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## PRACTICE SUSTAINABLE DEVELOPMENT CODES



# Facing Water-Based Challenges with Sustainable Development Codes

By Jonathan Rosenbloom

Development codes across the country are exacerbating the challenges associated with extreme precipitation events. When coupled with prolonged drought, extreme precipitation can lead to a number of cascading hazards and impacts to communities. This phenomenon, when extreme dry conditions are followed by extreme wet conditions and vice versa, is called “precipitation whiplash.” Communities across the United States are already experiencing this whiplash and its associated impacts to people, ecosystems, and local economies, and can expect an increase in the frequency of whiplash events in the future.

Local governments are increasingly reviewing their development codes to identify regulations that result in unintended consequences and aggravate precipitation events. Many of the actions taken by local governments have been or will be summarized, described, and categorized in the Sustainable Development Code (SDC), a new, fully searchable, free service providing best practices to amend development codes. This article describes the recommendations currently included in and planned for the SDC that may help address precipitation whiplash, uncertainty, and the daunting water-based challenges facing local communities.

## EXTREME PRECIPITATION AND INFRASTRUCTURE VULNERABILITIES

This section discusses four related issues that make addressing water-based challenges particularly difficult for communities. These are: precipitation whiplash and worsening patterns of extreme weather, the need for development to accommodate projected population increases, inefficiencies in development codes, and existing infrastructure vulnerabilities. The following outlines each of these issues in more detail.

### Precipitation Whiplash and Extreme Weather

Precipitation whiplash is “the occurrence of two consecutive years during which rainy

season (November–March) precipitation falls under the . . . 20th percentile (in the first year) and subsequently exceeds the . . . 80th percentile (in the following year)” (Swain et al.). Recent examples in California help to illustrate the kind of precipitation whiplash communities are facing. California’s four-year drought from 2012 to 2016 ended with catastrophic and record-setting rains. The rain in the Feather River watershed north of Sacramento contributed to the failure of the Oroville Dam’s primary spillway and the emergency evacuation of hundreds of thousands of people. The rain was followed in 2017 and 2018 by the record-setting Mendocino Complex, Thomas, and Camp Fires.

A 2018 study confirmed that Californians’ experience over the last seven years will reoccur with increasing regularity. Extreme weather events are projected to lead to a 100 to 200 percent increase in overall seasonal rainfall in California by 2100. Yet, years slightly dryer than the 2013–2014 drought year can be expected to occur in a “robust manner” throughout the state around 2060 (Swain et al.). Thus, Californians can expect more extreme flood events and more impactful droughts.

Communities in California are not alone in dealing with persistent drought, flood, and wildfire. The water-based challenges experienced by the community around Des Moines, Iowa, are emblematic of the challenges facing communities across the United States now and into the future. In the fall of 2012, the U.S. Drought Monitor noted that Iowa was under extreme, exceptional, and severe drought conditions throughout the state (National Drought Mitigation Center). The drought put immense pressure on infrastructure, ranging from transportation to emergency services, to stormwater management, to the provision of potable water. As tributaries dried up, the Des Moines Water Works struggled to provide potable water to more than 500,000 people in central Iowa. Then Governor Terry Branstad assembled a team of 138 science faculty and research

staff to research drought response. The group concluded that climate change contributed to the ongoing drought, and that Iowans could expect similar and worsening drought conditions in the future.

