



By Ted Lee Eubanks

SHOAL CREEK WATERSHED PROTECTION PLANNING SCOPING & FUNDING STRATEGIES

PREPARED FOR THE SHOAL CREEK CONSERVANCY



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT

TEXAS STATE UNIVERSITY

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PREPARED FOR THE SHOAL CREEK CONSERVANCY

SEPTEMBER 2016

This report provides a summary of recent efforts to collect information necessary for the development of a comprehensive, holistic plan to manage the Shoal Creek Watershed. Current activities, priorities, resources and other information was collected both from the City of Austin (see Section 1) and from Shoal Creek Conservancy Board members (see Section 2). Plan goals, priorities, potential funding mechanisms, timelines and outreach strategies are presented below. It is intended that this summary report will provide a starting point for a campaign and strategy to engage the watershed community and develop a Watershed Management Plan for the Shoal Creek Watershed.



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT

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With special acknowledgement for the contributions by



POTENTIAL MISSION/VISION WORDING FOR THE WATERSHED PLAN

Based on SCC Board vision for a watershed plan

The Conservancy, the City of Austin, and watershed stakeholders will develop a comprehensive Watershed Plan to restore and protect Shoal Creek and provide a path to a resilient, health and safe creek. The Plan's short- and long-term innovative and science-based solutions will protect the watershed from flooding and erosion; ensure water quality and flow; and restore ecological function and ecosystem services.

SCC VISIONS FOR THE CREEK AND WATERSHED

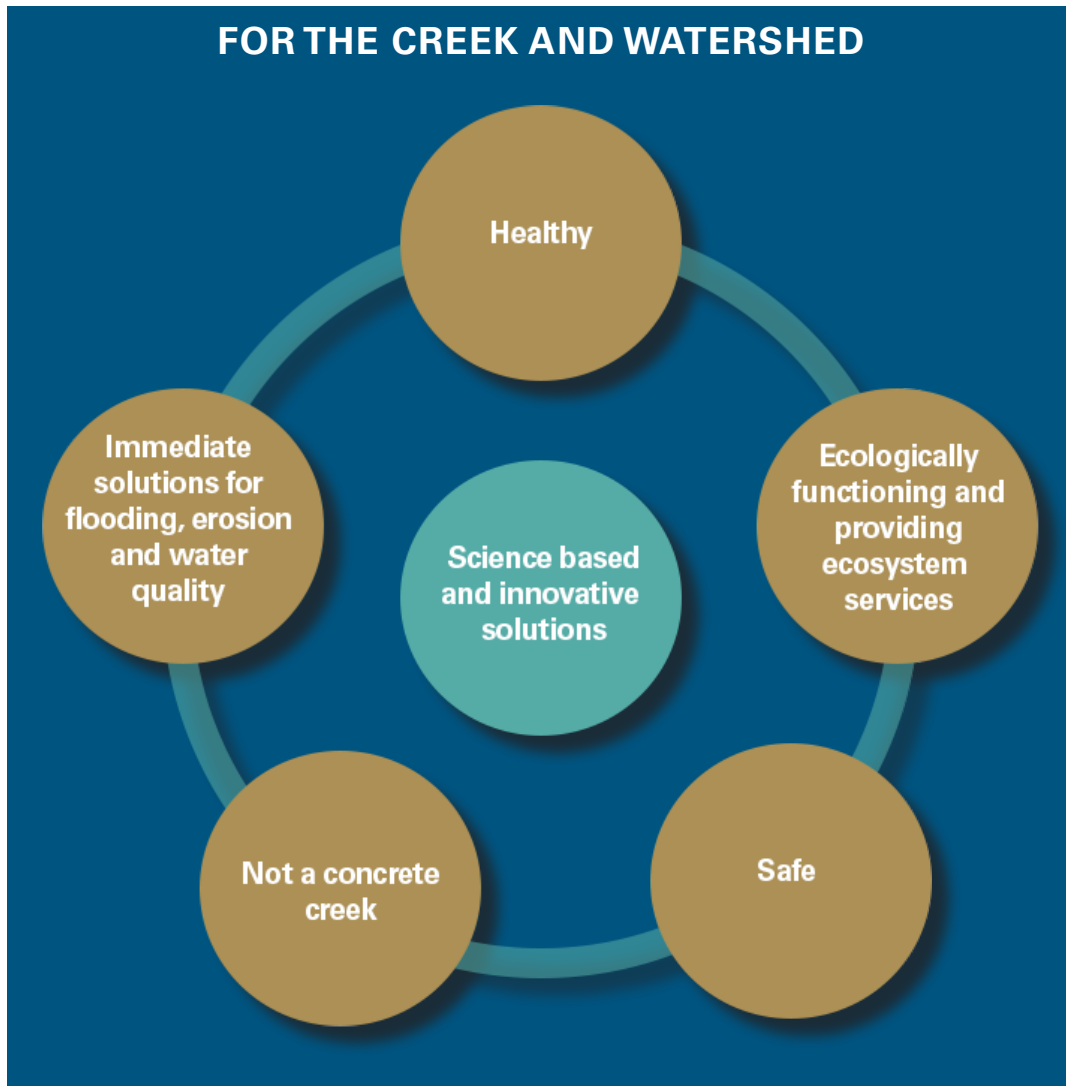


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SECTION 1 — RESOURCE SUMMARY

Introduction

The Meadows Center for Water and the Environment (The Meadows Center) and Alan Plummer Associates, Inc. (APAI) contracted with the Shoal Creek Conservancy to outline potential watershed protection plan elements and potential funding strategies. Section 1 of the report is a resource summary of available existing information regarding watershed management, flood, water quality, erosion, habitat, project and spring flow related efforts in the Shoal Creek Watershed.

To initiate the project, Alan Plummer Associates, Inc. (APAI) coordinated with the City of Austin and the Shoal Creek Conservancy to obtain maps, reports, and other data to gain an understanding of what has been completed and what is being contemplated to manage the Shoal Creek Watershed. A bibliography of these findings can be found in Appendix A.

The Shoal Creek Conservancy (SCC) has retained many reports and studies on its website, including parks and recreation information. In addition, the SCC hosted a watershed forum series earlier this year consisting of six separate events that were attended by 170 people and provided insight into the concerns and issues of watershed residents and business owners. A common theme from these meetings was the request for flood mitigation projects and programs to minimize the frequency and extent of flooding in the watershed. There was interest in another forum series to provide additional information to the community that could link directly to the Shoal Creek watershed planning process.

Watershed Summary

A key document prepared by the City of Austin, Draft North Urban Watersheds Report, compiled important flood, erosion, and water quality information from multiple sources within the City of Austin. Some key statistics are noted below:

- Watershed Drainage Area = 12.9 square miles (8,000 acres)
- About 27% of the watershed is over the Edwards Aquifer Recharge Zone
- About 30% of the watershed has tree canopy cover
- Shoal Creek's water quality is rated as fair on the City's Environmental Integrity Index (EII)
- 71% of the watershed was developed before the 1991 Urban Watersheds Ordinance regulations
- Watershed impervious cover is about 53%, one of the highest in the City
- There are 339 flood detention and 100 water quality treatment basins in the watershed, however, they manage only about 21% of the impervious cover
- Inundated structures in the floodplain: 274 in the 100-year, 127 in the 25-year, 67 in the 10-year, and 6 in the 2-year
- Total are 655 structures within the 100-year floodplain
- There are 54 roadways within the 100-year floodplain with 46 inundated by the 100-year, 41 inundated by the 25-year, 35 inundated by the 10-year, and 11 by the 2-year floods.



By Ivers McGraw

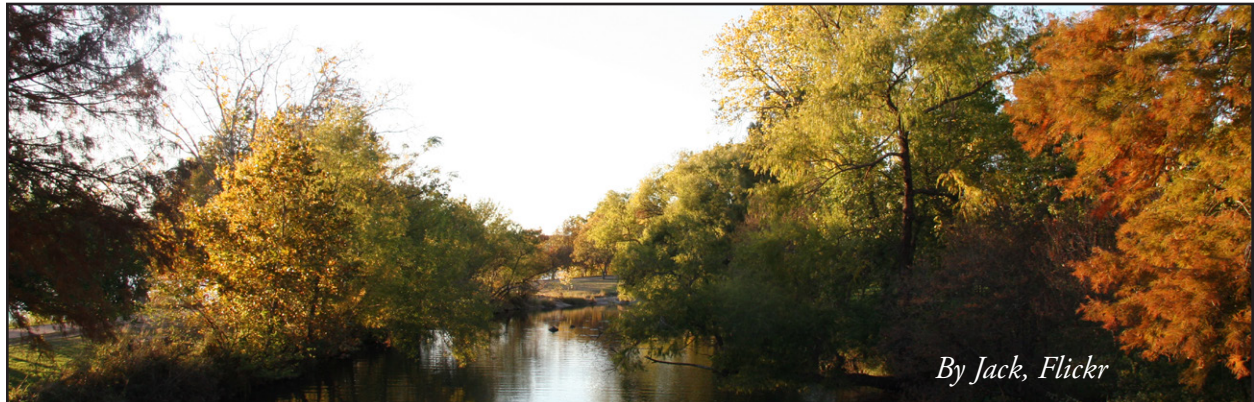
The City of Austin requested watershed planning teams' input on the draft report and comments were provided by APAI and SCC and are found in Appendix B. The City provided a draft final report in October 2016.

Meeting with City of Austin Watershed Protection Dept.

The watershed planning team met with City of Austin Watershed Protection Department staff on May 11, 2016 to identify potential watershed plan goals, opportunities and constraints. Several discussion items are highlighted below:

- Staff noted that it will be challenging to obtain a “good” water quality score due to the amount and intensity of urbanization prior to the requirement of stormwater/water quality controls.
- City staff is proposing the commencement of a comprehensive flooding and mitigation study that will begin in early 2017 and could take over one year to complete. This study will investigate flood management project options, costs, benefits, and constraints with an emphasis on lower Shoal Creek.
- Staff also noted that the City completed a summary of flood reduction strategies in August 2014 which can help guide flood mitigation options. The technical memorandum is found in Appendix C.

The meeting summary is contained in Appendix D and illustrates the positive working relationship with the City and their willingness to provide support and work as a partner with the SCC.



By Jack, Flickr

City of Austin Flood Mitigation Task Force Final Report

Also flood related, the City of Austin Mitigation Task Force released their report in May 2016 after a year-long evaluation of flood policy, problem areas, and project funding. The report summary is contained in Appendix E. Several report highlights are:

- The task force report focused primarily on Onion Creek with little mention of Shoal Creek.
- Most flooding in Austin is associated with pre-1977 development (before the City’s Drainage Criteria Manual).
- Funding large projects should be through general obligation bonds, not just the Drainage Utility Fund which generates about \$6 to \$7 million per year in capital projects for flooding, erosion, and water quality improvements.
- The City should not grant variances for development or re-development that may lead to future flooding.

Water Quality Protection Grant Application

During the watershed scoping and planning process, the SCC elected to pursue a water quality protection planning grant from TCEQ. This grant would fund a portion of the stakeholder engagement process, education and outreach activities and development, primarily, of the water quality portion of the Watershed Plan. Although this effort would focus on water quality, quantifying effects of, mitigating and managing erosion are closely related, as are managing spring flows and habitats. If funded, this grant would allow SCC and partners to convene stakeholders and create a framework and venue for drafting a comprehensive plan. APAI, The Meadows Center, and SCC prepared submitted the grant application on September 1 and anticipates receiving feedback from TCEQ by early 2017 to gain insight on the potential of being awarded the grant. The grant request included many partners and is in the amount of \$112,500 with a total project amount of \$218,417, when considering grant and in-kind contributions.

Future Capital Improvement Projects

Several studies and projects are underway with a key upcoming study being the Lower Shoal Creek Flood Mitigation Study noted above. This effort will begin in early 2017 according to City staff. Other planned active projects identified on the City's Capital Improvement Program website:

- Lower Shoal Creek Restoration Planning, 5th Street to Lady Bird Lake, project has been completed. APAI provided recommendations regarding creek maintenance and floodplain reduction benefits.
- Shoal Creek Greenbelt/Trail Improvements, 4th to 5th Street, Gap Project, under construction
- Shoal Creek Restoration, 15th to 28th Streets, Pease Park, under construction
- Shoal Creek, 5th to 15th Street Preliminary Engineering Report, ongoing planning, report completion by 2017, no current construction funding
- Lighting the Shoal Creek Trail at 12th Street, solar lights, completed
- Hancock Branch Flood Mitigation Study, ongoing study



By Randall Chancellor

SECTION 2 — VISIONING FOR WATERSHED PLANNING

Introduction and Summary

The purpose of a visioning session with the SCC Board and discussions with City of Austin staff was to outline the Conservancy's strategy for developing a comprehensive management plan for the Shoal Creek Watershed and to determine City of Austin resources and activities for partnering. Objectives included:

- Sharing concerns and visions for Shoal Creek
- Identifying and prioritizing Board member goals for the future state of the watershed
- Outlining and prioritizing Plan components
- Defining and identifying Stakeholders and partner roles
- Developing guidelines for funding strategies
- Creating a planning horizon and timeline



The following sections include material collected during the visioning process and recommendations for incorporating goals into the Planning process. Potential phases for developing a comprehensive plan are outlined in the tables below and provide a broad structure for the planning process. If the TCEQ Water Quality Protection Planning grant is awarded for the water quality planning process, it will provide a framework for incorporating other plan components.

As we await the response from the TCEQ regarding the Water Quality Protection Planning Grant award, it is recommended that early phases focus on flooding and creek erosion. Phases 1-3 could be completed within six to nine months, with mid-project activities, such as watershed characterization and stakeholder start-up potentially shared with TCEQ to illustrate the effective process. Please also see the Timeline at the end of this report and Appendices F, G and H for education and fundraising strategies, as well as watershed planning approaches.

