New Braunfels Stormwater Management Strategy

New Braunfels, Texas

Final Report

January 2013

DESIGNWORKSHOP

Contents

Abbreviations

CDBG . . . . . Community Development Block Grants
CFM . . . . . Certified Facility Manager
DCM . . . . . Design Criteria Manual
EARIP . . . . . Edwards Aquifer Recovery Implementation Program
ETJ . . . . . Extra-territorial Jurisdiction
FEMA . . . . . Federal Emergency Management Act
FFE . . . . . Finished Floor Elevation
FMA . . . . . Flood Mitigation Assistance
GBRA . . . . . Guadalupe-Blanco River Authority
GEAA . . . . . Greater Edwards Aquifer Alliance
GESC . . . . . Grading, Erosion and Sediment Control Manual
HMGP . . . . . Hazard Mitigation Grant Plan
NBU . . . . . New Braunfels Utilities
PDM . . . . . Pre-Disaster Mitigation
PFC . . . . . Permeable Friction Course
SRL . . . . . Severe Repetitive Loss
TCEQ . . . . . Texas Commission on Environmental Quality
TWDB . . . . . Texas Water Development Board
TxDOT . . . . . Texas Department of Transportation
USACE . . . . . United State Army Corps of Engineers
USGBC . . . . . United States Green Building Council
WORD . . . . . Water-Oriented Recreation District

Definitions

City . . . . . the governing body of New Braunfels
Developer . . . . . an individual or entity that is actively developing a property
Landowner . . . . . an individual or entity who owns property

I

Phase I Report

Staff Kick Off

A staff kick off meeting was held on January 12, 2011. Representatives from Design Workshop, LAN and the City attended. City officials present included the City Manager and representatives from Planning, Engineering, Building, Public Works and River Activities departments.

The agenda covered

1. Vision and Critical Success Factors
2. Study Area Boundary
3. Project Management Plan
4. Final Deliverables
5. Metrics
6. Immediate Policy Changes
7. Public Engagement Plan
8. Watershed by Watershed Issues

Key Findings

Key findings that came out of the Staff Kick Off included:

1. Vision is for a state of the art stormwater management plan that is practical, economical and forward thinking.
2. Stormwater planning goes beyond city limits and is driven by watershed boundaries. Strategies need to work for this geographic range.
3. Specific watersheds with concerns include:
   - Alligator and Geronimo Creek | There are many approved but unbuilt subdivisions with no water quality mechanisms in place, even with 303d listing for e-coli and phosphorous.
   - Dry Comal | Testing indicates e-coli levels should continue to be monitored and Best Management Practices (BMP's) developed to maintain levels below appropriate recreation standards.
   - Comal | Springs, lakes , mill race and river have endangered species issues and river recreation issues.
   - Old Channel of the Comal | Tourism relies on this waterway and water quality is critical for tourism and endangered species.
   - Blieders Creek | This watershed outfalls at Landa Lake. There is a large development working through the City that would greatly impact this watershed, which is already suffering from erosion and sedimentation.
   - Guadalupe | There is various infrastructure that relies on this watershed, including surface water plant and recreation.
4. The immediate policy changes include establishing drainage improvement plans that are bonded by a developer for two years and construction of drainage improvements sufficient to mitigate development as it occurs.
5. In May 2011, City Council increased mitigation through detention, retention or some other technique that must be designed, constructed and maintained to reduce the post-development discharge to below that of pre-development for the 2-year, 10-year, 25-year and 100-year design storms. Participation in neighborhood or regional mitigation is an acceptable option. The stormwater master plan should support this.
6. Public engagement needs to include key stakeholders who have water rights on the rivers, like Schlitterbahn, as well as the general public.

7. The Watershed Advisory Committee, or steering committee, needs to be made up of a diverse group of people and will play a critical role in the review of the Stormwater Management Plan, Drainage Criteria Manual and the Federally Mandated Municipal Separate Storm Sewer (FM MS4) Permit process. They may or may not be a long term watershed advisory group.

Watershed Advisory Committee

The selection of the Watershed Advisory Committee (WAC) began in February 2011 and continued through June 2011. The schedule and progress of the plan was adjusted to accommodate the appointment of the WAC.

Project Site Tour

On July 12th, 2011, the WAC, City of New Braunfels, Design Workshop and LAN participated in a site tour looking at stormwater issues and opportunities around the City. The site tour included the following:

- Review of green infrastructure management practices using native lowland prairie, wetland benches and wet ponds as a form of water quality and water quantity needs for a retail project.
- Review of traditional stormwater management practices of water quality and water detention ponds in a residential development currently under construction.
- Review of New Braunfels Utilities site conditions and adjacent runoff near one of the Comal Springs with endangered species.
- Review of Landa Park, associated springs, Panther Canyon and human impact to water edge conditions including discussions of the impact to Landa Park after the June 2010 storm event.
- Review of the Dry Comal and adjacent development impact to water quality including discussions on e-coli levels and the creek assessment completed by LAN and Design Workshop in the spring of 2010.

These five reviews offered the WAC an opportunity to see firsthand a variety of stormwater issues and opportunities that play a role in the economic, environment, community and aesthetic value in New Braunfels.

Key Findings

During the tour, it was observed that stormwater management has to be consistently analyzed at a macro and micro scale, from regional to site specific solutions. Also observed was the need to understand issues associated with stormwater quality and stormwater quantity as it relates to New Braunfels, since the natural beauty plays such a significant role not only in the recreational tourism, but also the health and safety of the community.

Goals and Metrics

Goals for the Stormwater Management Plan are in line with DW Legacy Design® methodology that creates special places that meet today's needs, and are sustainable environments for all time. This process seeks to imbue every project with the perfect balance between environmental sensitivity, community connections, artistic beauty and economic viability. Projects that achieve this harmony are enduring places that make a difference in society, the well being of the planet and leave a legacy for future generations.

Each goal has one or multiple metrics that are used to measure progress toward the goal. Each metric has a baseline and target to create the foundation of the

Goal	Metric	Target/ Objective	Baseline
Encourage development patterns that improve stormwater management opportunities.	Metric 1: Woodlands and Grasslands	Target: Increase the acreage of woodland or grasslands designated for stormwater management in the study area to 25%. (Source: Americanforests.org)	***City*** Total percentage of the study area in Woodland = 11.0% (3104.1 ac) Total percentage of the study area in Grassland = 33.5% (9536.4 ac) ***Watershed*** Total percentage of the study area in Woodland = 29.8% (99,544.2 ac) Total percentage of the study area in Grassland = 38.5% (128,658.7 ac)
	Metric 2: Floodplain and Stream Setback	Target: 100 % of the floodplain is designated as open space or parkland. 100% of the stream setback is protected with no buildings in the stream setback. Setback distance from Stream Centerline: 0-100 feet, dependent upon drainage basin size (in square miles)	***City*** Total percentage of the floodplain protected = 94.5% (253.3 ac) Total percentage of the stream setback protected = 93.2% (1,150 ac) ***Watershed*** Total percentage of the floodplain protected = 99.1% (16,297 ac) Total percentage of the stream setback protected = 97.3% (9,177 ac)
	Metric 3: Compressed Development	Target: Increase density in areas that are appropriate for development 33% (Target 1.8 units/acre) higher than the rest of New Braunfels.	***City Core*** Average density of block groups in the city core = 2.0 units/ acre ***City*** Average density of city = 1.2 units/ acre ***Watershed*** Average density of watershed study area outside the city limits = .2 units/ acre
Minimize impervious surfaces	Metric 4: Impervious Surfaces	Target: Reduce impervious surface area per parcel.	***City*** Average impervious cover per parcel within City Limits= 26%

measurement. The baseline is the existing condition of the study area. Targets for New Braunfels will be defined over the course of the project by looking at existing conditions, relevant case studies, third party sources (studies, rating systems, etc.) and public acceptance.

Through the establishment of goals and metrics in each of the four Legacy categories, the Stormwater Management Plan will meet the vision of a plan that is practical, economical and sustainable.

Goal	Metric	Target/ Objective	Baseline
Prevent flooding and erosion caused by stormwater runoff.	Metric 5: Flooding	Target: Reduce structures within the 100-year floodplain and eliminate ALL structures in the floodway. Prevent all future structures from developing in the floodplain.	***City*** Number of structures in the FEMA 100 year flood plain = 560 Number of structures in the floodway = 315
	Metric 6: Erosion	Target: Increase amount of stabilized stream banks.	***City*** Total miles of river or creek bank = 35 miles x 2 sides = 70 miles total ***Watershed*** Total miles of river or creek bank = 496 miles x 2 sides = 992 miles total
Protect water quality of receiving waters, particularly the streams and Landa Lake.	Metric 7: Pollutant Total Load Reduction	Target: Initiate and/or Implement all projects by 2014	***City*** Edwards Aquifer Habitat Conservation Plan Year 1 Workplan
Ensure construction does not create environmental degradation (even on a temporary basis).	Metric 8: Construction Activity Pollution Prevention	Target: The plan must conform to the erosion and sedimentation requirements of the TCEQ stormwater permit for construction. In addition to statewide requirements, plan must also follow Edwards Aquifer Protection Program requirements when in the Edwards Recharge Zone.	***City*** In the Drainage and Erosion Control Design Manual (DCM), general guidelines for erosion control plans are given, but TCEQ standards are not required.
Ensure stakeholder buy-in on stormwater strategies.	Metric 9: Stakeholder Communication	Target: 80% of the participants feel that there was a good public process with a diversity of viewpoints present.	After the process is complete, we will update this percentage.

Goal	Metric	Target/ Objective	Baseline
Make sure responsibility for operations and management of stormwater infrastructure is clear.	Metric 10: Operations and Maintenance	Target: Develop a plan ensuring operations and maintenance of all stormwater facilities.	Maintenance plan is not required by city regulations.
Utilize parks and open space for stormwater storage and infiltration.	Metric 11: Parks/ Open Space	Target: Increase stormwater facilities in parks and open space.	***City*** Total park acreage = 583 acres of parkland.
Align the city's tourism industry practices with sensible stormwater management.	Metric 12: Tourism Industry Practices	Target: Create guidelines balancing the protection of the water quality and natural resources with access , specifically in areas of valued tourism such as Landa Park as an event space, the Guadalupe River as a water recreation site, the downtown as a heritage tourism attraction, the Comal River and Schlitterbahn as a family-oriented entertainment venue.	Number of Tourist Outfitters along the rivers and creeks = 5
Develop stronger stormwater standards without stifling growth and development.	Metric 13: Incentives	Target: Increase in the number of times the public incentive options are used.	Existing incentives: • Economic Development Incentives such as grants and loans • Reinvestment Zone Designation (TIF/TIRZ) • Freeport Exemption • School Property Tax Relief • Industrial Development Bond Financing • Utilities Impact Fee Waiver • State-sponsored programs • Tax Abatements
Ensure that public investment in infrastructure proves to have a positive ROI for the community.	Metric 14: Return on Public Investment	Target: Revenue per capita of the stormwater user-fee goes down.	New Braunfels has not approved a stormwater utility fee.
Ensure craftsmanship of stormwater infrastructure will result in permanence.	Metric 15: Durability	Target: Structural material should have a life-cycle of at least 50 years.	Material specifications are not determined by the city.

Existing Conditions

Using GIS analysis, the existing conditions in the New Braunfels area watersheds were mapped and used as measuring tools for the baseline conditions of the Goals and Metrics.

Information collected included:

- Watersheds
- Land Use
- Drainage (Digital Elevation Model and Slope Analysis)
- Impervious Surface
- Parks and Open Space
- Flooding
- Aquifers
- Land Cover and Vegetation
- Soils

Existing Code and Planning Documents

Existing land use and development code was reviewed for stormwater related issues such as stream setback, impervious coverage, parking requirements, landscape, water course protection, water harvesting/ conservation, and reuse/ recharge. In addition, City standards on landscaping, maintenance of parks and roads right of ways were reviewed. Finally, existing studies done on watersheds in New Braunfels, including EARIP, Alligator Creek Watershed Study and TCEQ Edward's Aquifer Stormwater Regulations were reviewed to incorporate components or ensure compatibility.

Review of these reports and documents were compiled into an excel database spreadsheet and tracked by specific code and page. This detailed data will be used as recommendations are made for the Stormwater Management Plan and Drainage Control Manual updates to ensure compatibility among City code, regulations and previous studies findings.

Next is a summary of the documents reviewed and application to the Stormwater Management Plan and DCM.

Document Summaries

TPDES Phase II Existing Stormwater Management

1. *The New Braunfels TPDES Phase II - Storm Water Management Plan* addresses the Texas Pollutant Discharge Elimination System (TPDES) program that designates New Braunfels as subject to regulation under Phase II storm water permitting requirements. This document contains valuable data that can relate to metrics.

Water Quality Documents

2. *TCEQ: Complying with the Edwards Aquifer Rules - Technical Guidance on Best Management Practices* was reviewed for the requirements that address activities that threaten the water quality in the Edwards Aquifer, including aquifer fed wells and springs and upland drainage areas. This document outlines the minimum requirements for water quality however the City of New Braunfels can be more stringent if desired.

3. *The Edwards Aquifer Authority Act* was reviewed because the EAA developed their own best management practices for stormwater within Edwards Aquifer zones.

4. *Comal River Review* shows a decrease in levels of bacterial contamination from the late 1990s to the mid 2000s. There was an increased reporting of elevated levels in 2008 and 2009.

5. *E-Coli* samples were reviewed for baseline e-coli conditions.

6. *High Priority Restoration and Mitigation Actions for the Comal and San Marcos Springs Ecosystems* was reviewed for information on the restoration and mitigation projects in the New Braunfels area.

City Ordinances and Permitting

7. *Ordinance Chapter 14:*

   The Building Code and Building Regulation Ordinance was reviewed for consistency with best stormwater management practices. Building permit requirements for fences should not obstruct flows up to and including the 100-year peak flow.

8. *Ordinance Chapter 58:*

   The Flood Damage Prevention Ordinance was updated in 2010 and was reviewed to confirm regulations for development in floodways and for floodway variance. The document covers variance procedures, flood hazard reduction, residential construction, non-residential construction, enclosures and manufactured homes in designated in the 2009 Flood Insurance Rate Maps and/or Flood Boundary-Floodway Maps (FIRM and/or FBFM) as Floodways or FEMA Flood Zone A. The City of New Braunfels Building Department provided additional outreach after the 2010 flood to help homeowners navigate the permitting process for repairs due to flood damage.

9. *Ordinance Chapter 83:*

   The Parks and Recreation Ordinance was reviewed for information relating to river access and fees. It is an offense and a violation of this section for any person to enter any lake, river, stream or waterway by jumping, diving or performing any other dangerous acts on or off any bridge, street, highway, appurtenance, publicly owned land or public right-of-way.

10. *Ordinance Chapter 114:*

    The Streets and Sidewalks Ordinance was reviewed for potential opportunities to incorporate Low Impact Design stormwater techniques into the road networks. Landscaping in street right-of-ways is regulated by the City and NBU. Efforts should be taken to ensure LID type of vegetation is allowed and supported.

11. *Ordinance Chapter 118:*

    The Platting Ordinance addresses water, sewer, drainage facilities and flood hazards for subdivisions. This document was reviewed for requirements related to drainage and runoff. Natural waterways and channels should be used to carry runoff, whenever practical. Landscape features are encouraged in locations where future street improvement, sidewalks, drainage improvements or utilities would not be located.

