____

Property Address

_____

Building Contact Name, Phone#

_____

Permission to enter premises (note if administrative warrant required)

_____
(signature of building contact or owner)

Team conducting assessment _____

Date Started_____ Date Closed _____ Time In_____ Time Out_____

Report Generated? ☐Y ☐N If yes, who was report sent to?

_____

Referred to Another Agency? ☐Y ☐N If yes, who?

_____

Follow up Required? ☐Y ☐N If yes, what and to whom?

_____

INVESTIGATION

OUTDOOR EVALUATION

Estimated % of Building Damage
☐ None
☐ 0-25%
☐ 25-50%
☐ 50-75%
☐ 75-100%

Provide a sketch of the assessed building or rooms and areas of concern.

Describe level of inundation from ground level

_____

Primary Building Type (e.g., Residential, Commercial, Manufactured, Historic, Agricultural), Building Use, and Function

_____

Describe any exterior damage addressing each of the following:

Roof Damage

_____

Electrical Damage

_____

HVAC Damage

_____

Gas Leaks or Damage

_____

Municipal Water System Damage

_____

Sewage/Septage Backup

_____

Private Well and Septic Damage (casing, water pressure, soil saturation, drain field damage)

_____

Exterior Hazards not otherwise noted:

_____

_____

INDOOR EVALUATION

List interior damage impacting building use including the following:

Smoke or Carbon Monoxide Detectors – present and functioning?

_____

Electrical or Furnace Damage

_____

Ventilation

_____

HVAC System

_____

Toilets Functional/Free From Sewage Backup

_____

Doors/Windows Open and Shut Easily

_____

Water System Operational – Hot Water/Drinking Water/Ability to Boil Water/Appearance

_____

Flooring Damage - Hazards

_____

Evidence of or Entry Routes for Vectors/Pests

_____

Electrical Generator In Use

_____

Occupant specific issues - If building is habitable but cannot provide intended use, describe how occupant specific use has been compromised (evident water intrusion, airborne particulates, etc):

_____

_____

Other Environmental Health Hazards noted (lead, asbestos, etc.):

_____

_____

Additional Comments

_____

_____

_____

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FEMA

https://www.fema.gov/sites/default/files/2020-07/fema_p-2055_post-disaster_buildingsafety_evaluation_2019.pdf

https://19yigp8o402s7j7yyn3cqw4t-wpengine.netdna-ssl.com/wp-content/uploads/2018/09/flood_recovery_checklist.pdf

https://www.fema.gov/sites/default/files/documents/fema_mitigation-guide_public-health.pdf

Other WEB Resources

https://floodcoalition.org/resources/dualdisaster/

https://www.co.montgomery.ny.us/sites/public/government/publichealth/PublicHealth_Documents/flood_checklist.pdf


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