Potential Watershed Action Plan Elements

Based on information from stakeholders, input from the SCC Board in the Visioning Session, and findings from this evaluation, the following is suggested as an approach to perform the watershed planning process:

Phase 1 - Stakeholder Involvement and Pre-Engagement Strategies, Activities	
Develop print, online and media educational and outreach materials including posters, flyers/brochures, website content, newsletter articles (for partners), PSAs. See Appendix F	
Schedule and host forums, meetings, tours, etc and participate in available community/educational events	
Targeted education and outreach activities to: <ul style="list-style-type: none"> • Increase stakeholder awareness of watershed issues • Increase visibility of SCC and watershed planning activities (including fund raising) • Continue partner development • Engage potential Watershed Plan Stakeholder Committee Members and partners 	
Phase 2 – Development and Implementation of Funding Strategies (significant overlap with Phase 1 is anticipated)	
Identification of opportunities, scheduling and application for grants, foundation funding	
Develop print and online materials targeting support from partners and sponsors	
Identification of partnership opportunities for funds, in-kind support, formal requests for support <ul style="list-style-type: none"> • NGOs (Educational, environmental) • Corporate, Downtown, local businesses • HOA, other organizations 	
Launching of online, mail and other forms of fundraising, crowd sourcing, memberships	
Structure Phase 3 based on funding availability <ul style="list-style-type: none"> • Break down by protection/management activity or category (erosion, water quality, water quantity, etc) • Break down by Plan process/steps (characterization, targets and milestones/desired outcomes, recommendations for BMPs) 	

Phase 3 – Stakeholder Committee Formation and Conceptual Watershed Plan (some overlap with Phase 1, 2 is anticipated)

Finalize watershed characterization (a portion of the information can be found in existing documentation, including the recent City of Austin North Urban Watersheds Report which will be complete in October 2016)

Meet with City of Austin staff to obtain detailed input on their studies, plans, and program activities in the Shoal Creek watershed

Prepare graphic resource guide that identifies problem areas and issues in a map and tabular format, obtain City of Austin review and input

Identify stakeholders and create a stakeholder committee that will provide policy and plan guidance
Host kickoff meeting with the stakeholder committee using resource guide and other information to start the process, obtain input for the planning process

Noted Items:

- Collect information on Brentwood LID (from City)
- Reach out to Sustainable Sites, US Green Building Council for technical support
- Compile EPA Ecosystem Services Guidelines, new LID GI documents/resources

Using existing outline, prepare an initial high-level conceptual plan illustrating problem areas, potential solutions, current and future City projects, and needs. Create an executive summary document for this conceptual type plan that will address flooding, erosion, water quality, habitat, and vegetation within the Shoal Creek watershed. Potential solutions/actions include:

- Construction projects, small retrofits
 - ✓ Regional solutions
 - ✓ Localized solutions
- Education and outreach
- Regulatory enhancements
- Spring flow management, conservation
- Coordination with the City Departments
- Drought planning and restoration
- Land use change assessment/opportunities
- Program and project optimization to minimize cost and accelerate watershed improvements

Develop updated and ongoing educational and outreach tools including watershed posters, brochures, articles, web and media content, social media, etc

- Communicate Plan progress
- Showcase findings
- Invite participation
- Funding tool
- Solicit feedback

Phase 3 – Stakeholder Committee Formation and Conceptual Watershed Plan (continued)

Share conceptual plan with stakeholders and obtain feedback

Summarize stakeholder input and document in a technical memorandum

Noted Items:

- Provide input into City's Shoal Creek Flood Mitigation Study (will not be completed for 2 years)
- Work with COA Public Works and Parks and Recreation Depts to develop trail plan and parks plan

Assessment of funding needs to develop Detailed Watershed Plan (Phase 4)

Phase 4 – Detailed Watershed Plan

Incorporate stakeholder feedback and updated available information into detailed Plan with:

- Timeline, cost, milestones and identified party for implementation of specific Plan activities
- Funding and implementation mechanisms
- Partnership efforts
- Ongoing education and outreach
- Adaptive management strategies

Seek specific funding commitments for Plan activities and seek additional grant/foundation and other funding sources

Public presentation of Plan

- City, county, state, federal, funder and community acceptance/approval



By Ted Lee Eubanks

Shared Concerns and Issues to be Included in Planning Activities

Concerns, Issues	Related Goals*
Flooding	<ul style="list-style-type: none"> • Protection of Property, life (including buildings, infrastructure) • Use method similar as used to identify Waller Creek's flood reduction goals** • Mitigation of flood impacts • SHORT TERM solutions to flooding (18-24 in) • Flood reduction benefits equivalent to tunnel • Safe Creek, Watershed • Use of innovative technology
Water Quality	<ul style="list-style-type: none"> • Fishable, swimmable waters • Safe Creek, Watershed
Erosion	<ul style="list-style-type: none"> • Healthy riparian areas • Reduced erosion
Infrastructure (existing) <ul style="list-style-type: none"> — Bridges — Sewer lines 	<ul style="list-style-type: none"> • Safe Creek, Watershed • Flood reduction • Removal of sewer lines from creek • Other?
Habitat (protection and restoration) <ul style="list-style-type: none"> — Invasive species — Habitat loss 	<ul style="list-style-type: none"> • Healthy riparian areas • Healthy creek • Conserved areas • Removed invasives
Public Access	<ul style="list-style-type: none"> • Safe Creek, Watershed • Additional access points
Safety	<ul style="list-style-type: none"> • Buy-outs? • Safe access to creek • Safe water in creek • Reduced flooding, reduced effects of flooding
Parks, recreation, trails	<ul style="list-style-type: none"> • Increased and improved opportunities for recreation • Recreation components that promote improved watershed function, reduced flooding, reduced erosion and good water quality
Land Development Code / Code Next <ul style="list-style-type: none"> — Inclusion of measures to protect creek and reduce flooding 	<ul style="list-style-type: none"> • Science and/or evidence based solutions • Coordinate/inform LDC rewrite process • LDCs that include creek, watershed protection

Concerns, Issues	Related Goals*
Community and residents' perception of creek, watershed and issues	<ul style="list-style-type: none"> • Comprehensive education and outreach to all stakeholders
Need for increased general understanding of Creek/Watershed's history — Stories about flooding	<ul style="list-style-type: none"> • Comprehensive education and outreach to all stakeholders • Improved understanding of historical changes • Increased stakeholder ethic? • Behavioral changes
Degraded, non-functioning creek	<ul style="list-style-type: none"> • Restoration • Naturally functioning, providing ecosystem services (environmental function) • Reduced shoaling/lower creek bed, lessen runoff, removed vegetation (where appropriate) • Upstream detention, increased use of and capacity of detention features
Effects of Drought	<ul style="list-style-type: none"> • Drought contingency planning • Resilience and decreased vulnerability associated with climate extremes

* Note that goals may be different for upper and lower portions of the creek and watershed.

** For example, “The Waller Creek Tunnel will protect lives from the dangers of flash flooding, removes more than 28 acres of downtown from the floodplain, protects 42 structures, 12 roadways and creates an environment suitable for redevelopment.” (<http://www.austintexas.gov/department/waller-creek-tunnel>)

During plan development, metrics and milestones must be developed to ensure that the goals in the table above are met. The next three tables list watershed issues by level of priority and provide guidelines for the stakeholder committee to develop metrics and indicators for tracking implementation progress and advancement of plan activities to meet goals.

HIGH PRIORITY Watershed Issues for Inclusion in Plan & Related Metrics	
Flooding — Short term = 0-5 yr — Midterm = 6-10 yr — Long term = 10+ yr	Modeled effects/mitigation potential of short, mid and long term BMPs and strategies to determine appropriate metrics, comparison of flood damage for small and medium flood events post BMP implementation; suggest researching realistic potential flood mitigation percentages from BMP installation; potentially track process for funding tunnel or other large infrastructure; measure potential monetary savings not spent if local and regional efforts could decrease required size of tunnel
Erosion	Reduced TSS instream concentration, # units bank restored/stabilized, # BMPs/measures installed, estimated # soil kept in place
Water Quality	Stakeholder selected targets (move toward over time), state standards and criteria, TMDL targets
Education/Outreach — Understanding of the history of the creek, watershed and flooding issues — Involvement of community and stakeholders in solutions (public-private partnership opportunities)	Tracked utilization of materials, increase in web, media, print and in –person presence of SCC and its educational materials, # of schools, organizations receiving information/partnering in watershed programs, # and impact of special events, # partners
Utilization of LID and green infrastructure	# LID/GI measures implemented by City, partners, HOAs, businesses and individuals; increases in technical references, incentives for implementing LID/GI
Habitat	# of units of habitat restored, estimate of increased function and ecosystem services provided by improved habitat (including pollution and erosion reduction/prevention), Texas Stream Team Riparian and instream biodiversity assessments compared over time, set goals for # units per year in strategic locations
Riparian areas	Same as above
Ecosystem function	Same as above (% improvement)
Coordination of efforts with the City (restoration, flood mitigation, regulations, ordinances, education, etc)	Track meetings, joint efforts, funds saved via reduced overlap, #s reached, quantitative metrics listed above (X # linear feet restoration added via collaboration, pooling of funds, etc)
Safety	# water quality exceedances, track flood damage, report on increased recreation opportunities, track outreach efforts regarding safe practices during floods, dashboard to report water quality safety issues

MEDIUM PRIORITY Watershed Issues for Inclusion in Plan & Related Metrics	
Public access and utilization	Track utilization, new opportunities for recreation and use, outreach efforts to increase understanding and awareness about access to the creek
Spring flow / baseflows / water storage	Track spring flow and baseflows (couple with water quality data), calculate potential increased infiltration of implemented BMPs
Management of open spaces, conservation	Similar to riparian areas and habitat, set goals for units of space and conservation activities, track value in terms of flood and water quality management
Drought planning	Track changes in flows and quality during drought periods, track drought measures implemented, conservation savings realized by partners, community, municipality
Biodiversity	Biomonitoring data and units of habitat restored, see Habitat above
LOWER PRIORITY Watershed Issues for Inclusion in Plan & Related Metrics	
Parks, trails and connectivity * Note that this is a high priority for SSC, but a lower priority for the Watershed Plan. SSC is pursuing a trail plan that will be coordinated with the watershed plan to the extent possible.	Units park/trails developed or connected, environmental value (flood and pollution mitigation), increased types of recreation, # accessing creek and open spaces; changes in perception about watershed, suggest working with Siglo group to determine best metrics
Other recreation considerations	Types of recreation, # accessing creek and open spaces; changes in perception about watershed, suggest working with Siglo group to determine best metrics
Economic development	# LID, GI and BMPs associated with new development, calculate changes to quality and flooding/stormwater from increased impervious cover and requirements to mitigate, calculate potential tax revenues for watershed management?
Other?	TBD

Watershed Plan Stakeholders

"Anyone who lives, works, visits or recreates in the watershed."

STAKEHOLDER AND POTENTIAL ROLES

- Residents, neighborhoods (Neighborhood Associations, HOAs and individuals): *participants/representation*
- Local businesses, Chamber of Commerce: *participants/representation, funders*
- Corporate businesses: *participants/representation, funders*
- City of Austin (multiple departments): *partner, technical assistance, funding, matching funds*
- University of Texas, Austin Community College, Concordia University: *technical assistance, matching funds, representation*
- State Agencies (TCEQ, TPWD, TWDB): *partner, technical assistance, funding*
- Federal (multiple): *partner, technical assistance, funding*
- NGOs and non-profits: *participants/representation, technical assistance, funding, education and outreach assistance, matching funds*
 - Local example – Pease Park Conservancy, Austin Parks Foundation
 - Regional/State example – The Nature Conservancy
 - Federal example – Trust for Public Land
- Money granting foundations: *funding, matching funds*
- Public (AISD) and private schools: *education and outreach assistance, participation, matching funds (volunteer hours), representation*
- Faith based groups: *participants/representation, education and outreach assistance, participation, matching funds (volunteer hours)*
- Other: *technical assistance*
 - Siglo Group
 - Spicewood TMDL team
 - Engineering Firms
 - Landscape Architecture Firms
- Other: *participants/representation*
 - Developers
 - Real Estate Agencies

Draft Watershed Plan Elements

- 1. WATERSHED CHARACTERIZATION** (include City North Urban Watershed Report and other documents)
 - a) Description of the watershed (physical, environmental/ecological, cultural, demographic)
 - b) Significance of the watershed (existence value, biodiversity, urban setting, community uses)
 - c) History of the watershed and protection/restoration efforts
 - d) Static picture of current watershed conditions
 - e) Detailed assessment of watershed issues (including methods of analyses)
 - Flooding
 - Erosion
 - Water Quality and quantity (spring flow)
 - Other prioritized components on page 5
 - f) Expected future watershed conditions (additional development, landscape changes)
 - g) Identification of types and sources of pollution, erosion, etc (to be included in the TCEQ grant)
- 2. WATERSHED PARTNERSHIPS AND STAKEHOLDERS**
 - a) Mission statement and vision
 - b) Plan purpose, objectives and goals
 - c) Plan methods, development process, public participation
 - d) Description and partner linkages, goals, roles in planning
- 3. MANAGEMENT MEASURES AND PRACTICES**
 - a) Identification and review of existing management programs and practices
 - b) Needs and opportunities for modified/new management programs and practices
 - c) Management measures and practices (Applicability, Effectiveness, Costs, Feasibility, Owner/Implementing party) by type or category:
 - Flood mitigation (short, mid, long term)
 - Drought Planning
 - Water Quality
 - Erosion
 - Spring Flow Management
 - Restoration and conservation
 - Coordination with parks, recreation areas and trails
 - d) Prioritization of activities
- 4. PARTNER ROLES, CONTRIBUTIONS IN IMPLEMENTING PLAN**
- 5. TECHNICAL AND FINANCIAL ASSISTANCE NEEDS** (potential sources of funding to implement management activities)
 - a) Implementation funding strategy
 - b) Cost savings identified through LID, green infrastructure applications
 - c) Social impact investment
- 6. EDUCATION AND OUTREACH PROGRAM AND MATERIALS (INCLUDES PLAN FOR COORDINATION)**
- 7. IMPLEMENTATION SCHEDULE FOR MANAGEMENT ACTIVITIES AND EDUCATION/OUTREACH**
- 8. MILESTONES, MEASUREMENTS, INDICATORS AND METRICS FOR TRACKING IMPLEMENTATION PROGRESS**
- 9. MONITORING PLAN** (data to be collected to evaluate progress toward milestones and goals)
- 10. ADAPTIVE MANAGEMENT STRATEGIES** (to ensure goals, milestones are met)

Draft Plan Development Budget

(costs include salary, supplies and other expenses)

*Note: This budget does not include matching or other contributions from the City of Austin or other partners.

