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I. Background

The Flood Mitigation Task Force was created by the Austin City Council by Resolution 20150604-044 on June 4, 2015. The Resolution directed the Task Force to review existing flood mitigation and preparedness strategies, including buyouts and variances; project and operational financing; affordability; stakeholder collaboration; and citizen communication; and then make recommendations for new strategies and policies. The resolution also directed the Task Force to pay specific attention to Upper and Lower Onion Creek, where flooding has been particularly severe and impactful to residents of the neighborhoods.

City Council and the Mayor each appointed two individuals to the Task Force. Since that time, the 22 members of the Task Force have met regularly as a whole and in working groups. Working Groups were broken out by Capital Improvement Projects, Operations & Maintenance, and Buyouts; each group made recommendations and provided background on their particular point of view. A Writers Group then convened to reduce the background and recommendations into a consistent document, which was then reviewed, discussed and edited in detail by the entire Task Force.

The final report includes the full list of recommendations approved by the entire Task Force. It then also includes the initial recommendations and background compiled by each Working Group. Note that some recommendations made at the Working Group level were not agreed upon by the full Task Force, but those recommendations are intact in the Working Group reports.

II. Executive Summary

III. Recommendations by Resolution Sections – from Resolution No. 20150604-044

1a - Overall Flood Mitigation and Preparedness strategies

Recommendations:

1. Adopt a city wide prioritization policy based on loss of life, general health and safety, property damage, and/or other criteria to prepare for and mitigate flooding. All subsequent policy and budget decisions should be evaluated through this framework.
 - a. Develop a plan to repair and replace the highly critical local drainage systems within 5 years. If necessary, issue debt instruments every five years until the major local flood mitigation CIPs are completed.
 - b. Develop a schedule to perform routine maintenance, inspections, and repairs to all storm water infrastructure (such as pond, pipes, inlets, and open waterways) on a minimum 5-year cycle.
 - c. Create a proactive approach to repair and maintain drainage systems in desirable development areas and neighborhoods with storm drainage systems constructed before the Drainage Criteria Manual was adopted in 1977.
2. Conduct a financial and organizational audit of the Watershed Protection Department, (WPD) to evaluate staffing resource allocations, program effectiveness, and successful implementation of master plan goals and objectives. Conduct the audit on a regular basis, i.e. every 5 years.
3. Evaluate whether WPD should be moved to the City's "Infrastructure Services" service group of departments to better reflect WPD's as an infrastructure rather than the "Development Services" service group.
4. Consider continuation/permanence of FMTF with oversight of WPD, including follow-through on this report and further address certain parts of the resolution, and provide for continued citizen engagement.
5. Develop a more balanced approach for allocating the Drainage Utility Funds (DUF) between the various watershed protection missions to better support CIP and O&M needs.
6. Review and update the Watershed Protection Master Plan on a 5 year basis and tie-in program performance measures with the plan.
7. Set goals to reduce the number of habitable structures at risk of flooding based on all mitigation solutions and tools, e.g., retention and detention ponds; street gutters, drainage pipes; flood walls; individual floodproofing such as garden walls, elevation, and individual property floodwalls; and maintenance of closed and open waterways.
8. Review and revise the prioritization methods used to address problem flooding, combining multiple approaches that would include risk and event-based, as well as individual property damage and clustered property damage.

9. Conduct a third-party evaluation of the effectiveness and accountability of the Regional Stormwater Management Program (RSMP) to mitigate flooding and consider whether revisions and expansion of the program should be made.
10. Establish a comprehensive asset management plan allowing for better short and long-term planning of maintenance and capital improvement costs and needs.
11. Investigate and consider additional detention methodologies used by other jurisdictions.
12. Complete local flood modeling to have known local flood areas modeled by the end of Fiscal Year 2019.
13. Gather community input early in the project development in a flood plain regarding strategies to be examined; allowing the public to see the results, costs, and benefits for the alternatives studied.
14. Ensure a system and process exists such that the Development Services Department's "One Stop Shop" can easily determine if new development, or redevelopment, is in or near any known flood problem areas. Advise applicant, staff, and the Neighborhood Plan Contact Team (NPCT) of this data during the building and/or site plan review, and include this data in the Development Viewer.
15. Where creek and channel conveyance can be impeded by vegetative growth or debris:
 - a. Maintenance should include cleaning under bridges and around culverts, removing fallen trees that can act as debris dams, and obvious obstacles that could cause increased water surface elevation.
 - b. If little to no maintenance is/will be performed on a creek(s), WPD should ensure that assumptions in the models account for higher roughness factors.
 - c. Add personnel and/or employ contractors to remove vegetation and debris.
16. City should stage personnel and assets around the city to improve response time to flooding and be more proactive in preventative maintenance.
17. Continue to update FEWS equipment and software due to the reliance of many departments, the Emergency Operations Center (EOC), and the general public that rely on this system.
18. Coordinate with the US Geological Survey to add more flood-hardened rain and flood stage gauges for better flood forecasting.

1b – Flood plain variances and flood buyout policy

I. FLOODPLAIN VARIANCES

A floodplain variance is an exception to the standard development regulations for properties within the floodplain. There is a standard process for granting administrative variances by the Watershed Protection Department Director, when a development meets all of the administrative variance criteria. When a project does not conform to the requirements for an administrative variance, the Austin City Council may take action to grant a floodplain variance to the property owner/developer.

It is important to note that there are other types of variances to environmental and drainage regulations which may be granted (e.g., variances to impervious cover limitations, variances to

detention and/or water quality requirements). The request for a floodplain variance should not be conflated with these other types of variances. For example, a property can be within the allowable impervious cover limits and still require a floodplain variance in order to get a development permit to remodel a bathroom, to build a second story, or to add a carport.

On average, there are 3 administrative variances are granted per year (based on 2004-2015), and there is an average of 6 requests per year to Council to grant floodplain variances (based on 1995-2015).

Floodplain Variances Recommendations:

1. Continue current floodplain policy as it relates to FEMA National Flood Insurance Program and Community Rating System to help reduce flood hazard insurance rates for all homeowners and property owners.
2. Continue the current floodplain policies, except as modified below, while allowing a variance process for many of the existing homes to remain or be modified in a reasonably safe manner and without damage to others.
 - a. Require public notice for Council floodplain variances. Notice should be given to Neighborhood Groups as well as potentially-affected property owners.
 - b. Expand the requirements of the City Code section of the floodplain management regulations that explains floodplain variances (Chapter 25-12-3 Appendix G, Sections G105) to include additional information commonly discussed at past floodplain variance hearings as defined in the Buyouts Work Group report.
3. Implement additional flood mitigation requirements if development or redevelopment is allowed in a floodplain such as:
 - a. education for safe evacuation and safely sheltering in place.
 - b. disclosure by seller/owner (or their representative) and education for buyer/renter of property that has been granted a floodplain variance that may constitute a health and safety risk.

II. FLOOD BUYOUT POLICY

Buyouts are just one type of flood mitigation tool that can be used to reduce the risks to human health and safety as well as to property. This mitigation tool serves as a method of last resort for responsible communities to support their citizens, when other structural or maintenance solutions are infeasible, ineffective, or have a disproportionately high in cost relative to the benefits they would achieve.

The most reliable way to ensure that people do not flood is to keep them as far away from the hazard as possible; however, in an urban area it would be a gross oversimplification of an extremely

complex reality to adopt a management strategy of only removing development from flood-prone areas. All of the available flood mitigation tools need to be considered when selecting the appropriate solution, and the Watershed Protection Department does consider and utilize the entire range of tools, including regional detention ponds, storm sewer improvements, and flood tunnels.

In order to grapple with the question of buyouts, the buyout/variance subcommittee of the Flood Mitigation Task Force has focused on three primary areas:

- I. Examination of the Lower Onion Creek Buyout Program;
- II. Examination of project prioritization approaches; and,
- III. Examination of the acquisition process.

The Lower Onion Creek Buyout Program is an extremely important focal point for Austin citizens and the City Council alike, and it serves both as an exercise in contrast and as a springboard for understanding the core elements that might form a general (city-wide) buyout policy, if one were to be adopted.

Prioritization is the first key step in the process of developing flood mitigation solutions. The Watershed Protection Department has developed a consistent and sophisticated process for prioritization, based on the philosophy that the highest risk problems should be addressed first.

Acquisition of property, along with relocation support, is at the heart of executing a buyout program. The City of Austin has significant flexibility in the acquisition process when the buyout program is voluntary (i.e. optional for property owners to sell). There are more prescriptive processes that have been established when using the powers of eminent domain. However, even when eminent domain is used there may be flexibility: constraints stem from the regulatory requirements (federal, state, and city) associated with the funding source (e.g., requirement to use specific provisions of the Uniform Relocation Act for federal funding from U.S. Army Corps of Engineers buyout program).