12. *Ordinance Chapter 130:*

    The Public Utilities Ordinances is the section implementing the TPDES and discusses wastewater and discharge. Illicit discharge is also regulated in Chapter 110 and 142 of the Ordinance Code.

13. *Ordinance Chapter 143:*

    The Drainage System Ordinance was reviewed for minimum building requirements relating to drainage improvements, setbacks, and impact analysis. The ordinance states that owners must provide a study of downstream impact and the city's drainage system's capacity to accept stormwater. Municipal Drainage Utility System Ordinance is reviewed in more detail as part of the DCM review following this code review.

14. *Ordinance Chapter 144:*

The Zoning Ordinance was reviewed for potential metrics and conflicts to stormwater. Topics reviewed include common open space, overhang easement, roof runoff, construction, pollution prevention, drainage, and fences. The following sections relate to stormwater management.

- Section 5.1 Parking paving requirements may create additional impervious cover.
- Section 5.2 Landscaping should take into consideration stormwater LID features. Fences may not be lower in elevation than the highest point on either side of a drainage easement.
- Section 5.8 Agriculture uses should have some regulation specific to drainage ways.
- Section 5.20 The use of human-scaled elements on buildings could be rain harvesting.

Watershed Related Studies

15. *The Watershed Management Fee Implementation Study (2003)*

This study was reviewed for potential policies and the methodology for applying costs associated with drainage and stormwater related expenses. This study recommended a fee based upon impervious cover for parcels, watershed and stormwater management and identified potential funding sources. In April 2011, the City of New Braunfels proposed a potential fee to the City Council and supported the creation of the Watershed Advisory Committee. A decision was tabled indefinitely on June 25th, 2012.

16. *Geronimo and Alligator Creek Protection Strategies*

These strategies were reviewed for urban stormwater and wastewater management practices that could provide baseline material for metrics. Outreach education programs and funding partnerships are explored as mechanisms to protect water quality. Nutrient management training to interested parties is recommended. Sanitary sewers are proposed for areas served by septic systems.

17. *Stream Assessment Deliverable 01*

This assessment provides the methodology from which stream assessments will be conducted. It provides basic rules and guidelines for assessment teams. This document was reviewed for best management practices and techniques.

18. *River Expenses*

This document was reviewed for actual costs of river expenditures including police, streets, parks, management, litter, and anti-litter campaigns. This data is useful for baselines of metrics.

19. *The Impact of Tourism on Comal County*

This document measures the economic impact of tourism, which includes a specific measurement of river tourism. Obvious economic benefits are outlined as well as non-measurable impacts. The conclusion suggests that spending decisions influencing this sector be seen in a broad context. The data in this document is useful for identifying baselines of metrics.

20. *New Braunfels CIP Costs and Proposed Projects*

This document was reviewed for understanding of previous drainage projects completed by the City of New Braunfels. Consideration for future projects should be made for potential increased costs due to more strict regulations in the 2012-2017 FM MS4 implementation.

DCM Review

A detailed review of the existing Drainage Control Manual was completed by the consultants and City Staff in January and March. This review identified key issues related to the stormwater plan for New Braunfels and prioritization of completing changes. An overview of the recommended changes are summarized below:

II

Phase II Report

Stakeholder Meeting Process

There were two rounds of stakeholder meetings during this process. The purpose was to build upon the four day public input after the floods in 2010. Instead of having a large meeting where one faction can control the conversation, our approach was to have a series of two-hour meetings with likeminded stakeholder groups. This enabled the conversation to stay focused on the point of view of the stakeholder group.

The first round of stakeholder meetings was a series of focus group workshops over a two day time period on October 9 and 10, 2011. The purpose of this first round of meetings was to introduce the process, gather priorities on stormwater strategies for the community and present best management practices (BMP) as it relates to stormwater management.

The second round of public meetings was a series of focus group workshops over a one day time period on January 22, 2012. These meetings focused on the prioritization and location of specific implementation tools associated with preferred stormwater strategies gathered from the last series of meetings.

Strategy Development

Stormwater strategies were developed through the review of existing documents, review of approved EPA mechanisms and consultation with City Staff.

The City of New Braunfels has an existing MS4 permit and a Drainage Criteria Manual that currently guides stormwater management. A review of these documents was completed to gather a base understanding of existing stormwater strategies in the City.

The Environmental Review of approved EPA mechanisms supplemented the list of stormwater strategies with green infrastructure options that have multiple benefits for the City.

A final list of potential stormwater strategies was created in consultation with City staff after review of the above strategy options.

Strategy Details

For each stormwater strategy, a brief description was created based upon the common understanding of the strategy in City or governmental materials. This description was followed with a list of benefits and limitations of each strategy. Finally, each strategy included information on the typical scale at which the strategy may be applied (site, community, regional) and the phase of the project the strategy is most applicable to (policy, design and construction,operations, maintenance and monitoring).

The following pages have the above information summarized. Appendix B has full cards that were used for each strategy during the public engagement process.

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
OPEN SPACE CONSERVATION PLAN	Set aside lands to preserve open space that has high infiltration rates which contributes to reduced peak flow levels and increased infiltration into underground aquifers.	• Preserve the character of the New Braunfels Hill Country • Maintain (or reduce) impervious cover existing in watersheds contributing to New Braunfels • Contribute to TCEQ permit approval	• Will not increase infiltration, only maintains existing status • Require funding for potential purchase of land or easements	•					•
FLOODWAY BUILDING PROHIBITIONS	Further limit or restrict new construction in the 100-year floodplain and floodway beyond existing ordinance.	• Reduce flood damage and insurance claims • Increase open space area	• Reduce landowners' area of usable land	•				•	•
STREAM BANK SETBACKS	Establish setbacks from streams for buildings, parking lots and other structures.	• Protect waterways from point source pollution • Reduce flood damage and insurance claims • Prevent or minimize erosion and gully formation	• Reduce direct access to water	•	•		•	•	•
BUILDING MATERIAL REGULATIONS	Limit the use of materials in construction that contribute to water pollution.	• Improve downstream water quality • Improve wildlife habitat • Improve drinking water quality • Increase cost savings over time • Increase energy efficiency	• Be more costly and not as readily available as other strategies	•	•		•	•	
	Enhanced seeding, mulching, sediment traps, silt fencing, erosion control plan beyond existing requirements.	• Be less costly to contractors during construction if implemented from the beginning • Reduce sedimentation in waterways • Increase water quality	• Be costly for small projects	•	•		•	•	•

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
STORMWATER FACILITIES INVENTORY	Inventory of all stormwater facilities in each watershed, including type, capacity, maintenance responsibility and schedule.	• Be extremely useful for city to have on record and when determining needs for new stormwater facilities	• Be difficult to keep up to date once in place • Require a time-consuming survey	•		•		•	•
MAINTENANCE PLAN AND REGULATIONS	Outline responsibilities for ensuring maintenance is completed and operating correctly and incorporate BMPs into regular City maintenance practices.	• Reduce costs associated with poorly managed facilities and infrastructure • Reduce wasted natural resources	• Require on-going staff training • Require the creation or revision of a maintenance procedures manual	•	•	•	•	•	•
DENSITY BONUSES	Incentives and bonuses for increased density.	• Reduce the impacts such as increased flooding from impervious cover • Allow the City to incentivize increased density in desired areas • Require TCEQ permit approval	• Require additional study to determine which areas could become more dense	•			•	•	•
STORMWATER UTILITY FEE	Implement fee to fund maintenance of stormwater facilities.	• Help defray the costs of maintaining existing facilities as the city grows	• Inhibit new development if fee is perceived as too costly	•		•	•	•	•
CITY INCENTIVES OR FEES	Some examples: Buy into watersheds to pay in lieu or transfer to other properties Impact fee / mitigation fee / linkage fee Expedited permitting process	• Increase revenue that can be used to finance infrastructure or capital projects	• Inhibit new development if fee is perceived as too costly • Cause development in undesirable areas that may not have an impact fee	•			•	•	•

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
IMPERVIOUS COVERAGE REDUCTIONS OR LIMITS	Increased densities, decreased road sections, reduced parking requirements; ensure no more than 65% impervious cover in City Limits or ETJ.	• Be applied at multiple scales with various mechanisms • Decrease the peak flow stormwater runoff	• Require changes in City regulation and standards • Require coordination among land owners when implementing at a community scale	•	•		•	•	
POROUS PAVEMENT	Increase use of pervious paving materials by amending code to allow the use of such materials in roadways and parking lots.	• Reduce volume of runoff • Reduce delivery of associated pollutants to warm water bodies • Reduce need for more involved stormwater drainage, conveyance and treatment systems • Contribute to TCEQ permit approval	• Be costlier than traditional materials • Is typically used for more lightly-trafficked (vehicular) sites • Require more frequent maintenance • Offer different TCEQ benefits depending on concrete or asphalt • Not be applicable for curb and gutter roadway sections		•		•	•	
RETENTION - WITH OR WITHOUT BIOTIC HABITAT	These structures maintain a permanent pool of water in addition to temporarily detaining stormwater. Stormwater capture through wet ponds and stormwater wetlands creates water filtration, habitat and detention of water. Potential for re-use of filtered water for irrigation.	• Be aesthetically pleasing by adding a water feature and plant material • Remove dissolved nutrients • Contribute to TCEQ permit approval	• Increase construction costs • Increase maintenance costs • Contribute to thermal pollution and cause downstream warming • Be a safety concern for children • Cause nuisances such as mosquitoes, odor, algae • Have the potential to dry up during drought without external water source		•		•	•	•

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
BUILDING RUNOFF CAPTURE	Capture and storage of rainwater from roofs, cisterns.	• Mitigate or eliminate increased runoff volume • Reduce the required capacity for down-slope retention and sediment control BMPs • Contribute to TCEQ permit approval	• Increase building costs, for example: installing a green roof • Will not claim flood control credit unless sized properly • Be hard to enforce		•		•		
INFILTRATION BASIN	Examples include swales, infiltration basins, rain gardens or shallow excavated trenches filled with gravel or crushed stone that is designed to infiltrate stormwater through permeable soils into the groundwater aquifer; often used to treat runoff from parking lots or sidewalks.	• Have relatively low costs of construction • Be aesthetically pleasing • Treat certain pollutants • Contribute to TCEQ permit approval	• Not appropriate for sites where there is a possibility of groundwater contamination or where there is soil with a high clay content that could clog the trench • Require maintenance • Be subject to additional regulation by EAA		•		•	•	•
BIOFILTER	Biofilters may consist of either biological or engineered characteristics. The use of native plants in stormwater facilities increases habitat and evapotranspiration. Examples include grassed channels, swales and filter strips. Engineered mediums filter out various contaminants and pollutants.	• Have relatively low costs of construction • Be aesthetically pleasing • Treat certain pollutants • Contribute to TCEQ permit approval	• Require periodic maintenance		•	•	•	•	•

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
DETENTION BASIN (INCLUDES MULTI-USE STORMWATER DETENTION FACILITIES)	Basins that temporarily detain a portion of stormwater runoff for a specific length of time and can increase water quality. Examples of multi-use detention facilities include parks, open space, bike paths and fields.	• Improve infiltrated water quality • Reduce flooding • Prevent downstream channel scouring • Increase park and open space area • Contribute to TCEQ permit approval	• Require maintenance which is both essential and costly		•			•	
WETLAND BASIN OR CHANNEL	Engineered systems designed to perform the water purification functions of natural wetlands. Best when used in conjunction with other BMPs, such as minimization of initial runoff volumes and use of pervious pavement or swales. May also be restored wetlands.	• Be very effective in removing pollutants • Decrease irrigation needs • Provide groundwater recharge • Contribute to TCEQ permit approval	• Contribute to thermal pollution and cause downstream warming if shallow water is present • Be a safety concern for children • Require frequent and intensive maintenance • Cause nuisances such as mosquitoes, odor and algae • Limit nearby future development due to wetland regulations		•		•	•	•
LITTER CONTROL	Clean up or minimization of litter in rivers, storm drain facilities and along streets to reduce the amount of debris in the rivers, creeks and detention basins.	• Be a cost effective strategy • Reduce maintenance of other stormwater structures • Reduce chances of localized flooding due to drainage blocks	• Require on-going efforts in the community • Limit the use of disposable materials in key locations	•		•	•	•	•
RETROFIT EXISTING STORMWATER FACILITIES	Upgrade existing facilities that are in need of repair to current standards and low impact development techniques.	• Reduce future maintenance costs post-retrofitting • Improve functionality of unmaintained facilities	• Require costly upgrades		•	•	•	•	•

STRATEGY	KEY FEATURES & COMPONENTS	BENEFITS	LIMITATIONS	PROJECT PHASE			SCALE		
				POLICY	DESIGN & CONSTRUCTION	OPERATIONS, MAINT. & MONITOR	SITE	COMMUNITY	REGIONAL
STREAM AND RIVER RESTORATION	Restore hydrology to original functioning. Restores channel and waterway ecosystem.	• Alleviate issues of increased sediment accumulation and nutrient loading • Restores wildlife habitat • Contribute to TCEQ permit approval	• Be a very costly process • Require land use changes		•	•		•	•
CLUSTERING	Allows the same amount of houses on the site as a traditional development, but the houses are on smaller lots and large areas of open space are preserved as open space where structures may never be built.	• Increase open space by focusing development • Manage stormwater more effectively than in conventional developments • Contribute to TCEQ permit approval	• Inhibit development through restrictions	•	•		•	•	

Round One Stakeholder Meetings

Process

A series of stakeholder meetings was held on October 10 and 11, 2011. The stakeholder meetings were used in order to have focused discussions of stormwater issues with like-interested groups regarding specific stormwater concerns. The following groups were represented: Agriculture, Developers and Real Estate, Designers and Engineers, Economic Interest, Environmental, Water -Based Businesses, Agencies, Home Owners Associations (HOAs), Public, Council, and the Watershed Advisory Council (WAC).

During each meeting, participants were given a brief introduction and overview of the goals for the process and were asked to prioritize the strategies using a set of strategy cards. Each group was given 23 strategy cards and were asked to identify their top 10 strategies, rank them in order of most appropriate for New Braunfels and identify any strategies that were not at all appropriate for New Braunfels.

Results

As a result of the October meetings, the stakeholder groups indicated that the stormwater strategies most important to them include the following:

	STRATEGY
1	Maintenance and Monitoring
2	Flood Hazard Mitigation
3	Detention Basin
4	Litter Control
5	Open Space Conservation
6	Stream and River Restoration
7	Construction Control Measures
8	Retrofit Stormwater Facilities
9	Impervious Cover Reductions
10	City Incentives or Fees

A detailed account of the results from the stakeholder meetings can be found on the following page.