Plan Elements (pg 8)	MEADOWS CENTER/ APAI Tasks	MEADOWS CENTER/APAI Estimated Cost	SSC Tasks	SSC Estimated Cost	Total Cost	Time Period
n/a (ongoing through plan completion)	Assistance with fundraising campaign, grant writing	\$15,000	Fundraising campaign, grant writing	\$50,000	\$65,000	1st – 4th quarters
#1	Watershed Characterization	\$15,000	Assist in document compilation	\$5,000	\$20,000	1st quarter
n/a (ongoing through plan completion)	Education and Outreach - ongoing	\$8,000	E&O activities including forums, meetings, events	\$45,000	\$53,000	All quarters
#2, all elements	Assistance with stakeholder engagement and facilitation	\$20,000	Stakeholder engagement, correspondence	\$15,000	\$35,000	All quarters
All elements	Coordination with COA	\$27,500	Assistance with partner coordination	\$10,000	\$37,500	All quarters
#3, 4, 11	Assessment of issues and goals, management measures, adaptive management strategies	\$70,000	Assistance with reporting and stakeholder / public communications	\$20,000	\$90,000	2nd – 4th quarters
#5, 6	Assistance securing implementation commitments from Partners	\$35,000	Securing implementation commitments from Partners	\$40,000	\$75,000	4th – 6th quarters
#7	Education and Outreach Program and coordination (Plan component)	\$10,000	Assistance with O&E plan and material development	\$15,000	\$25,000	2nd – 4th quarters

Draft Plan Development Budget (continued)

Plan Elements (pg 8)	MEADOWS CENTER/ APAI Tasks	MEADOWS CENTER/APAI Estimated Cost	SSC Tasks	SSC Estimated Cost	Total Cost	Time Period
#8, 9, 10	Implementation schedule, metrics and monitoring plan	\$30,000	Development of schedule, metrics	\$10,000	\$40,000	5th – 6th quarters
Implementation	Plan roll out activities	TBD	Plan roll out activities	\$15,000 (additional TBD)	\$15,000	6th quarter
THE MEADOWS CENTER/APAI Total		\$230,500	SSC Total	\$225,000	TOTAL	\$455,500

* Note that tasks associated with specific grants and grant deliverables are not included here and may reduce the total fundraising required. For example, TCEQ would cover a significant portion of the Watershed Characterization and educational activities (especially with regard to water quality and storm flow).

Potential Funding Sources for Plan Development

(some potential Implementation sources noted)

Name of Funder	Due Date	Interests	Request Amount
Corporate			
ERM Foundation	Year-round application process and awards grants quarterly. All grant applications must be submitted by ERM employee.	projects that provide clean water and sanitation, nurture environmental education, and encourage carbon reduction and biodiversity	TBD
Private Foundation Requests			
Dixon Water Fund	9/1/2016 and 03/01/2017	Broad Water use, sustainability	\$25,000
Meadows Foundation	rolling	Environmental Initiative, of which water issues are a major part, is one of the 3 major initiatives which is supposed to guide their grantmaking through 2021.	TBD
Reese Foundation	10/1/2016	Broad Water use, sustainability	\$20,000
Mattson McHale Foundation			TBD
National Fish and Wildlife Federation/Wells Fargo Environmental Solutions for Communities	likely early December 2016 for 2017 cycle	Conserving water resources and improving local water quality; restoring and managing natural habitat, species and ecosystems important to community livelihoods; facilitating investments in green energy; broad based citizen participation in project implementation	\$100,000
Shield-Ayres Foundation	Feb-17		\$12,000
Creekmore and Adele Fath Foundation	Likely 7/15/2017		TBD
Mitchell Foundation	Invitation Only	Water sustainability, groundwater connectivity	\$30,000-\$100,000
Still Water Foundation	Rolling LOI	Groundwater related	\$100,000

Name of Funder	Due Date	Interests	Request Amount
Government Grants			
TCEQ Nonpoint Pollution Grant	9/1/2016	Water quality and watershed protection	\$110,000
EPA Environmental Education Grants	likely early April 2017	local environmental education	TBD
NFWF Five Star and Urban Waters Restoration Grant	1/2/2017	Watershed Action Plan, community outreach in the watershed to improve overall health, habitat restoration	\$50,000
Public/Stakeholder Campaign			
Individual Donors	ongoing	Creek Lovers	\$5,000
Public Stakeholder Campaign	TBD	General fundraising efforts, events, online, social media and mail campaign	\$20,000
Partnerships for In-kind Resources/Possible Cash Match			
Education Partnerships	TBD	Examples include Master Naturalists, Student Conservation Association, Keep Austin Beautiful, Council for Environmental Education, UT, The Meadows Center	In-kind, TBD
Colorado River Alliance		in kind support for education/outreach, possible cash match	In-kind, TBD
LCRA		in kind support for education/outreach, water quality monitoring, possible cash match	In-kind, TBD
Austin Youth River Watch (LCRA Colorado River Watch Network and TST partner)		in kind support - volunteer service project with AYRW focused on stream restoration	In-kind, TBD
Texas Stream Team/Colorado River Watch Network		In kind support – matching funds, water quality monitoring, education/outreach	In-kind, TBD

Potential Timeline

* Meadows Center staff will work with SCC staff to determine fundraising goals, dates

** If at all possible, raise \$10-50,000 to get started in early Fall (November 2016)

*** Dates and completion time may change depending on funder requirements/grants

Phase	Activity	Start Date	Duration
	Finalize Grant Submission List (Based on available funding opportunities and board, staff and partner capacity)	October 30th (additional opportunities to be added as they arise)	Ongoing (time set aside for grant writing and application process)
	TCEQ Water Quality based Watershed Protection Plan Application (included in Grant Submission List above)	Proposal due to TCEQ September 01, 2016 COMPLETE	* If funded, notification received by January 2017; * Contract/grant would begin late Spring/early Summer 2017
PHASE 1	Begin Pre-engagement education and outreach efforts as funding allows	Fall/Winter 2016/2017	Ongoing, will roll into plan development educational and outreach efforts
PHASE 2	Submission of request for support to City of Austin (for support with proposals, match, cash contributions)	Fall/Winter 2016/2017	* Need to discuss timing with City Staff
	Submission of request for support from Foundations	Fall/Winter 2016/2017, then ongoing as new sources are identified	Foundation/Program specific; Mitchell and Meadows accept throughout the year
	Dixon Water Foundation Application (included in Grant Submission List above)	March 1, 2017 or September 1, 2017	Can take up to 6 months to receive notification/funding
	Finalize Initial Campaign for Fundraising	November 15, 2016	1-3 months
	Fundraising for Plan Development	Fall/Winter 2016/2017	Ongoing, depending on funding goals
PHASE 3	Begin Stakeholder activities and Planning Process	Once initial funding goal has been met, likely Spring 2017 (as soon as possible)	Stakeholder Committee formed in 60 days; Complete draft of Plan in 18 months if funding goals are met
PHASES 3, 4	Begin TCEQ WPP activities	Late Spring/early Summer 2017	Appx. 1 year to submit draft WPP (portion of overall Plan)
	Stakeholder approval process for TCEQ and other Plan components	Once draft Plan (and water quality WPP) are completed	30-90 days for comment period, 30-60 days for edits, 30+ days for Austin City Council approval, TCEQ/EPA acceptance
	Other Plan components to be determined based on funding availability	See Phases outlined above on pages 7-9	--

SECTION 3 — APPENDICES

Appendix A: Bibliography for Shoal Creek

USACE STUDY

- Indicated in 1980's the need for flood control suggested nonstructural measures including flood proofing, zoning, evacuation, and increased flood warning.
- Expected that development in the floodplain will continue to be a problem and increase
- 13.9 million in average damages within Shoal Creek.
- City will continue to enforce zoning regulations, participate in the NFIP, individual flood proofing of structures and provide flood warnings

NORTH ECONOMIC DEVELOPMENT PLAN

- Recommended channel improvements in upper areas of shoal Creek in 1991 project costs 82 million.
- 2014 Watershed Protection Department Analysis
- Left out Shoal Creek when discussing channel improvements in upper areas of Shoal Creek because the improvements included grassy areas and concrete channels that did not meet the overall goals of the WPD
- 19th street (Shoal Creek) tunnel chosen for further analysis because it appears to be feasible and appears to mitigate flood risk- Shoal Creek tunnel has an estimated cost of 133 million dollars
 - Benefits include 100 year or 1 percent storm event 59 structures would be out of the high flood area 18 would have reduced water height
 - 25 year or 4 % chance storm event 57 structures would be out of the flood plain 3 remaining structures would have reduced water height
 - 10 to 2 year events 10 percent and 50 percent chance storm events all structures and roadways would have risk of inundation eliminated
- Lower part of Shoal Creek ranked number 4 on creek flood mission's regional top 15 flooding priorities
- The first influx of funding planned for 2017 for preliminary engineering

TDML REPORTS

- 2006 reported elevated levels of bacteria in 4 city streams (Not Shoal)
- City adopted Total Daily Mass Load to address this issue in Waller, Spicewood, Taylor, Slough South and Walnut

- Draft version of TDMLs developed in 2014 by TCEQ scientist
- Stakeholders will implement plan within the next 3-5 years
- Commission approved and implemented the plan in 2015
- Federal Clean Water Act Sec. 303 requires states to regularly identify water bodies that do not meet water quality standards
- Impaired: if sufficient data demonstrates that a numeric or a narrative criteria specific to a designated or presumed use is not achieved

PROJECT LIST:

SHOAL CREEK FLOOD IMPROVEMENT- FROM COA FORUM SERIES, SPRING 2016

- Mopac Pond 1 & 2
- Steck Ponds
- PSP Pond 1 & 2
- Jefferson Street Channel Improvement
- Sliverway Bridge removal
- Woodhollow detention Improvements
- Little Shoal Creek Tunnel
- Westover Hills Storm drain improvements
- Rickey Drive Storm Drain Improvements
- Shoal Creek Buyouts
- Shoal Creek Blvd. bridge
- 2K pond
- 2222 Bridge Replacement and Channel Improvements
- West 34th Street reconstruction
- West 38th Street bridge improvements
- Regalea Storm drain improvements
- Rosedale storm drain improvements
- Grover culvert and channel improvements
- Green Lawn Bridge Improvement

- Arcadia Avenue drainage improvements
- Remberton Emergency Repairs
- UT Pond
- Far West Pond
- Allendale Storm drain improvements
- Spicewoods Springs Ponds
- Silverway Buyouts

Project List Shoal Creek Library				
Project Name	Date	Status	Type	Authors
SCC Feasibility Study Final Report	Jul-05	Completed	Written Report	Joanna Wolaver, Jimena Cruz, Ted Siff
Shoal Creek Watershed Integrity Score	2009	Completed	Map	City of Austin, EII
Shoal Creek Greenway Action Plan	1998	Completed	Written Report	Greenways Inc.
Shoal Creek Greenbelt Rating	2004	Completed	Website	Austin Explorer Website
Map of the Shoal Creek Greenbelt		Page Not Found		
The Trail Enhancement Plan	2008	Completed	Written Report	City of Austin
Urban Trails		Completed	Website	City of Austin
Report on 3rd street bridge	2015	Completed	Memo	City of Austin
Report on 3rd street bridge	2001	Completed	Report	City of Austin
LCRA-34th Street Data	2016	Ongoing	Website	Conservancy and Youth River Watch
USGS Shoal Creek Gauge at Silverway Drive	2016	Ongoing	Website	USGS
USGS Shoal Creek Gauge at 12th Street	2017	Ongoing	Website	USGS
USGS Shoal Creek Peak Streamflow Data	2018	Ongoing	Website	USGS
Shoal Creek Watershed Summary Sheet, Environmental Integrity Index	2011	Completed	Report	City of Austin
City of Austin Watershed Summary Report 2011-2012	2013	Draft	Report	City of Austin-Watershed Protection
City of Austin Spicewood Springs Shoal Creek Tributary TMDL Project 2013	2016	Completed	Report	City of Austin
City of Austin Rain Gardens – Keeping Water on the Land Webpage	2016	Completed	Website	City of Austin

Project List Shoal Creek Library				
City of Austin Floodplain Changes Interactive Map	2016	Completed	Website	City of Austin
Shoal Creek Watershed Erosion Assessment 1997	1997	Completed	Report	City of Austin
Water Chemistry of Shoal Creek 1997	1997	Completed	Report	USGS
City of Austin Shoal Creek Watershed Water Quality Retrofit Master Plan 1994	1994	Completed	Report	City of Austin
Image of Flood Waters at Shoal Creek 1981, USGS	1981	Completed	USGS	
Image of Flood Waters at Shoal Creek and West 6th Street, 1915, Portal to Texas History Website	2016	Completed	Report	Austin
Image of Flood Water on Shoal Creek and West 4th Street, 1915, The Portal to Texas History Website	2016	Completed	Report	Austin Public Library
The 1981 Memorial Day Flood – Article in the Allandale Reporter	Not Found	Not Found	Not Found	
Shoal Creek 15th-28th Restoration Documents	2016	Completed	Website	City of Austin
Storm Drain Marking Volunteer Program – Austin Watershed Protection	2016	Completed	Website	City of Austin-Watershed Protection
Guide to the Geology of Travis County, Shoal Creek Field Trip, University of Texas at Austin	NA	Completed	Trail Guide	University of Austin
Economic Value of Parks (Trust for Public Land)	2009	Completed	Trust for Public Land	
Tree City Bulletin (urban forests, storm water detention)	2010	Completed	Article	Tree City USA
Scoop the Poop – Austin Watershed Protection	2016	Completed	Website	City of Austin-Watershed Protection
Austin Christmas Bird Count	2015	Completed	Website	Austin Conservation Committee
Shoal Creek on the Austin Parks Foundation website	2016	Completed	Website	Austin Parks Website
Parks and Recreation Department Long Range Plan (2010)	2010	Completed	Report	Parks and Recreation Department
Downtown Austin Parks and Open Space Master Plan (2010)	2010	Completed-draft	Report	ROMA Austin and HR&A Advisors