Flood Buyout Policy – General Recommendations:

4. A buyout program has shown to be a viable mitigation tool and it should remain a strategy, although not the first option.
 - a. Where buyouts have been identified as the optimal flood mitigation solution, expedite implementation of funding buyout programs.
 - b. Continue the buyout program as primarily a voluntary program (i.e. optional for property owners to sell) except where there is a demonstrable threat to life and safety, or where Eminent Domain is a condition of funding.
 - c. Evaluate the efficiencies of the buyout program experiences by citizens, including staff and contractor performance. Conduct a post-buyout evaluation to ensure that important lessons can be captured and integrated into future processes.

- d. Plan for a sustainable buyout program through consistent annual funding and ongoing focused evaluation and re-evaluation of flood risk.
5. Initiate Upper Onion Creek buyout program with initial focus on those homes that were substantially damaged in the 2013 and 2015 floods.
6. Develop a program of voluntary buyouts by citizen request.
7. Evaluate the potential need for buyouts or other costly flood mitigation before annexing any property.
8. Continue to evaluate the potential to implement flood mitigation solutions (such as detention ponds) on land that has been purchased via a mitigation buyout.
9. Ensure that all property purchased for flood mitigation buyouts not be put to any use that is contrary to mitigating flooding.
10. Ensure that property owners fully understand the program due to the complexity of the process.
11. Assist property owners in understanding the consequences of not participating in a voluntary buyout program (e.g., increase in insurance rates, health and safety concerns, neighborhood character, etc.).

Flood Buyout Policy – Lower Onion Creek (LOC) Buyout Project (855 properties in the program):

12. Expedite the remaining LOC buyouts to finish by end of 2016, and expedite the existing Williamson Creek buyout program.
13. Evaluate the LOC outreach program and determine if there are improvements that can be made for the current and future buyouts.
14. Develop a plan for eventually buying the LOC properties at risk, even if the current owner does not yet want to sell.

Flood Buyout Policy – Prioritization:

15. Develop a program for purchasing structures that have been catastrophically flooded by a rainfall event including:
 - a. Develop a method for prioritizing individual flooded properties.
 - b. Develop a funding program.
16. Develop a method for prioritizing individual/isolated properties which are at risk of flooding (i.e. those that meet specific thresholds of risk such as 10-year flood depth and which are not part of a cluster).

17. Consider whether other risk parameters should be incorporated into prioritization (and perhaps drainage design standards) such as watershed size, history of watershed experiencing high-magnitude events, and other factors.

Flood Buyout Policy – Acquisition:

18. Adopt a consistent policy to be used across all buyout programs (both voluntary/optional for property owner and eminent domain acquisitions) so that all buyout program participants have access to equitable benefits.

1.c Structure and use of the adopted drainage utility charge

Background

The Drainage Utility Fee (DUF) is a fairly young construct, having been used in Texas for less than 20 years. The current structure of the fee is based perceived use of the stormwater system and the ratio of pervious to impervious cover. While the recent updating of the DUF attempts to address certain elements of inequality, the underlying construct is incomplete; stormwater drainage is inherently non-voluntary, meaning the individual property owner has little control over the problem, and the stormwater system is highly interdependent. Every single property effects stormwater runoff on the surrounding properties, but does so in a complex way, making analysis difficult.

The biggest challenge to reducing the potential for loss of life and property damage is funding to implement the necessary capital improvement projects (CIPs). The Watershed Protection Department has a great deal of information regarding where current flooding is located, what causes it, and what can be done to mitigate damages. With an estimated cost of between 2-4 billion dollars to address the creek and local flooding problems and only a portion of the DUF being spent on project development and implementation, it will take an estimated 80 to 100 years to address known issues.

The DUF alone is not sufficient to fund major CIPs within a reasonable time frame. However, it is important to maintain the fee to ensure adequate funding exists for staff, planning, maintenance, and smaller-scaled projects. It should be noted that the Flood Mitigation Task Force heard from numerous citizens who expressed concern regarding the current formula for calculating the DUF and the process through which the new ordinance and formulas were developed. Task Force members understand the City was revising the DUF based on a court order and recognize that the schedule to adopt the revisions was hamstrung by the fiscal calendar; however, now that the deadline time-crunch has passed, the City should reopen public discussions to address citizen concerns such as using the percentage of impervious cover as a multiplier, including roof over hangs in the calculation, and addressing the perceived lack of a responsive public process when crafting the amended DUF.

Operations and Maintenance (O&M) funding is entirely made up of a distribution from the funding collected through the DUF. O&M receives approximately 40% of the dollars collected. As a practical

matter, the DUF cannot be relied on for solving Austin's flood problems. The DUF's present revenues are insufficient to cover all of the needed O&M expenses, and yet a large portion of the Fund is directed to purposes other than O&M. Increasing the DUF to cover the necessary O&M costs is problematic; as a regressive and inequitable fee, owners in the lower income tiers are already struggling with payments.

All flood mitigation projects evolve through a methodical process beginning with identification, moving through the evaluation of suitable solutions, and finishing with its implementation. Buyouts are one of many possible mitigation solutions that may be selected after careful prioritization and evaluation. Ideally, structures where buyout is the optimal mitigation solution should be purchased before they experience flooding. However, since this is not always feasible (due to funding and programmatic constraints), a program should be put in place to quickly assess whether a flooded structure is a suitable candidate for a buyout so that a voluntary buyout process may be initiated by staff following a flood event.

Looking at the City's stormwater system funding of capital improvement projects, operations and maintenance, and other specific, strategic programs designed to address flooding issues, it is very hard to picture the current DUF adequately meeting the high level of service expected by residents. Given the many constraints, more attention needs to be given toward finding innovative funding solutions, keeping the DUF equitable and affordable, and addressing current impediments to making current flood mitigation funding go farther to address citizen's needs. It may be time for thinking about the DUF in a new perspective, one where the fee is treated in a manner similar to roadways and other public infrastructure rather than electric or water utility rates; the latter being based on volume of use that is controllable by the property owner. Doing this may result in a more logical and equitably apportioned fee structure.

Recommendations

1. Analyze the current allocation of the DUF to make sure funding matches the City wide priorities mentioned in section 1a, recommendation 1.
 - a. Direct more funding toward flood mitigation solutions, operations, and maintenance costs.
 - b. Reduce the allocations to interdivisional transfers.
 - c. Continue the analysis to allocate funding toward the most critical needs.
2. Continue to gather through an established public process input on the newly adopted Drainage Utility Fee for future amendments.
 - a. Allow for more citizen input to address concerns regarding the equity of the current fee's structure.
 - b. Explore and consider other factors, for example, the percentage of impervious cover as a multiplier and roof overhangs and their factoring into the fee.
3. Consider creating a reserve fund for buyout of properties affected by an extraordinary flood event, or alternatively, approve requests by WPD to perform post-flood recovery buyouts on an as-needed basis
4. Issue a series of debt instruments every five years until the major creek flood mitigation capital improvement projects are completed. Major projects should be designated by those that are too large to have construction completed in one annual funding cycle via the DUF.

5. In relation to section 1a, recommendation 1, flood mitigation is a public safety responsibility and the Council should consider reducing spending on non-essential projects that do not directly improve public health and safety until the flood mitigation and deferred maintenance activities are caught up to the point where they align with the WPD's asset management program.
6. Primarily direct DUF funding toward flood mitigation projects and operational expenses in keeping with the spirit of the fee's inception (related to section 1a, recommendation 1).

1d. Stormwater management system operation and maintenance costs (O&M), capital costs, city fees, flood insurance, and other identified factors that have impacts to affordability and equity

The Task Force did not look directly at the question regarding how the cost of operations, maintenance, capital projects, city fees, or flood insurance impact affordability and equity; however, we recognize that the cost of making the necessary improvements will require a significant expenditure by the City for the foreseeable future. We also recognize the real and ongoing costs in terms of quality of life, flood damage (existing and potential), and life-safety will continue to effect the City if Austin does not have the fortitude to effectively address flood mitigation. Many of the known problems have been identified for decades (in some cases more than 30 years) and the cost to implement solutions is not going to decrease. Furthermore, previous and current planning policies (via Austin Tomorrow Plan 1979 and Imagine Austin 2012) encourage higher density in older areas of the City (built prior to the 1977 Drainage Criteria Manual DCM.) with undersized existing drainage infrastructure.

