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Integrating Land and Water: Tools, Practices, Processes, and Evaluation Criteria

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Abstract

Land and water are highly connected resources yet are managed and regulated by different entities. Land use planners and water managers may be interested in better connecting land and water but lack an understanding of how to actualize this connection within their programs and procedures, in both of their jurisdictional and regulatory spheres. The goal of this project was to create a toolbox, Generalized Evaluation Matrix for High-Level Decision Making, of land use and water management integration tools that encompasses the realm of connection points between the two, and assess these connection points according to criteria that help practitioners understand which connection points may be most important to address in their own community. The list of activities in this toolbox is comprised of integrated land use and water management activities from every stage of the development or re-development process. It includes eight criteria against which the activities are assessed to help readers understand which land use and water management integration activities may be most applicable to their local contexts.

To this end, a focus group of land use and water management experts assisted on all aspects of the toolbox creation. In addition to the toolbox, this focus group provided additional valuable insights about integrated land and water management, and how to assess the utility of any given tool for a local context. This paper describes the toolbox development process, each component of the toolbox, and presents the toolbox itself. Three appendices expand on some of the ideas considered during toolbox development and provide further context and resources for this toolbox development process as a whole.

About the Author

Erin Rugland is a Program Manager for the Babbitt Center for Land and Water Policy, a center of the Lincoln Institute of Land Policy. She analyzes the intersection of water, land, and governance in urban planning and water management to support community resilience in the face of drought and climate change. She undertakes research, writes guidance and policy documents to help inform practitioners and policymakers in decision-making, leads workshops, and offers consultations and technical assistance to communities for specific projects or policy changes.

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Overview

Integrated land use and water management, whether it be in planning, policy, or community programs, is of increasing interest to communities across the country that struggle with a variety of water-related challenges. From issues of drought to flooding, and everything in between, communities are realizing that land use development may be limited by water resources—quantity, quality, or physical hydrology. Even without pressing resource limitations, there is a need to make land use decisions so that water resources do not become a limiting factor to community growth or sustainability.

Many resources have tried to define the boundaries and activities for what constitutes integrated land use and water management. Defining these is a challenge for several reasons:

1) Land use and water management use different terminology to describe their work. The same word can have different meanings between the two disciplines, and the same concept can use different words. It is a challenge to create a cohesive lexicon of integration points between the two disciplines when they utilize different terminology.

2) Land use and water management responsibilities typically reside in different management entities and agencies, with varied jurisdictions and authorities, even in a municipality where they may both be departments in the local government. Often, resources that define integrated land use and water management are directed more to one discipline than the other, for example, focusing heavily on the nuances of zoning as a land use tool for water management. Such an example provides useful information about one of the tools for integrating land use and water management, but is more likely to be utilized by land use planners who already know the general uses of zoning, and less likely to be used by water managers, where influencing zoning codes is outside their normal scope of work.

3) There are numerous ways to integrate land use and water management, some more specific than others. A challenge in trying to define the realm of these types of tools and practices is deciding where to draw the boundaries in terms of specificity. For example, landscaping is a useful and tangible way to integrate land use and water management; however, the full range of ways one could use landscaping to be water-efficient, water-absorbing, and everything in between is overwhelming. For this project, we focus on 40 high-level concepts rather than list all the ways land use tools can be used for some water management benefit. Appendix B provides a comprehensive list of approximately 400 specific tools for connecting land use and water management.

4) Finally, land use and water management integration tools can be implemented in a variety of ways—the implementation method can change the function of the tool, making it, effectively, a different tool. At the very least, practitioners need different guidance for distinct implementation approaches, even for the same tool. For example, a municipality

implementing a low-water-use plant list for residential landscaping could make it mandatory or voluntary, which changes how the municipality will need to advertise or enforce the same plant list. Such differences are a real challenge to illustrate in a categorization system that attempts to capture all connection points between land use and water management. They would be more appropriate in a guide that focuses on landscaping or plant lists specifically and exclusively.

One goal of this project is to consolidate existing resources, terminology, and categorization of different connection points between land use and water management in a way that speaks to both land use planners and water managers.

The other goal of this project is to provide information for practitioners so that they begin to understand which of the 40 categories of tools may be applicable in their local contexts. Another gap in land use and water management integration is a lack of concerted evaluation of the tools for integrated management—in part because, as discussed above, mere definition of the tools for integrated management is problematic. This project does not formally or rigorously evaluate the 40 categories of tools here according to robust evaluation criteria; rather, we explore the types of criteria that may be most useful to practitioners, provide the perspectives of experts who helped define these criteria, and begin the assessment of the tools against the criteria.

Methods

For this project, a focus group of 24 land use and water management experts helped us define a list of land use and water management tools and practices that would illustrate the realm of all land and water management connection points, develop criteria, and assess the tools and practices against these criteria. This project was conducted in several phases:

1) Individual interviews with all members of the focus group. Members of the focus group were sent an initial list of practices created by the research team and asked a standard set of questions.

2) An online survey based on the individual interviews to better clarify, refine, and begin to create consensus on some of the ideas gleaned from the individual interviews, prior to assembling the focus group for a virtual workshop.

3) Virtual workshop held to discuss final revisions and suggestions for the lists of practices, and brainstorm and refine criteria ideas that had come up in the individual interviews and in the survey.

4) Three subgroup workshops organized based on the primary criteria from the virtual workshop: water-related issues, resilience and equity, and cost and implementation. Each subgroup critiqued and helped further refine the criteria and helped with assessment.

All questions and materials for this process are in Appendix C.

Tools, Practices, and Processes for Integrating Land and Water

To create a list that encompasses the realm of land use and water management integration points, we structured two levels of subjects—higher level categories that primarily represent points within the integration process, and lower level categories of more specific types of integration activities. The higher level represents stages in the development process—when collaborative processes occur, to when decisions are made, to building, and finally, to post-completion. These are the six column headings in the toolbox, Generalized Evaluation Matrix for High-Level Decision Making. This approach has been employed by other descriptions of land use and water management tools as well, but previous efforts differed slightly and emphasized the land use tools over the water management tools (See Appendix B References for Castle and Rugland 2019; Curgus 2018; Fedak et al. 2018; Friends of the Verde River 2017; Nolon 2017; 2018; Quay, Lawless, and Ryder 2018; Rugland 2020). The toolbox builds on these previous efforts and includes more water management activities.

The lower level of categories, the individual cells within the Table 1 below, describe specific types of integration activities that land use and water managers may undertake. These are still classes of activities rather than specific, actionable practices, primarily to keep the list shorter by grouping similar tools together to make this a digestible and useful list for readers, as well as due to challenges 3 and 4 identified in the Overview section of this document.

Table 1 displays this categorization, with the higher-level process categories as column headers, and the specific activities filling the cells. Detailed descriptions of each activity category and examples of a few of the more specific tools within each of these categories follows. Appendix B contains a compressive list of the over 400 individual tools, practices, and processes that are encompassed by the activity categories included in Table 1.

Table 1: Tools, Practices, and Processes for Integrating Land and Water

Collaborative Processes	Planning	Regulations: Codes and Ordinances	Development Review	Water Supply and Infrastructure	Post-Occupancy Demand Management
Remove Existing Barriers	Comprehensive and Master Plans	Building Codes	Development Agreements/PUDs	Water Supply Infrastructure	Rate Structure and Conservation Rate Structure
Ongoing Communication	Water Resources Plans	Plumbing Codes	Site Planning	Wastewater Collection and Treatment	Fixture, Appliance, or Landscaping Retrofits
Coordinated Data and Information	Capital Improvement Plans	Landscape and Irrigation Codes	Connection Charges	Stormwater Management	Water Audits and Leak Detection
Education Programs	Sustainability and Climate-Related Plans	Zoning and Land Use Codes	Developer Incentives	Water Quality and Source Water Protection	
Public Engagement and Participation	Hazard Mitigation, Response, and Recovery Plans	Subdivision Regulations		Water Reuse and Use of Impaired Supplies	
Scenario Planning		Annexation or Growth Policies		Water Recharge and Storage	
Pilots, Demonstrations, and Models		Water Restriction and Other Water Use Codes			
Coordinated Pre-Application Meetings		Water Budget, Allocation, and Dedication			
Closed Approval Loop Between Land/Water		Assured Water Supply			
Monitoring and Program Evaluation		Water Demand Offsets/Water Neutral Code			
		Consistency Requirements and Formalized Collaboration			

Collaborative Processes

This category refers to the coordination of the traditionally separate activities that land use planners and water managers may undertake to inform process, policy, or practice. Working together, land use planners and water managers may expand their efforts to collaborate more fruitfully with elected officials, the public, affected industries, developers, or non-governmental organizations to ensure their collaborative practices, policies, and programs are well-suited for and well-received by their community. Enhanced collaborative processes among sectors can

improve the design and implementation of all other tools listed here, and of particular importance, collaborative processes seed the intersectional thinking that can lead to more resilient systems and more equitable outcomes.

Remove Existing Barriers – Land use planners and water managers identify potentially conflicting organizational barriers, codes, policies, or messages sent or enforced by their units and work to remove these barriers. Examples of competing policies might include a xeriscape landscape code but requiring turfed stormwater retention basins, or, creating an incentive program for on-site graywater reuse while building and plumbing codes prohibit graywater reuse.

Ongoing Communication – Land use planners and water managers have regular meetings or communication to identify and capitalize on synergies and points of leverage, resolve conflicts, improve coordinated actions, better understand each other's work, and build trusting relationships.

Coordinated Data and Information – Land use planners and water managers coordinate data and information, such as using the same population projections, sharing data and assumptions, or collaborating to compile and analyze datasets. It may be particularly important to share information about hydraulic modeling, watershed mapping, ecosystem functions, or minimum flow data with land use planners so that land use decisions can be made cognizant of important water resource needs; and of planned and projected land use changes that water managers can relate to associated water demands. Departments may also look to standardize and share the data and information on which they coordinate. This can be especially relevant for regional entities that coordinate data among several jurisdictions that may collect or report similar data in different ways and through different metrics. Shared data, whether it be climate, water use, land use, or social data, is critically important for building resilient, equitable outcomes.

Education Programs – Land use planners and water managers work together to educate the public about water programs and policies. Land use planners and water managers may also consider joint education programs or training programs for internal staff, elected officials, and for relevant public stakeholders so that each understands the importance of local integration of land and water decision making. Additionally, education programs can be used to build support or compliance with other programs described throughout this toolbox.

Public Engagement and Participation – Land use planners are well-versed in public engagement and participation as part of comprehensive planning processes and public meetings for development reviews or rezonings. This expertise should be brought to land and water integration activities so that community members can envision and co-create solutions with land use planners and water managers, and agencies can receive feedback and information from the public of which planners or water managers may not be aware. Authentic, inclusive public engagement and participation is particularly crucial to addressing equity issues.

Scenario Planning – Scenario planning identifies potential future conditions and the strategies that will be useful to address them. Land use planners and water managers conduct or participate in scenario planning exercises to identify the variety of potential futures (scenarios) and viable

strategies for successfully navigating through those futures. Scenario planning should include authentic and inclusive public engagement, visioning, and co-creation of solutions to truly identify resilient and equitable outcomes. Scenario planning can also be an effective tool for addressing controversial issues such as climate change or changes in community character and size, because the approach focuses not on predicting the future but on preparing for a range of potential futures that could occur. This allows participants with differing opinions to see their views included within the set of scenarios being considered.