Project List Shoal Creek Library				
Parks and Recreation Department “Long Range Plan for Land, Facilities, and Programs” (2011)	2010	Completed	Report	City of Austin
Images of the Historic Bridges of Shoal Creek – Portfolio by Ted Eubanks	NA	Completed	Photo Series	Ted Eubanks
Austin’s Urban Forest Plan: A Master Plan for Public Property – City of Austin (PDF)	Not Found	Not Found	Not Found	City of Austin
Austin, Texas, Illustrated: Famous Capital City of the Lone Star State – Book on The Portal to Texas History Website	1900	Completed	Report	NA
Splitrock (Burns-Klein Home) History Website	2015	Completed	Website- Blog	NA
The Shoal Creek Pleiosaur	2010	Completed	Website	NA
George W. Davis Family Cemetery – The Allandale Reporter	2006	Completed	article	Jack Kern and Doug Davis
Imagine Austin Plan	2011	Completed	Report	City of Austin
Seaholm Redevelopment District. Lower Shoal Creek and New Central Library Planning and Design Coordination (2010)	2010	Completed	Report	Library Task force
Shoal Creek-Library Task Force Report (2010)	2010	Completed	Report	Taskforce
Great Streets Master Plan: Great Streets Program and Great Streets Standards(2002)	2002	Completed	Report	City of Austin
Seaholm District Master Plan (2001)	2001	Completed	Report	City of Austin
Town Lake Corridor Study (1985)	1985	Completed	Report	City of Austin
Bicentennial Project of the Horizons 76 Committee of the American Revolution Bicentennial Commission (1976)	1975	Completed	Report	Bicentennial Commission
Bryker Woods Neighborhood Association	2016	Completed	Website	Neighborhood Association

Appendix B:

SCC/APAI Comments on Draft North Urban Watersheds Plan - June 2016

Comments from Joanna Wolaver and Amy Combs

SECTION 2: CHARACTERIZATION

- Suggest shortening this section to include just key facts and then include the additional details in an appendix
- Suggest limiting the comparisons made between the watersheds and focusing more on stating the information about each watershed. The comparisons are interesting, but might be less necessary or helpful in determining solutions to the issues

SECTION 3: PROBLEMS

- What an amazing amount of information!
- Suggest adding a simple explanation of a 100-year flood. Perhaps a call out box?
- Inclusion of ranking information very helpful
- Section seems to be a combination of solutions in addition to a description of problems. It might be better just to focus on describing the challenges and problems - and top issue areas here - and then go into details about what is being done or what should be done in the Solutions section
- In terms of the solutions and projects underway that are included in this section, would be helpful to explain where the City is in the implementation process and the next steps
- Thank you for including SCC in this section. If it would be helpful to include, our mission is “To restore, protect and enhance the ecological, social and cultural vibrancy of Shoal Creek for the people of Austin by engaging and partnering with the community.” Could also mention that SCC has a partnership agreement with the Watershed Protection Department to pursue a watershed plan for Shoal Creek.
- In section 3.4, suggest adding information about the water quality issues on Spicewood Springs tributary of Shoal Creek and the current TMDL/Implementation Plan
- Might be helpful to include more information about the causes of the water quality issues and particular problem areas in the watershed

SECTION 4: SOLUTIONS

- Great summary of what is being done now, but would be great to include other possible solutions that could be pursued with additional funding. This might be the role of the Shoal Creek specific watershed plan. Could be helpful to mention that additional work is being done on solutions

- Might be planning to add more on solutions, costs, timelines and implementation plans in this section. If not, would be good to mention that that a more details solutions discussion and planning will be needed, such as through the Shoal Creek watershed-specific planning process
- On page 49, it doesn't include any Shoal projects underway or planned. Is this correct?
- On page 46, table states that the Shoal Creek Tunnel is in the Waller watershed.

GENERAL COMMENTS

- EII Score highest in Shoal creek compared to other Northern creeks, but did not score high overall*
- Northern creeks were among the top 15 most densely populated watersheds in Austin
- Northern watersheds were areas first developed throughout Austin before modern watershed regulations Shoal Creek developed faster than the other north watersheds and is the most developed watershed out of all of the north Austin watersheds – experiencing the most development before 1974 (12,000 parcels compared to 6,000 and 2,000 of other northern watersheds)
- Single family (35 percent) and commercial (28 percent) are the largest land uses built within Shoal Creek watershed before 1974
- Shoal Creek is comprised of 51 percent impervious cover- one of the highest impervious cover watersheds throughout the city
- North urban watersheds are among the worst scoring watersheds for riparian vegetation making passive restoration techniques more difficult to implement
- Shoal Creek has a poor toxins in settlement score compared to other creeks due to the high level of metals and pesticides in the water compared to level of aquatic life
- Only a small percentage of the impervious cover is treated for water quality throughout the North Austin Watersheds, despite a high percentage of water quality controls
- 75 percent of storm drains are outdated in the Shoal Creek watershed
- 53 percent of city wide public care facilities are within the north watershed 100 year flood plain and 46 in a 10 year event
- Shoal Creek accounts for a large percentage (20 percent) of the “very high” narrative scores compared to the other northern watersheds
- Shoal Creek had the second highest citizen complaints of localized flooding within the all of Austin's watersheds
- Shoal Creek had the highest percentage of highest problem areas of local flooding (12 percent)
- Shoal is the largest of the northern watersheds, but only 2.7 percent of the total creek system of Austin
- Shoal Creek was the top scoring watershed of the erosion reach problem score- high erosion

concerns along Austin's drainage system

- Shoal Creek has 563 million dollars in unfunded needs which accounts for 24 percent of citywide unfunded needs
- *Side note EII Score study 2013-2014
- Standard deviation seems high for the study... with the average watershed increasing two points on average could we really say that the creeks have improved overall or just stayed the same compared to historic averages?
- Shoal Creek appears to be average compared to other studied creeks' 2013-14 scores in Ph (7- 9 standard units), conductivity (250-1000 us/cm), dissolved oxygen (7-14 mg/ L), E.coli (1-2,400 MPN/ 100 ml)
- Shoal Creek did score 50 points higher than historic averages of benthic
- Report's overall recommendations for Shoal creek to improve and update aging wastewater pipelines goes with the Watershed Tasks force recommendations to improve and update wastewater pipelines and to fully fund capital projects

TOM HEGEMIER COMMENTS

- I agree with Joanna, great information and excellent details. Please see my input below to create an executive summary and other questions.
- Please add a Report Cover and Table of Contents
- Please add an executive summary, four pages max, bring up tables from the report highlighting:
- Executive Summary
- Introductory paragraph
 - Key Features by watershed in bullet format
- Watershed development, IC, development since water quality regulations,
- Watershed Ordinance summary in bullet format
- Brief hydrology summary, % IC, drainage area, peak flow rate at Lady Bird Lake
- Flood, erosion, and water quality issues in bullet format, select the top 3 for each
- Water quality scores, toxin in sediments - summarize
- Percent storm drains built before DCM, total miles in each watershed
- Capital projects expenditures/projects built and projects planned (list)

Table Example:

Watershed	Drainage area (acres)	Impervious Cover	100-year Peak Flow Rate	25-Year Peak Flow Rate
Lady Bird Lake				
Johnson				
Shoal				
Waller				

Watershed	Percent watershed treated	Percent IC treated	Detention ponds	Water quality ponds
Lady Bird Lake				
Johnson				
Shoal				
Waller				

Report comments

- I am surprised that 21% of the Shoal Creek watershed impervious cover is treated, seems high, please verify since most of the watershed was developed before the Urban Watershed Ordinance became effective.
- Figure 17, add watershed labels below each bar in the chart on the right. Include percent watershed treated
- Section 3.1.1 – structures within the floodplain and those inundated. Define inundation as I presume it is a certain depth within the structure? What is the level of accuracy to assess inundation, i.e. finished floor elevations?
- Clarify colors in Figure 20 to clearly show the different storm events and flooding
- Numbers in front of flood project areas can be confusing, need to clarify to the reader why it jumps from 2 to 6 to 8 to...
- Figure 28, clarify colors in chart
- Table 6, define inundation depth, similar to comment above regarding structure inundation
- Page 25 - 100-year peak flow of over 15,000 cubic feet per second at 9th Street (for comparison, Waller Creek reaches a peak flow of approximately 8,000 cfs at the inlet). What

does at the inlet mean?

- Table 7 – over what time period where the complaints received?
- Figure 33 – why is Johnson Creek ranked the highest? Provide a brief sentence description.
- Table 8 – over what time period?
- Figure 36 – “above ground channels”. The lay person could read this to mean channels above the ground, like a ride at Schlitterbahn.... Suggest using the term “natural and constructed channels” if that reflects the mapped length.
- More information to clarify the differences between Tables 9 and 10
- Good summary on the bottom of page 41 that describes the full set of erosion, water quality, and flood problems for the Waller Creek 1 reach. Take this approach to compare/contrast “mission” type projects.’
- Clarify legend on page 46.
- List all projects and cost to sum for each watershed, separate into completed, under construction, and planned. Could be part of Table 12, include cost.
- Table 13, include cost.
- Table 14, include cost.
- Table 15, include cost.
- 4.2.4 Grow Zones – how do these grow zones affect floodplain elevations? Affect conveyance maintenance?
- In Section 4 you might provide the annual budget amount for each of these programs/ activities. I realize it is City-wide, but it provides a perspective to the reader on how funds are being applied towards the City’s programs.
- Table 16 – provide source.
- 4.5.1 – How does unfunded needs vary from “capacity”? Provide a brief explanation for this and subsequent sections. Section title is “unfunded” and unfunded is also included in some of the projects. I am not understanding the details in this section.
- Please add a “Next Steps Section”, such as:
 - Watershed planning process to develop a vision for Shoal Creek, conduct stakeholder input, assess alternative solutions and funding sources, work in tandem with the City of Austin, prioritize watershed protection/solutions, and facilitate the City’s efforts in implementing projects through education/outreach, funding, and partnerships for capital and operations/maintenance
 - Land development code changes, water quality, detention for re-development, LID/GI incentives, beneficial use of stormwater
 - Watershed-wide asset inventory
- Other....

Appendix C: City of Austin, Summary of Flood Reduction Studies in the Shoal Creek Watershed, August 2014



Summary of Flood Reduction Studies in Shoal Creek Watershed August 2014

The purpose of this summary is to provide a brief recap of known studies that have been completed that investigate ways to mitigate flooding risks within the Shoal Creek Watershed. Based on known records, the most significant study to date is the United States Army Corps of Engineers (USACE) study titled Interim Report and Environmental Assessment (latest available version dated November 1991). Since then, the Watershed Protection Department (WPD) has performed brief conceptual analyses that build upon the USACE study with the most recent analysis completed in June 2014. The USACE study and the most recent WPD analysis are discussed below.

1991 USACE INTERIM REPORT SUMMARY

Scope of Study

The USACE report is approximately 500 pages in length. The study was undertaken based on various Congressional directives to look at water and other related land resource problems in the Shoal Creek watershed. Over the years, there have been multiple flood related issues that have caused property damage and loss of life. The study was initiated upon the request of the City of Austin in 1983 with the need for flood control as the primary problem identified. Several alternatives were investigated for flood prevention designs to include structural and nonstructural measures. Sufficient work was done for each alternative measure to determine its feasibility and to determine the best alternative based on engineering, economic feasibility, area needs, and environmental and social acceptability.

Plans Considered

Structural Measures

1. Detention Reservoirs – No detention reservoirs were considered since the City had already constructed two detention ponds in Northwest Park and developed three detention ponds north of US Highway 183 in the northern part of the Shoal Creek watershed. Additional ponds would not have been beneficial due to the lack of available land and little benefit to most of the watershed by building such a structure.
2. Channel Improvements – The improvements would decrease flood stage levels by increasing the improved channel velocity and permitting higher flows. The improvements considered included minimum, intermediate, and maximum channel improvements for Shoal Creek and Hancock Creek. Even the maximum channel improvements for Shoal Creek, which would vary from grass lined, trapezoidal to concrete lined, rectangular channels that have bottom widths ranging from 45 feet to 90 feet and costs of approximately \$67 Million (1991 dollars), only provided protection up to the 50-year (2-percent chance) storm and not the 100-year (1-percent chance) storm. The City chose to proceed further with the Hancock Creek Channel Improvement, and a Project Design Memorandum was completed in August 1993. The improvements per the Project Design Memorandum consisted of selective clearing of the existing creek, grass lined channel, gabion and concrete trapezoidal channel, a diversion box

- culvert, rectangular concrete-line channel, and bridge and road alterations at an estimated project cost of \$7.3 Million (1993 dollars) and provide protection against the 10-year (10-percent chance) storm.
3. Levees – Levees were not considered feasible due to adverse environmental impacts, extensive relocations of the numerous residential and commercial structures located along Shoal Creek, and the required continuing maintenance to prevent failure.
 4. Tunnels – Diverting the floodwaters directly into the Colorado River was considered as a viable option as it would minimize the relocations and help provide adequate flood protection. The tunnel sizes that were considered included diameters of 10', 14', 16', 18.5', and 23'. The sizes were selected based on available tunnel boring machines at the time of the study. Below is an economic summary table for the tunnel plans that was extracted directly from the report:

**ECONOMIC SUMMARY
TUNNEL PLANS
(February 1991 Price Level)**

<u>Plan</u>	<u>Tunnel Diameter</u>	<u>Total First Cost</u>	<u>Average Annual Cost 1/ (in thousands</u>	<u>Average Annual Benefits of dollars)</u>	<u>Benefit- to-Cost Ratio</u>	<u>Residual Damages</u>	<u>Net Benefits</u>
<u>Northwest Park</u>							
<u>Dry Creek Alignment 2/</u>	18.5	40,100	4,001	5,231	1.3	8,625	1,230
	23	60,432	6,024	5,255	0.9	8,601	-
<u>Bull Creek Alignment</u>	14	42,024	4,192	5,168	1.2	8,224	976
	18.5	46,288	4,616	5,231	1.1	8,625	615
<u>45th Street</u>	18.5	34,193	3,571	2,425	0.7	11,431	-
	23	70,122	7,307	6,425	0.9	7,431	-
<u>Hancock-45th Street</u>	18.5	47,466	4,734	4,126	0.9	9,730	-
<u>24th Street</u>	14	26,742	2,563	2,603	1.0	11,253	40
	18.5	31,830	3,048	3,102	1.0	10,754	54
	23	37,396	3,578	3,304	0.9	10,552	-
<u>19th Street</u>	14	23,964	2,294	2,433	1.0	11,422	139
	16	25,422	2,432	2,533	1.0	11,322	101
	18.5	28,329	2,709	2,774	1.0	11,081	65

5. Combination Plans – In an effort to provide a comprehensive solution, various channel improvements and tunnel options were combined and analyzed. The combination plans are identified with a letter followed by the number. The number indicates the tunnel diameter size.