Legend

= ranking priority of strategy, 1 being the highest and 10 being the lowest

X = strategy is not appropriate for New Braunfels

STRATEGY	STAKEHOLDER GROUP										
	AGRICULTURE	DEVELOPERS AND REAL ESTATE	DESIGNERS AND ENGINEERS	ECONOMIC INTERESTS	ENVIRONMENT	WATER BASED BUSINESS	AGENCIES	HOA	PUBLIC	COUNCIL	WAC
OPEN SPACE CONSERVATION PLAN	1	8		8	7		8	7	10	7	4
FLOODWAY BUILDING PROHIBITIONS		2	1		2			10			
STREAM BANK SETBACKS		5	5		3	10	9				
BUILDING MATERIALS	X		X	X			X				
CONSTRUCTION CONTROL MEASURES		4	10	X	5	5	10	8	4		
STORMWATER FACILITIES INVENTORY				7		9	1				3
MAINTENANCE AND MONITORING		6	4	2		2	3		3	2	5
DENSITY BONUSES	X		X	X				X			9
STORMWATER UTILITY FEE			X	4			2	X		4	
CITY INCENTIVES OR FEES	X	7				3	5	X			2
IMPERVIOUS COVERAGE REDUCTIONS OR LIMITS				3	1		7		6		
POROUS PAVEMENT			9	X					5	8	10
RETENTION - WITH OR WITHOUT BIOTIC HABITAT	5		7				X	3		10	
BUILDING RUNOFF CAPTURE	4	9				4	6	X	9		
INFILTRATION BASIN	8			9	8			9			8
BIOFILTER	9				9					9	6
DETENTION BASIN		3	8		4		4	4	2	6	
WETLAND BASIN OR CHANNEL								6			
LITTER CONTROL	2			1		6		2	7	5	
RETROFIT EXISTING STORMWATER FACILITIES	6		3	6		8		5	1	3	
STREAM AND RIVER RESTORATION	3	10	6	5	10	7		1			
CLUSTERING	X				6				8		7
FLOOD HAZARD MITIGATION	7	1	2	10		1	X			1	1

Round One Online Web Survey

Process

Meetings were held in October of 2011 that introduced the online polling process to the City of New Braunfels. As part of the public outreach for this project, this online tool, hosted by Metroquest, allows the general public to access an interactive internet website where they are able to view and receive information about various stormwater strategies in effort to gain a better understanding of the benefits and limitations each streategy possesses for the City of New Braunfels. This website also allows each user to provide feedback by prioritizing the strategies by how they think each best represents what the City of New Braunfels should incorporate into its new comprehensive vision for the future of stormwater management in the city.

The online polling opened on October 10, 2011 and was closed on December 7, 2011. The online polling provided the Design Workshop team with a very valuable set of information with which to move forward as work continues on this project with the City of New Braunfels and other various planning consultants.

Results

At the conclusion of the online polling, the results were collected from the MetroQuest web application and compiled into six separate documents composed of various pieces of information. Among these documents are the *Feedback by Visitor*, *Community Rankings* of the stormwater strategies, *Demographics by Visitor*, and information of *Visits by Location*. All of these results are documented in Appendix C & D.

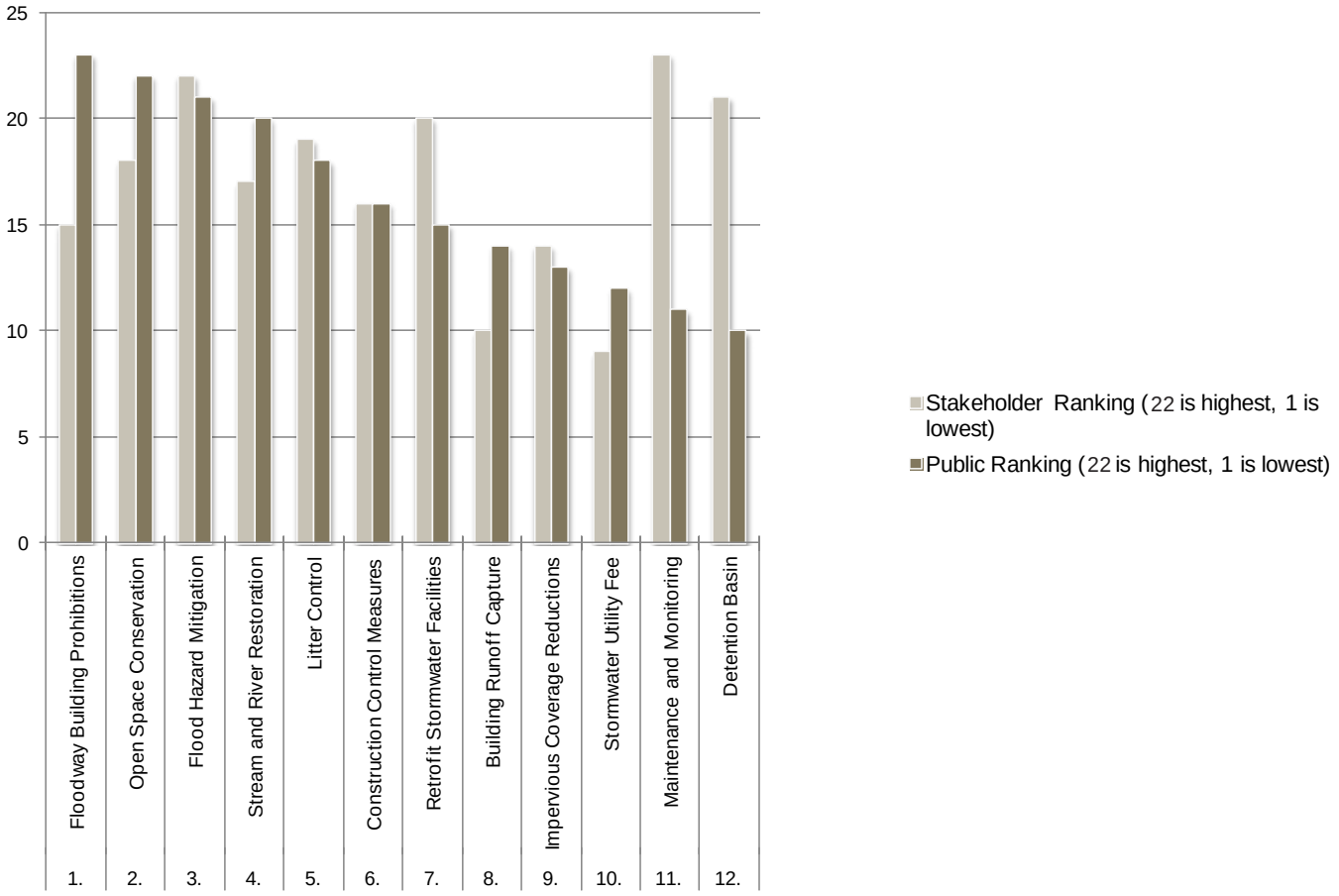
The *Community Rankings* document, perhaps of most relevance to this process, contains the results of the prioritization from all the website visitors who took time to organize their top strategies to be considered. The strategies read in descending order of what is most important to what is least important according to those who participated in the survey. The results of the priorities are as follows:

	STRATEGY
1	Floodway Building Prohibitions
2	Open Space Conservation
3	Flood Hazard Mitigation
4	Stream and River Restoration
5	Retention
6	Litter Control
7	Density Bonuses
8	Construction Control Measures
9	Retrofit Stormwater Facilities
10	Building Runoff Capture
11	Impervious Coverage Reductions
12	Stormwater Utility Fees
13	Maintenance and Monitoring
14	Detention Basins
15	Clustering
16	Stream Bank Setbacks
17	Wetland Basins
18	Biofilters
19	City Incentives of Fees
20	Building Materials
21	Stormwater Facilities Inventory
22	Infiltration Basin

Priority Strategies

Based upon the results from the stakeholder meetings and the online poll, 12 strategies were identified as top strategies to pursue in the City of New Braunfels.

The category of “Implementation Tools” consists of the Stormwater Utility Fee, Density Bonuses and City Incentives or Fees strategies, which is shown with an average.



This graph represents both the stakeholder and public ranking order for the strategies.

Analysis Categories

The top 12 strategies were analyzed according to:

- The goals for the Stormwater Management Strategy
- The governing authority (City Limits, Extraterritorial Jurisdiction (ETJ) or Other)
- The time frame of implementation (Past or Future)
- The method of implementation (Policy, Design and Construction or Operation and Maintenance)
- The scale of the strategy (Site, Community and/or Regional)

Goals

The first level of analysis was to measure the amount of times that each goal was met by the chosen strategies. The frequency of the times that the goal is met indicates whether or not the goal may be achieved with the voted strategies.

Each of the 13 goals was met by at least one strategy. The goals to encourage development patterns that improve stormwater management opportunities, ensure stakeholder buy-in on stormwater strategies and to develop stronger stormwater standards without stifling growth and development were met through the higher-voted strategies, while the goal to align the city's tourism industry practices with sensible stormwater management was only in two of the top twelve strategies.

The significance of this is that the plan's recommendations will need to ensure that the alignment with tourism industry practices goal is met.

STRATEGY	GOAL 1: ENCOURAGE DEVELOPMENT PATTERNS THAT IMPROVE STORMWATER MANAGEMENT OPPORTUNITIES.	GOAL 2: MINIMIZE IMPERVIOUS SURFACES.	GOAL 3: PREVENT FLOODING AND EROSION CAUSED BY STORMWATER RUNOFF.	GOAL 4: PROTECT WATER QUALITY OF RECEIVING WATERS, PARTICULARLY THE STREAMS AND LANDA LAKE.	GOAL 5: ENSURE CONSTRUCTION DOES NOT CREATE ENVIRONMENTAL DEGRADATION, EVEN ON A TEMPORARY BASIS.	GOAL 6: ENSURE STAKEHOLDER BUY-IN ON STORMWATER STRATEGIES.	GOAL 7: MAKE SURE RESPONSIBILITY FOR OPERATIONS AND MANAGEMENT OF STORMWATER INFRASTRUCTURE IS CLEAR.	GOAL 8: UTILIZE PARKS AND OPEN SPACE FOR STORMWATER STORAGE AND INFILTRATION.	GOAL 9: ALIGN THE CITY'S TOURISM INDUSTRY PRACTICES WITH SENSIBLE STORMWATER MANAGEMENT.	GOAL 10: DEVELOP STRONGER STORMWATER STANDARDS WITHOUT STIFLING GROWTH AND DEVELOPMENT.	GOAL 11: ENSURE THAT THE INVESTMENT IN INFRASTRUCTURE HAS A POSITIVE RETURN ON INVESTMENT FOR THE COMMUNITY.	GOAL 12: STORMWATER INFRASTRUCTURE SHOULD BE VISUALLY PLEASING.	GOAL 13: ENSURE CRAFTSMANSHIP OF STORMWATER INFRASTRUCTURE WILL RESULT IN PERMANENCE.
Floodway Building Prohibitions	X				X			X		X			X
Open Space Conservation	X			X				X			X	X	
Flood Hazard Mitigation	X					X			X				
Stream and River Restoration	X	X	X	X		X		X	X	X		X	
Litter Control	X				X	X	X			X	X		X
Construction Control Measures			X	X	X		X			X			X
Retrofit Stormwater Facilities			X	X		X	X			X			X
Building Runoff Capture		X	X		X	X					X		X
Impervious Coverage Reductions		X	X			X				X		X	X
Maintenance and Monitoring	X			X			X	X		X		X	
Detention Basin	X	X	X	X		X		X		X		X	
Implementation Tools	X		X	X		X				X	X		X

Governing Authority

Strategies that are applied within the City limits will use implementation tools based on City regulation and incentives. Strategies that are applied in the ETJ will require partnerships and cooperation with other jurisdictions for implementation.

This chart (right) shows that all of the strategies fall within the City Limits governing authority, while approximately half will have both City Limits and ETJ purview.

STRATEGY	CITY LIMITS	ETJ
Floodway Building Prohibitions	X	
Open Space Conservation	X	X
Flood Hazard Mitigation	X	X
Stream and River Restoration	X	X
Litter Control	X	X
Construction Control Measures	X	
Retrofit Stormwater Facilities	X	
Building Runoff Capture	X	
Impervious Coverage Reductions	X	X
Maintenance and Monitoring	X	
Detention Basin	X	X
Implementation Tools	X	

Time frame of Implementation

Each of the strategies were evaluated based upon applicability to past or future actions.

The majority of the strategies will effect future actions. Only the stream and river restoration and retrofitting of stormwater facilities will have impacts that affect structures or actions retroactively. Discussion on how to address existing infrastructure needs to continue.

STRATEGY	PAST	FUTURE
Floodway Building Prohibitions		X
Open Space Conservation		X
Flood Hazard Mitigation		X
Stream and River Restoration	X	
Litter Control		X
Construction Control Measures		X
Retrofit Stormwater Facilities	X	
Building Runoff Capture		X
Impervious Coverage Reductions		X
Maintenance and Monitoring		X
Detention Basin		X
Implementation Tools		X

Method of Implementation

A balanced approach to stormwater management requires strategies to be implemented at the policy, design and construction, and operations and maintenance phases of projects. This ensures long term solutions and changes in the approach to stormwater management.

These strategies focus more on policy and design and construction projects. Through building in operations and maintenance into some of the design and construction projects, a balanced approach to stormwater management could be achieved.

STRATEGY	POLICY	DESIGN AND CONSTRUCTION	OPERATIONS AND MAINTENANCE
Floodway Building Prohibitions	X		
Open Space Conservation	X		
Flood Hazard Mitigation	X		
Stream and River Restoration		X	X
Litter Control	X		X
Construction Control Measures	X	X	
Retrofit Stormwater Facilities		X	X
Building Runoff Capture		X	
Impervious Coverage Reductions	X	X	
Maintenance and Monitoring	X	X	X
Detention Basin		X	
Implementation Tools	X		

Scale

Understanding the most appropriate scale for implementation of strategies is needed to make sure that stormwater is being managed comprehensively. Many of the management tools are best applied based upon drainage patterns and should not be applied based upon jurisdictional lines.

The strategies provide a balance among site, community, regional scales. Most of the strategies will be implemented at multiple scales, reinforcing a balanced distribution of approaches.

STRATEGY	SITE	COMMUNITY	REGIONAL
Floodway Building Prohibitions		X	X
Open Space Conservation			X
Flood Hazard Mitigation		X	X
Stream and River Restoration		X	X
Litter Control	X	X	X
Construction Control Measures	X	X	X
Retrofit Stormwater Facilities	X	X	X
Building Runoff Capture	X		
Impervious Coverage Reductions	X	X	
Maintenance and Monitoring	X	X	X
Detention Basin		X	
Implementation Tools	X	X	X

Priority Strategy Implementation Options

In order to best understand the implementation options, the current conditions in New Braunfels were evaluated specific to each strategy. This evaluation provided an existing condition specific to each strategy.

A series of case studies around each of the strategies was then completed to better understand how other cities similar to New Braunfels have implemented similar strategies. These case studies were based upon four criteria: comparable size to New Braunfels, economy has river-based tourism, regionally similar with priority to Texas examples, and presence of MS4 permit.

The proposed implementation options for each strategy are based on the case studies and extensions of the strategies that New Braunfels currently has in place. These proposed implementation options are summarized at the end of this chapter.

The following pages outline each strategy, explaining the actions that New Braunfels has already taken to address the strategies, the recommendations that were pulled from the corresponding case studies and the proposed implementation options for New Braunfels.

Proposed implementation options are explained in Phase III of this document.

Floodway Building Prohibitions

New Braunfels Existing Conditions

Fences constructed in drainage easements must not restrict the flow of drainage water.

New development must not increase the water surface elevation of the base flood level more than one foot.

The lowest floor of new construction must be elevated to at least two feet above the base flood level.

Floodway encroachments are prohibited unless it can be demonstrated that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the 25-year and base flood discharge.

The Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP) provided New Braunfels with funds for a buyout program for flood damaged properties following the Flood of 2002.

Case Study Recommendations

King County, Washington | Prohibit "flood fringe" development.

King County, Washington | Increase floodway to encompass nearly the entire floodplain.