Pilots, Demonstrations, and Models – The land use authority or water provider implements water-related techniques on a site scale to model its use and encourage broader implementation, or works with a developer who will model and test a water-related technique on private property. Examples include demonstration projects for stormwater, green infrastructure, and landscapes. Effective pilot or demonstration projects will be followed with some regulatory change or incentive expansion to ensure that others follow the example project after it is shown to be effective in meeting its water-related goal. Land use planners and water managers can also create model plans, such as model home requirements, landscape plans, or plant design, for developers and residents to encourage low water use plants without creating a landscaping requirement. Regional planning bodies or water authorities may also create model plans or model codes, for potential adoption by their member agencies, in order to establish locally appropriate models that, if adopted, also create regionally consistent requirements. Local governments can make these model codes into "reach standards," accompanied by incentives that a developer can obtain if they build their development according to the reach standards rather than the mandatory minimum development standards. Local governments can use international green codes, state model codes, or other existing codes as their reach standards.

Coordinated Pre-Application Meetings – Coordinated pre-application meetings are a procedural step that land use planners and water providers can implement to ensure water providers are at the table in the earliest phases of development planning and review and have the opportunity to comment on preliminary plans to propose simple and effective changes to reduce the ultimate water resources impacts of the proposed development. Likewise, these meetings can ensure that land use planners are involved in the initial phases of water system planning and review meetings on requests for water service.

Closed Approval Loop Between Land/Water – The departments work together to ensure a coordinated review and approval process during development review. For instance, the planning department can ensure there is a final will-serve letter from the water utility after a development plan is changed, even if it received an initial will-serve letter with a different development design. The water utility can ensure that the development maintains its stated water demand over the course of changes to its design and can suggest improvements for water efficiency throughout the review process.

Monitoring and Program Evaluation – Monitoring is critical for effective implementation of any policy or practice and must be clearly defined between land use and water authorities. Effective monitoring can be codified in some way so that procedures, inspections, and consequences are clear and delineated among enforcing authorities, regardless of whether responsibility lies with the land use authority, water utility, police agency, or another entity. Local governments can add

an aspect of program evaluation into their monitoring efforts to gauge the ease of compliance and effectiveness of any new program or regulation and make changes accordingly if the results are not as anticipated or new barriers arise. Communities may consider monitoring and evaluating programs for their impact on identified water issues, resiliency, or equity by setting goals to address these issues with metrics to benchmark progress towards these goals.

Planning

This category refers to the planning activities that land use planners and water managers may carry out collaboratively or separately that, in any case, present opportunities for integration of land and water policies and practices, and can serve as the foundation for implementing the other tools of this toolbox. Additional planning tools beyond those described in this section, such as Environmental Impact Reports, Equity Strategies, or Habitat Management Plans, are also available for land use planners and water managers to consider, in particular, how these tools can also be leveraged to support land and water integration. The planning tools in Table 1, in addition to other community or environmental planning in which a community engages, can help a community evaluate all other tools in this table in terms of costs, benefits, relation to community goals, and feasibility in more detail and with more localized nuance than this toolbox otherwise provides. Planning with an eye toward a community's water issues, overall resilience, and social equity is essential in order to take implementation actions that will best address these issues. These plans should also serve as public documents that facilitate both public engagement and transparency.

Comprehensive and Master Plans – The comprehensive plan includes plans and strategies to achieve local water sustainability. Ideally, a water element (chapter) will be included in the plan and water issues will be integrated as appropriate throughout the plan. Land use planners involve water managers in the comprehensive planning process or otherwise integrate water management topics and policies into the comprehensive plan. Authentic and inclusive public participation is crucial to comprehensive land use planning, particularly to address any water resilience or equity issues that the community may be trying to resolve.

Water Resources Plans – Water resources plans typically detail a community's water supply and demand and necessary infrastructure into the future, and may include policies to bolster the quality and quantity of water resources. Land use practices can be included in this suite of policies to aid in water demand management. In the planning process, water managers should use land use plans and growth projections as the basis for their water supply and demand planning. Water managers should also work in concert with land use planners to identify potential limits or threats to water supply and how to overcome those. Integrated water resource plans connect the silos within water management and may be even more effective points of intersection for discussion with land use planners.

Capital Improvement Plans – Capital improvement plans outline the scheduling and financing of capital projects. Tying any other plan—particularly the comprehensive and/or water resource plans—to a capital improvement plan can ensure funding for projects that advance the goals of such plans. Land use planners and water managers advocate for capital improvement plans to

include the investments necessary to implement the policies and procedures identified in other planning documents and processes.

Sustainability and Climate-Related Plans – Numerous types of plans have emerged in recent years to address local community needs related to climate change and sustainability. These may include sustainability plans, climate mitigation plans, or resiliency and adaptation plans. A sustainability plan can integrate land use planning and water management through themes of water sustainability, water efficiency, and land uses and design that promote water conservation and good water management. A climate mitigation plan may address climate impacts to local water supplies along with strategies for addressing these impacts. A resiliency or adaptation plan may recognize changes needed in local land use or water management, practice, or policy in order to adapt to new conditions brought by climate change and other factors either anticipated or not.

Hazard Mitigation, Response, and Recovery Plans – Hazard mitigation plans identify local hazards as well as pre-disaster mitigation and emergency management strategies for addressing potential hazards. Integrating land and water into hazard planning would include recognizing the hazards that may impact water resources or water management and the land use tools or changes that might help protect water resources from hazards. Hazard planning can be particularly important prior to infrastructure planning and land use planning, so that new infrastructure and development is not in hazard zones, or is modified to withstand the potential hazard. Water utilities and municipalities are required to create hazard plans to be eligible for certain Federal Emergency Management Agency (FEMA) funding. Coordination of hazard planning and mitigation activities, when possible, is crucial to successful planning. Drought mitigation can be a valuable part of the hazard planning umbrella, especially for jurisdictions who outline water use restrictions and other water use curtailments as part of their drought mitigation efforts. Disaster recovery can present an opportunity to redevelop in ways that better integrate land and water and/or reduce the risks from future hazard events.

Regulations: Codes and Ordinances

This category captures the regulatory mechanisms that can integrate land use planning and water management. The regulations described here often apply city or community-wide. Certain covenants may govern Homeowners Associations (HOAs); the best way to address covenants may be through city or community-wide codes (for example, where feasible, enacting a city-wide xeriscape landscaping code in order to overrule HOA turf requirements). All regulations, codes, and ordinances will ideally outline the enforcement mechanism for each tool, including consequences if such regulation, codes, or ordinances are not followed, and designate the entity responsible for enforcement.

Building Codes – Building codes include water efficiency either through an advanced state standard or conservation-oriented local standards. For instance, some states or local governments may adopt green building codes as their mandatory building code; and green building codes are more likely to promote water efficiency.

Plumbing Codes – Plumbing codes work hand in hand with building codes to identify, prioritize, or mandate the use of water-efficient fixtures. Plumbing codes can also address innovative on-site water management approaches such as grey water systems and rainwater capture.

Landscape and Irrigation Codes – Landscape and irrigation codes emphasize low impact development or otherwise prioritize low water use plants, turf restrictions, soil quality requirements, or water-efficient irrigation equipment to reduce outdoor water demand. These codes may also be written to prioritize plants that can withstand flooding, better absorb excess stormwater, and bioremediate pollutants. Landscape and irrigation codes can be used to develop or redevelop landscapes that are much more adaptable to drought or flood conditions. These codes can also include requirements for landscaper or irrigation system installer certifications.

Zoning and Land Use Codes – Zoning codes can influence urban form to be more water-efficient, such as through compact or infill development codes or policies. Zoning codes can also be explicitly designed to protect water quality or quantity, such as through overlay zones, water source or water recharge protection zones, or through zoning categories that are associated with a standard water demand. Form-based land use codes may also be used to advance water-related goals, such as by requiring certain stormwater capture and treatment design standards.

Subdivision Regulations – Land use planners and water managers can employ subdivision regulations and processes to gauge how the subdivided land may align with or complement broader community goals. For instance, land use planners and water managers can determine how the subdivision may compare to surrounding land uses and other community plans, such as the community's Stormwater Mitigation Plan, Integrated Water Master Plan, Open Space Plan, or Stream Restoration Plans. Even without such plans in place, land use planners and water managers can consider how the subdivision may impact the broader landscape or watershed scale and whether design changes to the proposed subdivision may further advance stated community water-related goals. Assured water supply rules (see below) are often applied as part of the subdivision review process.

Annexation or Growth Policies – Annexation or growth policies can be used by land use authorities to limit a community's boundaries and encourage denser development rather than urban sprawl. They can also designate service boundaries beyond which city water utilities will not provide water, given the relative costs and inefficiencies that may be associated with expansion of service areas to such locations. Alternatively, annexation policies can be structured to support annexations that protect water quality or water quantity benefits, such as annexing lands suitable for groundwater recharge or watershed protection. Growth policies can also require "concurrency," which connects the timing of development to a requirement that adequate infrastructure and service levels are provided in advance of development or maintained as the development occurs.

Water Restriction and Other Water Use Codes – Water restriction and similar codes can include time of day watering restrictions to reduce outdoor water use, as well as limitations on intensive water uses in features like fountains. These may also include water conservation ordinances or similar requirements.

Water Budget, Allocation, and Dedication – Water budgets can be calculated at a site scale or for an entire community. On a site scale, land use planners and water managers can calculate the expected water use of a development based on its land use type and ultimate end use, and then use water rates or other penalties to incentivize users or building owners to stay within, or even reduce, expected water use. At a community level, an aggregation of individual water demands provides a full picture of water demand to compare to its water supply portfolio. Calculating this at a community scale can demonstrate whether a community may be water-limited when planning for future development, and thus impact the kind of future development the community may want to support or disincentivize. Two policies that may stem from community-wide water budgets include water allocation policies and water dedication policies. Water allocation policies link water to economic development by outlining the priority of uses for water in a jurisdiction. In practice, this may mean that a water provider will only supply a level of water service sufficient for planned types of development, and development that falls outside of this category (such as large water users) may be required to acquire their own water or be served from a particular water supply, such as lower quality water or recycled water, if such supplies are applicable to the development (such as for cooling needs in an industrial development, power plant, or data center). A water allocation policy may also specify that a development must return some level of wastewater to the system for reuse or recharge, or it will not be served. Water dedication policies require that developers who need additional water supplies beyond their water budget or the community's available water supplies must procure additional water rights and transfer those to the municipality; or provide cash-in-lieu that the city will then put toward water rights acquisitions or water demand offsets to accommodate the new demand.

Assured Water Supply – Assured water supply rules require, or at least identify, the legal and physical availability of a water supply into the future prior to approving new subdivisions. This is often a state-level policy that is implemented, and in some cases, strengthened, at the local level. States create requirements for subdivisions or the water providers supplying these subdivisions to demonstrate adequate water supplies 20, 100, or 300 years into the future and during single or multiple dry year scenarios. Local governments may have some ability to impose a stricter standard, whether that be establishing a longer time horizon or more detailed steps for review and approval. Assured water supply rules may include an option to provide cash-in-lieu to enable the local government or water provider to acquire and develop additional water supplies. Cash-in-lieu options should be priced at the market rate of water and include an option for those funds to go toward local conservation programs to offset demand rather than acquire new supplies.

Water Demand Offsets/Water Neutral Code – New developments are required to offset their expected water use by on-site conservation techniques, retrofits to existing development, or cash in lieu fees to the municipality or water utility that will be put toward water efficiency programs.

Consistency Requirements and Formalized Collaboration – Local governments can adopt consistency requirements enabling or mandating coordination between land use planners and water managers, thus ensuring collaboration regardless of leadership change or staff turnover. Additionally, these requirements may mandate that local planning and regulatory efforts be consistent, such as requirements that specify consistency between different plans: for example, that the community's Capital Improvement Plan be consistent with its Comprehensive Plan

and/or Water Resources Plan. In several states, local governments are required to ensure that their zoning and other land use ordinances are consistent with the Comprehensive Plan. Similarly, formalizing collaboration between land use planners and water managers at the local level is another method to maintain collaboration in the event of leadership change or staff turnover.