While there are widespread creek and local flood problems throughout our community most of them can be associated with pre-1977 development. The districts and neighborhoods impacted by these floods are demographically diverse and, while the brunt of major flooding is felt by the effected residents, the reality is that there is a fiscal cost to the entire city. Those costs include the labor of City personnel and emergency responders, repair and replacement of City infrastructure, and community-wide flood insurance rates. Although the total cost of the 2013 Halloween Flood is still being tallied by City Staff the numbers to date indicate the final number will surpass \$150 million dollars.

Because we should be focused on the life-safety aspect of flood mitigation, and because these problems are spread across the City, and because watersheds do not recognize political boundaries, we do not believe that solutions can be, or should be, divvied up by Districts to ensure equitable spending across the City. Instead, and as mentioned in other sections of this report, the Task Force believes that the problems and solutions should be prioritized by risk to human life, risk to critical infrastructure, and risk of potential damage to buildings such that the most dangerous problems are addressed first.

The City Council will need to address the issue of affordability in how the recommendations of this report are implemented, but at the same time Council must recognize that the costs of flood recovery are borne by the entire City and the costs to mitigate should be as well. To maintain affordability we recognize the full implementation of the Watershed Protection Master Plan will take time but we firmly believe that we cannot wait decades longer to address the critical flood problems facing the City. It may be necessary for City management and Council to make some difficult budgetary decisions regarding the things we want to spend money on as a community versus things we must do to keep our residents safe.

Recommendations:

1. Before increasing fees or calling bond elections, Council should undertake a review of the entire City budget, specifically items related to priorities to keep the citizens of Austin safe, and make difficult decisions about how we prioritize spending and about funding the things we must do to keep our residents safe.
2. Council should consider directing staff to prepare detailed analyses or assessments of potential flood problems and the cost of mitigation in areas identified for annexation to better define anticipated costs in the service plans for these areas.
3. The City should adopt a uniform buyout program so that any buyouts, regardless of the reason, are treated uniformly and fairly.
4. The City should consider forming watershed coalitions, partnerships, or flood control districts in select watersheds (such as Onion Creek) to develop and fund regional flood mitigation strategies. This will encourage comprehensive solutions throughout entire watersheds and spread the financial burden and mitigation responsibilities over a larger geographic area.

1e. Methods and means to provide more public education and outreach to new residents and visitors to raise awareness of flash flooding potential, as well as actions and strategies for the public to remain safe

Even though Austin is known as Flash Flood Alley, the city has largely been spared the scenes of New Orleans during Hurricane Katrina: homeowners being rescued from their roofs by helicopter, drowning of elderly due to lack of bus drivers or buses to evacuate frail residents from nursing homes or the faces of frantic parents trying to reach children at schools cut off by high water.

However, as a result of the October 2013 and 2015 extreme flood events, Southeast Austin and Travis County took the greatest hit in the loss of life and extensive property damage. The Lower Onion Creek flooding claimed eight souls with the youngest being only six months old. In the Memorial Day 2015 flood, somehow a man ended up atop a telephone pole at House Park on Lamar Blvd. escaping a rapidly rising Shoal Creek blocks away. This image as well as one of a man rescued by helicopter from a tree top near upper Onion Creek are a permanent reminder that not everyone in Austin knows the saying “Turn Around Don’t Drown”. To try and prevent the images of New Orleans being repeated here in Austin, the following education and outreach strategies are recommended for the City of Austin.

General public education is critical to the safety of our population. The City’s Early Warning Flood Gauge and Rain Gauge System are a core piece, warning residents of rainfall and the potential for flooding, alerting emergency responders to crisis locations, and warning

downstream communities of impending flooding. We understand the City is currently upgrading this system.

Education and outreach needs to move away from the “100-year floodplain” approach and talk to people about the probability of flooding. For example, a 100-year flood has a 26% chance (about 1 in 4 chance) of occurring over a 30-year mortgage. Another way of thinking about it is that there is a 1 in 6 chance of a 100 year flood occurring in 18 years.

Flooding in Austin is not confined to the FEMA-identified floodplains. The massive “water bombs,” such as the 14 inches of rain that hit the airport in 2015, can strike anywhere and can cause flooding in any neighborhood overwhelming the storm water system. There is no practical way to build systems that can take on water bomb levels of rainfall.

Early warning systems save lives. Installing an Emergency Siren System similar to one used in Tulsa, OK, would provide residents and visitors with notice of imminent danger. Flood zone signage similar to hurricane zone signage along the Gulf and tsunami signage on the coasts would further enhance flood danger awareness. Information on emergency tool kits if surrounded by rising waters (access to the attic, breaking through the roof) pending rescue by first responders is critical for survival. Assistance with Emergency Preparedness Plans empowers communities. With the proper development and implementation of these resources the COA should minimize the potential of its residents or visitors being unaware of pending flood dangers.

The Flood Early Warning System (FEWS) is critical to public safety and should continue to be well maintained, expanded to cover more creeks, and updated as technology evolves. The FEWS program is funded under the O&M budget with a current funding level of \$1.4 million a year. Floodplain modeling is allotted \$0.5 million. The FEWS program currently contains approximately 100 gauges, including gauges maintained by the COA and US Geological Survey (USGS). Gauges must be Flood Hardened

With the substantial growth seen in the Austin Metro Area in recent years, strategically locating additional flood hardened gauges to provide more data points for better flood modeling is crucial to saving lives at the beginning and during extreme flood events.

Educating the public on available early warning systems is critical. The Integrated Public Alert Warning System (IPAWS) provides public safety officials with an effective way to alert and warn the public about serious emergencies using the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), the National Oceanic and Atmospheric (NOAA) Weather Radio, and other public alerting systems from a single interface.

The Regional Notification System (RNS) is a reverse 911 messaging system for the Council of Governments 10 County Area (Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, Lee, Llano, Travis and Williamson counties). This System is utilized for warning specific parts of the community, not just the County as a whole. It uses the 911 database (landlines) and allows residents to register their cell phones in order to receive the warnings.

<https://public.coderedweb.com/cne/en-US/21C524DBEA1F>. If residents do not have a landline phone, and they have not registered their cell phones to the RNS they will not receive the warning messages that could be targeted to their specific neighborhood or place of business.

Lastly, concern exists that the WPD's name does not accurately convey the role the Department plays in this critical function to the community. Simple changes could help citizens and taxpayers better understand where these dollars go and why.

Recommendations:

PUBLIC EDUCATION AND OUTREACH

1. Watershed Protection Department shall enhance the current community outreach approach by actively:
 - a. Tailoring the current "Flood Safety Resources" warning safety tips to include local information specific to the COA residents (refer to Louisville, KY example: <http://www.msdlouky.org/programs/crssite/fpfloodsafety.html>).
 - b. Providing the information in www.ATXfloods.com in a multilingual format
 - c. Educating COA residents on registering their phones and the use of the Integrated Public Alert Warning System (IPAWS) through the COA Office of Homeland Security and Emergency Management.
 - d. Educating COA residents on the Regional Notification System (RNS).
 - e. Issuing NOAA Radios to residents in floodplains.
 - f. Providing information to residents in floodplains on emergency tool kits.
 - g. Coordinating with First Responder agencies on public education/awareness on the difference between rescue (water still rising-danger of drowning vs water crested-shelter in place until help arrives), etc.
 - h. Effectively communicating the flooding chances residents face beyond the standard 100-year floodplain, including outside the floodplain. Creative ways to do so might include games and other education tools.
 - i. Educating the Public about 100-year floodplain terminology.
 - j. Establishing and conducting regular flood informational media blitz events with the goal to reinforce emergency flood preparedness throughout the COA.
 - k. Implementing effective marketing techniques to include communities challenged with Internet connectivity, specifically areas at risk of flooding.
 - l. Including the Watershed Protection Master Plan "Problem Score" Viewer link as an additional educational/information resource to the COA residents: <http://austin.maps.arcgis.com/apps/MapJournal/index.html?appid=d45481abb0804c95a8e6b033188982b9>