**ECONOMIC SUMMARY
COMBINATION PLANS
(February 1991 Price Level)**

	<u>Plan</u>	<u>Tunnel Diameter</u>	<u>Total First Cost</u> (in thousands of dollars)	<u>Average Annual Cost*</u>	<u>Average Annual Benefits</u>	<u>Benefit- to-Cost Ratio</u>	<u>Residual Damages</u>	<u>Net Benefits</u>
A	Channel, Northwest Park Tunnel	14	59,097	5,896	8,037	1.3	5,819	2,141
		18.5	66,241	6,607	8,065	1.2	5,791	1,458
		23	72,278	7,208	8,274	1.1	5,582	1,066
B	Channel, Northwest Park Tunnel, 45th Street Tunnel	18.5	92,913	9,691	10,122	1.0	3,734	431
C	Channel, Northwest Park Tunnel, Hancock- 45th Street Tunnel	10	53,019	5,543	7,503	1.4	6,353	1,960
		18.5	96,041	10,016	11,530	1.2	2,326	1,514
		23	118,119	12,312	12,728	1.0	1,128	416
D	Channel, Northwest Park Tunnel, 24th Street Tunnel	14	85,748	8,946	9,854	1.1	4,002	908
		18.5	88,371	9,219	10,356	1.1	3,500	1,137
E	Channel, Northwest Park Tunnel, 19th Street Tunnel	10	62,669	6,546	8,425	1.3	5,431	1,879
		14	74,485	7,775	9,970	1.3	3,886	2,195
		18.5	87,303	9,108	10,407	1.1	3,449	1,299
F	Channel, Northwest Park Tunnel, 19th Street Tunnel, Hancock Channel	10	70,922	7,404	9,513	1.3	4,343	2,109
		14	81,697	8,525	11,560	1.4	2,296	3,035
		18.5	93,514	9,754	11,898	1.2	1,958	2,144

Nonstructural Measures

The intent of the nonstructural measures is not to reduce or eliminate the flooding issues. Instead, the intent is to manage the floodplain to minimize the negative impacts. Some of the recommendations considered included the following:

1. Floodproofing – The primary benefit is to reduce or eliminate flooding of existing structures. Methods include water-tight coverings, raising minimum floor elevations, raising access roads and escape routes, constructing levees or floodwalls and waterproofing walls around structures. This alternative was not recommended due to minimal benefits.
2. Zoning – This alternative requires modifications to existing land use and zoning regulations to control future development. This alternative was not recommended due to the already existing high damage potential.
3. Permanent Evacuation – A buy-out project would be implemented to eliminate structures in the floodplain for whatever frequency event is chosen as the desired level of protection. For the 5-year (20-percent chance) floodplain, it was determined that 157 residential structures would be impacted. This alternative was not recommended due to the low benefit-to-cost ratios of 0.6 to 1.0 that were determined.
4. Flood Warning – Warning systems can be implemented in cooperation with the National Weather Service.

No Action Alternative

It is expected that development in the existing Shoal Creek floodplain will remain stable and the existing flood threat will continue. This will discourage repairs and improvements to the structures. Since the City participates in FEMA's National Flood Insurance Program (NFIP) it is expected the floodplain management regulations will prevent further developments within the 100-year floodplain. It was further

noted that the average annual damages will be about \$13.9 million for the study area. It was recommended that the City continue to enforce the zoning regulations, participate in the NFIP, encourage individual flood proofing of structures, and provide flood warnings.

National Economic Development (NED) Plan

Plan F14 was recommended as the NED plan. It consists of channel improvements in the upper reaches of Shoal creek, the 14-ft diameter Northwest Park Tunnel, the 14-foot diameter 19th Street Tunnel, and channel improvements to the Hancock Branch Creek. The recommended plan had an estimated 1991 project initial cost of approximately \$82 Million with a Benefit to Cost (B/C) ratio of 1.4 to 1.0. The B/C value was estimated based on a 100-year period of analysis. Benefits include monetary savings or benefits due to damages prevented, reduction in the cost of emergency services, and the reduced disruption of the economy. Costs include initial project cost (which include construction and associated costs to support construction), the interest of the initial cost during construction, the operation and maintenance costs, and the interest to amortize the project cost over the life of the project.

In 1991, an Environmental Assessment (EA) was performed for the recommended plan. The costs that were identified in the EA were slightly different than indicated in the interim report; however, the scope of work remained the same. The EA indicated that no mitigation for the proposed project was required. In a letter from Colonel Brown dated August 19, 1991, he wrote “I have concluded that the proposed action will not have a significant adverse effect on the human environment nor is it environmentally controversial.” The letter also indicated that an Environmental Impact Statement would not be required.

2014 WPD ANALYSIS

In June 2014, WPD revisited the USACE recommended plan and focused on the 19th Street Tunnel option. Channel improvements to Shoal Creek and Hancock Creek were deemed impractical because clearing out natural creeks and making them uniform, grass lined and concrete channels do not meet the overall goals of WPD, which aside from reducing the impacts of flooding also include reducing the impacts of erosion and water pollution. The Northwest Park Tunnel also appeared to be impractical because of its length and it having to go under Loop 1 to get to Lake Austin.

The 19th Street Tunnel was chosen for further analysis for the following reasons:

1. It appears feasible based on the results of the ongoing Waller Creek Tunnel project. The 19th Street Tunnel would be similar in diameter and length.
2. It has potential to mitigate flooding risks to many properties and roadways downstream of 19th Street.

The 19th Street Tunnel, which from herein will be referred to as the Shoal Creek Tunnel, would start at Pease Park at 19th Street (Martin Luther King Jr. Boulevard) and outlet into Lady Bird Lake. Figure 1 presents the general location and alignment of the tunnel. The Shoal Creek Tunnel would be 26 feet in diameter (matching the largest Waller Creek Tunnel segment) and approximately 6,100 feet long. Assuming similar hydraulics to the Waller Creek Tunnel, WPD estimated that up to 10,000 cubic feet per second (cfs) of flow would be diverted out of Shoal Creek and into Lady Bird Lake during the 100-year storm event. The potential flood reduction benefits of the tunnel include:

- 100-year (1% chance) storm event: 59 structures would have the risk of inundation eliminated; 18 remaining structures would have reduced inundation depths. Two roadways would have the risk of overtopping eliminated; five remaining roadways would have reduced inundation depths.

- 25-year (4% chance) storm event: 57 structures would have the risk of inundation eliminated, 3 remaining structures would have reduced inundation depths. Five roadways would have the risk of inundation eliminated; two remaining roadways would have reduced inundation depths.
- 10-year and 2-year (10 % and 50% chance) storm events: all structures and roadways would have the risk of inundation eliminated.

The Shoal Creek Tunnel has an estimated initial project cost of approximately \$133 Million. The initial project cost includes the construction cost, engineering, project management, construction inspection, Right-of-Way acquisition, utility relocation, and permitting costs. The construction cost is based on the Waller Creek Tunnel construction bid documents (2012 dollars). The other costs are estimated as percentages of the construction cost.

WPD recognizes the flooding risks within the Shoal Creek watershed and the importance of reducing these risks. The lower part of Shoal Creek is ranked number four on the creek flood mission's Regional Top 15 Flooding Priorities. The first influx of funding is currently planned for Fiscal Year 2017 for preliminary engineering.

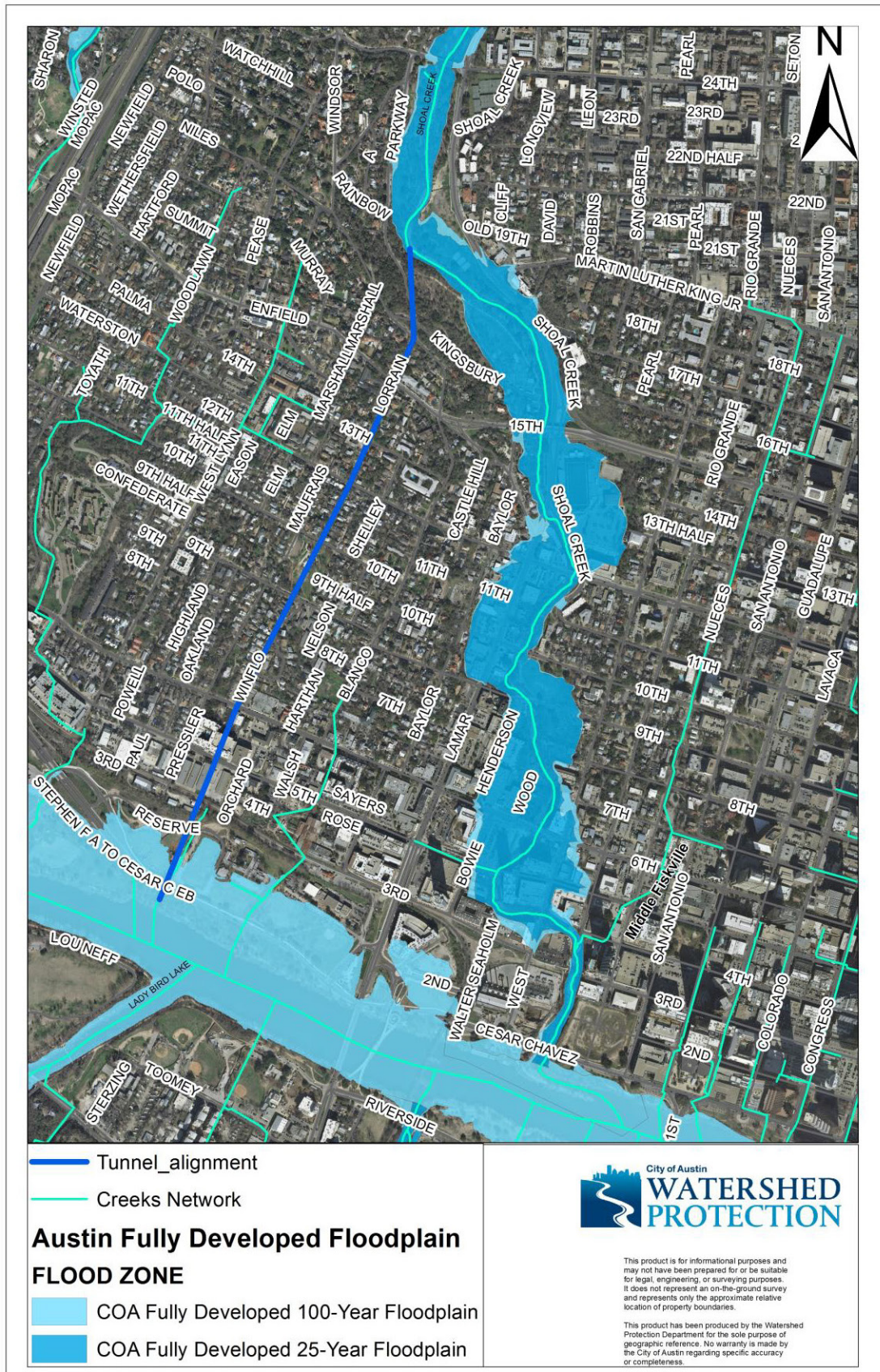
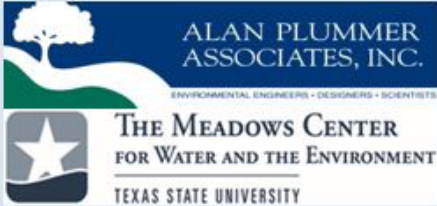


Figure 1 – Shoal Creek Tunnel General Location and Alignment Map

Appendix D: Watershed Protection Department Meeting Summary, May 11, 2016

		May 11, 2016 3:00 pm – 4:00 pm Shoal Creek Watershed Planning Visioning Mtg.	
Meeting called by:	Meredith/Tom	Meeting purpose:	Identify potential watershed protection plan goals, challenges, opportunities, constraints
Leader/Facilitator:	Meredith	Recorder:	Tom
Attendees:	Meredith Miller, Tom Hegemier, Joanna Wolaver, Jean Drew, Erin Wood, Kelly Strickler, Amy Combs, Reem Zoun		
Please bring:	Pen & Paper		
Agenda	Who	Time	
1. Review existing scope/deliverables	Meredith	5 min	
2. Shoal Creek Forum summary	Joanna	5 min	
3. Watershed project plan visioning session	All	40 min	
4. Modify scope/approach/deliverables?	All	5 min	
5. Next steps	Tom	5 min	
6.			
7.			
Additional Information			
Meeting summary follows this page.			

MEETING SUMMARY

Attendees:

City of Austin: Jean Drew, Erin Wood, Kelly Strickler, Reem Zoun
Shoal Creek Conservancy: Joanna Wolaver, Amy Combs
Meadows Center for Water and the Environment: Meredith Miller
Alan Plummer Associates, Inc.: Tom Hegemier

Project Purpose: Develop and refine a scope of work for a Shoal Creek Watershed Protection Plan that coordinates with City of Austin programs and projects and helps accomplish the Shoal Creek Conservancy vision for Shoal Creek to be a vibrant corridor that integrates the flow of water and people, engages the community, and inspires the public.

Documents/Resources:

- Watershed Plan: North Urban Watersheds
- Imagine Austin Plan
- Shoal Creek Greenway Plan
- Waller Creek Plan
- City of Austin Watershed Master Plans
- Capital Improvement Project Plan – past, ongoing, future projects
- Corps of Engineers Downtown Tunnel Study
- Brentwood Green Infrastructure/LID Study - share a draft copy? Completion date? Being expanded to Arroyo Seco area. New study commissioned to evaluate benefit in terms of reducing creek/culvert conveyance improvement costs. Schedule?

Shoal Creek Statistics from the North Urban Watersheds Report

- Watershed Drainage Area = 12.9 square miles (8,000 acres)
- About 27% of the watershed is over the Edwards Aquifer Recharge Zone
- About 30% of the watershed has tree canopy cover
- Shoal Creek's water quality is rated as fair on the City's Environmental Integrity Index (EII)
- 71% of the watershed was developed before the 1991 Urban Watersheds Ordinance regulations
- Watershed impervious cover is about 53%, one of the highest in the City
- There are 339 flood detention and 100 water quality treatment basins in the watershed, however, they manage only about 21% of the impervious cover
- Inundated structures in the floodplain: 274 in the 100-year, 127 in the 25-year, 67 in the 10-

year, and 6 in the 2-year

- Total are 655 structures within the 100-year floodplain
- There are 54 roadways within the 100-year floodplain with 46 inundated by the 100-year, 41 inundated by the 25-year, 35 inundated by the 10-year, and 11 by the 2-year floods.