Development Review

This category captures the tools that land use planners and water providers can use during the development review process to integrate land use planning and water management. Most requirements of a development review process are outlined in codes and regulations; thus, it is important that the content described in this category not only be done as a matter of process but be integrated into local rules and regulations. The development review process creates several intervention points to reinforce existing policies. For example, the preliminary plat review (referred to as subdivision or site plan review in some states) is typically the point at which a development is first thoroughly reviewed for compliance with the related codes and regulations; compliance could impact the development's design. Land use planners and other reviewers make recommendations at this stage about what must be changed in the development design by final plat, the stage in which the development is officially recorded and approved. Water managers can be included at this stage to ensure that the water-related codes and regulations, with which they may be more familiar, are followed and enforced. Water utility staff may also be better suited to review water studies that may be required for preliminary plat approval. The development review process as well as pre-proposal meetings can be used to ensure the development meaningfully addresses the community's development rules and regulations.

Development Agreements/PUDs – Land use planners and water managers can structure development agreements or planned unit developments (PUDs) to be contingent on water efficiency improvements, stormwater capture and design, or open space and watershed protection. Communities could consider expanding the requirements of successful development agreements or PUDs into their overall land use regulations.

Site Planning – Site planning includes the design specifications and review process for a site or building location. Land use planners and water managers can use the site planning process to ensure the project meets all other development standards; and can recommend specific design changes, such as improving building water efficiency or on-site stormwater capture, that support broader community water-related goals.

Connection Charges – Connection charges are one-time fees a developer must pay to be connected to the water system. These include the infrastructure fees that are associated with new development—tap fees, water demand or impact fees, hydrant fees, stormwater system fees, and other fees for water service, or sewer service, along with development fees for streets and other infrastructure. Water providers and land use planners can structure these fees to incentivize development in existing service areas or disincentivize (or prohibit) development in areas that would require new infrastructure. A community's water budget, if one has been implemented, may be tied in part to these connection charges. Tap sizes and water demand calculations may be related to differing tap or demand fees, which may be used to reinforce water budgets: if a

property exceeds its water budget, it may be required to purchase a new tap or pay a higher tap or demand fee even after service is established.

Developer Incentives – Land use planners or water managers can design incentives to encourage developers to create developments that are even more water-efficient than otherwise mandated by codes. These incentives include density bonuses that allow more units to be built, contingent on water-related upgrades, and an expedited review process as a result of water-related building specifications such as water efficiency upgrades, stormwater or green infrastructure retention sites, and open space and water quality protection areas.

Water Supply and Infrastructure

This category captures the water supply development and physical infrastructure needed to integrate land use planning and water management.

Water Supply Infrastructure – This includes water collection, transmission, storage and treatment infrastructure as well as distribution systems, water meters, and other infrastructure needed to supply water to customers. Leak detection and repair may be advantageous points of land and water integration in supply infrastructure. Asset management plans may help land use planners and water managers understand the full extent of their water supply systems. Water metering on an individual household scale can help utility managers and residents understand and shift peak water demands

Wastewater Collection and Treatment – Wastewater collection and treatment is crucial for maintaining water quality and can facilitate collection of reclaimed water for communities that need an augmented water source (this aspect is covered in the water reuse category below).

Stormwater Management – Conveyance infrastructure moves or stores stormwater for detention, retention, plant watering, water recharge, and other uses. Green infrastructure may be used to create nature-based solutions for stormwater conveyance, storage, and water quality treatment. Local governments may also consider enacting stormwater offsets that require developers to include stormwater management and green infrastructure features in their developments. Further flood management and infrastructure like storm walls, levies, or floodplain protection may be needed for broader flood control management of 20 to 100 year or larger events that go beyond regularly occurring events; these features are even more critical in areas where storms severity has increased as a result of climate change. The movement of water across a community and where that water is directed or is treated can adversely affect community resilience and equity if a community lacks sufficient conveyance systems, stormwater quality treatment or bioremediation, or if particular neighborhoods bear the brunt of stormwater or flood flows.

Water Quality and Source Water Protection – Land use practices are used to protect water quality, such as watershed and wellhead protection, wildfire mitigation, vegetated buffers, water quality protection zones, open space or large landscape conservation, and other physical interventions such as road design to protect source water or mitigate stormwater.

Water Reuse and Use of Impaired Supplies – Wastewater, contaminated water, stormwater, saline water, and graywater can be treated for potable use, industrial processes, landscape and agricultural irrigation, replenishment, and watershed restoration. Community design and landscaping standards can facilitate the effective use of reclaimed water.

Water Recharge and Storage – Wastewater and excess supplies including stormwater are treated (if necessary) and used to recharge groundwater or bolster surface water supplies.

Post-Occupancy Demand Management

This category captures the programs that land use planners and water providers may use after a development has been built or redeveloped to encourage reduced water use.

Rate Structure and Conservation Rate Structure – Rate structures are how water providers charge their users for water service. Conservation or tiered rate structures can disincentivize high water use, while drought or seasonal rates can curb peak water demands. If a community has implemented water budgets per site, rate structures may be connected to the land use type of the site or other class as defined by the local water budget system.

Fixture, Appliance, or Landscaping Retrofits – Land use planners and water managers can offer incentives to commercial property managers, homeowners associations, or residents to reimburse them for the partial cost of water-efficient fixture upgrades, turf removal, or use of water-efficient landscapes and irrigation systems.

Water Audits and Leak Detection – Land use planners and water managers can offer water audits to water customers. These audits evaluate water use on a site to detect leaks and make recommendations for water efficiency and, ultimately, lower customers' water bills. Such audits may be provided for free or include an incentive for participants, such as a free fixture.

Categories of Evaluation Criteria

A primary goal of this project is to provide land use planners and water managers with a starting point to understand the list of integration tools and activities that might be most impactful for their local context. To this end, the focus group participants helped brainstorm and refine criteria that would be most instructive to practitioners across the country, whether from the land use planning or water management side. Many of the criteria ideas fell into two themes: tool effectiveness and feasibility of tool implementation.

Given the universal goal of the toolbox to resonate with a variety of practitioners working in very different environmental, economic, and social conditions, greater specificity was needed than the two classes of criteria described above. To gauge whether a tool is "effective" requires understanding the reason for using tool. Therefore, we created six goal-related categories of criteria: four related to water issues, one for resiliency, and one for equity. Moreover, assessment of a tool's "feasibility" calls for knowledge about what resources are required to implement the

tool, so we added a category for cost and a category for ease of implementation to the Categories of Evaluation Criteria:

- Criteria Addressing Water Issues
    - Water Adequacy
    - Flooding and Combined System Overflows
    - Aging Infrastructure
    - Water Quality

- Criteria Addressing Community-Wide Goals
    - Resilience
    - Equity

- Criteria Addressing Feasibility
    - Magnitude of Integration Cost
    - Ease of Implementation

These categories become the column headers in Table 2, Generalized Evaluation Matrix for High-Level Decision Making, and the inputs in each cell evaluate how the tools described above meet the criteria. More context is provided for these categories below.

Additional criteria ideas are in Appendix A. Draft criteria ideas vetted with the focus group are in Appendix C.

Criteria Addressing Water Issues

Criteria addressing water issues is a crucial way to assess whether an integrated land use and water management tool will be appropriate for a community. Some integrated tools may be highly useful for addressing issues of water adequacy, but not helpful at all for improving water quality or preventing flooding. The following four categories in Table 2 are crucial for assessing the tools, particularly given our goal of making these practices applicable to communities across the U.S. with different water needs and concerns.

Water Adequacy – This column evaluates whether a tool is useful for addressing issues of water adequacy. The primary concern of water adequacy is whether a community's water supply and water demand align; a shortage of supply versus demand demonstrates an issue of water inadequacy. This shortfall of water supply may be caused by drought, groundwater depletion, limited water rights, water quality or supply impairment, cost, or a host of other drivers. The tools marked in this column can help a community balance its water supplies and demands regardless of the cause of inadequate supplies.

Flooding and Combined System Overflows – This column evaluates whether a tool is useful for addressing issues of flooding, localized flooding, and combined system overflows. Flooding and combined system overflows may be caused by extreme precipitation events, infrastructure failings such as broken dams or levees, or system inundation from sea level rise or groundwater

saturation. The tools marked in this column can help absorb excess water regardless of the cause of flooding or overflow.

Aging Infrastructure – This column evaluates whether a tool is useful for addressing issues of aging infrastructure. Aging infrastructure can cause many problems in a water system, from inefficiency, leakages, contamination, and water quality concerns. The tools marked in this column can help a community address, finance, repair, and replace aging infrastructure, and retrofit infrastructure for a changing climate.

Water Quality – This column evaluates whether a tool is useful for addressing issues of impaired water quality. Poor water quality has a variety of causes and impacts a community in various ways. Addressing the causes of water quality impairment or methods for mitigating and improving water quality is necessary regardless of the cause of impairment. The tools marked in this column can help a community improve its water quality.

Table 4 in Appendix A expands upon further criteria related to water issues.

Criteria Addressing Community-Wide Goals

Resilience and equity are community-wide goals that have gained traction in recent years, particularly as the climate crisis accelerates and inequality in the U.S. receives increasing attention. These additional filters help contextualize a tool's potential efficacy by indicating whether it will improve a community's capacity to withstand and rebound from a disruptive event, as well as whether it could help improve quality of life, related to water resources, for all members of the community.

Resilience – This column evaluates whether a tool can help a community improve its capacity to prepare for, respond to, and bounce forward from a disruption, disaster, or other shock. Community resilience can mean a variety of things: water resilience will mean resilience to drought to one community, while to another it will mean withstanding extreme precipitation events, and to yet another it may mean accommodating higher overall precipitation. Further, natural disasters such as wildfire, tornadoes, or earthquakes can cause disruptions to the water system without an associated precipitation event, as can events such as a pandemic. Communities can prepare for such shocks in a variety of ways: diversify their water systems, so they have options during disruptions; design and build more modular water systems, so the whole system is not equally disrupted by a shock; and create redundancies within water systems, to build in fail-safes and multiple mechanisms for achieving the same services or goals. In conversations about local resiliency, a community may also consider whether they want to preserve certain systems against shocks or harmful impacts; make these systems adaptive to change to be responsive to shocks; or transform the system to prepare for and respond to shocks in entirely new ways. The tools marked in this column can help a community become more prepared for and responsive to shocks that may come their way.

Equity – This column evaluates whether a tool can improve equity by improving inclusion and involvement of all populations in access to resources, decision-making, and all the benefits of land and water integration. The main water issues affecting equity in communities are often

water accessibility, affordability, water quality, flooding impacts, and the siting of water infrastructure and treatment facilities, though a community may identify additional equity issues. The tools marked in this column can help improve equity among all members of a community by ensuring everyone has the right to participate and prosper, so long as these tools are undertaken with an intentional goal of improving equity among all groups.

Table 5 in Appendix A expands upon further criteria related to community-wide goals discussed above, as well as other criteria beyond those topic areas.

Criteria Addressing Feasibility

We chose two criteria for Table 2 to help ascertain how feasible tools might be: cost and ease of implementation. Cost—expressed as net cost, relative expense, and cost/benefit, to name a few—was of primary concern for many in our focus group, as it is for many communities. We chose to focus on the size of the incremental additional costs expected from adding integrated land use and water management practices into existing practices. This approach was taken, in part because many of the tools within the toolbox are ongoing activities with costs already encumbered by local governments so the decision was that we should evaluate how the costs of these practices might be changed by pursuing them in an integrated manner. Another rationale for the approach of evaluating the incremental additional cost is because the capital costs of water infrastructure—several categories in the toolbox—dwarf the hard costs of something like a municipal code change. Re-shaping costs into a category about the potential added costs of integrated land use and water management prevented undue comparisons and demonstrated more accurately whether undertaking a tool or activity in an *integrated manner* represents a substantial financial burden.