Open Space Conservation

New Braunfels Existing Conditions

New Braunfels defines an "Open Space" park land as land which is not programmed for any specific active recreational purpose. Its value is typically defined as visual, ecological and providing compensation for impermeable surfaces.

The recommended level of service for Open Space park land is 10 to 15 acres per 1,000 residents. The year 2015 need with 77,726 projected residents is 777-1,166 acres and the 2020 need with 99,200 projected residents is 992-1,488 acres. New Braunfels has three existing Open Space parks including portions of Cypress Bend park, Solms Park and Fischer Park.

The 2010 New Braunfels Strategic Parks and Recreation Master Plan recommends that land banking should be considered crucial and a program to be put in place to ensure the acquisition of parkland. Available land to address current and future needs may include existing vacant land, land subject to flooding along the creeks and drainage channels and land dedicated as parks as a requirement of developers to fulfill the City's Parkland Dedication Ordinance.

Case Study Recommendations

Maricopa County, AZ | Natural drainage channel includes recreational uses while increasing floodwater conveyance capability.

Roseville, California | Permanently protected site guarantees the site will always be used for flood control, wetland habitat and public recreation.

Hays County, Texas | Assemble 10-15,000 acres of preserved land over 30 years through a phased conservation banking approach.

Flood Hazard Mitigation

New Braunfels Existing Conditions

New Braunfels submitted the following mitigation action items for inclusion in the Alamo Area Council of Governments Regional Mitigation Action Plan:

- Remove trees and debris from Dry Comal Creek and the Guadalupe River to allow for better creek drainage.
- Acquire flood-damaged structures along the Guadalupe River to remediate repetitive flood losses and convert those areas to open space.

New Braunfels is currently underway or has completed the following flood mitigation projects:

- North Tributary Regional Flood Control Project
- South Tributary Regional Flood Control Project
- Dry Comal Flood Control Project
- Landa Dam culvert repair

In April 2011, eight sirens were installed along the Comal and Guadalupe Rivers, which will serve to warn residents about hazardous flooding conditions.

In January 2011, the City Council approved Resolution No. 2011-R02 which authorizes the City Manager to support the Guadalupe-Blanco River Authority's application for flood protection planning grant assistance filed with the Texas Water Development Board.

In June 2011, New Braunfels adopted a flood damage prevention ordinance, which seeks to minimize losses due to flood conditions.

Case Study Recommendations

State of South Carolina and King County, Washington - Include prevention measures, property and natural resource, emergency service, reduction of risk to structures and critical facilities and public information activities in Flood Hazard Mitigation Plans.

Stream and River Restoration

New Braunfels Existing Conditions

New Braunfels is affiliated with the Geronimo and Alligator Creeks Watershed Partnership. They provide outreach materials and programs related to how bacteria and nutrients affect water quality.

The Partnership seeks:

- To provide nutrient management training to appropriate parties regarding proper nutrient application and soil testing.
- To provide educational programs for homeowners who have septic systems.
- To repair, replacement or upgrading of failing septic systems.
- To expand sanitary sewer system to areas currently served by septic.
- Funding for more frequent and expanded household hazardous waste and bulk waste cleanups in the watershed.

Case Study Recommendations

Georgia - Increase pollution awareness through education.

Georgia - Provide citizens with opportunities to monitor waterways.

Georgia - Encourage relationships between citizens and government.

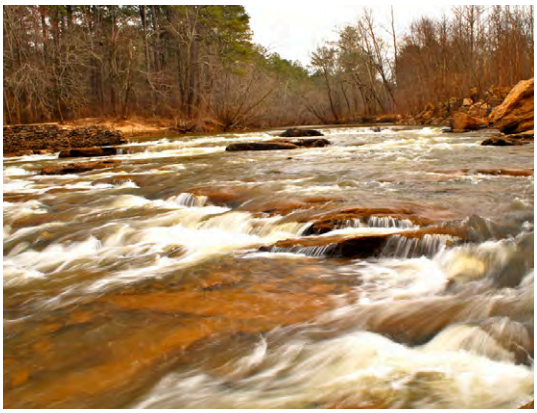
Georgia - Collect quality water data through citizen involvement.

Boston, Massachusetts - Remove built-up sediment to restore original dimensions of river.

Boston, Massachusetts - Daylight and install large culverts.

Boston, Massachusetts - Remove invasive vegetation.

Buford, Georgia | Protect naturally vegetated riparian buffers through enforcement of a 50-foot undisturbed buffer with an additional 25-foot impervious surface buffer along intermittent streams.



Litter Control

New Braunfels Existing Conditions

It is illegal in the City of New Braunfels to dump any type of debris into a canal, stream, river or drainage ditch. A fine between $200-$2,000 can be imposed. The violator will also be responsible for cleanup.

In November of 2010, the City Council voted unanimously to support the Edwards Aquifer Recovery Implementation Program, which is a collaborative, stakeholder process involving stakeholders to formulate a plan to protect species affected by management of the Edwards Aquifer.

The City passed Ordinance 86-14 in November 2011 to prohibit all disposable containers on certain public waterways, including the Guadalupe River. The ordinance will go into effect in January 2012.

In December 2011, City Council will consider a proposal to charge visitors a fee to access the river. The proceeds from the fee will help to offset the $1 million per year that goes towards cleanup and river management.

Case Study Recommendations

Monterey, California - Provides legal authority to regulate illicit discharges in Stormwater Discharge Management Ordinance.

Wichita Falls, Texas - Require loads to be covered with a tarp during transfer to waste station and landfill.

Wichita Falls, Texas - Provide annual operator awareness training.

Construction Control Measures

New Braunfels Existing Conditions

New Braunfels requires a soil erosion and sediment control plan submittal for commercial permits.

Case Study Recommendations

Douglas County, Colorado - Pre-submittal meetings are encouraged prior to Storm Water Pollution Prevention Plans (SWPPP).

Douglas County, Colorado - Site inspections throughout the construction process.

Eugene, Oregon | Outcome-based erosion control program.

Charolette, North Carolina - All construction activity, regardless of size, must meet minimum standards.

Charolette, North Carolina - Inspections that do not meet standards can be fined up to $3,000 per day.

Retrofit Stormwater Facilities

New Braunfels Existing Conditions

Digital submissions of all drainage reports and structures are required to be submitted to the City of New Braunfels.

New Braunfels created a Watershed Advisory Committee (WAC) due to a federally-mandated stormwater requirement. The WAC is comprised of a committee of nine voting members from a broad spectrum of professional backgrounds.

In February 2011, the committee advised on a list of potential stormwater improvement projects including channel lining, road reconstructions, culvert construction and detention ponds.

In June 2011, New Braunfels approved a budget adjustment for the Stormwater Development Fund. This funds operations and maintenance expenses for personnel and equipment that provides upkeep to drainage facilities and easements.

Case Study Recommendations

Seattle, Washington - The city regularly inspects all privately owned stormwater detention, treatment and conveyance systems.

Seattle, Washington - Property owners are responsible for maintaining drainage systems to ensure long-term functionality.

Montgomery County, Maryland - Consistently update database of stormwater facilities.

Montgomery County, Maryland - Construct bypass weirs, add wetlands or retention and dredge to capture and treat additional volumes of rainfall runoff.

Building Runoff Capture

New Braunfels Existing Conditions

New Braunfels Utilities, and agency separate from the City, offers a rebate toward the purchase of rain barrels or cisterns to help offset the cost of rainwater harvesting systems. The rebate reimburses $0.50 per gallon of water storage installed and is for residential only.

Case Study Recommendations

Los Angeles, California - Install greywater systems, dry wells and cisterns.

Los Angeles, California - Strategically plant and maintain vegetation near impervious areas to help in cleaning stormwater runoff.

Portland, Oregon - Remove or replace impervious pavement with pervious materials.

Portland, Oregon - Direct roof runoff to swales and planters.

Portland, Oregon - Re-grade paved areas so they drain into new or existing landscaping.

Portland, Oregon - Install roof gardens that reduce stormwater flow into sewers.

Lacey, Washington - The Zero Impact Development Ordinance provides developers with the opportunity to demonstrate zero effective impervious surfaces. It requires developers to maintain a site's original hydrologic function after development.

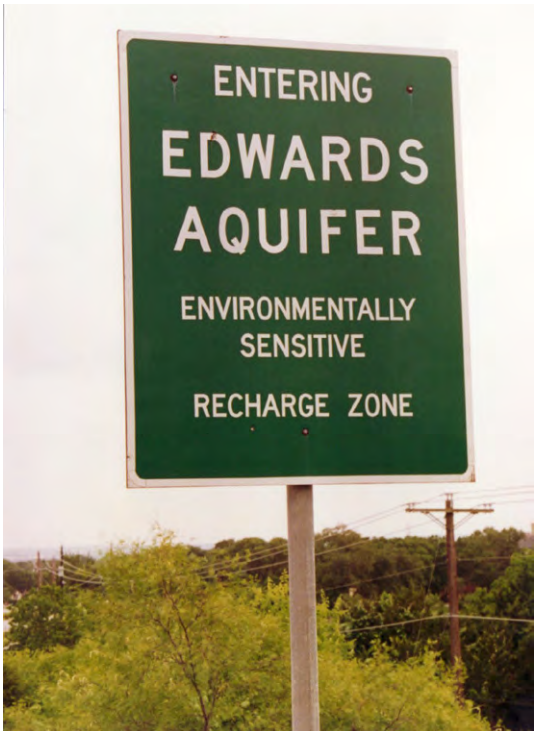
Lacey, Washington - Low Impact Development is a legal alternative to conventional site design.

Impervious Coverage Reductions

New Braunfels Existing Conditions

New Braunfels existing impervious coverage restrictions currently focus on landscape. The planning director may require a professional arborist's report that defines the impact of a development upon existing trees affected by proposed construction and impervious cover limitations adjacent to protected trees.

Landscaping is accepted as adding value to property and is in the interest of the general welfare of the city. The provision of landscaped area also serves to increase the amount of a property that is devoted to pervious surface area which, in turn, helps to reduce the amount of impervious surface area, stormwater runoff and consequent non-point pollution in local waterways. Therefore, landscaping is hereafter required of new development as provided in this section, except landscaping is not required for single-family and two-family, and agricultural uses.



Case Study Recommendations

Austin, Texas - The Edwards Aquifer Recharge Zone Building Limitations limits impervious cover and density in the Edwards Aquifer Recharge Zone. Developers may transfer impervious cover or development rights. The Limitations also specify stormwater treatments and construction management, require detention and stream bank setbacks or buffer zones.

Seattle, Washington - Neighborhood blocks have allowable percentage of impervious surface overage.

Seattle, Washington - Reduce street widths.

Seattle, Washington - Maintain a future redevelopment threshold database.

Maintenance and Monitoring

New Braunfels Existing Conditions

New Braunfels Utilities periodically contracts outside sources to test the water quality in water bodies throughout the New Braunfels area. The purpose of the studies is to provide additional water quality data to assist in determining whether nutrient limitations on point source discharges from New Braunfels Utility's wastewater treatment plants will prevent growth of excessive aquatic vegetation.

The Guadalupe-Blanco River Authority (GBRA) partners with the Texas Commission on Environmental Quality (TCEQ) and has several Comal County water quality monitoring sites located in New Braunfels. They are funded entirely by fees assessed to wastewater discharge and water rights permit holders. The sites are monitored on a monthly or quarterly basis for bacteria and water flow.

Case Study Recommendations

Monroe County, New York - Enlist citizens to monitor water quality, and vegetate riparian corridors.

Monroe County, New York - Establish a stormwater outfall adoption pilot program.

Hillsbrorough County, Florida - Volunteer Adopt-a-Pond Maintenance Program reduces pollution and litter while increasing citizen awareness of stormwater impacts.

Central New York - Engagement of local schools teaches children about stormwater impacts and water quality which at the same time benefits the city by allowing for the collection of scientifically-valid data for water quality monitoring.

Detention Basin

New Braunfels Existing Conditions

The Drainage and Erosion Control Design Manual requires that most development types include post-development discharge mitigation through detention or some other technique. Participation in neighborhood or regional mitigation is also an option.

New Braunfels 2010 Open Space Master plan prioritizes detention over other areas. (Need more details)

Case Study Recommendations

Chicago, Illinois - Detain stormwater on-site, which is then maintained as park or open space by the Parks Department. The Parks Department has an agreement with the community that the stormwater detention facility will only be maintained if it has a recreational use.

Chicago, Illinois - Land can be used for golf courses, sports fields, tennis courts and nature areas.

Tuson, Arizona - Detention basins used as recreational areas provide opportunities for environmental restoration of degraded riparian ecosystems while improving neighboring communities.

Implementation Tools

New Braunfels Existing Conditions

New Braunfels approved stormwater utility fees in July 2011. This fee would potentially raise $2.3 million per year to fund drainage work in New Braunfels. The fee would amount to $4.60 per month for a 2,000-3,000 square foot home. Smaller homes would receive a $3.00 fee and larger homes could pay up to $6.60. Commercial properties would pay approximately $4.60 per month.

The City also provides incentives regarding the drainage facility criteria. A fee may be utilized in place of a detention or retention system. Collected fees will be used to construct public flood control improvements.

Case Study Recommendations

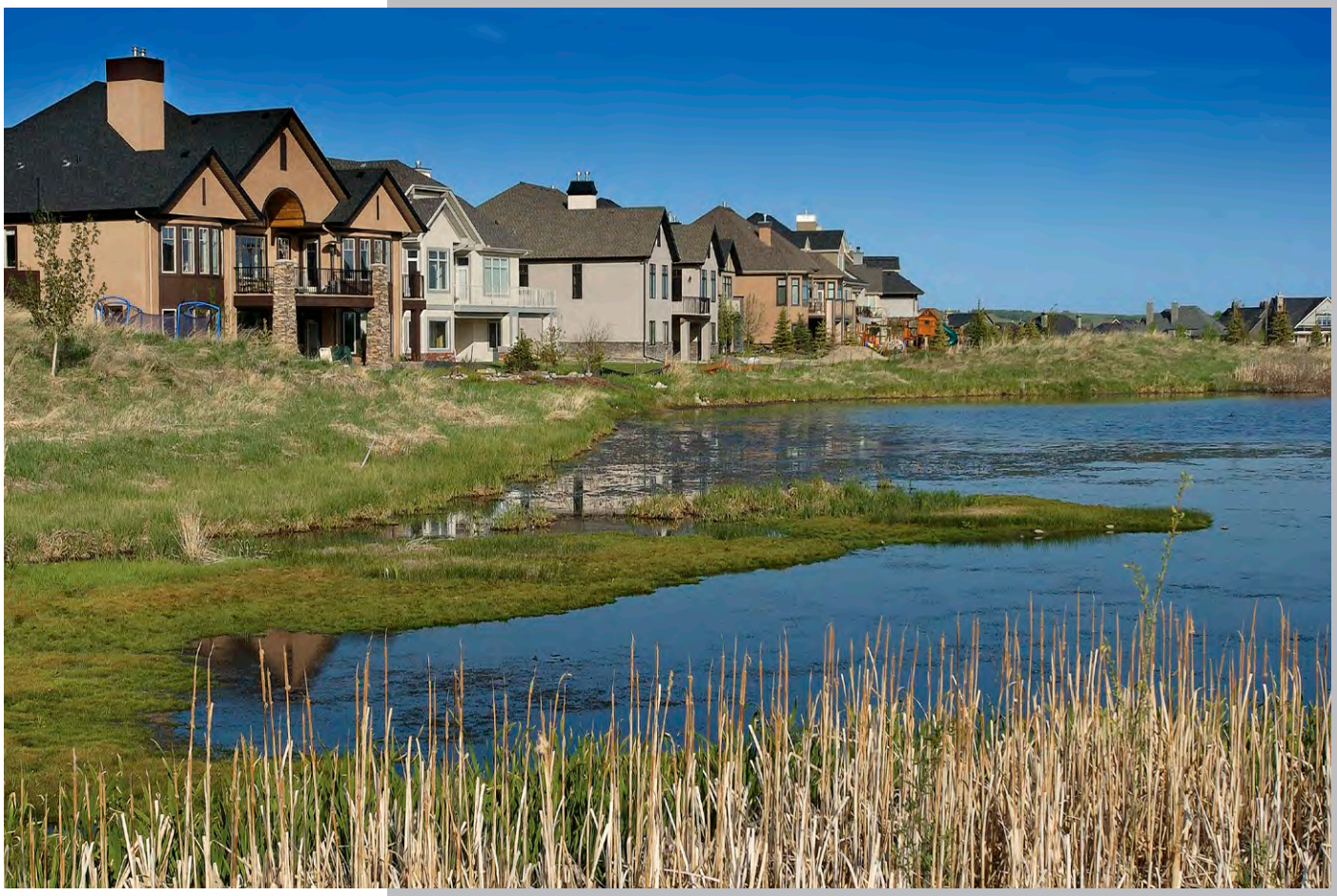
Arlington County, Virginia - Require development site pollutant removal based on the amount of existing and proposed impervious cover. Compliance options include additional on-site or off-site treatment or monetary contribution to the Watershed Management Fund.