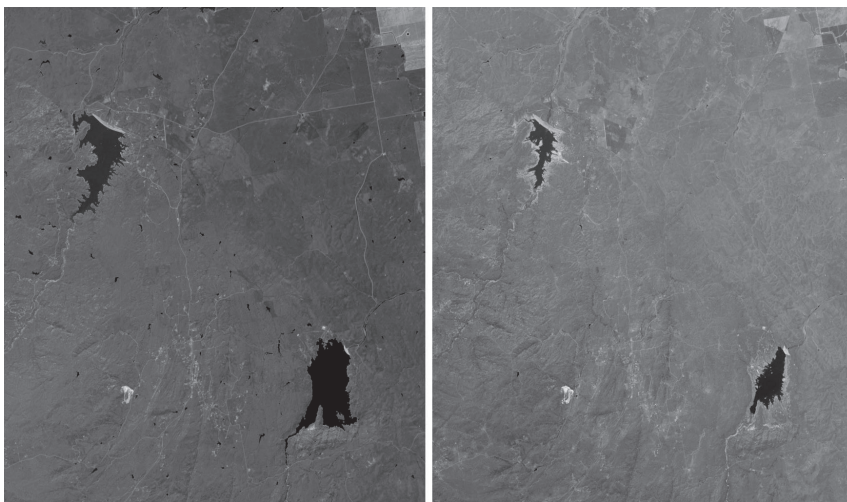
In the spring of 2013, shortly after the group reached its conclusions, the drought ended with the most spring rainfall—18 inches—that Iowa had experienced in 141 years of record keeping. The quick shift in moisture burst water mains, led to widespread flooding, and ultimately resulted in a spike in nitrate levels (caused predominantly by fertilizer runoff) through the spring and into the summer of 2013. Because nitrate levels tested above the U.S. Environmental Protection Agency’s maximum allowable levels for distribution of potable water, the Des Moines Water Works was required to add a layer of filtration through a reverse-osmosis system that cost ratepayers nearly \$1 million in treatment costs (Stowe 2014).

Much like Californians, Iowans can expect their water-based challenges to worsen. Just this year, the Upper Midwest spent late winter and most of early spring wrestling with mass flooding from the March “bomb cyclone.” Midwestern towns, cities, and counties experienced levee breaches and flooding that left communities without critical services for weeks. The National Oceanic and Atmospheric Administration’s Spring Flood Outlook for Iowa indicates that many parts of the entire central United States will continue to experience major, moderate, and minor flooding.

In a very short period of time, communities in California, Iowa, and other states faced too little water, too much water, and significant impacts to overall water quality. For the foreseeable future, communities can expect more uncertainty in which water challenges are dramatically different from one day, month, or year to the next.

### More Development is Coming

Population growth and shifts in migration patterns will require significant development



The recent California drought is reflected in a vastly changed landscape in the Sierra Nevada foothills.

over the coming decades. Such development will add stress to already overstressed natural and man-made systems and will increase natural hazard risks to people, ecosystems, and communities. While approximately 41 million people already live in flood zones, that number is expected to increase as populations grow and areas at risk of flooding expand (Mazur 2019). The United States is projected to add 50 to 75 million people in the coming decades. This population increase and the phasing out of older buildings will require massive amounts of development, including approximately 90 billion additional square feet of commercial, retail, and industrial space and 80 million new residential units (Nelson 2004).

In the last few decades, land consumption (often in the form of sprawling single-family and commercial spaces) outpaced population by 30 to 50 percent. Much of this land consumption occurred in greenfields. These development patterns to accommodate population growth and migration are expected to continue into the future. In many cases, this will result in the removal of functioning ecosystems (forests, prairies, wetlands, etc.) that help build natural resilience to extreme precipitation, drought, and related natural hazards.

#### Inefficiencies in Development Codes

Many existing local development codes regulate development in ways that remove

greenfield ecosystems and associated natural systems. These codes encourage, if not compel, gray infrastructure development that neither absorbs nor filters water, thus increasing vulnerabilities by removing important ecosystems *and* replacing them with static, inflexible infrastructure. As one article noted “[i]ll-conceived development . . . replaces water-absorbing forests and wetlands with impermeable surfaces—so there is simply nowhere for all that water to go” (Mazur 2019).

A significant amount of research and discussion concerns the role public infrastructure projects could and should play in the water infrastructure system (see, for example, the June 2018 issue of *Zoning Practice*, “Practice Coastal Adaptation,” which explores the challenges confronting coastal communities’ infrastructure). But what role do and should development codes that regulate the private end user play in this infrastructure system? What are and what should be the obligations of millions of property owners and developers as the infrastructure system is built out and needs improvement?

Property owners and developers are subject to a myriad of development code provisions as they construct, renovate, and operate residential, commercial, and industrial properties. Many of those provisions pertain to infrastructure. For example, development code provisions influence

infrastructure relative to streets, lights, sidewalks, driveways, roof structures, stormwater, the provision of water, and energy. How the resulting infrastructure—often a product of static and outdated regulations—interacts with both the built and unbuilt environment has important repercussions for existing and future water-based challenges.