Ease of implementation is a blending of criteria (see Appendix A) related to the general ease with which a community can adopt a tool and that a practitioner might expect in implementing the tool. Focus group members determined that the ease of implementation of these land use and water management tools would benefit greatly from a practitioner's specific knowledge of the unique characteristics of their own community. Considering the various factors that impact how easy or hard a tool will be to adopt and implement in a community will help practitioners select the right tools and best adapt them to their community. Practitioners should examine factors such as the political challenges of obtaining community and leadership support, the level of staffing and the skill level necessary to implement the tool, and the costs for target stakeholders to implement and comply with the tool. For example, in a comparison of regulations and financial incentives, regulations may be less costly for the local government to implement whereas it may be easier to obtain the political support necessary to adopt incentives. Thinking through these types of issues will help in selecting the most appropriate tools for a community, anticipate consequences, and perhaps adapt the tool to minimize potentially negative results.

Magnitude of Integration Cost – This column evaluates the economic cost of integrated land use and water management coordination for the tools in the matrix. This column speaks to the additional incremental cost of integrated or coordinated planning and implementation between land use and water agencies, not the hard cost or infrastructure costs of each tool. It is recommended that each community evaluate these tools for their localized hard costs; then this

column can help guide estimates about the potential added costs of coordinated activity on top of the hard costs.

Ease of Implementation – This column evaluates how feasible each tool is to adopt and implement in any given community. Ease of implementation includes factors such as the time or staff expertise required; political acceptability; public acceptance or enthusiasm; and the availability of existing resources for tool implementation. It is recommended that each community evaluate these tools for specific factors that may influence their ease of implementation in their localized context, using this column as a general guide to understand which tools may have the lowest barrier to entry.

Table 6 in Appendix A expands upon further criteria related to feasibility, including further measures of cost and ease of implementation.

Matrix for Tool Evaluation

The Generalized Evaluation Matrix for High-Level Decision Making, Table 2, brings together the tools and criteria described in this document. It is intended to help practitioners or decision-makers who develop, select, and implement tools a) understand the realms in which they might integrate land use and water management; and b) think through the usefulness, broader impacts, and feasibility in order to improve tool choice, adaption, design, and local implementation considerations.

Practitioners and tool developers can use the criteria as a starting point to consider intended and unintended consequences, utilize the tool to maximize positive impact, and anticipate and reduce any potential negative impacts that may stem from use of the tool itself or the barriers that may arise during implementation.

Appendix A includes a blank version of this matrix (Table 3) that you can fill in for your own community.

Table 2: Generalized Evaluation Matrix for High-Level Decision Making (see key at bottom of this table)

	Tool Usefulness for Addressing Certain Water Issues				Tool Contribution to Community Goals		Tool Feasibility	
Tools, Practices, and Processes	**Water Adequacy** Tool reduces demand, increases supply, or improves efficiency	**Flooding and Combined System Overflows** Tool absorbs or conveys excess water	**Aging Infrastructure** Tool funds, builds, and replaces infrastructure	**Water Quality** Tool reduces pollution and improve quality	**Resilience** Tool has a low, medium, or high impact on community capacity to prepare for, respond to, and bounce forward from a shock	**Equity** Tool improves inclusion and involvement of **all** populations in access, decision-making, and benefits of land and water integration	**Magnitude of Integration Cost** General estimate of operation and maintenance costs if land and water are integrated through the tool	**Ease of Implementation** A general estimation on how feasible it is for a community to adopt and implement the tool
Collaborative Processes								
Remove Existing Barriers	●	●	●	●	●	●	●	●
Ongoing Communication	●	●	◉	●	●	●	●	●
Coordinated Data and Information	●	●	●	●	●	○	●	●
Education Programs	●	○		◉	●	●	◉	●
Public Engagement and Participation	●	○		◉	●	●●	◉	◉
Scenario Planning	◉	◉	◉		◉	◉	◉	◉
Pilots, Demonstrations, and Models	○	○		◉	○	●	●	◉
Coordinated Pre-Application Meetings	●	○		◉	○		●	●
Closed Approval Loop Between Land/Water	●●	◉		○	●		●	●
Monitoring and Program Evaluation	●	●	◉	●	●	●	○	◉
Planning								
Comprehensive and Master Plans	●●	●	●	●	●●	◉	◉	◉
Water Resources Plans	●●	●	●	●	●		◉	◉
Capital Improvement Plans	●	●●	●●	●●	●	●●	◉	◉
Sustainability and Climate-Related Plans	●	●●	●	●	●●	●	◉	◉
Hazard Mitigation, Response, and Recovery Plans	●●	●●	●	●●	●●	●	◉	◉
Regulations: Codes and Ordinances								
Building Codes	●	◉		◉	●	○	●	●
Plumbing Codes	●	◉		◉	●		●	●
Landscape and Irrigation Codes	●●	●	○	◉	◉	○	●	◉
Zoning and Land Use Codes	●	●	◉	◉	○	○	●	◉
Subdivision Regulations	◉	◉	◉	○	○	○	●	◉
Annexation or Growth Policies	●●	●	◉	◉	●		●	○
Water Restriction and Other Water Use Codes	●				●		●	◉
Water Budget, Allocation, and Dedication	●●	◉			◉	◉	●	◉
Assured Water Supply	●●				◉	●	◉	○
Water Demand Offsets/Water Neutral Code	●		◉		◉	●	●	○
Consistency Requirements and Formalized Collaboration	●	◉		◉	○		◉	○
Development Review								
Development Agreements/PUDs	◉	◉	◉	◉	○		●	●
Site Planning	●	●	○	◉	◉	○	●	●
Connection Charges	●●	●	●		○		●	◉
Developer Incentives	●	◉	○	◉	○	○	◉	●
Water and Infrastructure								
Water Supply Infrastructure	●	◉	●	●	●	◉	○	◉
Wastewater Collection and Treatment		●	●	●	○	◉	○	◉
Stormwater Management	◉	●●	◉	●●	●	◉	○	◉
Water Quality and Source Water Protection	●	◉		●	◉	●	○	◉
Water Reuse and Use of Impaired Supplies	●	○	◉	●	●	●	○	◉
Water Recharge and Storage	●	●	◉	●	●	○	○	◉
Post-Occupancy Water Demand Management								
Rate Structure and Conservation Rate Structure	●●	◉			○	◉	◉	◉
Fixture, Appliance, or Landscaping Retrofits	●	○		○	◉	●	◉	◉
Water Audits and Leak Detection	●		●●	○	◉	●	○	◉
	Key ●● Highly useful for addressing this water issue ● Useful for addressing this water issue ◉ Somewhat useful for addressing this water issue ○ Marginally useful for addressing this water issue [no circle] No impact on this water issue				Key ●● Very High ● High ◉ Medium ○ Low	Key ●● Highly improves ● Improves ◉ Somewhat improves ○ Marginally improves [no circle] No impact	Key ● Low cost ◉ Medium cost ○ High cost	Key ● Easy ◉ Medium ○ Difficult

Conclusion

The realm of land use and water management integration activities, practices, processes, and tools is broad and difficult to summarize in a manner that will be useful for individual communities. The use of a national group of land use and water management experts to define, vet, and approve this realm lends it greater credence and validity. The categorization system developed herein should: 1) provide context for a general audience to better understand what is meant by "land and water integration"; 2) create a framework that can be expanded upon, further refined, and further researched; and 3) establish a useful framework for both land use and water managers, such that water managers see more activities within their purview represented, and to contribute to ongoing efforts to build a more common language between land use and water disciplines.

The tool categorization and evaluation approach in this working paper provides a starting point for future evaluation efforts. Rigorous, academic, scientific evaluation is lacking for many of these tools, such as definitive cost/benefit evaluations, calculations of real water savings, the most effective way to implement any specific tool, and more. This project proposes several evaluation criteria, both qualitative and quantitative, that could be ripe for further research. Any work that concretely demonstrates the benefits of integrated land use and water management will be extremely worthwhile to the field, and we hope this working paper sparks ideas for additional research.

The perspective of the 24 focus groups members has been an invaluable contribution to the work presented in this paper. We appreciate the insights of this group and the depth to which they thought about not only the task at hand—to create a useful toolbox—but the deeper implications of this work and the decisions feeding into the final product. Additional takeaways from this project include:

- Tools, practices, and processes for integrating land and water are highly interconnected. Implementing any of the tools within the Toolbox Matrix will likely be strengthened if several techniques can be implemented in each phase leading up to, during, and after development and re-development. Recognizing these interconnections, theoretically, can lead to reduced costs over time as efforts build on each other, and lead to more effective use of local government and water provider resources.

- Criteria for evaluating the viability of any of these tools can be incredibly context specific. Ideally, communities are best served by creating robust evaluation processes that spark a thought exercise prior to and during decision-making so that they generate important discussions and conclusions. Because communities are limited in their capacity to individualize and pursue this approach, there is still value in the generalized assessment of tools such that we demonstrate in this paper.

- There is great value in the exercise of examining how the various evaluation criteria can be applied to any tools being considered. We regularly developed new insights into land and water management needs and the likely impacts of different tools, including an

awareness of potential unintended consequences, as we went through the process of ranking the individual cells in the matrices. We recommend that practitioners and communities endeavor to follow a similar process, weighing the pros, cons, and appropriateness of different criteria, so that they may gain similar insights specific to their local contexts.

In sum, this project created a framework for a more holistic understanding of the connection points of integrated land use and water management. We explored numerous ideas on how to evaluate these connection points, bringing eight of these ideas to bear to assess the connection points within a matrix for practitioners to reference. The mission of integrated land use and water management will be aided if these ideas are further refined, developed, and measured, such that the benefits of integration can be more easily touted.

Appendix A: Additional Evaluation Matrices

The following tables illustrate additional, more specified evaluation criteria that practitioners may wish to adopt into their evaluation processes and procedures. Practitioners will need to determine the most appropriate way to measure whether a tool meets these criteria—including both quantitative and qualitative methods—as well as the data that may be most appropriate for such measurement.

Table 3: Blank Evaluation Matrix for High-Level Decision Making

	Tool Usefulness for Addressing Certain Water Issues				**Tool Contribution to Community Goals**		**Tool Feasibility**	
Tools, Practices, and Processes	**Water Adequacy** Tool reduces demand, increases supply, or improves efficiency	**Flooding and Combined System Overflows** Tool absorbs or conveys excess water	**Aging Infrastructure** Tool funds, builds, and replaces infrastructure	**Water Quality** Tool reduces pollution and improve quality	**Resilience** Tool has a low, medium, or high impact on community capacity to prepare for, respond to, and bounce forward from a shock	**Equity** Tool improves inclusion and involvement of **all** populations in access, decision-making, and benefits of land and water integration	**Magnitude of Integration Cost** General estimate of operation and maintenance costs if land and water are integrated through the tool	**Ease of Implementation** A general estimation on how feasible it is for a community to adopt and implement the tool
Collaborative Processes								
Remove Existing Barriers								
Ongoing Communication								
Coordinated Data and Information								
Education Programs								
Public Engagement and Participation								
Scenario Planning								
Pilots, Demonstrations, and Models								
Coordinated Pre-Application Meetings								
Closed Approval Loop Between Land/Water								
Monitoring and Program Evaluation								
Planning								
Comprehensive and Master Plans								
Water Resources Plans								
Capital Improvement Plans								
Sustainability and Climate-Related Plans								
Hazard Mitigation, Response, and Recovery Plans								
Regulations: Codes and Ordinances								
Building Codes								
Plumbing Codes								
Landscape and Irrigation Codes								
Zoning and Land Use Codes								
Subdivision Regulations								
Annexation or Growth Policies								
Water Restriction and Other Water Use Codes								
Water Budget, Allocation, and Dedication								
Assured Water Supply								
Water Demand Offsets/Water Neutral Code								
Consistency Requirements and Formalized Collaboration								
Development Review								
Development Agreements/PUDs								
Site Planning								
Connection Charges								
Developer Incentives								
Water and Infrastructure								
Water Supply Infrastructure								
Wastewater Collection and Treatment								
Stormwater Management								
Water Quality and Source Water Protection								
Water Reuse and Use of Impaired Supplies								
Water Recharge and Storage								
Post-Occupancy Water Demand Management								
Rate Structure and Conservation Rate Structure								
Fixture, Appliance, or Landscaping Retrofits								
Water Audits and Leak Detection								
	Key ●● Highly useful for addressing this water issue ● Useful for addressing this water issue ◍ Somewhat useful for addressing this water issue ○ Marginally useful for addressing this water issue [no circle] No impact on this water issue				Key ●● Very High ● High ◍ Medium ○ Low	Key ●● Highly improves ● Improves ◍ Somewhat improves ○ Marginally improves	Key ● Low cost ◍ Medium cost ○ High cost	Key ● Easy ◍ Medium ○ Difficult