Portland, Oregon - The Clean River Rewards Incentive and Discount Program allows property owners who manage stormwater on-site or on the public right of way to be eligible for discounts at 35% of the stormwater charge for on-site and 65% for the public right of way.

Centennial, Colorado - An annual stormwater fee for improved lands is based on impervious area and is charged to the property owner based on the impact that the property will have on the drainage system.

III

Phase III Report



Strategy Implementation Options Development

After stakeholders and the public ranked the strategies (see page 85 for the prioritized list), the next level of analysis was to determine how those strategies would be implemented in the City of New Braunfels.

The consultants reviewed the Drainage Criteria Manual and other city ordinances to determine the criteria that needed updating based on the Stormwater Management Plan's recommendations thus far.

Each strategy has 2-5 implementation options, which have been reviewed by City staff and the Water Advisory Committee.

Strategy	Phase			Scale		
	Policy	Design and Construction	OM and Monitoring	Site	Community	Regional
Floodway Building Prohibitions	●	○	○	○	●	●
Open Space Conservation Plan	●	○	○	○	○	●
Flood Hazard Mitigation	●	○	○	○	●	●
Stream and River Restoration	●	●	●	●	●	●
Litter Control	●	○	●	●	●	●
Construction Control Measures	●	●	○	●	●	●
Retrofit Existing Stormwater Facilities	○	●	●	●	●	●
Building Runoff Capture	○	●	○	●	○	○
Impervious Coverage Reductions or Limits	●	●	○	●	●	○
Maintenance Plan and Regulations	●	●	●	●	●	●
Detention Basin	○	●	○	○	●	○
City Tools	●	○	●	●	●	●

The matrix on this page shows what phase of the process each strategy could take place (Policy, Design and Construction, Operations and Maintenance/Monitoring) and at what scale it is implemented (Site, Community, Regional).

Round Two Stakeholder Meetings

Process

A series of stakeholder meetings were held on March 9, 2012. The purpose of these stakeholder meetings were to receive feedback and insight from the invitees in order to further the Stormwater Management Strategy in a manner that was consistent with a collective vision. The following groups were represented: Designers and Engineers, Environmental, Public, and Watershed Advisory Council (WAC).

Case studies for each of the strategies were presented, along with the implementation options that arose from each case study. The attendees were then asked to vote through keypad polling on the most appropriate implementation option for New Braunfels.

Results

The results from the stakeholder meetings were very much in alignment with the online poll. Attendees were more in favor of prohibiting new structures in the floodway, and were less in favor of reducing street lane widths. More detailed results from the polling are available in the Appendix.

Round Two Online Web Survey

Process

Building on the first online poll (see Phase II report), the purpose of the second online poll was to give the public an opportunity to assign a score to the impact and cost for each stormwater strategy implementation option.

Those who took the poll were able to assign a “thumbs up” or a “thumbs down” to each implementation option. The user could also rank the option as a favorite.
The second round of online polling opened on March 12, 2012 and was closed on May 18, 2012. The first online poll was still available for people to rank the initial stormwater management strategies. There were no major changes to the priority list.

Results

At the conclusion of the online polling, the results were collected from the MetroQuest web application and compiled into a spreadsheet that lists each stormwater strategy and its implementation options with a count of “thumbs up”, “thumbs down” and favorite votes. This document can be found in the Appendix.

The top three favorite options were:

- to update the Drainage and Erosion Control Manual
- to update the building code to allow the use of detention basin water for irrigation and provide incentives for developers that implement reclaimed water systems and
- to partner with Comal and Guadalupe Counties for conservation land acquisition of sensitive recharge areas and other open space.

The top three highest ranked options were:

- to require Storm Water Pollution Prevention Plans that produce outcome-based performance measures specific to each project
- to partner with Comal and Guadalupe Counties for conservation land acquisition of sensitive recharge areas and other open space.
- to prohibit (versus regulation of) new habitable structures from being constructed in the floodway.

Options that had more “thumbs down” votes than “thumbs up” include:

- reducing the street lane width requirement
- basing stormwater fees for improved land on percentage of impervious cover
- establishing a baseline fee for stormwater management, but allowing compliance options for developments, such as contribution to a fund or additional on- or off-site
- enacting an ordinance that limits disposable items, such as bags and cups
- enacting a Pet Waste ordinance
- creating a citizen-based monitoring program
- funding and staffing City inspections of private drainage facilities and
- establishing a funding source for sedimentation and invasive vegetation removal.

STRATEGY CATEGORY	IMPLEMENTATION OPTION
1. FLOOD HAZARD MITIGATION	Flood Risk Reduction - pg 46
	Public Information Enhancement - pg 46
	Improve Prevention Measures - pg 47
2. OPEN SPACE CONSERVATION	Conservation Banking Program - pg 50
	Conservation Programs Awareness - pg 50
3. STREAM AND RIVER RESTORATION	Partner with Local Education Institution - pg 54
	Create a Stream Setback - pg 54
	Maintenance of Drainage Ways - pg 55
	Establish Adopt-a-Stream Programs - pg 55
4. FLOODWAY BUILDING PROHIBITIONS	Prohibit Floodway Construction - pg 58
	Structure Removal - pg 58
	Floodway Boundaries Re-Evaluation - pg 59
5. LITTER CONTROL	Illicit Discharge Ordinance - pg 62
	Limit Disposal Items - - pg 62
	Education - pg 63
	City-wide Clean Up Program - pg 63
6. RETROFIT STORMWATER FACILITIES	Facilities Database - pg 66
	Low Impact Design Techniques - pg 66
	Privately Owned Facility Inspection - pg 67
7. CONSTRUCTION CONTROL MEASURES	Erosion Control Standards - pg 70
	Construction Site Inspections - pg 70
	Exceed Minimum State Requirements - pg 71
8. BUILDING RUN-OFF CAPTURE	Cisterns and Rain Barrels - pg 74
	Disconnect Downspouts - pg 74
	Zero Impact Development Ordinance - pg 75
	Re-grade to Direct Stormwater - pg 75
9. MAINTENANCE AND MONITORING	Citizen Based Monitoring - pg 78
	Maintenance Education Program - pg 78
	Expand City Monitoring Programs - pg 78
	School Bases Monitoring Programs - pg 79
10. IMPERVIOUS COVERAGE REDUCTION	LID Requirements - pg 82
	Reduce Street Lane Width - pg 82
	Limit Impervious Cover - pg 82
	Parking - pg 83
	Incentivize Pervious Parking - pg 83
11. DETENTION BASIN	Prioritize Detention Park Improvements - pg 86
	Reclaimed Water Systems - pg 86
	Fee-in-Lieu - 87
	Incentives for Detention Basins - pg 87
12. CITY TOOLS	Stormwater Fee Based on Cover - pg 89
	Compliance Options - pg 89

1. Flood Hazard Mitigation

Prepare to minimize, expedite communication during and swiftly recover after a flood hazard event.

Benefits

- Put a plan in place for recovery post-hazard events.
- Minimize risk of property and life in flood prone areas.
- Be prepared for flood events.

Limitations

- Limit development in high risk areas.
- Require a network of communication with additional infrastructure.

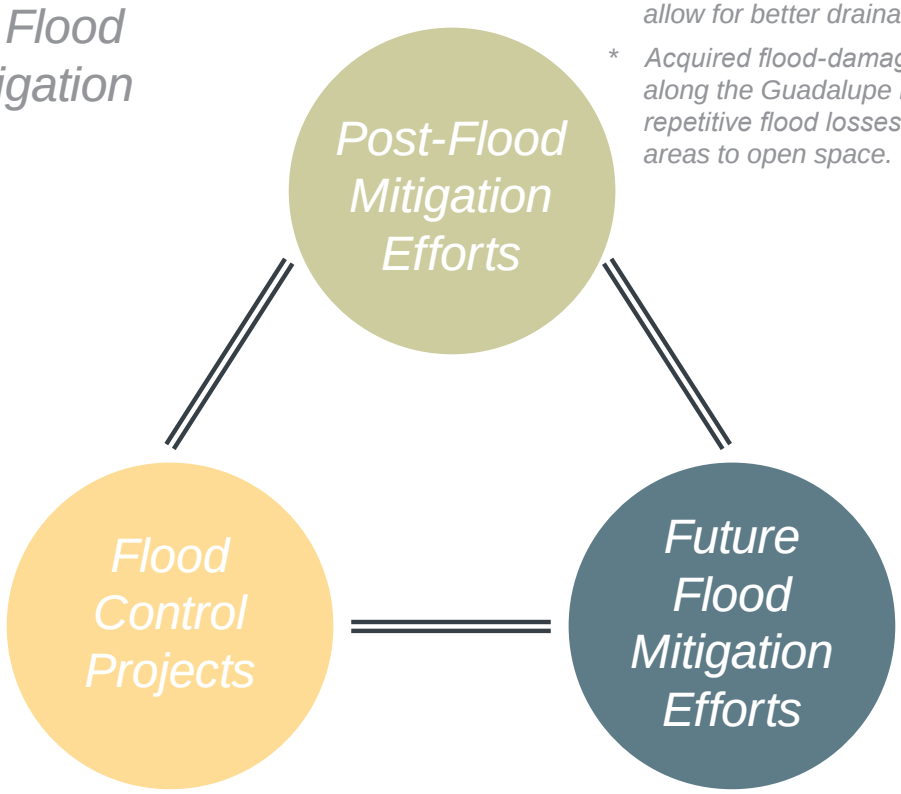
Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

What does Flood Hazard Mitigation Entail?



New Braunfels recently completed the following projects:

* *North Tributary Regional Flood Control Project*
* *South Tributary Regional Flood Control Project*
* *Dry Comal Flood Control Project*
* *Gruene Crossing Drainage Project*
* *Landa Dam culvert repair*

New Braunfels recently:

* *Removed trees and debris from Dry Comal Creek and the Guadalupe River to allow for better drainage.*
* *Acquired flood-damaged structures along the Guadalupe River to remediate repetitive flood losses and convert those areas to open space.*

New Braunfels recently:

* *Adopted a flood damage prevention ordinance, which seeks to minimize losses due to flood conditions.*
* *Approved Resolution No. 2011-R02, which authorizes the City Manager to support the Guadalupe-Blanco River Authority's application for flood protection planning grant assistance filed with the Texas Water Development board.*

How to Get There...

Flood risk reduction

Fund additional long-term, cost effective and environmentally-sound flood risk reduction structural projects, such as regional detention and channel improvements. Improve process to select and rank priorities city-wide.

Critical Path Components:

» Cost?
City: $$$$
Developer: -
Landowner: -

» How?
- Utilize Watershed Master Planning to identify best projects. Prepare alternative ratios considering expected depth of flooding and compare each project to a “buy out” option.

» Partners?
Comal and Guadalupe Counties
GBRA
USACE
FEMA

Public information enhancement

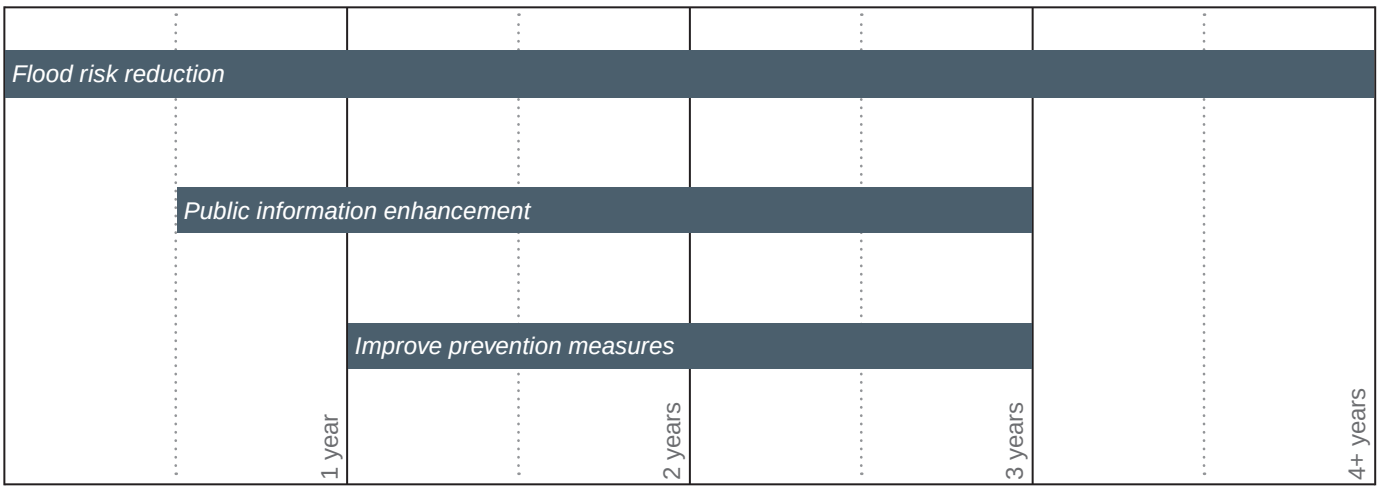
Enhance public information to both visitors and property owners about hazards.

Critical Path Components:

» Cost?
City: $$
Developer: -
Landowner: -

» How?
- Enhance website hosted by City that provides flooding information, including up to the minute known low water crossing and their status
- Install flood depth gauges in known flooding hazard areas.
- Creek name signage on major creek crossings.

» Partners?
TxDOT
Comal and Guadalupe Counties



Sequencing diagram

Improve prevention measures

Improve prevention measures through more stringent building elevation and flood-proofing requirements.