#### Stationary Laws and Gray Infrastructure

Stationarity is an overarching theme that can be found in the regulation of infrastructure in development codes. Ecologist C. S. Holling summed up the idea of stationarity as embedded in law by stating, “In a system anticipating transformation, in a flip from one state to another, laws are truly of limited help, because the transformed system has unknown key variables and processes and unknown risks and opportunities emerge” (Holling 2012).

In other words, laws and regulations such as development codes are fixed in time. For the most part, they do not quickly adapt to changing circumstances. Yet the world around them is changing. This is particularly true with many land-use codes that were drafted in the 1950s and 1960s and have not been significantly updated. When they are updated, the new provisions can be done in an ad hoc manner, often following a significant event such as flooding.

Stationarity in the local development codes is reflected in gray infrastructure requirements. Through local development codes and regulations, property owners and developers are faced with requirements to install gray infrastructure. Such infrastructure is the physical manifestation of stationarity and can make communities more vulnerable to rapidly changing circumstances. Examples of gray infrastructure requirements are many—and include regulations such as minimum parking standards, which often require massive impervious surfaces, and lax tree mitigation ordinances, which waive tree mitigation when trees are removed for gray infrastructure. A close look at development codes indicates not only a preference for gray infrastructure and stationarity, but also an aversion to green infrastructure and ecosystems.

For example, parking and private road requirements often demand large impervious surfaces. Parking provisions may

require developers to install a minimum number of parking spaces depending on the building size and use. (For examples see Santa Ana, California's Municipal Code § 41-1300-1420 (2017); Scottsdale, Arizona's Municipal Code § 9.103 (2017); and Omaha, Nebraska's Municipal Code § 55-734 (2017)). They may also require parking spaces to be constructed with impervious materials, such as asphalt or concrete, and may prohibit or greatly limit any sharing of spaces. (For examples see Coppell, Texas's Municipal Code §§ 12-31-1 to -2 (2018); Naples, Florida's Municipal Code § 50-102 (2018); and Marshall Township, Pennsylvania's Code Art. 1900 § 208-1902(B) (2017)). In addition, because most parking standards are minimums, developers may go beyond them.

Similarly, some local governments require all driveways and private roads, such as those used to access subdivisions, be topped with at least a minimum amount of asphalt. Chelan County, Washington's Cty. Admin. Code § 15.30.250(1)(B)(i) (2017) is an example. Further, for privately developed streets to qualify for services, they must often be asphalt and of a certain dimension (such as 22 feet at the narrowest point). For an example see Woodinville, Washington's Code § 12.27.020 (2017).

These types of gray infrastructure requirements are often at the expense of green infrastructure and existing ecosystems. It is not uncommon to exempt

development from tree mitigation (the removal and replacement of trees) if such removal was required for gray infrastructure, such as parking lots, streets, sidewalks, and stormwater detention. For an example see Des Moines, Iowa's Municipal Code § 42-550 to -557 (2017). Such laws have the dual effect of removing ecosystems and the resilience benefits they provide and replacing them with infrastructure that creates vulnerabilities to existing and future water-based challenges.

The examples above only touch the surface of the many provisions across the many codes having similar effects. The result of these provisions, however, is a massive concrete, impervious landscape. Putting aside the utility of requiring a certain number of parking spaces, these types of gray infrastructure and the laws that encourage them reduce infrastructure resilience to climate change and associated cycles of drought, extreme precipitation, and flood. Both infrastructure and laws are fixed (often literally and figuratively) and unable to adapt to an uncertain future. Oversized asphalt parking lots, driveways, and private streets force stormwater into sewer systems and waterways, leading to flooding, pollution, increased water treatment costs, and ultimately additional gray infrastructure to address the influx of water.

Further, impervious parking lots exacerbate sprawl, making driving—rather

than walking, biking, and even public transit—virtually mandatory. They contribute to traffic congestion, air pollution, and poorer public health. Traffic congestion in turn may result in calls for wider streets, bigger intersections, and even higher parking requirements, increasing costs and further damaging local ecosystems.

The cumulative result of these requirements is millions of individual and dispersed pieces of static infrastructure that are based on a set standard or level of precipitation. As communities experience changes in precipitation and whiplash events, this infrastructure will be stressed in uncertain ways for which it is not prepared.