Table 4: Expanded Evaluation Matrix for Water-Related Criteria

	Water Adequacy						Flooding					Infrastructure		Water Quality			
Tools, Practices, and Processes	Total Water Savings	Average Annual Water Savings	Meets Water Savings Targets	Improves Drought Prepared-ness	Improves In-Stream Flows	Addresses Water Supply /Demand Imbalance	Addresses Major Flooding Events	Prevents Combined System Overflows	Improves Stormwater Manage-ment	Improves Natural Hydrology or Drainage	Addresses Sea Level Rise	Replaces Aging Infrastruc-ture	Protects Existing Infrastruc-ture	Improves Water Quality	Prevents Water Pollution	Improves Fire Resistance	Improves Watershed Health and Bioremed-iation
Collaborative Processes																	
Remove Existing Barriers																	
Ongoing Communication																	
Coordinated Data and Information																	
Education Programs																	
Public Engagement and Participation																	
Scenario Planning																	
Pilots, Demonstrations, and Models																	
Coordinated Pre-Application Meetings																	
Closed Approval Loop Between Land/Water																	
Monitoring and Program Evaluation																	
Planning																	
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Water Reuse and Use of Impaired Supplies																	
Water Recharge and Storage																	
Post-Occupancy Water Demand Management																	
Rate Structure and Conservation Rate Structure																	
Fixture, Appliance, or Landscaping Retrofits																	
Water Audits and Leak Detection																	

Table 5: Expanded Evaluation Matrix for Community-Wide Goals Criteria

	General				Collaboration		Resilience			Equity					Sustainability		
Tools, Practices, and Processes	Effectiveness	High Likelihood of Success	Expands on Existing Regulations	Priority Identified by Customers	Addresses Other Community Goals	Agreement to Collaborate Among Departments	Makes a System More Diverse, Modular, or Redundant	Preserves, Adapts, or Transforms Water Resources/ Systems	Impact on Community's Ability to Withstand or Recover after Disruption	Improves Affordability	Improves Water Quality	Improves Equitable Siting of Facilities and Infrastructure	Improves or Increases Access to High-Quality Water	Addresses Historic Inequities	Advances Stewardship of Water Resources	Ensures Quality Water Supplies into the Future	Improves Governance and Management of Water Resources
Collaborative Processes																	
Remove Existing Barriers																	
Ongoing Communication																	
Coordinated Data and Information																	
Education Programs																	
Public Engagement and Participation																	
Scenario Planning																	
Pilots, Demonstrations, and Models																	
Coordinated Pre-Application Meetings																	
Closed Approval Loop Between Land/Water																	
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Water Reuse and Use of Impaired Supplies																	
Water Recharge and Storage																	
Post-Occupancy Water Demand Management																	
Rate Structure and Conservation Rate Structure																	
Fixture, Appliance, or Landscaping Retrofits																	
Water Audits and Leak Detection																	

Table 6: Expanded Evaluation Matrix for Feasibility Criteria

	Identification			Cost			Ease of Implementation								Target Audience		
Tools, Practices, and Processes	Required by State Law	Prohibited by State Law	Existing Activity	Estimated Cost	Potential Cost Savings	Projected Implementation Cost	Entity/Staff Responsible for Implementation	Coordinated Public Involvement/ Public Acceptance	Technically Feasible	Market Feasibility	Political Support/ Likely to be Adopted	Capacity Needed to Start Program	Capacity Needed to Maintain Program	Timeliness	New or Re-development	Spatial Scale: Site-Level, Neighborhood, Community, Regional	Customer Class: Residential, Industrial, Commercial, Institutional
Collaborative Processes																	
Remove Existing Barriers																	
Ongoing Communication																	
Coordinated Data and Information																	
Education Programs																	
Public Engagement and Participation																	
Scenario Planning																	
Pilots, Demonstrations, and Models																	
Coordinated Pre-Application Meetings																	
Closed Approval Loop Between Land/Water																	
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Subdivision Regulations																	
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Assured Water Supply																	
Water Demand Offsets/Water Neutral Code																	
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Water Reuse and Use of Impaired Supplies																	
Water Recharge and Storage																	
Post-Occupancy Water Demand Management																	
Rate Structure and Conservation Rate Structure																	
Fixture, Appliance, or Landscaping Retrofits																	
Water Audits and Leak Detection																	

Appendix B: Full Index of Land Use and Water Management Practices

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    - Joint Strategic Planning[15]
    - Joint Futures Planning[15]

- **Pilots, Demonstrations, and Models**
  - Joint Demonstration Projects[1]
  - Low Water Use Demonstration Homes[1]
  - Model Home Requirements[14]
  - Lead by Example[1]
    - Water Efficiency in Buildings Owned by the Provider or Land Use Authority[1]
    - Demonstration Gardens[1]
    - Success Stories and Case Studies[1]
- **Coordinated Pre-Application Meetings**
  - Coordination of Development Evaluation[5, 15]
- **Closed Approval Loop Between Land/Water**
  - Water Use Consistent with Final Approved Development Plan[1]
- **Monitoring and Program Evaluation**
  - Pre- and Post-Occupancy Inspections[1, 14]
  - Track and Coordinate Pre-Occupancy Estimates[1]
  - Consequences for Exceeding Post-Occupancy Estimates[1]
  - Water Use Benchmarking and Disclosure Program[14]
  - Water Efficiency Audits and Retro-Commissioning[1, 14]
  - Enforceable Administrative Restrictions on Use[14]
  - Post-Occupancy Documentation[1, 14]
  - Financial Incentives and Disincentives for Enforcement[14]
    - Stormwater Management Fee Reduction[14]
    - Property Tax Abatements[14]
    - Water Conservation Districts[14]
    - Homeowners Associations[14]
  - Penalties - Civil and Criminal[14]
  - Intermunicipal Inspections and Prosecutions[14]

- **Planning**
  - **Comprehensive and Master Plans**
    - Build in Ongoing Coordination Concerning Water[14]
    - Water Element in Comprehensive Plan[14]
      - Water Management[16]
        - Existing Water Supplies and Availability[16]
        - Water Use/Demand[16]
        - Water Financing[16]
        - General Water Conservation Programs[16]
        - Water and Wastewater Infrastructure[16]
        - Water Quality[16]
    - Water Efficiency Measures Throughout Comprehensive Plan[14]
      - Future Planning[16]
        - Projected Population and Economic Change[16]
        - Projected Development and Land Use Change[16]
        - Water-Related Hazard Mitigation[16]
        - Forecasting Water Supply/Demand[16]

- Water Supply Augmentation[16]
- Water Equity[16]
- Water Efficient Land Use[16]
- Collaboration for Land/Water[16]
- "Show Me the Water" Requirements[16]
- Water in Development Processes and Evaluation[16]
- Water Efficient Urban Form and Zoning Regulations[16]
- Landscaping/Irrigation Policies[16]
- Building/Plumbing Policies[16]
- Stormwater Management[16]
- Water for Ecosystem Functions[16]

Water Resources Plans

- Water Supplies[15]
  - One Water[15]
    - Integrated Water Resource Management[15]
  - Water Supply Availability[15]
  - Water Supply Threats[15, 13]
  - Analysis of Demand and Supply Balance[15]
  - Water Resource Planning Scenarios[15]
    - Water Resource Scenarios Land Use[15]
    - Water Resource Scenarios General[15]
- Water Demand[5, 5, 14, 13, 15]
  - Water Demand Indoor Water Use[15]
  - Water Demand Outdoor Water Use[15]
  - Water Demand Based on Land Use[15]
    - Compact/Infill Development[15]
    - Small Lot Land Use[13, 15]
    - Limited Landscape Land Use[15]
  - Water Use Per Capita[15]
  - Water Use by Sector[15]
  - Population Growth[5, 15]
  - Development Expectations[5, 15]
    - Impacts of Future Development on Water Bodies[5, 8]
    - The Effect of Development Patterns on Water Use, Wastewater Generation, and Ecosystem Biodiversity[3, 9, 14]
    - Designate Priority Areas for Growth and Areas for Conservation[14]
  - Water Demand Scenarios[6, 9, 15]
    - Water Demand Scenarios Population[15]
    - Water Demand Scenarios Land Use[15]
- Inventory of Existing Natural Water-Related Features[5, 9]
  - Water and its Hydraulic Force[5, 5]
  - Identification of Water Sources for which Reclamation is Feasible[5]
  - Watershed Boundaries[9]
- Transferrable/Acquirable Water Rights[15]

Capital Improvement Plans

Sustainability and Climate-Related Plans

- Use the Comprehensive Plan[14]
- Sustainability Plan Addresses Water[14]
- Water Conserving Goals in Sustainability Plan[14]
- Targets Related to Water Conservation in Sustainability Plan[14]
- Strategies and Implementation Actions for Water Conservation in Sustainability Plan[14]

Hazard Mitigation, Response, and Recovery Plans

- Evaluate Community's Risk to Certain Hazards[4]
- Assess Water Infrastructural Sensitivity to Damage from Hazards[3] and Upgrade Water Infrastructure Accordingly[17]
- Flood, Earthquake, Tornados[3]
    - Identify Water Storage/Water Treatment Options During Emergencies[3]
    - Identify Historic and Projected Climate Variability (e.g., temperature and rainfall patterns)[3]
    - Identify or Discuss Compounding Risks of Water-Related Hazards[3]
- Anticipate or Project How Climate Change May Affect Water Resources and/or the Occurrence of Hazards[3]
    - Reduced Streamflow[3]
    - Rising Temperatures[3]
        - Growing Health Risks in Water Supply (Bacteria and Fungus) Leads to Higher Treatment Costs and Risk of Infrastructure Damage[3]
            - Harmful Algal Blooms Risk[3]
            - Increased Outdoor Water Demands[3]
        - Damage to Pipes (Expansion)[12]
    - Sea-level rise[3]
        - Coastal Erosion[3]
        - Storm Surges[3]
        - Saltwater Intrusion[3]
- Participation in FEMA National Flood Insurance Program Community Rating System[17]
- Hazard Mitigation Plan[17]
    - FEMA-Approved Hazard Mitigation Plan
- Restrict Development in Hazard Zones[3]
- Drought[10, 12, 17] and/or Water Shortage Response[17]
    - Risk to Reservoir Storage Levels[3]
    - Haul in Water with Tanker Trucks Permitted to Carry Potable Water[17]
    - Consider Interconnections with Other Water Sources and Systems[17]
    - Secure a Diverse Water Portfolio[17]
    - Place Restrictions Designed to Reduce or Eliminate Non-Essential Uses[17]
    - Emergency Pricing or Surcharge[17]
    - Dedicated Conservation or Drought Response Fund[17]
    - Days of Water Available During emergencies[17]
- Wildfire[17]
    - Forest Health Programs to Prevent Post-Fire Flooding and Protect Water Storage/Quality[17]

- Remove Debris, Trees, or Other Fire-Hazard Materials[17]
- Modify Treatment Process for Sediment in Water[17]

Regulations: Codes and Ordinances

Building Codes

- Base Codes with Local Amendments for Water[14]
- Supplemental Code Provisions[14]
- Green Building Standards[1, 5, 14]