Key Goals:

- City of Austin – manage flooding along Shoal Creek
- Verify that the Corps of Engineers downtown tunnel solution is the appropriate project to resolve lower Shoal Creek flooding
 - Can green infrastructure/low impact development measures reduce tunnel size/cost?
 - Identify short term and long term solutions
 - Is there anything else possible to address flooding that has not been evaluated?
- Shoal Creek Conservancy: To identify solutions to the flood, erosion, water quality and habitat loss issues and develop a plan for implementing these solutions, including estimated costs, funding sources and responsible parties.”
- Community conversation in the Shoal Creek watershed to evaluate, prioritize, and seek funding for programs and projects that benefit flooding, creek erosion, water quality, and parks.

Water Quality

- The City believes it will be challenging to obtain a “good” water quality score per the Environmental Integrity Index (EII) scoring system due to intense urbanization before stormwater/water quality controls were required
- City is considering modifying EII metrics in the future
- One tool is the identification of neighborhood hotspots and developing action plans to address bacteria, lawn chemicals, litter, etc.
- A TMDL project is underway in the Spicewood Creek Tributary for bacteria

Other Processes Taking Place

- Watershed Protection Department is evaluating level of service to be provided for flood management with primary focus on localized drainage issues. Current thought is to not deviate from 100-year protection of low water crossings, at bridges, etc. The City is conducting a benchmarking process this summer with other cities and will release a policy in the fall/winter time-frame.
- CodeNext, anticipate draft code release in January 2017
- Watershed Asset Management Program, city-wide inventory of assets
- Consideration of requesting general obligation bonds for projects in excess of \$6 to \$7 million

as the Drainage Utility revenues are challenged to fund large capital projects

Shoal Creek Forum Series Summary

- Six forums were held on flooding, watershed planning, water quality, erosion, habitat, and springs.
- 170 people in attendance, many attendees were vocal about flooding issues
- Process gathered much information regarding the public's views and wants for Shoal Creek
- Attendees appreciated the opportunity to learn more about Shoal Creek and share their opinions
- Process could be duplicated, potential forums include: "Creekside living, What you can do as a landowner", "Floodplain Education", "Other Cities – Model Solutions"

Data/Report Needs

- Creek Corridor Plan – Erin may have this
- Asset Management Program (draft plan or update on its goals, expected outcomes, schedule)
- Spicewood Springs TMDL

Potential Watershed Protection Plan Scope

- Technical Base built on past City studies, reports, projects, and programs
- Obtain information on what other cities in the US are doing and potential application to Shoal Creek
- Plan for the future while addressing current challenges and the changes that will occur
- Designed around the question "What should Shoal Creek look like in 25 years, how should it function in tandem with the changing City?"
- Serve as a stakeholder process after the completion of the North Urban Watersheds Plan to educate watershed residents/businesses and gather input on the multitude of potential available tools
- Can get into the localized solution details, more of a "neighborhood master plan" on a sub-watershed scale to consider the accumulated benefits of multiple local actions that can benefit the Shoal Creek system at-large, mainly downtown flooding
- Coordinate with the CodeNext process, the Shoal Creek Tunnel Study, and other activities
- Identify constraints, challenges, and cost sharing opportunities (partnerships)
- Define time-lines and potential funding sources
- Recommend best entities/partners/new districts to implement

- Define measurable levels of success (metrics)
- Recommend short term and long term successes or solutions
- Develop a prioritization system to compare and evaluate projects/programs
- Need to ensure that the process is not redundant with other City programs/projects
- Process can help seek grant funds to expand the Shoal Creek enhancement effort
- Define who will review/comment on the plan. Is it Watershed Protection, Environmental Commission, other?

Activity	Date
Share City of Austin Meeting Summary	May 18
Comments returned to the Shoal Creek team	May 27
Project team meet with the Conservancy Establish visioning session date with Conservancy leaders/Board Compile City of Austin meeting summary comments/finalize	Week of June 6
Project team comments to the City on the North Urban Watersheds Report	Week of June 6
Further detail potential draft Shoal Creek Watershed Protection Plan (WPP) elements	Week of June 13
Obtain comments/input on (WPP) elements	Week of June 20
Host Visioning Session with Conservancy leaders/Board	June 28
Develop a strategy for potential funders to engage their involvement	Week of July 11
Prepare Visioning Session report	Week of July 11
Prepare 319 Grant Application to TCEQ	Months of June/July
Shoal Creek Conservancy staff and Board provide comments/input on report	Week of August 1
Prepare draft final WPP scope and stakeholder funding strategies	Week of August 15
Meet with the City and Shoal Creek Conservancy to review draft WPP scope/funding strategies	Week of August 22
Prepare final WPP scope, stakeholder strategy plan, and “case statement” documents to share with potential funders	Week of August 29

Appendix E: City of Austin, Flood Mitigation Task Force Report summary by Shoal Creek Conservancy & Alan Plummer Associates, Inc.

CITY OF AUSTIN FLOOD MITIGATION TASKFORCE SUMMARY

- Report published in May 2016.
- The taskforce included individuals selected by the city council members and the mayor. These individuals formed three working groups- buyouts, capital projects, and operations & maintenance
- Each working group conducted research and spoke to a wide range of stakeholders. Additionally, the group held a public meeting at City Hall to hear from Austinites about their specific concerns of flooding in the region.
- The report focuses largely on Onion Creek watershed, only mentioning Lamar Bld. briefly in the public education section as an example of the importance of using “Turn Around, Don’t Drown” signage throughout the city. In fact, the taskforce studied Onion, Bear, and Rinard Creeks- not specifically Shoal Creek.
- Buyouts and DUFs were the first issues addressed in the report prioritization of ongoing buyouts, education of homeowners, and further
- The taskforce generally found...
 - Most flooding in Austin is associated with pre-1977 development;
 - There was a need to increase public education initiatives focusing on the definition of 100 year flood plain and expanding already existing programs such as “Turn Around, Don’t Drown” signage;
 - Largest challenge is funding current and future capital improvement projects
 - There was no uniform buyout policy for residents and many residents that were affected by the floods did not meet the requirements for the current buyout program;
 - There are no stream by stream management plans for clearing debris and a “hands off” approach from the city was complicating flooding issues
 - The drainage utility fee (DUF) was not being used effectively;
 - Further research especially targeting the Onion Creek watershed needs to be completed immediately.
- The Taskforce recommended...
 - City Council should adopt a city-wide flood mitigation prioritization policy based on loss of life, general health and safety, and property damage. All subsequent city council policy and budget decisions should be made through this framework
 - Funding large capital projects should be accomplished through bonds and available grants, not through the Drainage Utility Fee (DUF). Further, only capital projects that are identified as mitigating life and safety issues should be funded initially.

- Bonds should be let starting in 2016. Drainage bonds have not been funded since 2006.
- The DUF should only be used for smaller capital improvement projects that are less critical and can be accomplished within a reasonable time frame. In other words, nuisance flooding (flooding that only impacts streets and yards) needs to be tolerated in light of the expansive and expensive list of capital projects already identified by the Watershed Protection Department.
- Work with city, state, and county authorities to continue to restrain development in 100-year floodplains.
- The City should not grant variances for development or redevelopment that may lead to future flooding or annex property that may already be a flood concern, and;
- All redevelopment should have to meet drainage criteria assuming an undeveloped condition, reducing runoff leaving the site to “greenfield” conditions.
- Investigate partnerships, grants or cost shares with other jurisdictions and the US Geological Survey
- Education and incentive initiatives should increase and target neighborhoods, schools, and businesses directly within the floodplain not only including signage, but incentives for retrofits for private land owners etc.
- City of Austin should adopt a uniform buyout policy and the buyout policy should be expanded to homeowners within the 25 year floodplain. Buyout whole areas rather than individual properties
- Recommendations, research and critical problems should be addressed and funded now and not wait until CodeNEXT.
- Devote more funds to creek maintenance rather than creek clearing
- City of Austin should adopt building requirements that positively impact the creeks and reduce flooding risks, update flood maps every three years and provide maintenance to infrastructure along all creeks including pipes and tunnels
- Onion creek needs to be cleared of debris, development needs to be discouraged within the 500 year floodplain, residents of the area should be on future flood research teams
- Floodwalls and channel benching could increase erosion, lower property values, and should be a lower priority than regular maintenance and education
- Dedicate future funding and resources to flood modeling to unstudied creeks
- City of Austin and surrounding counties should develop a regional taskforce that goes beyond Austin’s city limits to look at flooding as a regional issue rather than a local problem.
- Establish a permanent flood taskforce for the City of Austin and an Onion Creek flood control district

Appendix F: Education and Outreach Strategies to Assist with Fundraising and Plan Development

SSC and The Meadows Center/APAI staff will work with SCC to develop more detailed outreach strategies to assist with both fundraising and Plan development. The overarching **goals of outreach activities and messaging** are to:

1. Increase awareness of general public and stakeholders about issues in the watershed, especially flooding
2. Increase awareness of general public and stakeholders about watershed management and planning activities in the watershed
3. Introduce and involve non-traditional stakeholders in watershed management activities
4. Introduce opportunities for involvement/participation in watershed planning and fundraising
5. Create networks for dissemination of information regarding watershed planning and other activities
6. Encourage local funding of planning activities (including in-kind and matching funds)

Existing City materials and resources can be utilized and tailored to create coordinated messaging. Each 319 funded Watershed Protection Plan is required to have education and outreach programming and many Plans have useful and relevant materials. Please see <https://static1.squarespace.com/static/50cb6adbe4b0e32b244d64f6/t/5762c85c4402432b1eebce/1466091613445/WPP+Section++5++E%26O+.pdf> and <http://plumcreek.tamu.edu/outreach/> for examples.

Strategy components include forums, public events, written and social media campaigns, introduction of special memberships/groups, participation in community events and other activities to increase understanding of watershed issues and participation/funding of Planning efforts. Examples are listed below. SSC staff can reach out to local and corporate businesses for donations of materials, food, press, etc.

Shoal Creek Forum Series – continuing monthly from November through February, then quarterly or bi-monthly. Utilize guest speakers (list to be presented in final report) Initial topics to include: Planning process and how to be involved (including Creek Lovers), model watershed efforts in other cities, Helping the watershed over the Holidays

Events – partnering with organizations in the watershed to raise awareness and funds via special events (walks/runs, bird watching tours, local plant sales/give aways, pokemon watershed challenges, “evening out” benefits, wine and beer tastings, creek clean ups, rain barrel auctions, film showings, trivia events, workshops, etc)

Media – social and print campaigns, fundraising campaigns, community based fundraising challenges, art campaigns/competitions (professional and children), photo/video/psa competitions, online auctions, online quizzes/trivia with locally donated prizes, HOA watershed savvy competitions, PSAs through KUT, flood prevention information distribution

Membership opportunities – yard placards, bumper stickers, certification program for businesses, adopt a stretch of the creek, friends of the creek/creek lovers, creek stewards, Stream Team, school groups

School Programming – partnering with local public and private schools to present watershed specific information, hands on projects and learning activities. Existing curricula including Texas Aquatic Science (<http://texasaquaticscience.org/>), City of Austin resources, (<http://www.austintexas.gov/Watershed/YouthEd>) and other available resources can be tailored to the SCC watershed. There are limited funding resources for environmental education and these opportunities can be included in the fundraising campaign strategy.

Informal Programming – Similar to School Programming, but partnering with informal education groups, including boy/girl scouts, boys/girls club, community centers, faith based organizations, pre-schools and afterschool programming.

Research Partnerships – Partner with high schools and Universities (UT, Texas State, St. Edwards, ACC and others) to collect data (environmental, biological, social) and do targeted research projects to inform the planning process and promote outreach and involvement

Texas Stream Team – Volunteer based citizen science program that monitors water quality, riparian health and biodiversity and provides education and outreach at the watershed level (joinstreamteam.org). This project is administrated by the Meadows Center

Texas Watershed Stewards Program – this free program has online workshops, citizen education events and other resources to inform communities about watersheds and watershed management (<http://tws.tamu.edu/>)

Spotlights – Publicize HOAs, businesses, individuals with exemplary best practices in conservation, watershed protection, pollution prevention via social and print to promote awareness. City of Austin could take the lead on this effort. Could include a self-guided tour

HOA and Local Business Targeted Activities – host open houses, meetings and informational events for HOAs, community groups and local businesses to promote conservation, safety, pollution prevention and best practices

Appendix G: Fundraising Strategies

A multi-pronged approach is recommended for funding a comprehensive watershed management plan and centers on the following funding sources:

1. Public funding/grants for:
 - Water quality management, stormwater management, pollution prevention
 - Habitat and ecosystem protection
 - Watershed education
 - Green infrastructure and LID
 - Community development
 - Requires grant proposal development and submission and if awarded, project management, reporting
2. Private and Foundation grants for:
 - Water quality management, stormwater management, pollution prevention
 - Habitat and ecosystem protection
 - Watershed education
 - Green infrastructure and LID
 - Community development
 - Spring flow management, aquifer protection
 - Recreation
 - Innovative partnerships
 - Activities that promote or contribute to the planning process
 - Matching funds for Plan development and implementation
 - Requires grant proposal development and submission and if awarded, project management, reporting
 - May also require board involvement to solicit organizations and develop relationships
3. Partner funds, contributions for:
 - Small, specific components of plan development, depending on partner interest
 - Educational and outreach activities (may be in-kind)

- Educational programming (may be in-kind)
 - Technical assistance, mapping, quality assurance (may be in-kind)
 - Plan development
 - Stakeholder activities (may be in-kind)
 - Part of a targeted fund raising campaign, including other NGOs, businesses/corporations, City of Austin
4. Donations and community based funding for:
 - Small, specific components of plan development, depending on partner interest
 - Restoration efforts (could be crown sourced)
 - Participation in programming (friends of the creek, etc)
 - Plan development
 - Social media, direct mail fund raising efforts targeted toward individuals and small businesses that may include membership, sponsorship, small donations and participation in E/O activities
 5. Business sponsorships and charitable giving:
 - Small, specific components of plan development, depending on partner interest
 - Restoration efforts
 - Participation in programming (environmentally friendly business designations, business friends of the creek, etc)
 - Plan development
 - Targeted and direct mail fund raising efforts for large and small businesses that may include membership, sponsorship, donations, matching funds, fund raising
 6. General Board and SCC fundraising:
 - Solicitation of general operation funding for Plan development
 - Board commitment to raise funds via new and existing donor relationships