- m. Creating an informational brochure of available alternate Power Source options available to residents (manual backup systems) in flood prone areas that will temporarily support the family's power source needs until electrical service is restored.
 - n. Creating educational strategies on how residents and business operators can safely shut down utility valves for gas, oil, water and the main electrical supply (use tags on valves so they can be found quickly) AND include instructions that ONLY a professional can turn utilities back on if home and/or business flooded. This is ONLY feasible with advance warning.
2. All school campuses shall ensure each school campus located within a floodplain has an updated Emergency Preparedness Plan in response to flooding incidents each year.
- a. Those plans should be reviewed annually by the Administration in conjunction with campus security staff, teachers, local first responders and the Parent Teacher Association (PTA) and the Campus Advisory Council (CAC) leadership, as applicable. The sample Emergency Preparedness Document (attached) provides the type of information that should be included.
 - b. Conduct annual flood response training with students and staff.
 - c. Develop parental/custodial outreach and education materials so parents/custodians know what to do in a flooding incident emergency (who to call, where to go, etc.). Share plan with PTA and CAC, to include what the plan of action to inform parents/custodians of students will be (meetings, informational brochure, posters, information translated to other language(s) as needed, etc.). Informational materials must be included with "Back-to-School" Night events as well as in standard information packets for each new parent/custodians and students to all school campuses. All informational materials must be in the recipients' primary language.
3. Agencies and/or businesses with vulnerable populations:
- a. Charter Schools and Child Daycare Facilities should properly register to ensure their respective administration and security personnel, staff and parents are included in the "Emergency Flood Preparedness" list with the Department of Homeland Security and Emergency Management.
 - b. Agency and Building Administrators of Nursing Homes and other facilities that house vulnerable populations (disabled, incapacitated, minors, Wards of the State, etc.) shall take the same precautionary prevention, intervention and response strategies required of the school district. (Refer to SAMPLE Emergency Preparedness Document) On-site backup systems, emergency generators and required supplies (food, water, medications, etc.) must be incorporated into the Emergency Response Plan based on the needs of the population housed at the facility.

4. WPD shall assist in the establishment of an early warning network to communicate current conditions and warnings to local Home Owners Associations (HOAs) and neighborhood associations to help them get the word to residents, especially the elderly and infirm, who may not be aware of the flooding danger or who may need assistance.
5. Specific to floodplain variances, if development or redevelopment is allowed in a floodplain, WPD shall:
 - a. *Provide education for safe evacuation and safely sheltering in place and*
 - b. Require disclosure by seller/owner (or their representative) and education for buyer/renter of property that has been granted a floodplain variance that may constitute a health and safety risk.

ACTION AND STRATEGIES – ALERT AND RESPONSE

6. Watershed Protection Department and the COA incorporate information from the National Water Model needed to enhance the safety of all COA residents.
7. Continue to update FEWS equipment and software due to the reliance of many departments, the Emergency Operations Center (EOC), and the general public that rely on this system.
8. Closer coordination with USGS to add more flood-hardened rain and flood stage gauges for better flood forecasting in order to assist first responders during extreme rain events and for potential evacuations of Austin citizens.
9. Install, inspect, and maintain an Emergency Siren System designed to alert residents and visitors in flood prone areas.
10. COA develop and implement “First Responder” resources needed in response to expanding city boundaries (Refer to Fire Station Map and Response Times Documents).
 - a. Fire Stations with adequate staffing and operational support
 - b. EMS Stations with adequate staffing and operational support
11. Watershed Protection Department and First Responder Agencies review flooding incidents after 30 days and provide a condensed report to the COA City Council on what worked well and areas needing improvement
12. Watershed Protection Department coordinate with Texas A&M University for emergency veterinary services in response to flood events:
<http://vetmed.tamu.edu/files/vetmed/vet/texvet-0815-pages-34-35.pdf>

ACTION AND STRATEGIES – AWARENESS AND PREPAREDNESS

13. Watershed Protection Department continuously review and update creek and local flood maps on a 3-year cycle and update as necessary.

14. As local flood maps are generated or developed, the Watershed Protection Department should publish and share them online similar to creek floods.
15. Watershed Protection Department shall encourage Agency Heads and Building Administrators of identified structures in the floodplain to coordinate with their local “First Responder” agencies and develop or update the facility’s individual Emergency Response Plan to flooding incidents in response to current flood maps.
16. Require “Flood Zone” signage in high-risk flood zones by marking the curbs in the color “BLUE.” Informational brochures regarding the meaning of the color on the curbs will be developed and distributed to all utility customers in a multilingual format at least twice a year.
17. Neighborhoods, including camping and lodging areas, with documented creek and local area flooding require signage at all major arterial roads entering the neighborhood to designate area as susceptible to flooding during storms. (Like hurricane zone signage along the Gulf and tsunami signage on the coasts.)
18. Require property owners (or their representative) to notify residents in writing if the leased property is in a floodplain. The written notification shall be in the lessee’s primary language. Renter’s Insurance information should be included with the application.
19. Intergovernmental Coordination with surrounding counties on floodplain hazards in the area for consistency in the educational message and potential cost savings.
20. Examine renaming WPD to better communicate to Austin citizens the three primary goals of the Department: Water Quality, Erosion Control, and Flood Mitigation.
21. Agencies and business owners/operators located within floodplains install barriers and/or anchor/secure large physical hazards and properly store chemical hazards (toxic, caustic and flammable) at risk of posing a danger, further injury or damage to residents/occupants, including first responders, downstream.
22. For COA residents involved in the Flood Buyout Program, WPD shall ensure that homeowners who choose not to voluntarily sell their home be educated around the implications and consequences.
23. Create a public forum whereby citizens can address the oversight body of the Watershed Protection Department to voice grievances, and seek avenues for navigating the bureaucracy.

1f. Standard and Green infrastructure utilization; impacts, regulations, and management of impervious cover; master planning and studies underway

The following regulatory and planning mechanisms are recommended. These recommendations are intended to be adopted as soon as possible to send a strong message

to local residents that the City of Austin takes seriously its responsibility to minimize the risks to public safety posed by flooding.

Planning and Regulatory Recommendations:

1. WPD should engage in a comprehensive planning process regularly (e.g. every five years, perhaps in concert with the Watershed Protection Master Plan) that addresses land use, transportation, utilities, and drainage concerns to map known and potential flood problem areas and determine:
 - a. A maximum amount of total impervious cover for flood-prone neighborhoods that must be considered prior to issuing any building permits.
 - b. Where onsite detention is required for proposed new and redevelopment.
 - c. Where flooding problems remain unresolved, new development or densification is discouraged.
 - d. Where, in areas to be annexed, potential flooding concerns and the cost for improvements are identified prior to annexation. For example, staff currently asks residents in an area to be annexed about flooding but examples show that, although none reported flooding, it may just be due to lack of a recent large rain event.
 - e. Where flood problems are severe, do not issue permits for new development, redevelopment, infill and auxiliary structures until the flood problems are mitigated or the following conditions apply (no exceptions):
 - i. the developer provides a certified engineering study that proves no adverse downstream impact, or
 - ii. onsite mitigation is included in the development, or
 - iii. downstream infrastructure is improved by the development
2. Strengthen the City of Austin Land Development Code (LDC) regarding flood mitigation requirements for new development and redevelopment.
 - a. Known loopholes (as identified by staff) should be eliminated.
 - b. Existing code has provisions that would allow for the regulation of redevelopment but this code is not enforced. Identify, clarify and strengthen these provisions and provide a timeline and funding necessary for enforcement.
 - c. Determine whether the 1% annual exceedance probability (AEP) event should be replaced by a larger, less frequent event (perhaps only in certain watersheds) or if 'freeboard' requirements should be increased (freeboard is a factor of safety usually expressed in feet above a flood level for purposes of floodplain management).
 - d. Enforce stormwater discharge limit requirements in the COA LDC and Drainage Criteria Manual, Section 8.1.0., which requires that storm water management for peak rates of runoff shall provide for a temporary storage of stormwater runoff. Runoff is then released at a controlled rate which cannot exceed the capacities of the existing downstream drainage systems, or the pre-developed peak runoff rate of the site at each discharge point, whichever is less.
 - e. Require that all new or remodeled commercial and residential structures added to existing lots (e.g. Accessory dwelling units) comply with impervious cover limits.