Plumbing Codes

- Base Codes with Local Amendments for Water[14]
- Supplemental Code Provisions[14]
- Green Building Standards[1, 5, 14]
- Fixture Efficiency Standards[14, 13]

Landscape and Irrigation Codes

- Native Landscape[13, 15]
- Recharge Landscapes[15]
- Low Water Use Vegetation List[1]
- Model Landscape Plans[1, 14]
- Water Efficient Landscape Code[8, 14, 15]
  - Public Landscape Requirements[15]
  - Xeriscape[8, 15]
  - Soil Quality Requirements[14]
  - Tree Size Requirements[14]
  - Rain Sensors[14]
  - Spray Nozzle[14]
  - Positive Shut Off[14]
- Incentives for Reduced Irrigation[1, 8]
  - Turf Rebates[1, 15]
  - Turf Limitations (Type and Quality)[14]
  - Artificial Turf[14]
  - Irrigation System Efficiency Requirements[14]
- Model Landscape Ordinance[1]
- Certification or Registration of Landscape Professionals[1]
- Watering or Irrigation Restrictions[1, 5, 15]
  - Mandatory Water Restrictions[15]
  - Voluntary Water Restrictions[15]

Zoning and Land Use Codes

- Denser Development[14]
- Transit Oriented Development[14]
- Open Space Dedication[14]
- Open Space Preservation[14]
- Requirements for Compact Infrastructure[1, 14, 13]
- Water Efficient Zoning[1, 5, 8, 14, 15]
  - Environmental Zoning[15]
  - As-of-Right Permitted Uses[14]
  - Permitting Accessory Dwelling Units[14]

Conditionally Permit Water-Intensive Uses Upon Water Conservation Measures[1, 5, 8, 14]
Rezonings Based on Water Supply Impact[14, 13]
Bonus Density Zoning[14]
Planned Unit Development Regulations[14]
Floating Zone[14]
Overlay Zoning[1, 8, 14]
Transfer of Development Rights Program[8, 14]
Zoning Categories Reflect Water Use[1]
Zone for More Varieties of Multi-Family and Attached Housing[1, 14]
Mixed-Use Development[14]

Subdivision Regulations

Good Purpose Statement[14]
Criteria to Demonstrate Compliance[14]
Approved Design Is Constructed[14]
Low Water Use Development Strategies[15]

Annexation or Growth Policies

Annexation Includes Water Demand and Conservation[1, 5]
Growth Boundaries[14, 15]
Cluster Development[1, 14, 15]
Drought Resilient Design[8]
Development Moratoria[14]

Water Restriction and Other Water Use Codes

Golf Courses and Large Landscape Area Codes and Standards[8]
Water Feature Codes[8]
Water Waste Ordinances[1, 8, 14]

Water Budget, Allocation, and Dedication

Residential Water Budgets[12]
Water Efficiency Allocation Policy[8, 15]
Water Dedication Requirements[1]

Assured Water Supply

Water Supply Adequacy in Preliminary Plat Applications[14]
Final Plat Approval Contingent on Confirmation of Adequate Water[14]
Water Adequacy Determination Subdivision[8, 15]
Water Adequacy Allotment[15]
Water Adequacy Notification[15]
Water Adequacy Determination Zoning[15]
Water Adequacy Determination Site Plan[14, 15]

Water Demand Offsets/Water Neutral Code

Net-Zero or Water Demand Offset Policy[1, 8, 14, 15]
Percent Reduction in Water Use[14]
Water Conservation Bank[8]
Retrofit on Resale Requirements[1, 8]
Retrofit Requirements for New Building Permits[1]

Consistency Requirements and Formalized Collaboration

State Law for Consistency[15]

- Intergovernmental Agreements[15]
  - Institutionalized Collaboration[15]
  - Institutional Consolidation[15]
  - Memorandum of Understanding[15]
  - Policy and Regulatory Changes[15]
  - Capacity Audits[15]
  - Joint Meetings Among Elected Decision-Makers[1]
- Regional Coordination of Water Policy and Procedures[1]
  - Water Conservation Requirements Consistent[1]
  - Uniform Landscape Codes[1]
  - Uniform Landscape and Irrigation Contractor Certification[1]
- Watershed Groups, Programs, Studies[9]

Development Review

Development Agreements/PUDs

- Water Efficiency Measures[14]
- Fees-In-Lieu[14]
- Continuation, Expansion, and Enforcement Provisions[14]
- Impact on Supply in Development Decision[15]
- Development Agreements Impose Water Conservation Requirements[1]
- Development Agreements with Water Conservation and Verification Requirements[14]

Site Planning

- Plan Reviewer[15]
- Water Conservation for New Development or Re-Development[1]
- Development Water Use Limitations[15]
- Water in Infrastructure Decision[15]
  - Improvements Necessary to Deliver Water[14]

Connection Charges

- Water Efficient Tap Fees[1, 15]
  - Demand Based Tap Fees[14]
  - Impact Fees[15]
- Infrastructure Impact Fees[15]
  - Water Resource Impact Fee[15]
- Water Connection Charges[8]

Developer Incentives

- Sustainable Development Bonuses[1]
- Community/Homebuilder Partnerships[8]
- Environmental Protection Agency WaterSense Homes[1, 8, 14]
- LEED Water Certification[8, 15]
- Water Conservation as a Threshold for Incentives[14]
- Financial Incentives[14]
- Process Incentives[14]
- Assistance, Education, and Marketing Incentives[14]
- Additional Incentives[14]

- **Water Supply and Infrastructure**
  - **Water Supply Infrastructure**
    - Sub-Metering Ordinances[8, 14]
    - Smart Meters[14]
    - Water Infrastructure Financing[15]
      - Cost for Water Delivery Estimated[15]
      - Cost Benefit Tools[15]
  - **Wastewater Collection and Treatment**
    - Water and Wastewater Infrastructure
      - Existing Sources, Treatment, Distribution, Service[9, 14]
      - Wastewater Treatment and Disposal[5, 9, 14]
        - Existing and Planned Water and Wastewater Infrastructure[5, 9, 14]
      - Water Storage and Delivery Projects[15]
  - **Stormwater Management**
    - On-Site Water Harvesting[1, 8, 7, 9]
    - Stormwater Capture[9]
      - Stormwater Capture Non-Potable[9]
      - Stormwater Capture for Potable[9]
    - Community Stormwater Characterization[18]
      - Streamflow and Hydrology Assessment[10]
        - Identify Streams, Rivers, Lakes, Aquifers etc. That Can Carry/Store Water[10]
      - Current Stormwater Management System Assessment[18]
      - Identification of Areas for Improved Runoff Management[18]
      - Restore Natural Runoff Patterns/Hydrology[18]
    - Stormwater Management Strategies[11]
      - Stormwater Infiltration[5, 11]
        - Green Infrastructure[14]
          - E.g., Bioswales, Tree Planters, Pervious Pavement, and Rain Gardens
        - Low Impact Development[3]
        - Permeable/Pervious Paving[11]
        - Natural Hydrology Restoration[11]
          - E.g., Creek Daylighting, Riparian Corridor Restoration
      - Stormwater Flow Control[11]
        - Green Streets[11]
          - Curb Cuts[11]
      - On-Site Stormwater/Rainwater Harvesting, Retention, and Use[11]
        - Rainwater Harvesting[11]
          - Barrels or Cisterns[11]
        - Vegetation Irrigation[11]
          - Green Roofs[11]
          - Greens Walls[11]
          - Rain Gardens[11]
      - Source Control for Pollutants/Sedimentation[5]
        - Riparian Buffers[11]

- Protected or Constructed Wetlands[11]
- Bioswales/Green Infrastructure[11]
- Street Sweeping[3]
- Oil and Water Separators[3]

Policies to Promote Stormwater Management
- Design Standards for New Development[7, 14]
  - Setback Regulations[5]
  - Impervious Cover/Floor Ratio Restrictions[5]
  - Runoff Reduction Measures[3]
  - Source Pollutant Controls[3]
  - On-Site Storm Water Treatment[3]
- Community Stormwater Management Plan
- Natural Stormwater Design (as opposed to conventional channels and pipes)
- Multi-Purpose Flood Control Projects[8, 18]
  - Public Parks with Open Space for Groundwater Recharge[18]
- Stormwater Technical Assistance and Education Programs for Developers/Landscapers[7]

Water Quality and Source Water Protection

Water Quality[5, 9, 14, 15]
- Water Quality Regulation[15]
- Water Contamination Legislation[15]
- Hydraulic Fracturing Regulations[15]
- Existing and Potential Water Pollution Sources[5]

Setback Requirements[14]

Minimum Flow Requirements[3]
- Water for Habitat[9]

Environmental Demands/Stream Flow Included in Water Supply/Demand Calculations[9]

Preservation of Natural Watersheds[5, 5, 9, 15]
- Floodplain, Erosion Hazard, and Watercourse Codes[8, 5, 9]

Water for Recreation[9]

Water for Environment and Fishing[9]

Water Reuse and Use of Impaired Supplies

Water Reuse Non-Potable Domestic[15]

Water Reuse Non-Potable Non-Domestic[15]

Water Reuse Potable Domestic[15]

Greywater Reuse[1, 8, 15]
- Direct Potable Reuse[15]
- Indirect Potable Reuse[15]
- Non-Potable Reuse[15]

Coastal Desalination[15]
- Coastal Desalination Non-Potable[15]
- Coastal Desalination Potable[15]

Groundwater Desalination[15]
- Groundwater Desalination Non-Potable[15]

- Groundwater Desalination Potable[15]
- New Technology and Innovation[15]

Water Recharge and Storage

- Groundwater Banking[15]
- Aquifer Storage and Recovery Infiltration[15]
- Aquifer Storage and Recovery Direct Inject[15]

Post-Occupancy Demand Management

Rate Structure and Conservation Rate Structure

- Water Block Rate[15]
- Water Budget Rate[15]

Fixture, Appliance, or Landscaping Retrofits

- Water Efficiency Certification[8]
- Water Efficient Fixtures[14]
  - Fixture Rebates[14]
- Outdoor Fixture Rebates[1]

Water Audits and Leak Detection

- Landscaping Ordinance with Maintenance Standards and Inspections[14]
- Landscape Efficiency Evaluations[1]
- Commercial Audit Program[14]
- System Water Efficiency[15]
  - Water Loss Limits[15]

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Appendix C: Focus Group Materials

Individual Interview Questions

1. Are there toolbox categories missing from the toolbox?
2. Are there tools missing from the toolbox?
3. Would you move any of the tools into different toolbox categories?
4. Are any tools redundant?
5. Expand/contract?
6. What information might practitioners need to know about these tools in order to implement them?
7. What information may be most useful to a practitioner?
8. What information may be most useful to a policy maker (council or high-level staff)?
9. Might this information change between jurisdictions (municipality, county, water provider)? How so?
10. How might practitioners choose between these tools?