General Notes

1. Keep Plan development and implementation fundraising efforts separate, except for implementation of education and outreach strategies (which will be ongoing through entire process)

- Fundraising for educational activities to be done concurrently with Plan development (including coordination of existing educational and outreach activities by City, NGOs and other partners)
- 2. Develop Plan in sections as funds are raised (initial goal of \$10-50,000 from small donors by December 2016/January 2017 to begin Phase 1 (pre-engagement efforts).
- 3. Design Plan development to have multiple short-term deliverables to show progress to funders and community (based on plan components and other functional units for reporting, tracking progress)
- 4. Focus attention on this being the 1st individual watershed COA Plan completed and a potential model for others throughout Austin!
- 5. Use forums, educational events, media, social media, new members and dollars raised for tracking and campaigning
- 6. Design website content, print media, social media and direct mailing campaigns
- 7. Required match can be sources from partners, volunteer efforts, SCC expenditures and other non-traditional sources

Appendix H: Watershed Planning Approaches

SUMMARY OF WATERSHED PLANNING APPROACH

Although there are many ways to approach watershed protection plans (WPPs) and even more ways to format and present them, the EPA has identified nine elements that are often used as a platform for developing comprehensive, holistic plans. Many of the required planning steps are not explicitly outlined, but are implied in the list below (adapted from EPA's Handbook for Developing Watershed Plans). These elements provide helpful guidelines and a framework for structuring a WPP and can easily be altered, expanded and tailored for use in specific watersheds and for creating plans that meet specific watershed based goals. It is anticipated that The Meadows Center for Water and the Environment and its partners would work with the Shoal Creek Conservancy to determine the most appropriate format for developing a WPP with a focus on the elements listed below:

- trail, park development, recreation considerations
- protection and management of open spaces
- creek and riparian restoration
- habitat restoration and protection
- water quality improvement
- flood mitigation and protection
- erosion mitigation and protection
- spring flow protection and enhancement
- inclusion of City of Austin initiatives, including CodeNEXT and land development code rewrite activities
- inclusion of City watershed planning priorities

The graphic below notes the EPA's Nine Elements for developing a WPP. The orange text provides notes and information about adapting this process to the Shoal Creek Watershed.

#1	Element A
<ul style="list-style-type: none"> • Identification of causes of impairments and pollutant sources *and causes of flooding • Much of this work has already been done. Compiling and holistically analyzing past and current efforts will be valuable in identifying causes, hot spots and what has worked to reduce pollution. It is important to also consider stakeholder knowledge and obviously, to work closely with the City. 	
#2	Element B
<ul style="list-style-type: none"> • Estimate the load reductions expected from management measures *and reductions in flooding • First, future conditions must be determined and current as well as potential future water quality, erosion and flooding effects calculated. Then desired conditions must be developed as benchmarks. 	

#3

Element C

- Determine management measures needed to achieve load reductions *and flooding identified in Element B and critical areas in the the watershed wehere measures will need to be implemented
- The following will be required: an inventory of existing efforts, reports, knowledge; review of successful outcomes in similar watersheds; and a plan for application of appropriate, applicable management measures for the watershed based on pollution reduction, erosion and flooding requirements.

#4

Element D

- Estimate the technical and financial assistance required, costs associated with management measures and authorities that will implement the plan
- In conjunction with Element C, it is important to select a suite of management activities that are cost efficient and effective and work with critical stakeholders to ensure resources are committed. This could be organized as a menu of activities (prioritized).

#5

Element E

- Develop an education and outreach/informational component that will be used to implement the plan
- This plan will include several components for various audiences and should tie in to the Conservancy's mission and objectives.

#6

Element F

- Develop a schedule for implementing the measures in the plan
- Measures and activities should be implemented over time based on activities planned in the watershed, financial resources, goals, etc. This could include bond packages, TWDB loans or other long term funding strategies.

#7

Element G

- Create interim measurable milestones to determine plan progress
- It will be critical to utilize SMART indicators that align with the City's regulations, codes, watershed planning objectives and current measurements.

#8

Element H

- Develop a set of criteria to determine if progress in improving water quality, * water quantity, flooding, erosion (and other goals) is being achieved

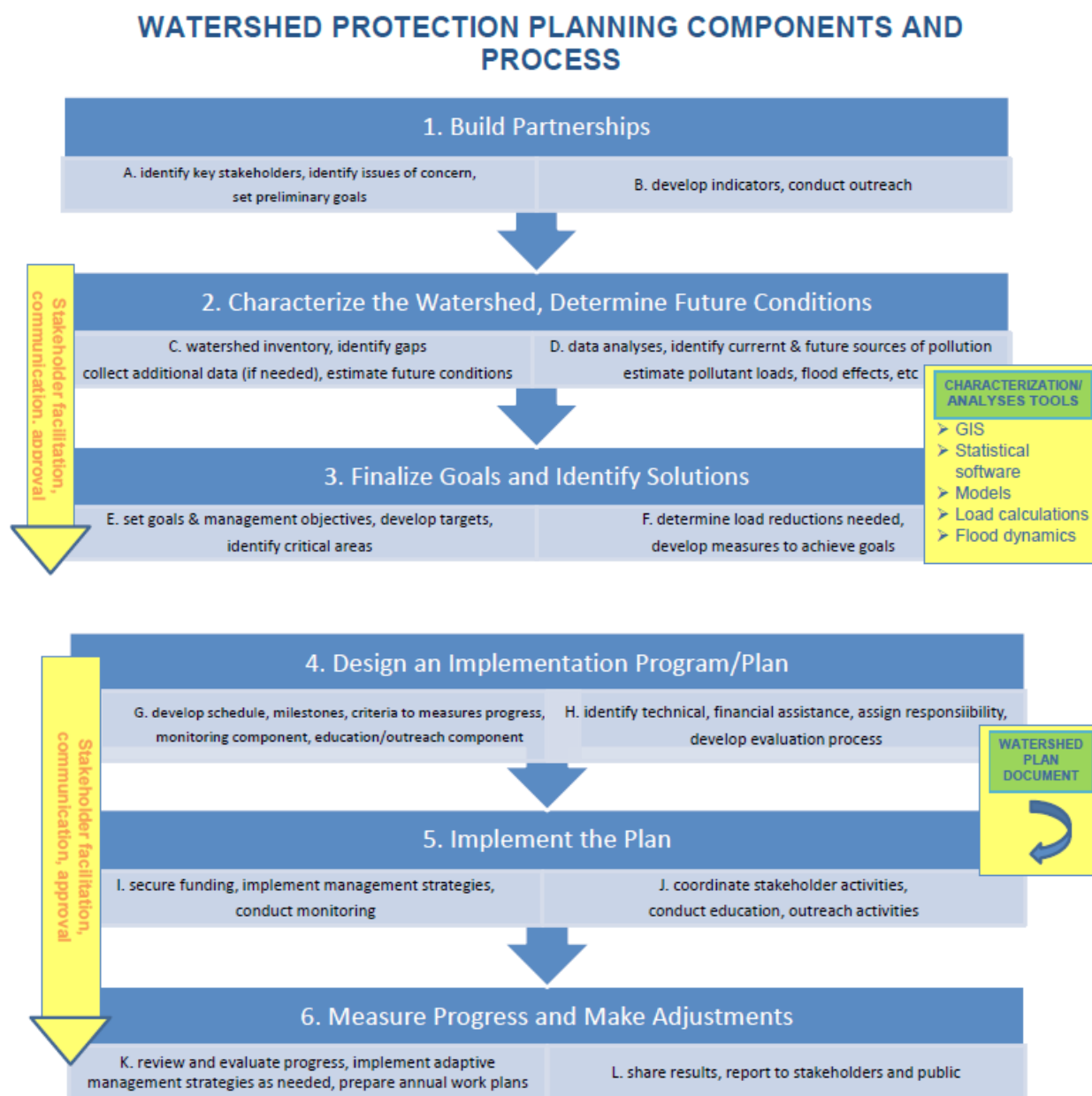
#9

Element I

- Develop a monitoring component to to evaluate the effectiveness of implementation efforts over time, measured against the criteria from Element H.
- This plan will include professional and citizen science measurements for water quality and also other measurements relating to recreational use, habitat, water quantity, etc. as well as evaluation of flood control measures.

COMPONENTS OF DEVELOPING A WATERSHED PLAN

The chart below was also adapted from the EPA guidelines but provides more information about the process required to engage stakeholders, determine needed information and formulate a plan. It is an iterative process in many ways, and must include stakeholder feedback in every component, although it is important to provide stakeholders with tailored, relevant and distilled information to avoid bottlenecks.



Appendix I: Case Statement Document Outlines

I. DRAFT CASE STATEMENT WORDING AND INFORMATION

It is anticipated that the following sections of text will be selected as needed and tailored to develop case statements for specific audiences. These case statements can be used to summarize watershed planning activities; garner support, funding and participation in watershed planning activities; support requests for funding and for other informational purposes. Examples of similar documents are provided in a supplement to this appendix.

A. SHOAL CREEK MATTERS

Topics to cover

- urban statistics (mostly developed but large population and commercial growth)
- current water quality issues in Shoal Creek and the City of Austin in general (bad and getting worse)
- importance of urban water use and supply sources (not tapping into limited hill country resources)
- need for increased water quality protection to protect regional groundwater supplies
- need for increased water conservation to minimize future water use and protect groundwater supplies
- loss of productive springs and pollution of aquifers (interconnectedness)
- The relationship between Shoal Creek and the Hill Country

The City of Austin's population is over 925,000 and is expected to grow to over 1.7 million in the next 50 years. Over two million currently reside in Austin's metropolitan statistical area and this number will grow exponentially - more than doubling in the next three decades (http://www.austintexas.gov/sites/default/files/files/Planning/Demographics/austin_forecast_2016_annual_pub.pdf, <https://www.twdb.texas.gov/waterplanning/data/projections/2017/popproj.asp>). A recent report by the Urban Institute noted that growth in the city could be between 30 and 80% in the next fifteen years (<http://apps.urban.org/features/mapping-americas-futures/#map>).

By many accounts, Austin is leading business and commercial growth in the region (Forbes.com, Kiplinger Finance Magazine) and this development often diminishes the health and function of our watersheds. Texas has seen double digit growth of businesses and nearly 80% of total nonresidential construction has been in Texas' metropolitan statistical areas: Austin-Round Rock, Dallas-Fort Worth-Arlington (DFW), Houston-The Woodlands-Sugar Land, and San Antonio-New Braunfels. Austin's annual commercial growth rate of 13.7% is five times higher than the state's annual rate

and more than triple the growth rates of Houston and Dallas (between 1981 and 2015). Office space in Austin for this same time period increased by 22% per year, retail space grew by nearly 20% and warehouse and industrial space surged by 40% (<http://www.sos.state.tx.us/about/newsreleases/2016/071316.shtml>, <https://assets.recenter.tamu.edu/Documents/Articles/2126.pdf>).

Urbanization, coupled with decreasing open spaces and undeveloped land results in increased flooding, degradation of water quality and loss of habitat and safe recreation areas. Challenges associated with managing water resources are indicative of this rapidly urbanizing City and are characteristic of difficulties faced in urban areas across the Southwest. Although the Shoal Creek Watershed is only 13 square miles, its population is expected to top 80,000 by the year 2030 and well more than one half of the watershed has been paved over (https://austintexas.gov/sites/default/files/files/Watershed/eii/Shoal_EII_ph1_2009.pdf).

As the population and impervious cover increases, urban watersheds like Shoal Creek are less able to provide valuable ecosystem services, including wildlife habitat and critical instream flows for local, regional and even coastal species. Three square miles of the Shoal Creek Watershed also recharges the aquifers that provide drinking water to many residents throughout Central Texas and the Hill Country.

Despite conservation efforts, municipal demand is expected to increase by more than 75% between 2020 and 2070 (<https://www.twdb.texas.gov/waterplanning/data/projections/2017/demandproj.asp>). With limited access to new sources, Central Texas and the Hill Country region will struggle to secure water to meet this growing demand and regional aquifers will become increasingly stressed. Small urban watersheds, like Shoal Creek that can capture rainfall to recharge the aquifer will become increasingly important with regards to protecting Hill Country water resources, even as development and impervious cover increase.

As the capacity to recharge groundwater decreases and local and regional pumping of groundwater increases, spring flows in the watershed are diminished. Nearby Spicewood Springs and the spring fed Spicewood tributary contribute to Shoal Creek's flow and are in danger of reduced flows or ceasing flow all together. These reduced flows can impact ecosystem services, including wildlife habitat and instream flows. Further, reduced flows can exacerbate the effects of pollution, impacting the quality of water in the creek for wildlife, recreation and ultimately drinking water.

Protecting the quality of recharge to the aquifer is as important as protecting and enhancing the quantity of rainfall making its way into groundwater supplies. As runoff flows through the watershed, it picks up pollutants and sediments that degrade surface water quality. These pollutants enter into aquifers through land based recharge features and through fissures and cracks in the creek and its tributaries as well, polluting our drinking water. Eventually some of this potentially contaminated water re-emerges into the creek via spring flow, further degrading surface water quality.

https://austintexas.gov/sites/default/files/files/Watershed/eii/Shoal_EII_ph1_2009.pdf

B. THE RELATIONSHIP BETWEEN SHOAL CREEK AND DOWNTOWN AUSTIN

Topics to cover

- What's happening here is happening elsewhere in Austin
- Shoal Creek can serve as a model for the rest of the City

Shoal Creek is the largest watershed of the North Urban watersheds, encompassing approximately 8,000 acres (12.9 square miles) of central and north-central Austin with about a quarter of the water situation on the Northern Edwards Aquifer Recharge Zone. Shoal Creek served as the original western boundary of the City—the area to the west of the creek remained largely undeveloped into the 1920s. It is best known for the 1981 Memorial Day Flood that devastated lower Shoal Creek and claimed 13 lives, but it has experienced significant flooding events throughout Austin's history. More than 50 percent of the Shoal Creek watershed is covered with impervious surface such as roads, buildings, homes, parking lots, and sidewalks. This high percentage of impervious cover leads to eroding stream banks, poor water quality, and diminished in-stream habitat. Despite the drainage issues, the Shoal Creek Greenway is a significant recreational resource shared by runners, commuters, nature watchers, dog walkers, volleyball players, and other Austin residents. The trail is increasingly important for access to newly developed downtown residential and entertainment centers.