### THE CURRENT STATE OF INFRASTRUCTURE

If the uncertainty concerning precipitation and the unpreparedness of existing development codes was not daunting enough, the existing state of infrastructure in the United States is nothing short of dilapidated. In 2017, the American Society of Civil Engineers (ASCE) stated that infrastructure “is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life . . . [T]he system exhibits significant deterioration. Condition and capacity are of serious concern with strong risk of failure.” ASCE cited 240,000 water main breaks a year and tens of thousands of sewage overflows discharging effluent directly into waterways (American Society of Civil Engineers 2017).

Further, a 2016 National Infrastructure Advisory Council (NIAC) study on U.S. infrastructure found that “the Nation's infrastructure suffer[s] from chronic underinvestment, system failures and service shortfalls” (National Infrastructure Advisory Council 2016).

Importantly, ASCE's report and NIAC's study were measuring the day-to-day operations of infrastructure and not the resilience of infrastructure to the kind of impacts or disturbances experienced in California, Iowa, and elsewhere around the country, which will exploit weaknesses and exacerbate the water-based challenges facing local communities.

### SUSTAINABLE CODE RECOMMENDATIONS FOR OVERCOMING WATER-BASED CHALLENGES

Local governments across the country are recognizing the mismatch between their



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Greenfield development often removes natural systems and decreases the overall ability of the landscape to absorb precipitation.



## THE SUSTAINABLE DEVELOPMENT CODE

The Sustainable Development Code (SDC) is a fully searchable, free website that compiles and describes in plain language development code best practices and case studies. The SDC is a collaboration among practitioners, academics, lawyers, planners, architects, city staff, and numerous law and planning schools from across the country. Of the 32 highly detailed SDC subchapters, several directly and indirectly address water flows, stormwater runoff, and related health effects directly, including:

- Climate Change (subchapter § 1.1) (fully launched)
- Low-Impact Development and Stormwater Management (§ 1.2)
- Sensitive Lands and Wildlife Habitat (§ 1.3) (fully launched)
- Water Supply Quality and Quantity (§ 1.4)
- Water Conservation (§ 1.5)
- Urban Forestry and Vegetation (§ 1.7)
- Floodplain and River Corridor Land Use (§ 2.1)
- Coastal Hazards (§ 2.3).
- Steep Slope Hazards (§ 2.4)
- Parking (§ 3.6)
- Complete Streets/Safe Streets (§ 4.1)
- Community Health and Safety (§ 6.1)

Each subchapter consists of 30 to 40 recommendations. Each recommendation is sorted into categories (remove code barriers, create incentives, or fill regulatory gaps) and ranked according to its ultimate impact on improving code sustainability.

Recommendations also have a corresponding brief designed by and for public officials and staff across the country. The briefs consist of:

- Introduction—explains the recommended ordinance to amend the code.
- Effects—details how adopting the recommended ordinance may affect the community, including costs and benefits.
- Examples—describes in plain language two or three examples of enacted ordinances adopting the recommendation. This section also includes links and citations for four to six additional ordinances adopted by local governments.

To learn more or to access the Sustainable Development Code recommendations and features, visit <https://sustainablecitycode.org>.



static development codes (and associated gray infrastructure), and dynamic and uncertain water-based challenges. Many communities are reimagining all aspects of development codes to identify areas to help build resilience instead of vulnerabilities. The SDC, described in the sidebar above, is a web-based resource designed to help build resilience by identifying development code amendments that address weaknesses in the development process.

The following development code recommendations for addressing water-based challenges draw from a wide body of case studies, examples, and guidance resources available through the SDC. These are some of only a handful of potential interventions local governments can take through development code amendments.

### Parking Maximums

To help limit the parking minimums trend often found in development codes, some local governments are turning to parking maximums. These maximums set an upper bound for the number of spaces allowed for a specific use, thus controlling the amount of land and impervious surface associated with parking. Parking maximum standards can reduce the physical size of lots, thereby promoting compact developments while reducing stormwater runoff and greenhouse gas emissions.