Table 7: Original Toolbox Received by Individual Interview Participants

Tool	Criteria (TBD)	Additional Criteria?
Collaboration		
Coordinated Data and Information	Evaluation (TBD)	
Ongoing Communication		
Remove Existing Barriers		
Public Education		
Planning		
Scenario Planning		
Comprehensive and Master Plans		
Capital Improvement Plans		
Water Resources Plans		
Sustainability Plans		
Hazard Plans		
Regulations: Codes and Ordinances		
Building Codes		
Plumbing Codes		
Landscape Codes		
Zoning Codes		
Water Restriction and Other Water Use Codes		
Water Allocation Policy		
Monitoring and Enforcement		
Development Review		
Assured Water Supply		
Coordinated Pre-Application Meetings		
Closed Approval Loop Between Land/Water		
Infrastructure and Public Investment		
Stormwater Management		
Green Infrastructure		
Demonstration Projects		
Water Quality Protection		
Water Reuse and Use of Impaired Supplies		
Water Recharge and Storage		
Charges and Fees		
Tap Fees		
Development Fees		

Rate and Conservation Rate Structure		
System Development Charges		
Incentives		
Developer Incentives		
Fixture Incentives/Retrofits		
Landscaper Certification		
Model Plans or Codes		
Plant Lists		
Water Audits		

Focus Group Survey Questions and Responses

1. **Are there organizational changes you suggest for the revised Toolbox?**
    a. The order of the subcategories could be improved, particularly in the Collaborative Processes category (e.g., placing similar activities near each other or an order based on roughly when that activity would occur relative to the others).
    b. I would add an umbrella layer for an equity lens that should be applied for all tools.
    c. Nothing significant, though I don't know what a "Reach Code" is.
    d. I might rename the last category Water Efficiency to reduce confusion that these practices are only related to customer use efficiency (water loss/leakage should also include water utility infrastructure).
    e. (1) There seems to be no category for preservation of the natural environment/ecosystems. (2) I liked the previous category of incentives, but seems reduced in scale to one row. Thinking density bonus, or environmental conservation incentives, etc.
    f. Water reuse (grey water, & direct) are often very dependent upon building and plumbing codes - not sure if reuse should be moved, but the cross-connection should be noted in both the codes and reuse sections.
    g. Looks great. Possibly only moving Coordinated Pre-Application Meetings to Development Review section.
    h. Not a change per se, but just a note that the tools/steps in development review will likely vary from place to place and based on development type/size and it may be worth exploring this more as the project continues in order to elaborate on different processes available within this category.
    i. The organization of regulation and development review are not entirely accurate. Everything is part of the development code. Subdivision review looks at the site plan and must comply with zoning standards and development standards. Development review are phases during the process to comply with the code.

2. **Are there additions/subtractions of tools you suggest for the revised Toolbox?**
    a. How would you address eastern versus western water rights issues? How to formalize a collaboration effort?
    b. I assume that environmental laws did not make the list for a reason.

c. Climate change vulnerability assessments may fit in. https://www.epa.gov/waterriskassessment/conduct-drinking-water-or-wastewater-utility-risk-assessment
d. I would like to see a One Water Plan somewhere in there. I'm not sure if it fits under integrated water resource or sustainability plans or by itself. I would get rid of the last two post occupancy water demand management elements. It's a stretch as land use planners have very little to do with those things. Keep rate structure, but tie it back into land use form and SDC's.
e. Under the Regulations section, would suggest adding Parking Standards (related to stormwater BMPs).
f. Perhaps something regarding post-development/redevelopment activity. Such as adding conservation measures to existing buildings (water tanks, rain gardens, etc.).
g. Wastewater due to possible expansion of treatment plants with population growth, which could provide reuse, and has utility planning and financial impacts.
h. This may be outside the scope but, advocating to change the state legislature.
i. Add building permits to the Development Review section as well as include reference of re-development or change in use resulting in increased water demand, which may result in the applicant having to go through the steps in the Regulations section again. Add 'identifying administrative processes' after 'remove existing barriers' in Collaborative Process.
j. Suggest adding water efficiency investments to Infrastructure and Public Investment. Suggest adding offsets and water neutral development to Regulations, Codes and Ordinances.
k. Reorganize the code/development review section. Remove site planning.

3. What top five (5) tools, either represented in the Toolbox or new suggestions, do you think are generally most effective?

Practice	Votes
Landscape/Irrigation Codes	7
Building/Plumbing Codes	6
Comprehensive and Master Planning	5
Rate Structure	4
Coordinated Data and Information	4
Water Resource Plans	3
Water Budget, Allocation, and Dedication	3
Water Quality and Source Water Protection	3
Education Programs	3
Coordinated Pre-Application Meetings	3
Water Restrictions	3
Stormwater Management	3
Ongoing Communication	3
Fixture Retrofits	3
Collaboration	2
Removing Existing Barriers	2
Closed Approval Loop Between Land and Water	2
Zoning and Land Use Codes	2
Demand Offsets	2
Scenario Planning	2
Water Supply Infrastructure	2
Connection Charges	2

Water Adequacy Requirements	2
Sustainability and Climate-Related Plans	1
Monitoring, Enforcement, and Program Evaluation	1
One Water Planning	1
System Development Charges	1
Reach Codes	1
Public Engagement and Participation	1
Water Audits	1
Capital Improvement Plans	1
Subdivision Regulations	1
Growth/Annexation Policies	1

   a. I think this depends on the situation and the quality of the available tools. The more comprehensive and integrative the tools are the more effective they will be.

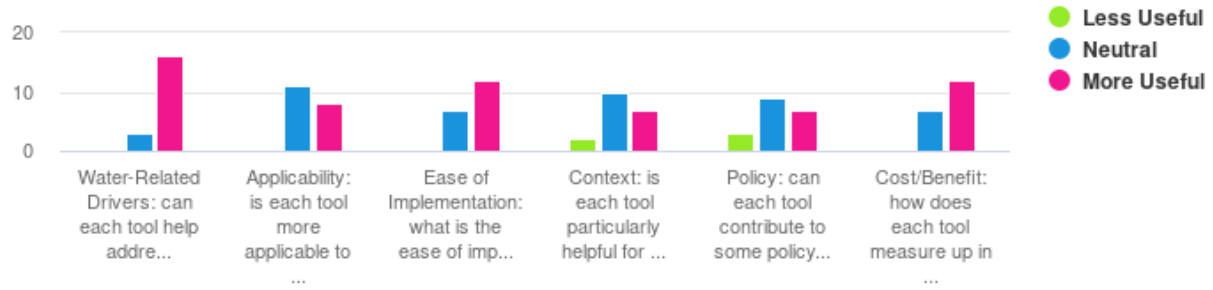
4. **In your answer above, what is your definition of "effective?" Are some tools only effective in particular contexts?**
   a. Improves water resilience/sustainability (3)
      i. Reduces water demand/results in water savings (7)
   b. Increases land and water integration (5)
   c. Feasibility - readily adopted and maintained by practitioners and decision-makers (3)
      i. Effective means to me results oriented; uniformly understood and interpreted; consistently enforced.

5. **Criteria Ranking Question**

	Less Useful	Neutral	More Useful
Water-Related Drivers: can each tool help address issues of water scarcity, urban flooding/sewer overflows, water quality, and aging infrastructure?	0	3	16
Applicability: is each tool more applicable to certain contexts like new development, redevelopment, site/customer level, and community/long-term level?	0	11	8
Ease of Implementation: what is the ease of implementation of each tool related to cost, political will, staff resources, program maintenance, and ease of compliance?	0	7	12
Context: is each tool particularly helpful for certain kinds of communities, such as fast or slow-growing; small, medium, or large communities; and private or public water utilities?	2	10	7
Policy: can each tool contribute to some policy goal, such as equity, affordability, sustainability, or resilience?	3	9	7

Cost/Benefit: how does each tool measure up in terms of volume of water saved, relative implementation cost, and potential long-term cost savings?	0	7	12

Please rank each criteria below based on how useful you think it would be for both land and water practitioners assessing which tool might work best in their community. Criteria have been grouped; the items following the colon of each grouping could represent the columns of the decision support matrix.



6. **Are there additional criteria our group should consider for this matrix? Are any individual criteria particularly useful? Would you mix and match criteria from the above groupings, or otherwise reorganize things, to create a new and potentially more useful group?**
    a. Other water users - agriculture, industry, energy, and recreation users.
    b. I think that context is very important, with ease of implementation and cost being second.
    c. In my opinion, nobody has time or money to do anything new/different, so it's got to be easy, quick, and politically supported. I think Ease of Implementation and Cost/Benefit fit this idea pretty well.
    d. Not sure I understand this. I'm not sure the criteria above are relevant, or the question isn't the right question. Basically, they all would be useful.
    e. I'm not sure how useful it is to group equity, sustainability etc., in one criterion
    f. 1) Applicability and Context seem very closely related; 2) "Ease of Implementation" should address feasibility, political, economic and practical. 3) "Policy" seems a lot like "co-benefits;" projects with strong co-benefits or multiple, cross-cutting benefits should rate higher under this criterion.
    g. I do not think I saw resilience as a criterion... Current organization seems OK.
    h. I'm not sure I really understand the value of the criteria groupings. If it's at a high level I could see its use, but everything is so dependent on local context it hard for me to weigh in on the specifics of these questions.
    i. Identifying a way to focus on equity in the tool (row or column) would be great.
    j. No specific comments. The current structure seems logical and together, comprehensive.
    k. The degree of innovation might be a useful criterion to add.
    l. I would separate out water quality from water quantity.

7. **Are there some criteria, either listed in this survey or additional that you recommend, that are more useful to land use planners than water managers or vice versa?**
    a. Development review for planners and water supply & infrastructure for water managers
    b. I would think that development review is, but I am not well qualified to answer this question.
    c. No, but each criterion will be evaluated and used differently by land use and water managers.
    d. Perhaps add Location affecting Critical Sensitive Environmental Resources - aquifer recharge, wetlands, karst, erodible soils, etc.
    e. United States
    f. Yes, almost all of them are more useful to one than the other; both would need to agree on the key tools they are going to engage with to make a difference -- probably requiring land planners to learn about and emphasize some water tools they now don't pay much attention to, and vice versa.
    g. Education
    h. Perhaps cost/benefit is more useful for water managers.
    i. Land Use decisions are more fraught with legal issues than water decisions are. Perhaps a criterion like "legal vulnerability" would be a useful criterion to consider on the land use side.
    j. United States

8. **Are there particular topics or subjects you'd like to discuss in our focus group meeting?**
    a. Not that I can think of. I'm not sure I if responded correctly to the ranking matrix - wasn't quite sure about it.
    b. Land use planning; comprehensive plans;
    c. Quick brain dump of any related resources that bear review in development of this and similar resources.
    d. How to get better collaboration between land use planners and water managers.
    e. I think it would be useful to discuss the development code/development review.

Table 8: Water Issues Categories for Subgroup Discussion

Tool	Tool Appropriateness for Addressing Certain Water Issues: Water Adequacy – Tool reduces water demand or increases water efficiency	Flooding and System Overflows – Tool helps absorb or convey excess water	Aging Infrastructure – Tool helps fund, build, and replace infrastructure	Water Quality – Tool helps improve water quality
Collaborative Processes				
Remove Existing Barriers	◔	●	●	◔
Ongoing Communication	●	●	●	●
Coordinated Data and Information	●	●	●	●
Education Programs	○	○		○
Public Engagement and Participation	◔	○		○
Scenario Planning	◔	◔	◔	
Pilots, Demonstrations, and Models	○	○		
Coordinated Pre-Application Meetings	●	○		○
Closed Approval Loop Between Land/Water	● *	◔		○
Monitoring, Enforcement, and Program Evaluation	●	●	●	●
Planning				
Comprehensive and Master Plans	● *	●	●	●
Water Resources Plans	● *	●	● *	●
Capital Improvement Plans	●	● *	● *	● *
Sustainability and Climate-Related Plans	●	● *	●	●
Hazard Mitigation, Response, and Recovery Plans	●	● *	● *	● *
Regulations: Codes and Ordinances				
Building Codes	◔	◔		
Plumbing Codes	◔	◔	●	◔
Landscape and Irrigation Codes	● *	●		◔
Zoning and Land Use Codes	●	●	◔	
Subdivision Regulations	◔	◔	◔	○
Annexation or Growth Policies	● *	●	◔	
Water Restriction and Other Water Use Codes	●			
Water Budget, Allocation, and Dedication	● *			
Assured Water Supply	● *			
Water Demand Offsets/Water Neutral Code	●		◔	
Consistency Requirements and Formalized Collaboration	●	◔		◔
Development Review				
Development Agreements/PUDs	◔	◔		
Site Planning	◔	●	◔	◔
Connection Charges	◔		●	
Developer Incentives	◔	◔	◔	
Water Supply and Infrastructure				
Water Supply Infrastructure	●	◔	●	●
Wastewater Treatment and Infrastructure			●	●
Stormwater Management	◔	●	◔	●
Water Quality and Source Water Protection	●	◔		●
Water Reuse and Use of Impaired Supplies	●	○	●	●
Water Recharge and Storage	●	◔	●	●
Post-Occupancy Water Demand Management				
Rate Structure and Conservation Rate Structure	●			
Fixture, Appliance, or Landscaping Retrofits	●	○		
Water Audits and Leak Detection/Repair	●		●	○

Key
● Appropriate for addressing this water issue
◔ Somewhat appropriate for addressing this water issue
○ Marginally appropriate for addressing this water issue
[no circle] No impact on this water issue

Figure 1: Outstanding Questions for Water Subgroup Discussion

Water Objectives Evaluation Subgroup
Work on tool appropriateness for addressing water objectives

- Remaining reactions to the selected objectives/issues and their definitions
  - Adequacy, Flooding, Infrastructure, Quality
  - What to call "Water Adequacy" – scarcity vs. supply vs. adequacy
- Filling out the cells for the 4 water issue columns –
  - *How appropriate is each tool for improving 1 of the 4 identified water objectives/ issues?*
  - Which assessment do you most disagree with? How should it be changed?
- Should we identify the tools that may be most effective in addressing each water issue, such as by asterisks as demonstrated?
  - Which tools are most effective to address each water issue?
    - Water adequacy: tool results in the most water savings
    - Flooding: tool absorbs or redirects the most water
    - Infrastructure: tool most directly creates a funding source or plan for replacing aging infrastructure
    - Quality: tool improves water quality by the greatest magnitude
- If you were to choose 5 tools that every community should do, regardless of their water issue, what would these 5 tools be?
  - In order words, what tools should any and every community pursue?