Critical Path Components:

- » Cost?
  City: $
  Developer: $ - $$
  Landowner: $ - $$
- » How?
  - Increase freeboard requirements. (DCM, 2.5.6)
  - Tighten substantial damage/ improvement threshold.
  - Require additional flood protection for critical facilities (hospitals, fire stations, etc.) (DCM, 2.5.6)
  - Prohibit or limit building enclosure size below FFE. (DCM)
  - Require CFM staffing or additional training for City staff.
- » Partners?
  Comal and Guadalupe Counties

**Assists with FEMA's Community Rating System program

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

2. Open Space Conservation

This strategy aims to set aside land intended to preserve open space that has high infiltration rates, which contributes to a decrease in peak flow levels and increased infiltration into underground aquifers.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

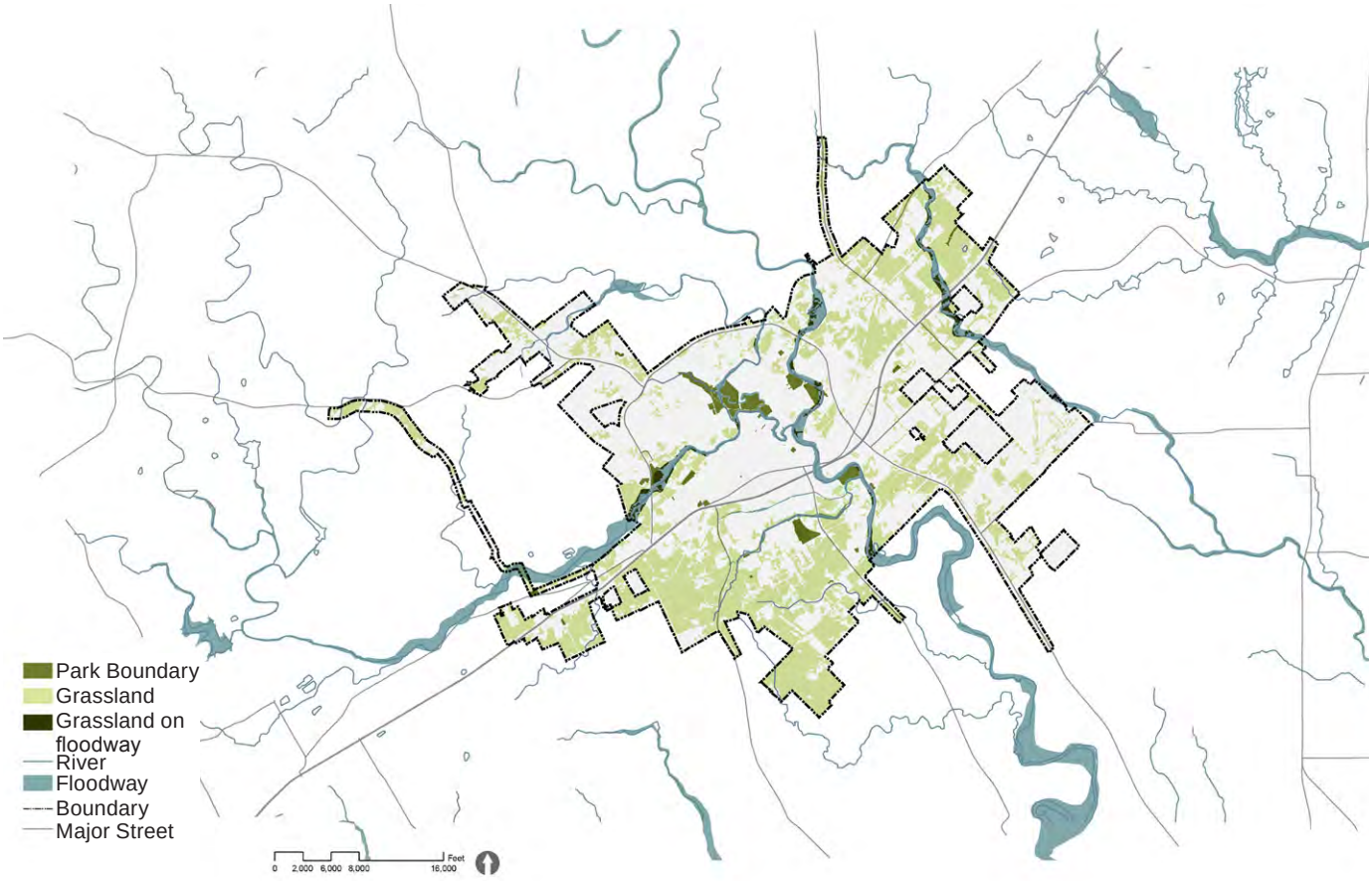
site | community | regional

Benefits

- Preserve the character of the New Braunfels Hill Country.
- Maintain (or reduce) impervious cover existing in watersheds contributing to New Braunfels.
- Contribute to MS4 permit approval.

Limitations

- May not increase infiltration, only maintain existing status.
- May require funding for potential purchase of land or easements.



The areas shown in dark green near the floodways are parkland areas that should be targeted for park acquisition to help with floodwater infiltration.

11%
City in a Woodland ecosystem.

34%
City in a Grassland ecosystem.

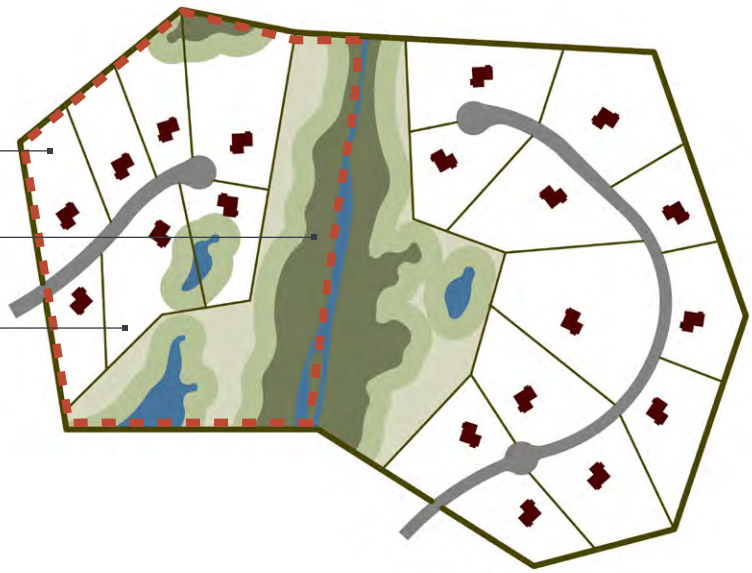
TARGET: Increase the acreage of woodland or grasslands preserved as open space in the study area by 5%.

Traditional Design - 19 Lots

Larger lots

Open space

Development within the recharge zone inhibits the percolation of water



Conservation Design - 24 Lots

Higher quantity of smaller lots

Increased contiguous open space area

Clustered development outside of the recharge zone allows stormwater to percolate into the aquifer and provides more green space

How to Get There...

Conservation banking program

Create a city program (staff and funding source) for conservation banking of floodway and floodplains and upland areas that include recharge areas and other open space.

Critical Path Components:

» Cost?
City: $$$$
Developer: -
Landowner: -

» How?
- Evaluation of appropriate conservation areas.
- Incentivize cluster development (dependent upon evaluation mentioned above). (Building Code, Ch. 14)
- Provide incentives when developers exceed minimum regulations of development over the Edwards Aquifer or other sensitive areas. (Zoning, Ch. 144)

» Partners?
Comal and Guadalupe Counties

Conservation programs awareness

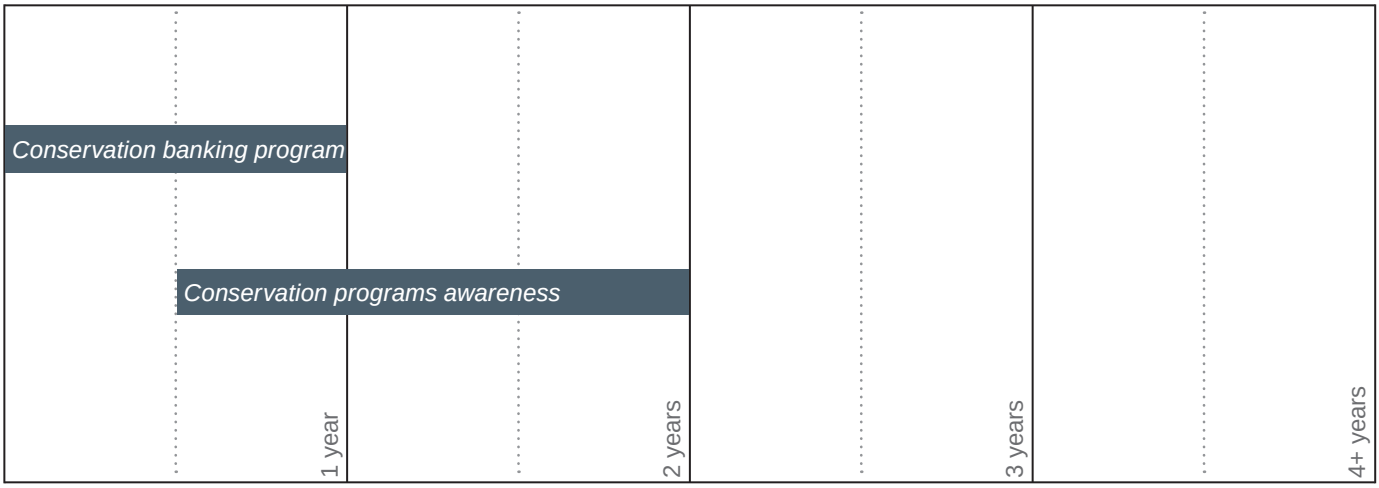
Partner with existing conservation programs to promote awareness of conservation programs and issues. Encourage responsible infiltration to the Edwards Aquifer Recharge Zone through education and incentives.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Coordinate with EARIP.

» Partners?
Hill Country Alliance
Hill Country Conservancy
EARIP/US Fish & Wildlife Service
GBRA
Comal and Guadalupe Counties
WORD
GEAA



Sequencing diagram

KEY

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

3. Stream and River Restoration

Restoring denigrated streams and rivers will restore original hydrological functioning to waterways and can restore channel and waterway ecosystems.

Benefits

- May alleviate issues of increased sediment accumulation and nutrient loading.
- May restore wildlife habitat.
- May contribute to MS4 permit approval.

Limitations

- May be a very costly process.
- May require land use changes.

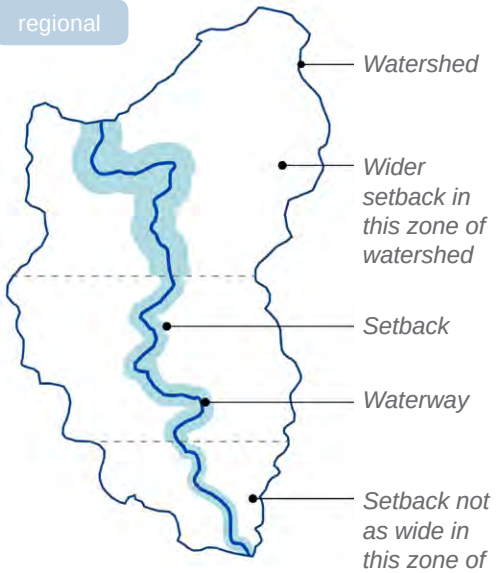
Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

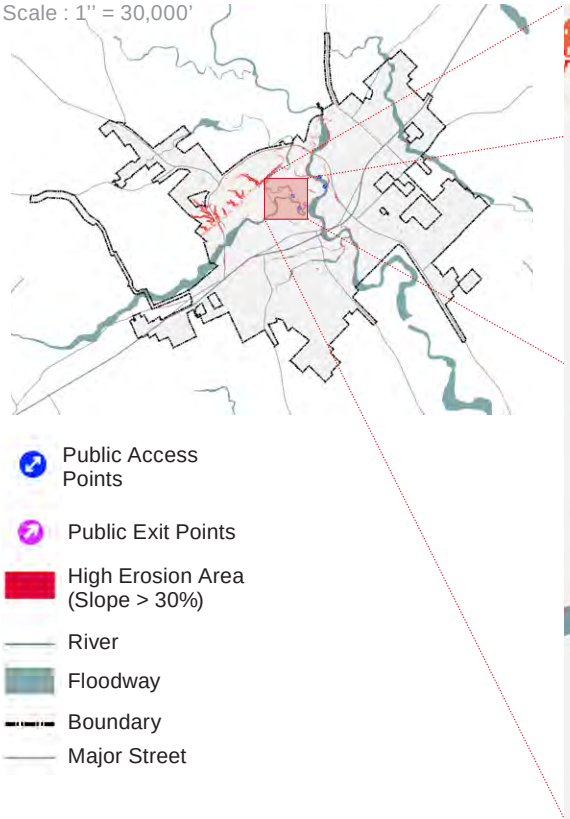
At What Scale?

site | community | regional

This plan recommends varying setbacks, dependant upon where the property is located along the flowline within the watershed.



Highly eroded river banks are a indication of high pedestrian activity and/or construction. In downtown New Braunfels, nearly 76% of the riverbanks are eroded greater than 30% slope. High erosion rates lead to greater siltation in the rivers, which can contribute to flooding.



35 miles

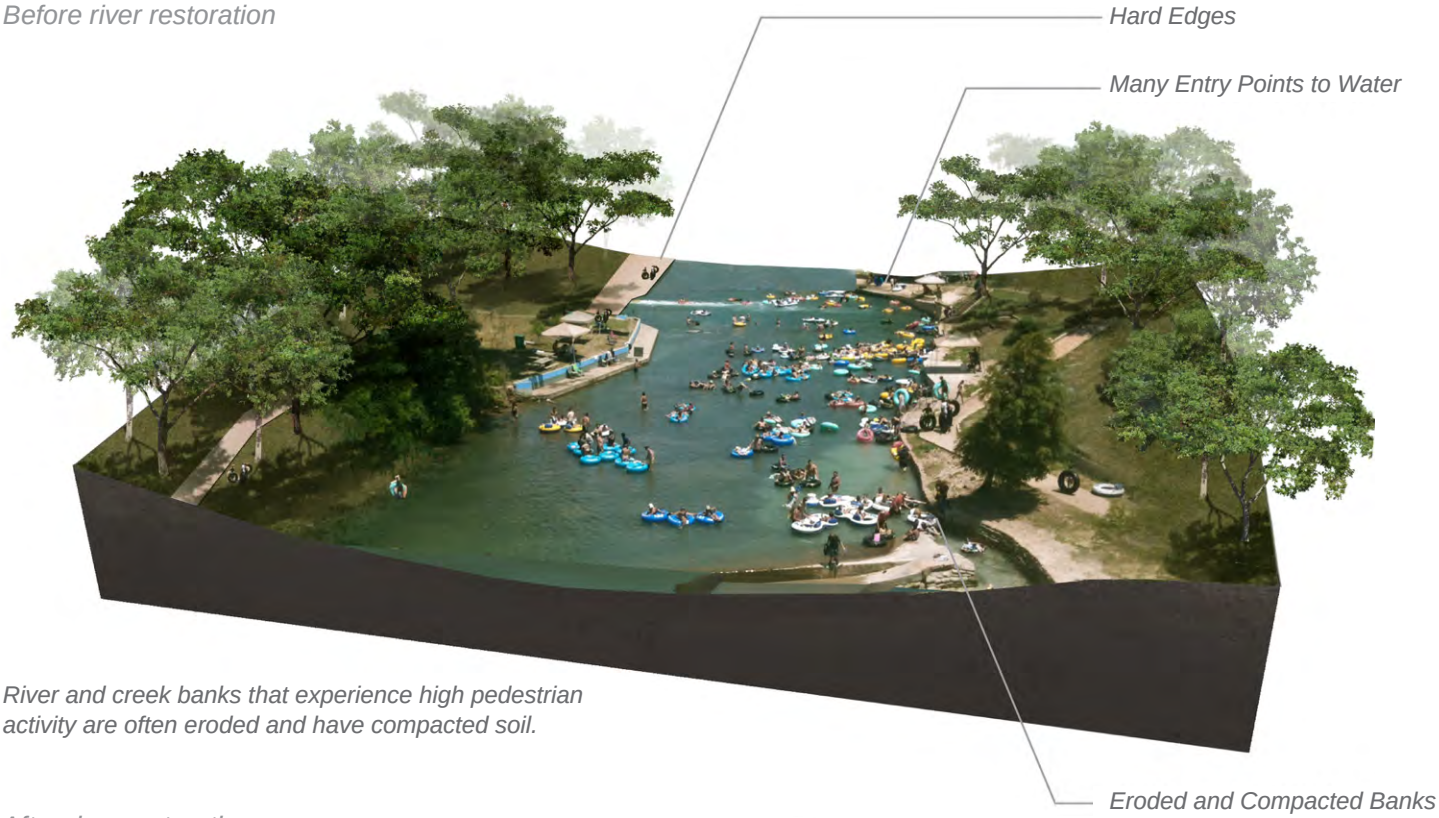
Miles of river/creek bank within city limits and watershed