The SDC provides several good examples, including Hartford, Connecticut, which manages parking lot sizes by setting out parking maximums through a table of use classifications similar to a standard parking minimums chart. Hartford includes

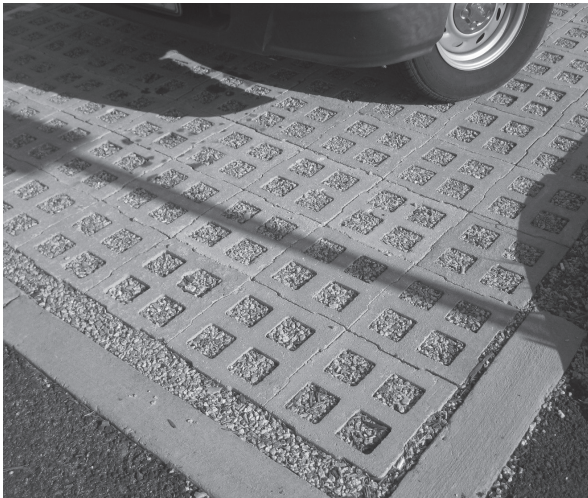
a catchall rule for uses not covered at no more than 110 percent of the parking minimum (Zoning Regulations § 7.2.2). Other examples include Charlotte, North Carolina, which sets parking maximums in transit-oriented districts (Code of Ordinances, Zoning, § 9.1208); Flagstaff, Arizona, which sets a maximum amount of parking at five percent higher than the minimum (Zoning Code § 10-50.80.040); and New York City, which creates parking maximums and no minimum requirements for specific districts and developments (Zoning Resolution Art. 2 Ch. 5).

### Pervious Cover Minimums

Beyond creating parking maximums, local governments are also seeking to limit impervious surfaces generally. Many communities have created their own incentives, requirements, or a combination of both to set permeability standards for development. Replacing impervious surfaces may help divert runoff from entering into stormwater management systems or bodies of water. This can help reduce system overloads and costs. It may also assist with reducing runoff pollution downstream.

SDC examples on pervious cover minimums include (among several others) Fairway, Kansas; Tybee Island, Georgia; and San Antonio, Texas. Fairway has ordinances that set mandatory permeable surface minimums for new development within the city. The regulations mandate a percentage of permeable and open space for Single Family Residential Districts, Business Districts, and Mixed Use Districts. For example, within Single Family Residential Districts, any lot under 10,000 square feet must meet a 60 percent permeability standard. Lots bigger than 10,000 square feet must meet higher standards between 75 and 100 percent (Code of Ordinances Sec. 15-264 Zoning Districts).

Tybee Island requires new residential driveways and replacements of more than 50 percent of existing driveways to be constructed of permeable materials designed to allow retention of at least the first inch of stormwater (Land Development Code § 3-080(C)(5)). San Antonio encourages permeable surfaces by providing permitting credits and stormwater fee discounts to developers for the installation of appropriate landscaping, parkland, tree canopy, and



Development codes that regulate, require, or incentivize permeable surfaces can help to increase local stormwater retention.

buffering. To qualify for the credit, the development must manage at least 60 percent of the stormwater runoff that the development will generate (Sec. 35-210 Low Impact Development and Natural Channel Design Protocol).

#### Expand Tree Canopy Cover

Some local governments are being more aggressive in reforesting their jurisdictions. Charlotte, North Carolina, for example, seeks to increase the citywide tree canopy cover to 50 percent by the year 2050. Communities such as Erie, Colorado; Lake Forest Park, Wisconsin; and Ventura County, California, are redrafting their tree mitigation ordinances to require developers to replace or exceed the replacement rate of each protected tree removed during development. Instead of allowing exceptions or replacement at the rate of one-to-one or even one-to-two, Ventura County requires a one-to-10 mitigation (Code of Ordinances § 8178-7.6.1).

To get a tree canopy cover of 40 percent by 2030, Baltimore established an afforestation requirement that requires developers to plant trees where there was previously no tree cover. For lower-density and medium-density residential developments, at least 20 percent of the land must be afforested. For planned unit developments and high-density residential developments, 15 percent of the land must be afforested (§§ 33-6-101 to 33-6-122).