Table 9: Resilience and Equity Categories for Subgroup Discussion Questions

	Tool Contribution to Community Goals					
Tool	Resilience – Contributes to a resilient system by making it more diverse, modular, or redundant	Resilience – Tool is preservative (protects existing resources), adaptive (adapts to potential changes), or transformative (creates a new, more resilient system)	Resilience – Tool has a low, medium, or high impact on community resiliency (withstand or recover after disruption)	Resilience – Tool improves a community's ability to withstand or bounce back after disruption or disaster	Equity Inclusion & Involvement – Tool improves inclusion and involvement of **all** populations for improved affordable water, access to quality water, beneficial siting	Equitable Outcomes – Tool improves or decreases equity through water affordability, access to quality water, siting of facilities, or all
Collaborative Processes					●	
Remove Existing Barriers	Modular	Adaptive	●	●	●	All
Ongoing Communication	Redundant	Adaptive	●	●	●	All
Coordinated Data and Information	Redundant	Adaptive	●	●	○	
Education Programs	Modular	Adaptive	●	●	●	Affordability, Access
Public Engagement and Participation	Diverse	Transformative	●	●	●●	All
Scenario Planning	Diverse	Transformative	◉	◉	◉	Siting
Pilots, Demonstrations, and Models	Modular	Adaptive	○	○	●	
Coordinated Pre-Application Meetings	Redundant	Preservative	○	○		
Closed Approval Loop Between Land/Water	Redundant	Preservative	●	●		All
Monitoring and Program Evaluation	Redundant	Adaptive	●	●	●	
Planning					◉	
Comprehensive and Master Plans	Diverse	Transformative	●●	◉	◉	All
Water Resources Plans	All	Transformative	●	◉		All
Capital Improvement Plans	All	Transformative	●	○	●●	All
Sustainability and Climate-Related Plans	Redundant	Transformative	●●	◉	●	All
Hazard Mitigation, Response, and Recovery Plans	Diverse	Transformative	●●	●	●	All
Regulations: Codes and Ordinances			●		○	
Building Codes	Modular	Preservative	●		○	Affordability
Plumbing Codes	Modular	Preservative	●			Affordability
Landscape and Irrigation Codes	Modular	Adaptive	◉	◉	○	Affordability
Zoning and Land Use Codes	Diverse	Preservative	○	○	○	Affordability, Siting
Subdivision Regulations	Modular	Preservative	○		○	
Annexation or Growth Policies	Redundant	Preservative	●			Siting
Water Restriction and Other Water Use Codes	Redundant	Preservative	●	●		Access, Siting
Water Budget, Allocation, and Dedication	Redundant	Transformative	◉	◉	◉	
Assured Water Supply	Redundant, Diverse	Preservative	◉		●	Affordability, Access
Water Demand Offsets/Water Neutral Code	Diverse	Transformative	◉	●	●	
Consistency Requirements and Formalized Collaboration	Redundant	Preservative	○	●		
Development Review						
Development Agreements/PUDs	Modular	Adaptive	○	○		Siting
Site Planning	Modular	Adaptive	◉		○	
Connection Charges	Redundant	Preservative	○			Affordability
Developer Incentives	Modular	Adaptive	○	○	○	Affordability, Access
Water Supply and Infrastructure						
Water Supply Infrastructure	All	Preservative	●	○	◉	Siting, Access
Wastewater Treatment and Infrastructure	Diverse	Preservative	○		◉	Affordable
Stormwater Management	Diverse	Adaptive	●	●	◉	Siting
Water Quality and Source Water Protection	Redundant, Diverse	Transformative	◉	●	●	
Water Reuse and Use of Impaired Supplies	Modular, Diverse	Adaptive	●	◉	●	Affordability, Access
Water Recharge and Storage	Modular, Diverse	Preservative	●	●	○	Access
Post-Occupancy Water Demand Management						
Rate Structure and Conservation Rate Structure	Diverse	Adaptive	○	○	◉	Affordability
Fixture, Appliance, or Landscaping Retrofits	Diverse	Preservative	◉	○	●	Affordability
Water Audits and Leak Detection	Redundant	Preservative	◉	○	●	Affordability
			Key ● High ◉ Medium ○ Low	Key ● Improves ◉ Somewhat improves ○ Marginally improves [no circle] Does not improve	Key ● Improves ◉ Somewhat improves ○ Marginally improves [no circle] Does not improve	

Outstanding Questions for Resilience and Equity Subgroup Discussion

- Which columns are most useful? We will only have one resilience column and one equity column in the final summary table. We will create a self-evaluation blank template for practitioners that can include some of these additional column ideas.
    - Have we proposed useful criteria and how to measure them, from the practitioner perspective?
    - Are the criteria constructive and truly speak to how these tools could make a meaningful improvement toward either resilience or equity?
    - Are the criteria too generalized? Would more guidance be needed to make sense of the dots in each column?
- Filling out the resilience and equity cells –
    - *Which tools improve community resilience?*
    - *Which tools contribute to equity through improved water supplies for vulnerable communities?*
- If you were to choose 5 tools that every community should do to improve land and water coordination, what would these 5 tools be?
    - In other words, what tools should any and every community pursue?

Table 10: Cost/Implementation Categories for Subgroup Discussion

	Tool Feasibility			
Tool	Economic Costs/ Economic Benefits – A general estimation of the tool's benefits compared to likely costs	Magnitude of Cost – General estimate of how expensive each tool is	Ease of Implementation – A general estimation on how feasible it is for a community to adopt and implement the tool	Ease of Implementation – perspective of a low-capacity community
Collaborative Processes				
Remove Existing Barriers	◐	●	●	◐
Ongoing Communication	●	●	●	●
Coordinated Data and Information	●	●	●	●
Education Programs	●	◐	●	●
Public Engagement and Participation	◐	◐	◐	◐
Scenario Planning	◐	○	◐	○
Pilots, Demonstrations, and Models	○	●	◐	○
Coordinated Pre-Application Meetings	●	●	●	●
Closed Approval Loop Between Land/Water	◐	●	●	●
Monitoring, Enforcement, and Program Evaluation	◐	○	◐	○
Planning				
Comprehensive and Master Plans	●	◐	◐	◐
Water Resources Plans	●	◐	◐	○
Capital Improvement Plans	◐	◐	◐	●
Sustainability and Climate-Related Plans		◐	◐	○
Hazard Mitigation, Response, and Recovery Plans		◐	◐	◐
Regulations: Codes and Ordinances				
Building Codes	◐	●	●	◐
Plumbing Codes	◐	●	●	◐
Landscape and Irrigation Codes	●	●	◐	◐
Zoning and Land Use Codes	◐	●	◐	◐
Subdivision Regulations	◐	●	◐	●
Annexation or Growth Policies	◐	●	○	◐
Water Restriction and Other Water Use Codes		●	◐	◐
Water Budget, Allocation, and Dedication	●	●	◐	○
Assured Water Supply	◐	●	○	○
Water Demand Offsets/Water Neutral Code		●	○	○
Consistency Requirements and Formalized Collaboration		●	○	◐
Development Review				
Development Agreements/PUDs		●	●	◐
Site Planning		●	●	●
Connection Charges	◐	●	◐	◐
Developer Incentives	○	●	●	●
Water Supply and Infrastructure				
Water Supply Infrastructure	◐	○	◐	◐
Wastewater Treatment and Infrastructure		○		◐
Stormwater Management	●	◐	◐	◐
Water Quality and Source Water Protection	●	○	◐	○
Water Reuse and Use of Impaired Supplies		○	◐	◐
Water Recharge and Storage		◐	◐	◐
Post-Occupancy Water Demand Management				
Rate Structure and Conservation Rate Structure	●	◐	◐	◐
Fixture, Appliance, or Landscaping Retrofits	◐	◐	◐	◐
Water Audits and Leak Detection/Repair	◐	◐	◐	◐
	Key ● Benefits exceed costs ◐ Benefits and costs approximately equal ○ Costs likely exceed benefits	Key ● Low cost ◐ Medium cost ○ High cost	Key ● Easy ◐ Medium ○ Difficult	Key ● Easy ◐ Medium ○ Difficult

Figure 2: Outstanding Questions for Cost/Implementation Subgroup Discussion

Economic and Implementation Evaluation

Work on confirming appropriate evaluation criteria and how to use them for this effort.

- What are the practicalities of either a general cost category or an ease of implementation category?
  - Can we generically identify which tools are more or less expensive?
  - Similarly, can we generically say something useful about which tools are more difficult to implement and/or require a higher degree of political will to adopt?
  - Reactions to our move from cost/benefit to costs
    - Justification: 6 other matrix categories show non-economic benefits of each tool
    - Do we need further guidance to help folks compare these evaluation columns to the other 6 proposed matrix columns? What might this guidance entail?
  - Is there a particular perspective we should have in mind for ease of implementation? Ease of implementation for what type of community—or does it matter?
- Do these evaluation methods belong in the general summary matrix or should they be discussed as something to be considered in a community-specific evaluation or as a separate decision support system?
  - What guidance should be offered for using evaluation criteria in a community-specific tool evaluation (such as shown on the next page)?
  - Are there other, related evaluation criteria we should consider instead of economic costs and ease of implementation?
- Filling out the evaluation categories
  - *Which tools are most expensive?*
  - *Which tools tend to be easier / more difficult to implement?*
- If you were to choose 5 tools that every community should do, what would these 5 tools be?
  - In order words, what tools should any and every community pursue?

Table 11: Top 5 Toolbox Tools as Identified by Focus Group Participants

Water Issues Subgroup	Resilience/Equity Subgroup	Cost/Implementation Subgroup	Aggregate Top 5
• Comprehensive and Master Plans	• Public Engagement and Participation	• Closed Approval Loop Between Land/Water	• Comprehensive and Master Plans
• Remove Existing Barriers	• Ongoing Communication	• Education Programs	• Remove Existing Barriers
• Assured Water Supply	• Remove Existing Barriers	• Public Engagement and Participation	• Public Engagement and Participation
• Rate Structure and Conservation Rate Structure	• Coordinated Data and Information	• Water Resources Plans	• Coordinated Data and Information
• Connection Charges	• Capital Improvement Plans	• Developer Incentives	• Closed Approval Loop Between Land/Water