- f. Enforce requirements that all proposed land development projects, whether new or redevelopment, demonstrate no adverse downstream impacts. Onsite (and any necessary offsite) stormwater controls must be modeled to simulate proposed condition discharges and their impact on the city storm drain system, including the receiving waters of each watershed.
 - g. Require that commercial and residential redevelopment reduce post development peak rates of discharge to match peak rates of discharge for undeveloped conditions instead of existing predevelopment conditions. Undeveloped conditions are assumed to be grassland unless otherwise demonstrated by the applicant.
 - h. Require that all objects such as, but not limited to, dumpsters and commercial use furniture (benches, picnic tables, etc.) in floodplains be anchored to the ground so as not to block storm drains, bridges and floodways during a flood. Food trailers should be transported offsite prior to flooding. Educate and enforce compliance during annual health inspections or similar routine inspections.
3. Implement City policies, programs, staffing levels, training opportunities and interdepartmental collaboration to enhance flood mitigation and preparedness.
 - a. Ensure that Development Review staff is aware of 2013 amendments in the LDC related to Watershed Protection Ordinance (Ordinance No.20131017-046) with special attention to enforcement of Article 4 Section 30-4-151.
 - b. Ensure a system and process exists such that the Development Services Department's One Stop Shop can easily check to see if proposed new or redevelopment is in or near any known flood problem areas. Advise applicant, staff, and the Neighborhood Plan Contact Team (NPCT) of this data during the building and/or site plan review, and include this data in the Development Viewer.
 - c. Resolve flood-related Code enforcement problems in a timely manner. Immediately remedy problems such as blocked drainage easements that create safety hazards.
 - d. If any existing stormwater infrastructure that is designed and/or constructed by entities other than the City of Austin requires corrective measures, those fixes shall be paid for by the responsible developer or contractor.
 - e. Implement a rapid licensing/approval process for flood restoration contractors in preparation for future flood events. This will provide assurance to homeowners and businesses that contractors are aware of current city regulations and that liability is assured.
 - f. Increase commercial inspection and enforcement efforts to disallow the storage of chemicals and hazardous materials in flood-prone areas. Ensure that inspectors in applicable City programs (e.g. WPD Pollution Prevention and Reduction Program, Code Enforcement, and others) are aware of flood problem areas.
4. Actively seek and participate in Public-Private Partnerships where the City can leverage private development activities to increase investment in new or updated flood mitigation infrastructure.
5. Implement a benefit-cost analysis for CIP projects to determine whether the use of smaller 'design storms' (e.g. less than 100-year flood protection) are more cost effective. This will

help determine project viability, make it easier to seek funding, and stretch limited resources.

Green Infrastructure Recommendations

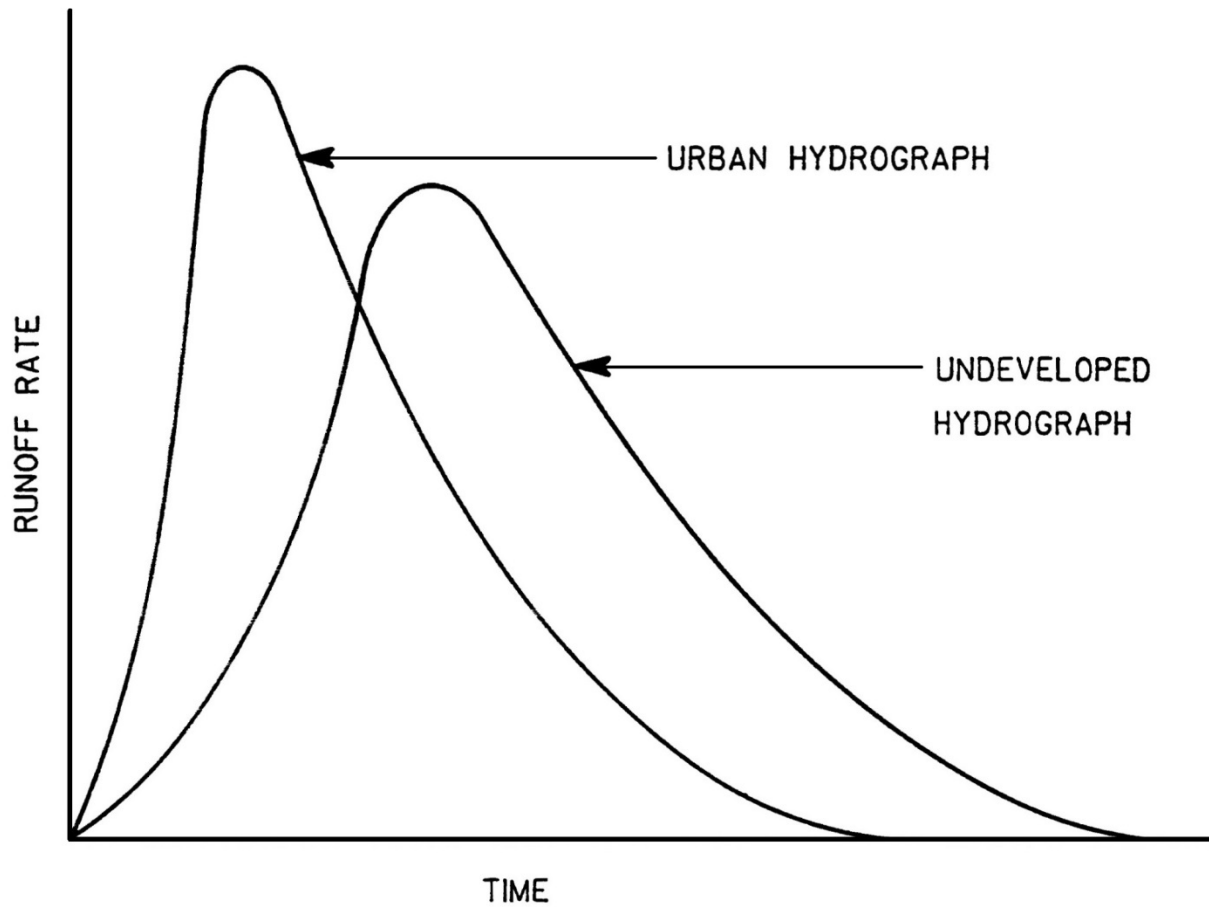
Green infrastructure for stormwater management reduces impacts from built environments using landscape features and engineered systems that mimic natural processes to control the quantity and quality of runoff. Green stormwater infrastructure (GSI) often includes elements such as rainwater harvesting, rain gardens and pervious pavement. These features typically detain small volumes of water and therefore aren't always considered effective flood mitigation measures. However, when implemented on a widespread basis throughout a neighborhood they can provide essential benefits (see the Geosyntec/CoA Brentwood Study). To that end, green infrastructure projects on private land offer a way for community-minded residents to reduce their flood footprint for their own benefit and that of their downstream neighbors.

Recommendations

1. Incentivize onsite retrofit floodwater management measures for private property owners.
 - a. Enhance outreach opportunities particularly for those who have suffered losses due to local flooding. Promote in specific neighborhoods (e.g., Brentwood).
 - b. WPD should partner with Austin Water Utility's existing Rainwater Harvesting and WaterWise Rainscape rebate programs to:
 - i. Enhance program guidance information regarding landscape elements that mitigate local flood impacts.
 - ii. Contribute rebate dollars when onsite solutions provide flood detention (e.g. rainwater harvesting volumes over 1,000 gallons).
 - iii. Consider increasing the rebate amount for systems that use a smart controller to ensure that detention volume is available when needed.
 - iv. Consider rebating professional drainage design guidance where local flooding problems exist.
 - v. Consider administrative costs (e.g. operational, maintenance, inspection and enforcement activities) associated with green stormwater infrastructure-related incentives and implement only those program elements that are cost-effective.
2. Consider offering one-time discounts to the City Drainage Fee for flood detention facilities that exceed regulatory requirements (consider location, size/capacity thresholds and possible cap on reduction values).
3. Collaborate in cost-sharing opportunities that integrate green infrastructure and flood detention with other projects, such as:
 - a. Other City CIP projects
 - b. Public-Private Projects
 - c. Interlocal jurisdictions and entities (see Section 4)
4. Integrate green stormwater infrastructure with standard CIP solutions (gray infrastructure) when it can serve a vital role, such as:

- a. to offset potential increases in peak flow created as a result of more efficient drainage conveyance (see figure _I_ below)
- b. redirecting runoff away from structures

Figure _I_ Hydrograph: Urban vs. Undeveloped



2. Identify available funds, including federal, state, and local sources as well as prioritizing future capital investment for flood mitigation and management.¹

The Watershed Protection Master Plan and on-going planning activities being conducted by the Watershed Department have and continue to identify and define where the creek and local flooding problems are, the root cause of the flooding, and feasible mitigation alternatives to be considered. While the residents of Austin have expressed a strong desire to move faster to implement flood mitigation projects, there remains a need to continue planning and studies necessary to bring future projects to fruition. However, the biggest challenge has always been and will continue to be funding to implement the full scope of the Watershed Protection Master Plan.

Watershed staff provided a summary of Drainage and Watershed Bonds 1975-2015 and reported that the citizens of Austin voted to approve all nine of the bond packages for drainage improvements in this time period with the last being ten years ago in 2006. (See addendum for summary).