In recent years, the Shoal Creek Conservancy and many of its partners have identified priority needs for the Creek, including flood alleviation, mitigation of erosion, spring flow protection, reducing pollution and improving water quality, as well as research required to improve our understanding of the watershed and how best to holistically manage its diverse landscape. Along with Shoal Creek Conservancy, The City of Austin, The Meadows Center for Water and the Environment and other organizations share these concerns and are diligently working to develop and implement watershed based solutions to enhance public safety, environmental conditions, and recreational opportunities.

These watershed based solutions will be part of a comprehensive, community and stakeholder based Watershed Action Plan to holistically manage the watershed. Demonstration projects throughout the watershed will educate City of Austin residents about the importance of managing storm flows and provide guidance for residents, business owners and other stakeholders throughout the City. Educational and outreach programming also will be applicable in all nearby watersheds and neighborhoods. This Plan ultimately will serve as a template for innovatively managing and connecting other nearby urban watersheds.

C. FLOODING IN THE WATERSHED

Topics to cover

- Minor flooding
- Major flooding
- Changing climate and uncertainty

Urban land uses and land practices in the Shoal Creek watershed have altered the way stormwater travels across the watershed, increasing the velocity and force of runoff. The way our cities are built can cause flooding, even in modest rainstorms. Impervious cover - asphalt and concrete - prevent storm water from soaking into the ground. In Shoal Creek Watershed, average rain events can result in localized flooding. While this flooding may not constitute an immediate safety risk, it has many negative environmental, social and economic impacts. “Nuisance flooding” has increased in Texas by several hundred percent in recent decades and is responsible for inconveniences like road and bridge closures, overwhelmed storm drains, minor damage to infrastructure, landscaping and residential foundations that adds up over time (NOAA Technical Report, 2014). Minor flooding can increase building and home maintenance costs, make maintaining roads and infrastructure more expensive, can increase the need for habitat and creek bank restoration and can increase the level of pollutants carried into our surface and groundwater.

“Urban flooding disproportionately affects lower-income communities, and being affected by flooding can send people into poverty.” (http://www.cnt.org/water/?gclid=CjwKEAjws5zABRDqkoOniLqfywESJACjdoiGPdbSSKBXujR-ZdX6XfEBEHZq46DkUSRZwWNIAAnVvRoCO_Hw_wcB)

The Shoal Creek watershed is one of the city’s highest priorities for controlling and mitigating floods. In 1981, flooding killed 13 people and resulted in \$35 million in damages. Several large floods, most notable in 1960, 1981, 2001 and 2013, have caused millions of dollars in damages to local businesses and homes. On Memorial Day weekend in 2015, rain storms caused flow in the creek grew from its average of 90 gallons per minute to 6 million gallons per minute. Flood waters again inundated roads, homes and businesses and necessitated dozens of rescues.

Good information available in <http://www.shoalcreekconservancy.org/wp-content/uploads/2016/02/20160223-shoal-creek-conservancy-presentation-final.pdf>

Over time, climate change is expected to lead to less frequent, but more intense periods of rain – the exact scenarios that lead to flooding in the Austin area and Shoal Creek Watershed. Times of drought may also become more intense and severe and will require new management solutions. As we begin to grapple with the effects of climate change, it will be important to consider how the risks of flooding and drought might change over time and what will be required to make our watershed more resilient and safe.

Useful quotes:

“From the Conservancy’s perspective it is so important to have a community conversation, about the solutions, that we sit down together and we talk about here is our range of options, here is the range of costs, what do we want to do together as a community, is it a tunnel, is it something else,” said Wolaver.

“During the past decade, Shoal Creek has experienced a number of instances of severe flooding, which have caused significant property damage, creek erosion and water pollution.” https://www.austintexas.gov/sites/default/files/files/Watershed/flood/fl_study_shoal.pdf

Rain falling on nearly 8,000 acres collects in the watershed and drains to Shoal Creek, “making it one of Austin’s larger creeks and one of the most flood-prone. There has been severe flooding along Shoal Creek throughout Austin’s history. Shoal Creek was particularly hard hit on Memorial Day 1981. 13 people died in the flooding that day, many of them along Shoal Creek. More recently, the creek was the site of dramatic flooding on Memorial Day 2015, although more extensive flooding is possible along Shoal Creek. There have been numerous smaller floods along the creek as well.” <http://www.austintexas.gov/shoalcreekfloods>

“This week’s flooding is a reminder of the threat Shoal Creek poses to life and property, particularly in the downtown area, and underscores, once again, the need for both short-term and long-term solutions to reduce the flood risk,” stated Wolaver.

The Conservancy is also working to identify immediate, short-term creek maintenance activities that could result in a measurable decrease in flood risk and an overall positive impact on creek health. “With the blessing of the City, we have hired engineering firm Alan Plummer Associates to survey the stretch of Shoal Creek from Lady Bird Lake to Fifteenth Street to determine the potential flood reduction benefits of managing debris, gravel and in-creek vegetation. The engineering study will establish the measurable impact of specific steps – such as the removal of vegetation or sediment in a particular location – on flood risk, while considering impacts on water quality, erosion and habitat,” added Siff.

D. PLANNING IS IMPORTANT

Topics to cover

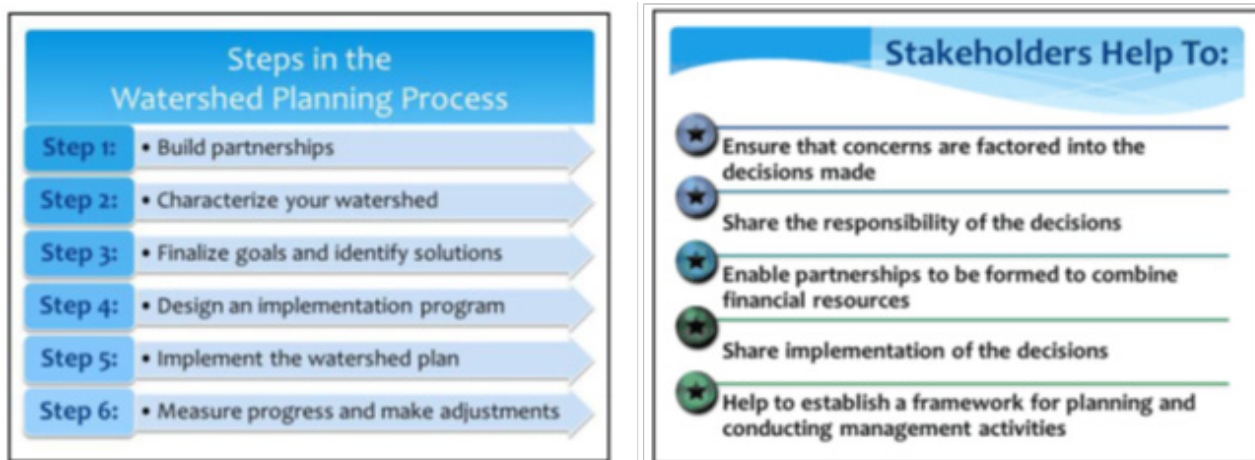
- Community based planning is essential (grass roots, bottom up approaches are needed to impart change and successfully manage resources)
- Comprehensive, holistic planning views the watershed and the community as inextricable, understanding that actions and impacts are interrelated.
- Benefits of Watershed Planning
 - Comprehensive, holistic nature required for successful planning
 - Partnership and stakeholder driven
 - Science-based
 - Adaptive and on-going
 - Use of innovative strategies
 - Funding resources

Management of watershed is a collection of strategies and approaches that must consider the interconnectedness of all aspects of the watershed, including the physical landscape and its human communities. Community-based planning includes measurement and management of the physical characteristics of a watershed, as well as important cultural, social and economic factors that cannot

be disassociated from watershed issues.

Watershed planning is an iterative, community driven process that relies on sound science, input from experts, and ultimately stakeholder participation. Partnerships in the watershed are critical to identifying and solving issues impacting the community's natural resources and their root causes. Best available science is compiled and presented to stakeholders in order to formulate short and long term solutions. Often, innovative ideas and partnerships result in major improvements across the watershed.

Although often completed in components, holistic and comprehensive plans best serve the watersheds and communities for which they are developed. Often the causes of pollution are often the same for flooding and erosion. For example, pollution carried across the landscape by stormwater affects surface and groundwater resources, as well as habitats and larger ecosystems.



The project outcome will be a useful and implementable plan that enables watershed partners to work together, pool resources and apply for funding assistance to implement plan components like stormwater quality treatment projects, ordinances, incentive programs, education programs, land conservation, technical assistance and more. Once a watershed protection plan is accepted by the community, TCEQ and EPA everything in the plan becomes eligible for future funding through multiple state and federal funds. For example, the Cypress Creek Watershed Protection Plan in Wimberley and Woodcreek currently has a grant for more than \$800,000 in Clean Water Act funds to begin implementing their plan. Their funding will support water quality monitoring, installation of rainwater harvesting systems and other demonstration projects, education/outreach and community support, tools for decision makers and resource managers, technical assistance with ordinances and permitting, a stormwater assessment and other financial assistance. We are hopeful the same can be accomplished with for Shoal Creek.

Resources:

<https://www.epa.gov/nep/fact-sheet-about-community-based-watershed-management-handbook>

https://engineering.purdue.edu/watersheds/resources/Academy/Community_Based_Watershed_Management.pdf

F. SUMMARY FOR FUNDING REQUEST FOR HILL COUNTRY SCOPE

SCC and its dedicated partners respectfully submit an application for funding to continue our work in the Shoal Creek Watershed. To protect the entire Hill Country and its urban neighbors, we envision an alliance of stakeholders and agencies cooperating with municipalities and new partners to develop a holistic watershed protection management plan for the Shoal Creek Watershed that restores, protects and conserves the urban watershed's natural resources. Further, this plan can be expanded to other urban watersheds bordering the Hill Country and will create partnerships and pathways toward a comprehensive regional strategy for linking and protecting the Hill Country's natural resources. This proposed effort would include collaborative work to better understand water resources and their urban linkages, creating a replicable watershed protection plan and regional strategy, and coordinating education and outreach across the Hill Country and Urban watersheds.

G. SUMMARY FOR FUNDING REQUEST FOR URBAN WATERSHED SCOPE

SCC and its dedicated partners respectfully submit an application for funding to continue our work in the Shoal Creek Watershed. To protect this highly developed watershed and its urban neighbors, we envision an alliance of stakeholders and agencies cooperating with municipalities and new partners to develop a holistic watershed protection management plan for the Shoal Creek Watershed that restores, protects and conserves the urban watershed's natural resources. Further, this plan can be expanded to other urban watersheds in the Austin area, along the I-35 corridor and into the Hill Country. This effort will create partnerships and pathways toward a comprehensive regional strategy for linking and protecting our irreplaceable natural resources, including collaborative work to better understand water resources and their urban linkages, creating a replicable watershed protection plan and regional strategy, and coordinating education and outreach across urban watersheds.

H. SUMMARY (GENERAL)

The Shoal Creek watershed is one of the most polluted, and most flood and erosion prone creek systems in Austin, Texas. The watershed has an area of 8,300 acres and includes more than 30 miles of streams. Shoal Creek flows north to south for 14 miles through central Austin. Once home to popular swimming and fishing destinations, the creek suffers from poor water quality, including elevated fecal bacteria and nutrient levels. The Spicewood Tributary to Shoal Creek has been listed on the Texas Integrated Report on Water Quality since 2002, due to bacteria levels. This tributary flows into Shoal Creek, contributing to the bacteria problem in the creek at large.

The highly urban character of the Shoal Creek Watershed presents special challenges and requires a multifaceted approach to restoring water quality. The Shoal Creek watershed is highly urbanized, with 53% of the watershed surfaced in impervious cover. The bulk of development in the Shoal Creek Watershed took place before the adoption of environmental protection regulations. 56% of development in the watershed was built before the adoption of drainage regulations in 1974, and 71% was constructed before the adoption of water quality regulations in 1991. Moreover, the

watershed is slated for increased density and further redevelopment in the years to come, as the City of Austin overhauls its Land Development Code. Over 1,300 residences and 94 commercial properties are located directly along Shoal Creek and its tributaries, and an estimated 70,000 – 100,000 people reside in the watershed. Nonpoint source pollution is a major challenge for the Shoal Creek Watershed, and the severity of this issue will increase as the population of the watershed grows. Human and canine fecal matter, fertilizer, sediment from erosion and construction sites, oil, grease, and other types of urban runoff all contribute to Shoal Creek's nonpoint source pollution issue.

Because the watershed is highly developed, stormwater flows quickly over the landscape, and in addition to carrying pollutants, causes significant erosion and destabilization of creek and tributary banks. Sediment worsens water quality conditions, degrades habitats, limits recreation and creates safety hazards. Further, channelized and rapid flow of stormwater lessens opportunities for rainfall to recharge local and regional groundwater supplies. Perhaps most importantly, impervious cover impedes drainage and results in both nuisance and devastating flooding.

The Shoal Creek Watershed Action Plan will expand and enhance existing efforts to improve water quality, promote recharge and protect against flooding on the part of the City of Austin and many nonprofit groups. This Plan will utilize City of Austin resources and initiatives, including Watershed Protection Department (WPD) activities to address TMDLs in the Spicewood Tributary, as well as to manage water quantity and storm flows across the watershed. The resulting Watershed Action Plan will be a comprehensive, community driven, science-based collection of implementable strategies for partners and watershed stakeholders to holistically manage the Shoal Creek Watershed.

II. FUTURE TOPICS TO COVER

- Recreation in the Watershed
- Living in the Watershed – your impact
- Emerging pollutants and contaminants in the watershed
- Where does the water go? Tracing Stormflows through the watershed (infographic)
- What is the cost of NOT planning and implementing?
- BMPs to compliment and reduce size and cost of large scale infrastructure
- Timeline of flooding in the watershed (visual, infographic showing economic impacts)
- The relationship between Shoal Creek and the Hill Country
 - groundwater connectivity across the region
 - .creating environmentally friendly urban development to prevent suburban sprawl into the hill country
 - creating an urban ethic to protect the hill country and natural resources

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