496 miles

Miles of river/creek bank within city limits and watershed

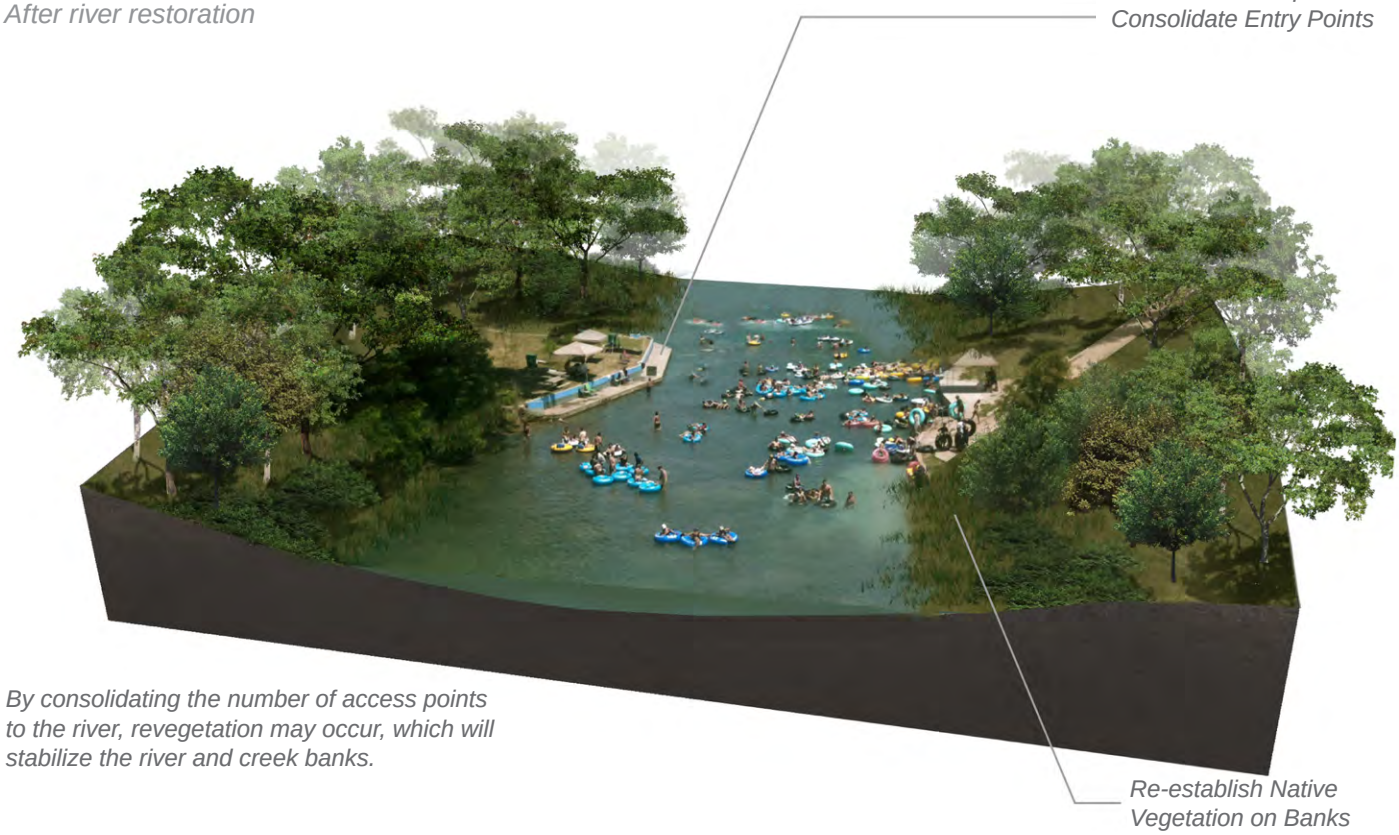
TARGET: Increase the amount of stabilized stream banks in the city by 10%.

Before river restoration



River and creek banks that experience high pedestrian activity are often eroded and have compacted soil.

After river restoration



By consolidating the number of access points to the river, revegetation may occur, which will stabilize the river and creek banks.

How to Get There...

Partner with local education institutions

Partner with local groups and universities to implement ecological and habitat restoration projects, research and studies.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Evaluate where restoration is most critical.
- Reach out to institutions to compile a comprehensive map of drainage easements and to assist with evaluation and data collection.

» Partners?
Texas State University
University of Texas
Howard Payne University

Create a stream setback

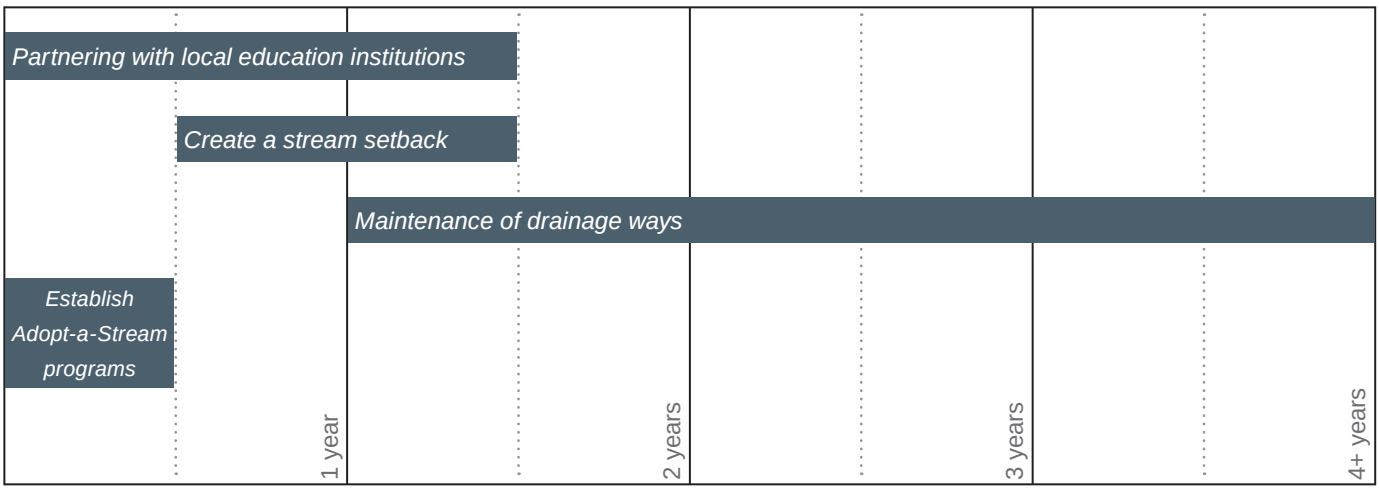
Create a stream and riparian corridor setback requirement, which can vary per watershed and creek size.

Critical Path Components:

» Cost?
City: $
Developer: $ (Depends on size of property and setbacks.)
Landowner: $ (Depends on size of property and setbacks.)

» How?
- Adopt a stream setback or buffer into floodplain ordinance.
- Add an additional buffer for impervious surfaces along intermittent streams. (Floodway Ordinance)
- Buffer rules could include allowance for narrower buffers with detailed engineering analyses. (Floodway Ordinance

» Partners?
Comal and Guadalupe Counties



Sequencing diagram

Maintenance of drainage ways

Establish a funding source for on-going sedimentation and invasive vegetation removal.

Critical Path Components:

» Cost?
City: $$$
Developer: $$
Landowner: $

» How?

- Improve operations and maintenance of drainage easements. (DCM)
- Create invasive species education program for city staff.
- Compile comprehensive mapping of drainage easement.
- Allocate a portion of the stormwater utility fee for creek clean-out.
- Update the DCM to be more specific on maintenance responsibilities.
- Per the EARIP, the City must perform flow-split management in the Old and New Channels and restore certain waterways in the City.

» Partners?
Comal and Guadalupe Counties
EARIP

Establish Adopt-a-Stream programs

Establish an Adopt-a-Stream program via grants.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?

- Establish stream bank and riverside planting programs.
- Establish stream bank and riverside litter clean-up programs for waterways that may not receive regular cleanup.

» Partners?
Local businesses
Other community organizations

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

4. Floodway Building Prohibitions

The Floodway Building Prohibitions strategy will further limit or restrict new construction in the 100-year floodplain and floodway beyond the existing ordinance.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

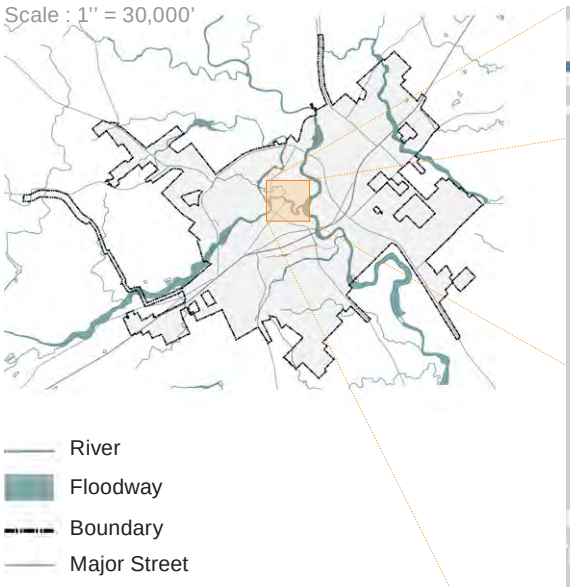
Benefits

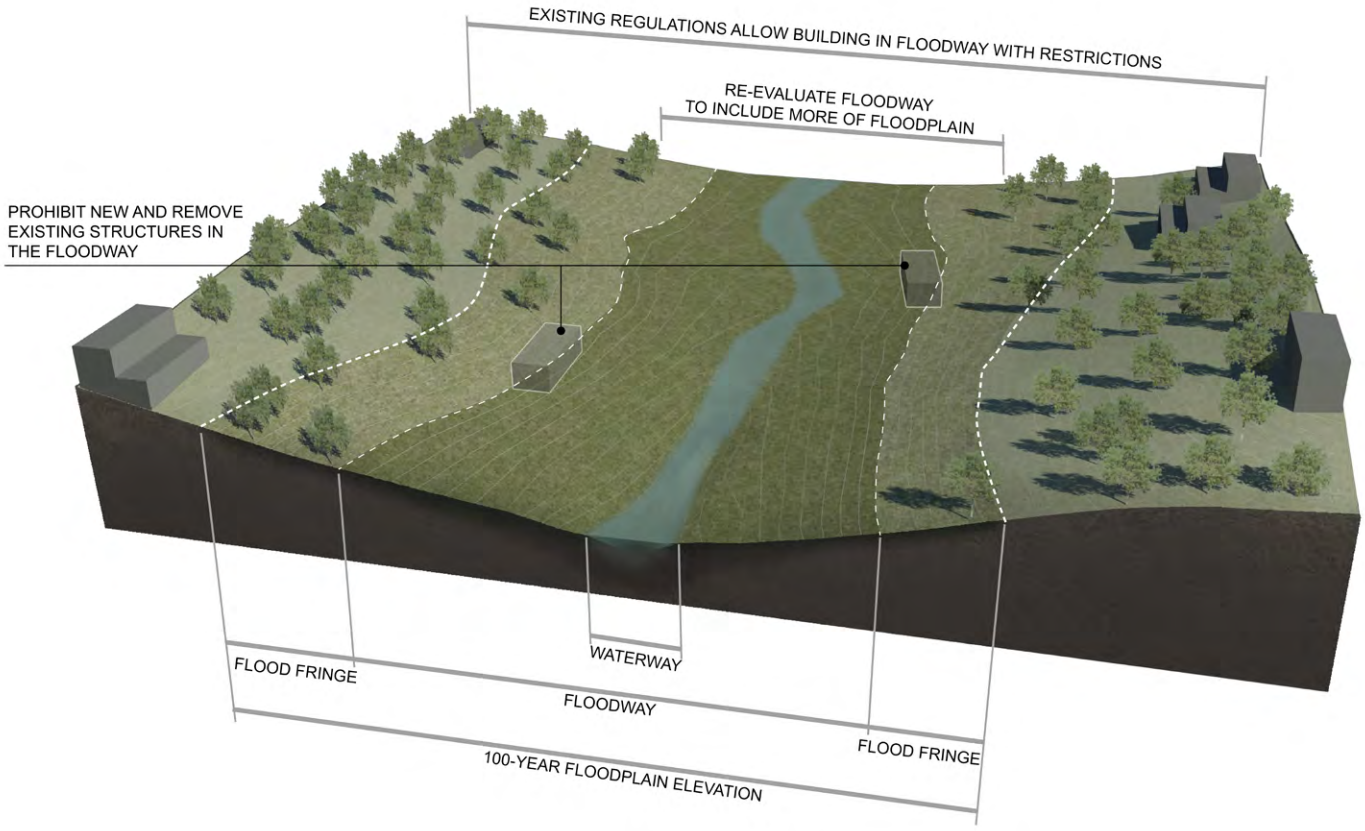
- Reduce flood damage and insurance claims.
- Increase open space area.

Limitations

- Reduce landowners' area of usable land.

Approximately 8.5% of downtown New Braunfels consists of floodway. There are 315 buildings in the floodplain within the city limits of New Braunfels. The goal of this strategy is to prevent all future structures from developing in the floodplain.





This plan recommends a re-evaluation of the floodway to include more floodplain and prohibition of all new structures within the floodway.

How to Get There...

Prohibit floodway construction

Prohibit (versus regulation of) new habitable structures from being constructed in the floodway.