Recommendations:

1. Issue debt consistent with the recommendations in this report.
2. Investigate opportunities for grants or cost sharing with US Geological Survey to install additional flood-hardened rainfall and stage gauges throughout the City.
3. Evaluate and identify opportunities to share costs with private development to upgrade outdated drainage systems.
4. Examine budgetary requests of other City Departments to identify projects less critical to public safety than flood mitigation and reallocate these resources to increase staff and resources of WPD. Council should prioritize capital spending in future budgets to focus spending on mitigating the most critical flood mitigation projects and to fund necessary maintenance operations over spending money on non-critical projects that do not impact public health and safety to reduce the fiscal impact to citizens.
5. Evaluate opportunities to leverage volunteer activities to encourage greater citizen participation in keeping waterways clear. Examples include Keep Austin Beautiful and the Colorado River Alliance. Understanding that the structure may be overly complex,

¹ The Watershed Protection Master Plan and on-going planning activities being conducted by the Watershed Department have and continue to identify and define where the creek and local flooding problems are, the root cause of the flooding, and feasible mitigation alternatives to be considered. While the residents of Austin have expressed a strong desire to move faster to implement flood mitigation projects, there remains a need to continue planning and studies necessary to bring future projects to fruition. However, the biggest challenge has always been and will continue to be funding to implement the full scope of the Watershed Protection Master Plan.

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Council should also explore simple straightforward financial incentives to spur citizen engagement, which could occur in the form of a tax credit or similar.

6. Leverage local funding with state and federal programs and funding options where practicable; however, take into considerations potential project delays or additional project needs/spending that may be part of the matching funds. Seek additional sources of funds for acquiring properties such as the Stafford Act’s Hazard Mitigation Grant Program (HMGP), the HUD’s Community Development Block Grant Program (CDBG), Flood Mitigation Assistance Program (FMAP), Executive Order 12898 (Environmental Justice) funding (where applicable), and private partnerships.

3. PEER CITIES – Evaluating best practices in peer cities with similar climate and flood issues.

<u>AUSTIN:</u>	2014 Population	912,791
	Square miles	271.8

The following cities have similar climate and flood issues as Austin and have experienced major flood events and implemented flood mitigation solutions that may be of interest and benefit to the City of Austin,

1. **TULSA:**

2014 Population	399,682
Square miles	196.8

Tulsa has a similar flood history as Austin with frequent flooding, rapid growth and a general denial of the possibility that floods could reoccur until their “year of the floods” in 1974 and 1984 Memorial Day flood, which killed 14, injured 288, damaged or destroyed nearly 7,000 buildings and did \$180 million in damages. **Following that flood, Tulsa appears to have taken the initiative to prevent future flooding and relocation of people through a series of policies and ongoing actions.**

Actions taken included:

1. 1984 flood caused relocation of 300 flooded homeowners & a mobile home park and damaged or destroyed 7,000 buildings;
2. Introduced a total capital program for flood control and master drainage plans.
3. **City Commissioners enacted a floodplain building moratorium following the 1976 flood.**

4. Created Dept. of Storm water Management to centralize flood, drainage and storm water programs and funded by the City budget.
5. **Storm water utility fee created to be utilized exclusively for maintenance of storm water detention facilities, stream channels, pumping stations, culverts, ditches and other drainage facilities. The current fee is \$5.43 per month, based on cost of clearing 2,650 square feet of property.**
6. **Storm drainage management is now part of the Streets and Storm water Dept.**
7. **After storms & when needed, crews clear the streams and detention sites also utilizing storm water fees.** On average, they clean more than 22 miles of ditches and clear about 5 miles of drainage pipe each year.
8. Phased implementation programs for large capital projects are funded by storm water fees, sales tax revenues or bond issues and utilized for acquisition of lands & construction of large water retention facilities, major drainage basin improvements and other related projects.
9. Building parks in the floodplains, sports fields in storm water detention locations and greenway trails on creek banks.
10. **“In Tulsa, growth is welcomed – so long as it will not flood or cause flooding elsewhere.”**
11. Tulsa now has the lowest flood insurance rates in the U.S. (40% discount) due to their initiatives.
12. Tulsa has installed over 80 sirens in the city, each audible up to one mile. They have three types of sounds:
 - a. a three-minute “steady” tone to warn of impending tornadoes and of chemical releases.
 - b. A three-minute “waving” tone to warn of nuclear attacks
 - c. Three-minute “high-low” tone to warn of impending flooding.

2. EL PASO:

2015 population	877,248
Square miles	256.3

In 2006, El Paso suffered record flooding which continued over an extended period in late July into early August. Recognizing the magnitude of the task and the logistical difficulties due to it’s location on the New Mexico and Mexican borders, and under the sponsorship of Congressman Silvestre Reyes, a Federal Flood Assessment Conference was convened to discuss levels of coordination between federal agencies.

What is relevant here is that El Paso recognized the need to bring all interested parties together to develop a joint solution for their flooding problems. Representatives from El Paso, New Mexico and Mexico joined together.

Included in the conference were:

NOAA, National Weather Service
U.S. Geological Survey
U.S. International Boundary and River Commission
U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
El Paso County Water Improvement District
Elephant Butte (New Mexico) Irrigation District
Department of Homeland Security
Federal Emergency Management Agency
Texas Department of Transportation
U.S. Environmental Protection Agency

Major recommendations made by the Conference included:

1. Clean trash, debris & vegetation & remove sediment from the Rio Grande floodplain/
channel
2. Create a Drainage District
3. Establish an Early Warning System
4. Restore the Rio Grande flood capacity to original design
5. Modify the channel
6. Increase the number of flood gauges
7. Survey the drain system

3. LOUISVILLE:

2015 population	597,337
Square miles	399

Located on the Ohio River, Louisville is highly susceptible to river flooding as well as flash flooding from interior streams and overloaded storm systems. In 1986, they created a Storm Water Drainage Authority under the Louisville Metropolitan Sewer District. The MSD Floodplain Board is responsible for approving any variance requests via public hearings.

Major improvements they have implemented include:

1. **Their 2016 Drainage Capital Budget is \$187 million (\$179m existing/ \$8.8m new projects) as a part of a long term plan of over \$1 billion.**
2. To combat the river flooding, Louisville utilizes floodwalls, levees, major pumping stations, roadway gate closures and sandbag street closures.
3. An outdoor early warning system is in place, in addition to the emergency broadcast system, for impending disasters. The system is tested the second Tuesday of each month. Public education is also in place through classroom and nursing home presentations, utility inserts, booths at area events and brochures to ensure everyone knows what to do in the event of an emergency.
4. For drainage, they have developed a Neighborhood Maintenance Program where they have divided the city into 50 distinct neighborhoods. Service requests and maintenance are grouped by neighborhood and scheduled on a yearly basis.
5. Any development or redevelopment within the floodplain must create detention facilities within the same watershed, either on the same property or an alternate site, if approved.
6. Floodplain permits can be issued for residences if the lowest level of the structure is at least one foot above the 100 year floodplain. Austin requires a minimum of 2 feet above the floodplain.
7. A natural vegetation buffer strip at least 25 ft. wide on each side of the stream bank is also required.

Louisville's flood insurance discount rate is 35%, one of the highest in the country, and well ahead of Austin's current 20% discount.

4. ONION CREEK RECOMMENDATIONS

October 30, 2015, marked the latest in a series of flooding disasters that have created serious property damage and loss of life along Onion Creek over the years. Prior to this, there was the Halloween Flood 2013, in which the flood waters reached a record level of 41 feet and, for the first time, severely damaged and destroyed homes in the Upper Onion Creek neighborhood in addition to lower [Onion Creek](#). The 2013 Halloween Flood had destroyed or severely damaged homes in Onion Creek at a total estimated cost of well over \$150 million, including some city services. This dollar loss was probably much higher due to the lack of complete data from the city and affected counties.

In response to the 2013 Halloween Flood on Onion Creek, the City Council had passed Resolution 20140515-028 directing the City Manager to, among other things, provide a report to Council regarding the costs associated with the purchase of homes in the Lower Onion Creek floodplain around the William Cannon Drive and Pleasant Valley Road area as well as funding options and an evaluation of the drainage fee.

The 2013 and 2015 floods resulted in a need to redraw the floodplain map, but also to look more closely at possible ways to reduce the impact of future floods and preclude the need for extensive buyouts in the future.

The goal of the current Onion Creek Floodplain and Flood Mitigation Study, in addition to redrawing the floodplain maps, was to eliminate potential inundation of buildings during a 1% annual chance event (ACE). It was determined by the consultants that a 3 to 5 foot reduction in the peak would be needed to achieve the target of reducing flood risk by 30%. The specific focus area of the Study was IH35 to E. Slaughter Lane, known as Upper Onion Creek, but we suggest that attention should continue to be directed to both Upper and Lower Onion Creek.