#### Setbacks Protecting Sensitive Habitats

Local governments are also taking a new look critical ecosystems that alleviate flooding, such wetlands and riparian zones. Communities are increasingly requiring expanding setbacks to protect environmentally sensitive areas or critical wildlife habitat areas, including littoral and riparian areas, wetlands, forests, habitats for certain species, and shorelines. The characteristics of these areas are often irreplaceable, which makes setback requirements an important tool in their

protection and value as habitats for native plants and animals. In addition to protecting wildlife, setbacks can help reduce rapid water level fluctuation in wetland or rivers from reaching inhabited areas and can filter water and air pollutants. In this way, they function as green infrastructure for flood protection, water absorption, and water quality that can pay significant dividends toward long term community resilience.

Fort Collins, Colorado, for example, requires that any wetland bigger than a third of an acre that is used significantly by water fowl or shorebirds have a general buffer of 300 feet, while lakes and reservoirs have a general buffer of 100 feet.

Developers who cause a disturbance to the buffer area are required to undertake restoration or mitigation measures (Land Use Code § 3.4.1).

In Surprise, Arizona, the code requires a buffer zone of at least 75 feet for natural habitats, features, and environmentally and culturally sensitive lands (Code of Ordinances § 122-12). Dover, Delaware, requires all buildings, structures, and impervious surfaces to have a setback of at least 100 feet from wetland areas greater than 0.25 acres (Code of Ordinances § 11.222).

#### Require Mitigation of Lost Critical Habitats

Some local governments not only require setbacks from critical buffer areas, but also

require the rebuilding of lost critical habitats. Such habitats help provide a natural buffer to water fluctuations and risks associated with precipitation whiplash. Habitat preservation also helps support a range of ecological services such as water purification and management, pollution prevention and remediation, soil formation, food supply, diverse gene pools, recreation, and educational opportunities. If a local government does not require the offset of lost habitats, the cost of providing the services associated with the habitats often shifts to the government and taxpayers.

Snowmass Village, Colorado, requires any removed habitats to be replaced. For example, for every one acre of elk or mule deer winter range impacted, the developer must enhance eight acres; and for every acre of elk or bighorn sheep concentration habitat removed the developer must enhance five acres. This should result in a net gain of habitat area, promoting significant increases in long-term wildlife habitat and biodiversity in the town (Municipal Code § 16A-4-20 (f) (1) (d)). Related measures can be found in Camas, Washington (Code of Ordinances § 16.61); the County of Los Angeles (Code of Ordinances § 22.44.1950), which prohibits development in designated areas unless the developer offsets the impact to the habitat by permanently preserving a greater amount of land; and the County of Indian River, Florida (Code of Ordinances § 928.06 (2)), which requires developers to replace destroyed wetlands at a ratio of two new wetlands for every one lost.

#### Vegetation Protection Areas

Local governments are also designating entire areas as vegetation areas to help absorb water fluctuations and build resilience. They protect these areas by creating zones that limit development and/or require the zone to only have native plant vegetation and animal life. Vegetation protection areas allow wildlife to grow and move, ensuring greater biodiversity—and also helping property values. They also build resilience to extreme droughts and increased rainfall.

SDC examples of vegetation protection areas include Wayland, Michigan, which created two overlay vegetation protection zones. Combined, the zones protect about 50 feet from the high-water mark and allow only minimal development (Code of Ordinances § 20-520). Another example is Thurston

County, Washington, which requires 60 percent of trees within a vegetation protection area to be native evergreen trees (Code of Ordinances § 23.36.060).

### MOVING FORWARD

The strategies described above for addressing water-based issues are only a few of the many opportunities for local communities to build resilience to current and future challenges through changes to their development codes. Other local actions to address these challenges that are also found on the SDC website include: green roofing, purchase of development rights, transfer of development rights, open space impact fees, cluster/conservation subdivisions, requiring native species, and removal of invasive species.

The only certainty for communities is a changing and potentially dangerous future of precipitation whiplash and related water-based challenges. This article is meant to give a brief introduction to the likely challenges and diverse actions local governments are taking to grapple with these future conditions. It is not meant to be comprehensive, but rather to provide direction.

Development codes provide a massive untapped resource to address many aspects of water-based challenges. Local governments can think of the development process as an opportunity to address not only the challenges of today, but the uncertainty of such problems in the future. Today's development can either contribute to increasing vulnerabilities or help to pay dividends for communities, citizens, and ecosystems far into the future.

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