In reading the Study and the cover letter from Watershed, we feel that a good job has been done by Halff Engineering, but it is still preliminary and needs further work, especially concerning upstream detention and the future issues to be faced if impervious cover controls are not implemented throughout the Onion Creek floodplain. This should be considered a high priority.

Options evaluated in the study for Upper Onion Creek included:

1. Property Buyouts
2. Regional Detention
3. Flood walls
4. Channel Modifications & Clearing
5. Channel Improvements

The Preliminary Study is now complete and has examined the potential viability of temporarily diverting a significant amount of the floodwaters, then releasing them back into the creek once that major crest has fallen. Although the 2013 crest lasted less than one hour, Onion Creek residents and residences suffered extensive damage.

BUYOUTS:

If buyouts were to be viewed as the sole solution for Upper Onion Creek flooding, the Study identified 222 structures within the preliminary floodplain. It was estimated that 147 of these properties would have to be purchased at an estimated cost of \$91 million and annual maintenance costs of \$23k. It wasn't clear as to what would be done with the purchased property after it is cleared.

It should be noted that this approach would:

1. Not provide assurance against further flooding in Upper or Lower Onion Creek if further impervious cover limits are not introduced concerning development and redevelopment upstream including in Hays County).
2. Potentially damage the viability of the community through reduced property values.

3. Not, by itself, ensure any additional security for properties downstream in Lower Onion Creek.

We feel that selective buyouts should be considered in those areas hit by both the 2013 and 2015 floods, but should be approached with the objective of also improving the neighborhood and not as a total solution. We recommend the City of Austin should evaluate structures within the 25 year floodplain for possible buyouts.

REGIONAL DETENTION:

Three Centex quarries in Hays County (Centex West, Centex East Offline and Centex East Inline) were identified and studied as possible temporary retention options to hold the water.

Centex West has a capacity of 5,700 acre feet, which was estimated could retain 10% of the targeted reduction, or approximately .5-1.0 feet, of the flooding. The time in which it could be detained was not identified. Estimated cost was \$34 m.

Centex East Offline and Centex East Inline were discounted as having multiple constraints and a low viability, but no details were provided in the Report. However, a 2013 Report, also by Halff, and prepared for The Texas Water Development Board and the U.S. Army Corps of Engineers on behalf of Hays County, did identify two additional detention possibilities, Rattlesnake Falls and Dripping Springs, which indicated potential reductions of 4 to 5 feet if all three options (Centex, Rattlesnake and Dripping Springs) were combined.

Limited discussions have taken place with the owners or managers of these facilities to date.

The Bornheim Quarry, owned by the COA, fronts onto Little Bear Creek and was not considered in either Study, even though the creek flows into Onion Creek.

Based on the combination of the two studies, we feel it bears further investigation for combining potential benefits from all of the quarries, including those not identified in this Study, especially in line with the 2013 Hays County Study which indicated potential reductions in the flood levels of 4 to 5 feet in Hays County, though it could be less once joined by Little Bear Creek in Travis County. However, these reductions could possibly be improved by including the Bornheim Quarry, located along Little Bear Creek.

Antioch Recharge Facility:

While not necessarily a part of the Onion Creek Mitigation Study, the Barton Springs Edwards Aquifer Conservation District (BSEACD) is studying ways that some of the detained water in the Centex Quarry might be diverted to the Antioch Recharge Facility, thus helping to recapture the water in the Edwards Aquifer and retain it for future use. This, and other recharge facilities, should be considered as a part of this project

FLOODWALLS: (See attached map)

Floodwalls were identified as one means of eliminating the flood threat for the Upper Onion Creek Community, but would require 6,200 ft of wall along Pinehurst with heights ranging from 7 feet to a maximum 16 feet, in addition to the purchase of about 55 structures and installation of an internal drainage system to drain approximately 110 acres of local runoff.

In the Wild Dunes area, they would need 3,400 feet of wall with a height ranging from 5 to 12 feet. 31 structures would have to be purchased

In both neighborhoods, the wall would need to be relocated as closely as possible to existing structures in order to minimize the height.

Total cost for the Floodwall Option was \$80 million with annual O&M costs of \$44k. It wasn't clear as to what would be done with the purchased property after it is cleared.

We consider this option to be the most destructive of the options:

1. It would still result in the purchase of 86 properties ,
2. Quality of life and property value could be seriously diminished for those directly behind the walls
3. Overall property values through the Onion Creek neighborhoods and resultant property tax revenues to the COA and Travis County could be greatly reduced.
4. Increased flow downstream could further increase future flood problems and potential buyouts in Lower Onion Creek.

CHANNEL MODIFICATIONS AND CLEARING:

CHANNEL CLEARING: According to the 2016 Study, totally clearing the channels and immediate overbanks can be considered an effective alternative to reducing flood elevations as it allows the water to run more freely and was estimated to decrease the water levels by up to 2.0 feet in the Wild Dunes area. There is also a potential benefit due to a reduction of fire threats in the area with the removal of the dead brush. However, efforts to clear and maintain the "cleared" channel would also potentially impact the riparian corridor along Onion Creek and cost approximately \$11.2m with an estimated additional \$1m in annual O&M costs as well as increase erosion.

REMOVE CONSTRUCTIONS: Selective efforts, such as excavating the channel below the River Plantation Bridge, could provide benefits by increasing the opening and reducing the water elevations in the Wild Dunes area. The result could also be to increase erosion. The impact of this increased flow on Lower Onion Creek must also be evaluated.

CHANNEL BENCHING: This option would result in increased velocity of water flow and could potentially be very erosive.

CHANNEL IMPROVEMENTS: Combining the channel alternatives does offer potential, but should be further evaluated in the final engineering analysis. Regular maintenance would be required and initial cost is estimated at \$74m, but water surface decreases of 1.4 – 2.7 ft in the Pinehurst area and 2.5-4.0 ft in the Wild Dunes area make it worth further investigation and, combined with the quarry alternatives, might achieve the mitigation goal. Once again, water velocity would be increased so the impact on Lower Onion Creek should also be considered.

While these recommendations are directed primarily towards Upper Onion Creek, they are made with the understanding that current efforts to complete the Lower Onion Creek Buyouts will be completed as quickly as possible.

RECOMMENDATIONS:

- 1. Specific steps for mediating the flood risk in Onion Creek:**
 - a. Clean and regularly maintain the Creek.**
 - b. Immediately expand the Halff Studies for upstream detention solutions.**
 - c. Organize the Regional Conference to galvanize support and cooperation from all interested parties into an Action Plan.**
 - d. Buyouts are essential for the immediate problems in Lower Onion Creek and there are selected at-risk areas in Upper Onion Creek. Expedite buyouts in those areas if an effective detention solution cannot be readily identified.**
 - e. Channel improvements should be considered, including benching, removing constrictions and channel clearing with consideration to potential erosion issues. Any channel improvement options must consider downstream impacts.**
 - f. A large-scale floodwall option is destructive and should be considered only as a last resort and in specific limited areas. Any floodwall options must consider downstream impacts.**
 - g. Evaluate individual property floodproofing, including elevation of structures and/or individual structure floodwalls (“garden walls”).**
- 2. Expand and expedite study of the Centex Quarries and all other options upstream, including the Bornheim Quarry, Rattlesnake inline detention alternative, IH 35 inline detention alternative, and Dripping Springs inline detention alternative to further quantify possible approaches and potential detention benefits.**
- 3. Immediately reach out to Hays, Travis, Bastrop, and Blanco Counties to jointly address the problem and potential solutions, including contacting Centex, Dripping Springs and Rattlesnake Falls ownership.**
- 4. Evaluate the viability and benefit from channeling a portion of the floodwaters into the Antioch Recharge Facility and recapturing it in the Edwards Aquifer.**
- 5. Evaluate other potential locations for detention facilities within the Onion Creek area.**
- 6. Convene a Regional Conference/ Task Force comprised of all potentially interested parties (local, county, state, federal and private) at the earliest possible date to confirm the findings, identify tasks and funding needed, and establish time frames and objectives. The City of Austin should take the lead on this endeavor.**

7. **Strongly discourage development or redevelopment within the Onion Creek 500 year floodplain until FEMA has reviewed the results of this Study and updated their maps.**
8. **Conduct a third-party evaluation of the effectiveness and accountability of the Regional Stormwater Management Program (RSMP) to mitigate flooding and consider whether revisions and expansion of the program should be made. Create an Onion Creek Flood Control District to manage the Onion Creek Floodplain. Potential partners include BSEACD, Hays County, Travis County and LCRA.**
9. **Appoint representatives from both Lower and Upper Onion Creek to join the Half Study Team as full members of the ongoing study team to formalize plans and provide community input and support.**
10. **Coordinate area early warning systems with strategically placed flood-hardened gauges to include all streams and creeks feeding into the Onion Creek watershed.**

POTENTIAL FUNDING/ PARTNER RESOURCES:

For any far-reaching solution to be successful in solving the Onion Creek flooding problems, it is essential to form partnerships with the other potential stakeholders. Onion Creek is not just a local Austin problem; it extends upstream into Hays and Blanco Counties and even has an impact downstream as it flows into the Colorado River just above Bastrop.

1. **LCRA**
2. **Texas Water Development Board**
3. **State of Texas**
4. **Hays, Travis & Blanco Counties**
5. **U.S. Army Corps of Engineers**
6. **FEMA**
7. **Creation of Onion Creek Flood Control District**
8. **Bonds**
9. **Barton Springs Edwards Aquifer Conservation District (BSEACD)**
10. **Other potential sources of funding (as referenced in Section 6)**

5. Collaborating with the City's Environmental Commission

The Environmental Commission has oversight of the Watershed Protection Department. On January 13, 2016, members of the Flood Mitigation Task Force briefed the Commission on the progress of the FMTF, with the intent to follow up with the Commission upon completion of the final report.

The FMTF recommendation for the Environment Commission are:

1. When considering acquiring properties for green space or environmental protection, include the benefits of flood mitigation.
2. Ensure the Watershed Protection Department is funded and staffed at a level that ensures the maintenance and upkeep of the open and closed storm water systems to ensure public safety during massive rain events.
3. Review vegetation and riparian policies along open water drainage systems to ensure the policies are benefiting the public and not causing flooding, stoppage or backups of flood water.
4. Create a public forum whereby citizens can address the oversight body of the Watershed Protection Department to voice grievances, and seek avenues for navigating the bureaucracy.
5. Develop a process for tracking and following up on citizens' grievances and concerns. Request an annual report on the status of grievances presented to the Environmental Commission.
6. As the oversight committee of the Watershed Protection Department, review the effectiveness and efficiency of the WPD's performance measures.

6. Collaborating with other jurisdictions and agencies that have interest, expertise, and investment authority regarding flood mitigation potentially impacting areas inside and outside of the City of Austin as well as with work groups or other regional initiatives focused on flood issues and storm water management.

Recommendations:

1. Form a regional council or task force comprised of water management, safety and environmental organizations to look at regional storm water management. There does not appear to be a regional authority or strategy to manage flooding incidents. City of Austin Watershed Protection Master Plan 2015 Update recommends Watershed Protection continue to partner with other jurisdictions to achieve watershed protection goals, but there is no recommendation to partner with other jurisdictions to achieve regional storm water management and flood mitigation strategies.
2. Consider partnering with the following organizations to develop the council or task force.
 - Hays County and its municipalities
 - Travis County and its municipalities
 - Bastrop County and its municipalities
 - Blanco County and its municipalities
 - Williamson County and its municipalities
 - Lower Colorado River Authority
 - Barton Springs/Edwards Aquifer Conservation District
 - Texas Department of Transportation
 - Texas Commission on Environmental Quality
 - Texas Water Development Board
 - Texas Facilities Commission
 - Texas General Land Office

- Texas Parks and Wildlife
 - Texas Division of Emergency Management
 - U.S. Environmental Protection Agency
 - NOAA, National Weather Service
 - U.S. Geological Survey
 - U.S. International Boundary and River Commission
 - U.S. Army Corps of Engineers
 - U.S. Bureau of Reclamation
 - Department of Homeland Security
 - Federal Emergency Management Agency
 - Texas Medical Center – Houston Weather Alert System
 - Environmental systems Research Institute @ Pickle Research Campus
 - Texas Tech University – TxDOT and hydrology research
 - Texas A&M University – flood forecasting
 - Rice University – post hurricane flood research
 - Texas Floodplain Managers Association (TFMA)
 - American Society of Civil Engineers (ASCE) Environmental & Water Resources Institute (EWRI)
 - Association of State Flood Plain Managers (ASFPM)
 - And other appropriate agencies
3. Form a Regional Flood Control District to focus on flood mitigation and stormwater management, and to fund flood mitigation programs.
 4. Investigate flood management programs used by El Paso County Water Improvement District, Elephant Butte (New Mexico) Irrigation District, Tulsa, Oklahoma, City of El Paso, Texas and Louisville, Kentucky. See recommendations in Section 3. Peer Cities.
 5. Encourage collaboration with surrounding communities to adopt floodplain and storm drainage policies comparable to the levels of City of Austin.
 6. Incorporate information from the National Water Model as needed to enhance the safety of all COA residents.
 7. Coordinate with Texas A&M University for emergency veterinary services in response to flood events: <http://vetmed.tamu.edu/files/vetmed/vet/texvet-0815-pages-34-35.pdf>
 8. Coordination with United States Geological Survey (USGS) to add more flood hardened rain and flood stage gauges for better flood forecasting in order to assist first responders during extreme rain events and for potential evacuations of Austin citizens. Investigate opportunities for grants or cost sharing with USGS to install additional flood hardened rainfall and stage gauges through the City.
 9. Install, inspect, and maintain an Emergency Siren System designed to alert residents and visitors in flood prone areas.
 10. Coordinate a flood warning system to include local news media, NOAA Weather Radios and local wireless phone and pager services. Ensure a contingency plan for massive power failures, lightning strikes, and damaged communication infrastructures.
 11. Coordinate with each school campus located within a floodplain to ensure each has an updated Emergency Preparedness Plan in response to flooding incidents each year.

IV. Work Group Scope & Strategies

The FMTF separated into 4 working groups to gather information and carry out the tasks of reviewing the programs and policies of the Watershed Protection Department. Work Groups met independent of each other to meet with individual staff members of the Watershed Protection Department. Following are the three Work Group and their areas of purview.

1. **Capital Improvements Work Group Strategies:** Flood mitigation, flood preparedness, flood buyout policy, capital costs, affordability and equity, green and grey infrastructure, Master Plan, other studies, identify funds and prioritization of CIP, peer city benchmarking.
2. **Operations & Maintenance Work Group Strategies:** Flood mitigation, flood preparedness, floodplain variances, operations & maintenance costs, capital costs, affordability and equity, public education & safety, green and grey infrastructure, Master Plan, other studies, peer city benchmarking.
3. **Buyouts Work Group Strategies:** Flood mitigation, flood preparedness, flood buyout policy, affordability and equity, Master Plan, peer city benchmarking.
4. **Report Writers Group Strategies:** Compile the three Work Group Reports into recommendations by resolution section and prepare an executive summary.

V. Work Group Reports

Capital Improvements Work Group Report (Appendix A)

Buyouts Work Group Report (Appendix B)

Operations & Maintenance Work Group Report (Appendix C)

VI. Citizen Communications

Names of Citizen Communications (Appendix D)

VII. Task Force member names, appointments and committees:

Rose Marie Klee (Mayor) Buyouts Committee, Report Writers
Jeffrey Henke (Mayor) Buyouts
Marvin Chaney (District 1) Operations & Maintenance, Report Writers
Ben Hodges (District 1) Operations & Maintenance
Ana Aguirre (District 2) Capital Improvements, Report Writers
Robert Kibbie (District 2) Buyouts
Kate Mason-Murphy (District 3) Capital Improvements
Richard Maness (District 3)
Rolando Delgado (District 4) Buyouts
Carol Olewin (District 4) Secretary FMTF, Operations & Maintenance, Report Writers
Ken Jacob (District 5) Capital Improvements, Report Writers
Rollin MacRae (District 5) Capital Improvements
Paul Morales (District 6) Operations & Maintenance
Jay Scanlon (District 6) Capital Improvements, Report Writers
Dale Gray (District 7) Vice Chair FMTF, Buyouts
Dorsey Twidwell, Jr, (District 7) Operations & Maintenance
Robert Henneke, (District 8) Capital Improvements, Report Writers
Matthew L Rienstra, (District 8) Chair FMTF
John Gleason (District 9) Capital Improvements, Report Writers
Elloa Mathews (District 9) Capital Improvements
Raymond Canfield (District 10) Capital Improvements
John Pitts, Jr (District 10) Operations & Maintenance, Report Writers

VIII. Watershed Protection Department Comments

Watershed Protection dedicated its staff to providing information and support to the full FMTF as well as to the individual work groups.