Critical Path Components:

- » Cost?
  City: $
  Developer: $ $ (Dependent on grandfather clause)
  Landowner: $ $ (Dependent on grandfather clause)
- » How?
  - Amend City Floodplain Ordinance to prohibit structures in the floodway.
- » Partners?
  Comal and Guadalupe Counties

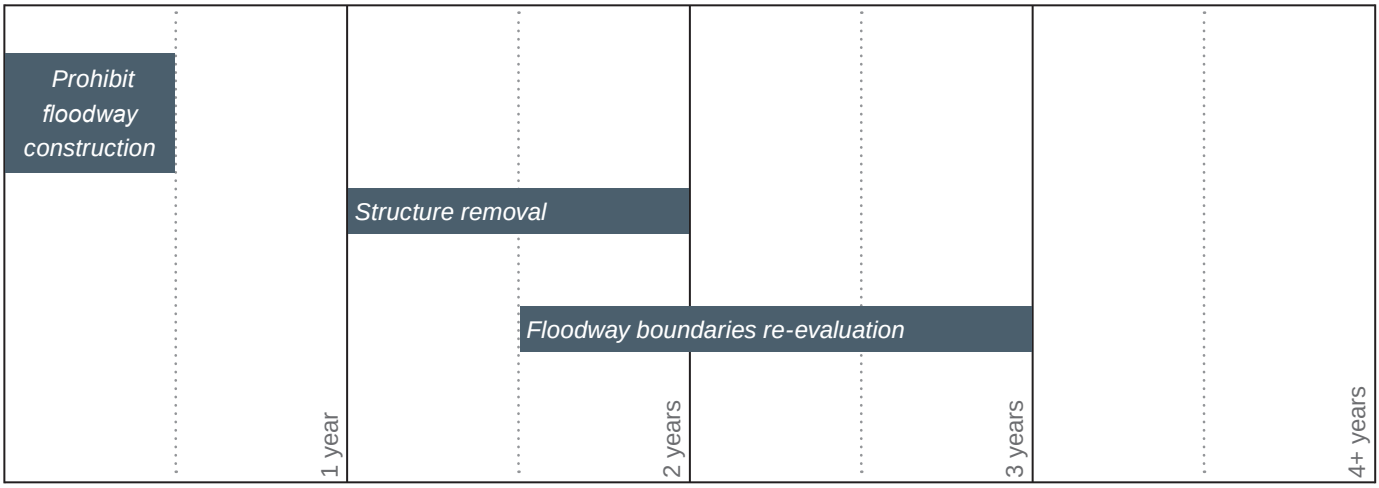
**Assists with FEMA's Community Rating System program

Structure removal

Establish a funding source for removal of existing buildings from the floodway.

Critical Path Components:

- » Cost?
  City: $ $ (Depends on funding)
  Developer: -
  Landowner: $
- » How?
  - Investigate grants before and after disasters occur.
  - Do a cost-benefit analysis on CIP projects that considers a buyout alternative.
  - Allocate a portion of the stormwater utility fee for a city buyout program.
  - Strategize buyout properties by investigating severe, repetitive loss structures
- » Partners?
  FEMA and TWDB
  -Flood Mitigation Assistance (FMA)
  -Severe Repetitive Loss (SRL) Program
  -Hazard Mitigation Grant Program (HMGP)
  -Pre-Disaster Mitigation (PDM) Program
  -Community Development Block Grants (CDBG)



Sequencing diagram

Floodway boundaries re-evaluation

Re-evaluate the floodway boundaries to include more of the floodplain.

Critical Path Components:

» Cost?
City: $$
Developer: -
Landowner: -

» How?
- Decide on a more conservative definition of the floodway. (Floodplain Ordinance)
- Determine necessity of floodway boundary re-evaluation and prioritize locations where it should occur. (Floodplain Ordinance)
- Focus on the most critical water bodies.

» Partners?
Comal and Guadalupe Counties
GBRA
FEMA

KEY

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

5. Litter Control

Litter control refers to the clean up or minimization of litter in rivers, storm drain facilities and along streets to reduce the amount of debris in the rivers, creeks and detention basins.

Benefits

- May be a cost effective strategy.
- May reduce maintenance of other stormwater structures.
- May reduce chances of localized flooding due to drainage blocks.

Limitations

- May require on-going efforts in the community.
- May limit the use of disposable materials in key locations.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

The average American household will generate 2.1 tons of waste per year.

In 2011, the City of New Braunfels collected 47,185 tons of waste.

"In May of 2011, a yearly cleanup collected 6 tons of litter from the Comal River - the shortest river in the world."

Source: AP article by Paul Weber, 7/5/12

TARGET: Create guidelines balancing the protection of the water quality and natural resources with access, specifically in areas of valued tourism such as Landa Park as an event space, the Guadalupe River as a recreation site, the downtown as a heritage tourism attraction, and the Comal River and Schlitterbahn as a family-oriented entertainment venue.

How does Litter Control relate to flooding issues?

Litter buildup...

...causes blockage in waterways...

...leading to flooding problems as buildup increases over time.

How to Get There...

Illicit Discharge Ordinance

Enact an ordinance that restricts discharges (includes litter, but broader definition) into waterways within City jurisdiction.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -
Businesses: $

» How?
- Evaluate and assess the outfalls located in creek areas. (Zoning, Ch 144)
- Pass an ordinance that has strict penalties for those who allow illicit elements to be discharged into waterways.
- Per the EARIP, the City will initiate a hazardous household waste program that will accept prescription drugs and Freon.
- Actively monitor for compliance.

» Partners?
TCEQ
EARIP

Limit disposable items

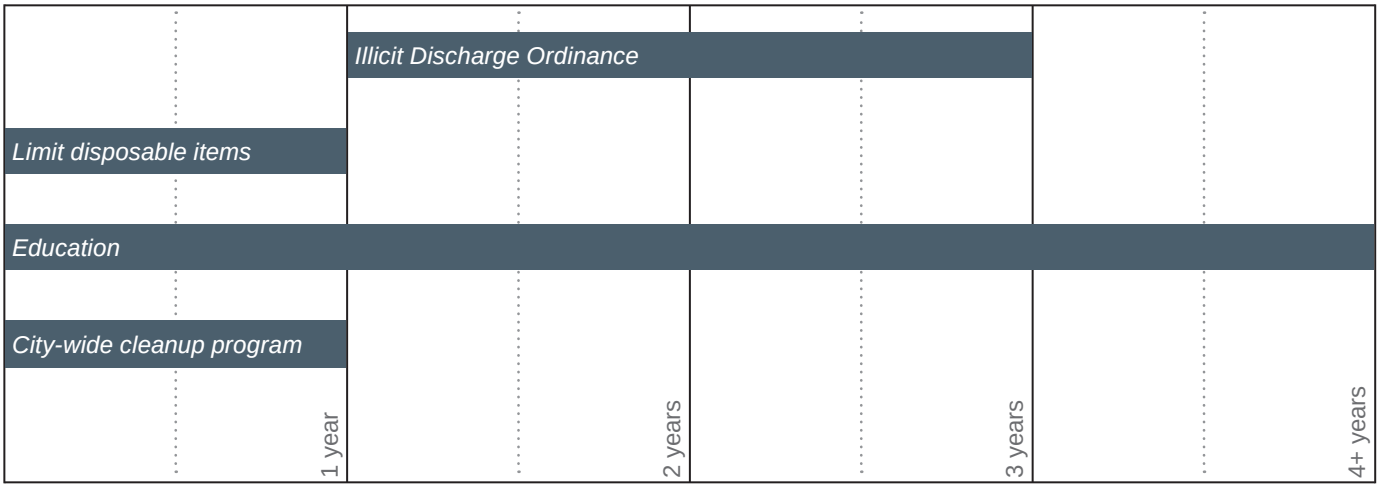
Enact an ordinance that limits disposable items, such as bags and cups.

Critical Path Components:

» Cost?
City: -
Developer: -
Landowner: -
Businesses: $

» How?
- Pass an ordinance to ban Styrofoam containers and cups in the city. (Solid Waste, Ch 110)
- Pass an ordinance to ban or charge for use of plastic bags in the city. (Solid Waste, Ch 110)
- Per the EARIP, river outfitters must provide litter bags to their customers and sponsor a river cleanup once a year.

» Partners?
Tourism bureaus
Chamber of Commerce
EARIP
River Outfitters



Sequencing diagram

Education

Educate the public about how litter, including pet waste, affects stormwater issues and can contribute to flooding.

Critical Path Components:

» Cost?
City: $$
Developer: -
Landowner: -

» How?
- TV and radio public service announcements.
- Brochures distributed at visitor centers and hotels about littering and protecting the quality of the waterways.
- Install pet waste stations in parks and open spaces.

» Partners?
Local radio and television stations
Tourist bureaus
Chamber of Commerce
River outfitters

City-wide cleanup program

Fund a city-wide regular cleanup program.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Focus on cleanup of put-in points
- Institute a “Clean Up My Park Day”.
- Institute an “Adopt-a-Stream” program.

» Partners?
Hill Country Conservancy
Hill Country Alliance
Tourism bureaus
Chamber of Commerce
EARIP

KEY

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

6. Retrofit Stormwater Facilities

Upgrade existing facilities in need of repair to current standards and low impact development techniques.

Which Phase in the Project?

policy | **design & construction** | operations, maintenance and monitoring

At What Scale?

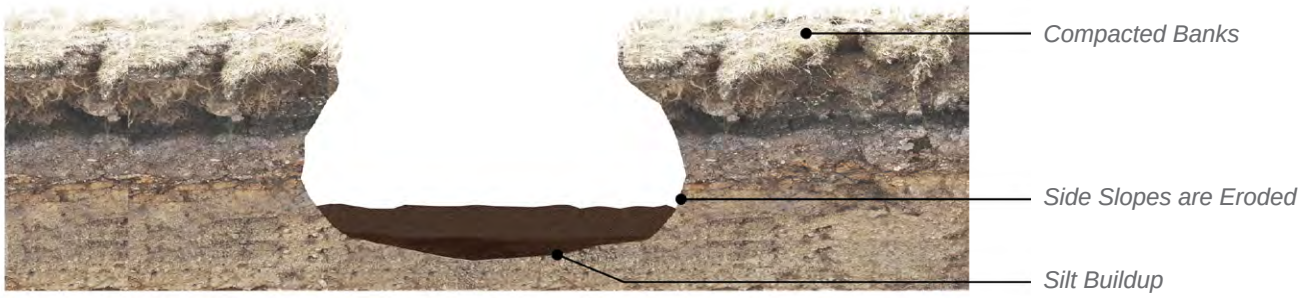
site | community | regional

Benefits

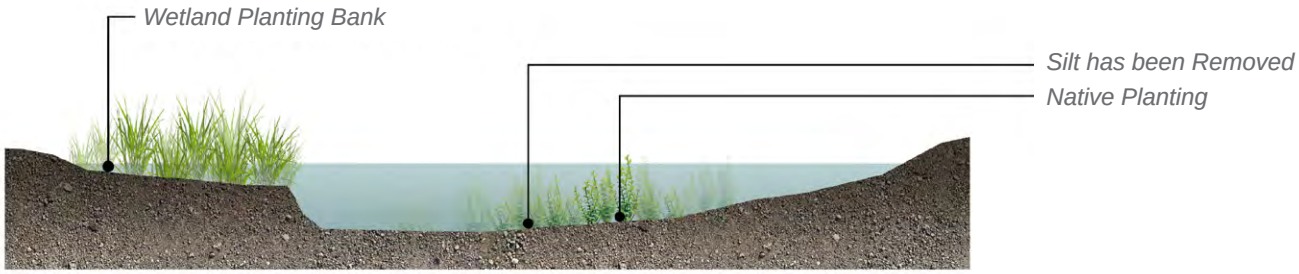
- May reduce future maintenance costs post-retrofitting.
- May improve functionality of unmaintained facilities.

Limitations

- May require costly upgrades.

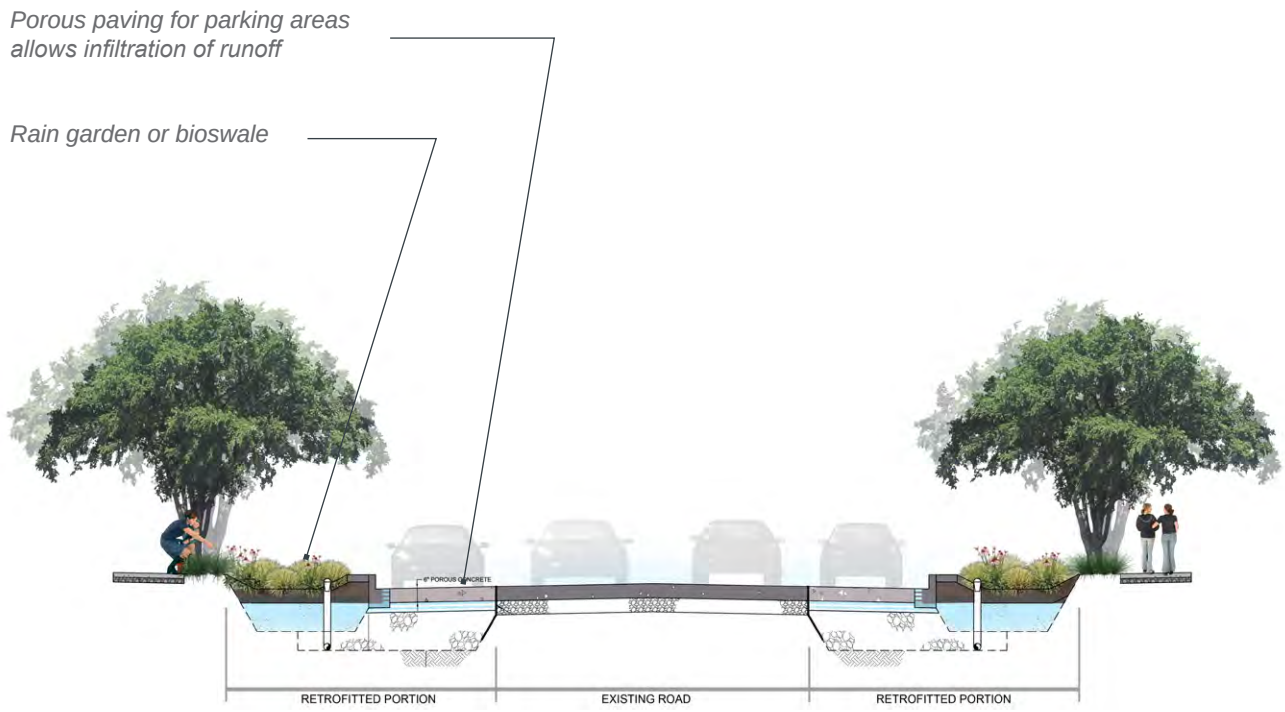


Before Retrofit



After Retrofit

Stream and riverbanks will erode over time if vegetation has been damaged and soil compacted by high pedestrian presence or construction activity is present. Silt builds up at the bottom of the water body, whether it is a channel, detention or retention basin, creek or river. Too much silt buildup may lead to flooding. A retrofit of existing detention facilities entails dredging silt from the bottom, regrading the banks to a more gentle slope and planting native vegetation along the edges.



Streets may be retrofitted by removing sections of impervious concrete and replacing with porous pavement. Rain gardens or bioswales along the sides of the street capture stormwater runoff from the road. The vegetation in these features treat the water by removing pollutants and toxins, ultimately improving the water quality. The stormwater then slowly percolates into the ground or evaporates into the air, thus reducing the amount of runoff that would normally go into the drainage system.

How to Get There...

Facilities database

Fund and staff an on-going stormwater inventory and needs assessment database. Require digital submissions for all drainage reports and design/as-built plans.

Critical Path Components:

» Cost?
City: $$
Developer: $
Landowner: -

» How?
- New development must submit plans digitally so that they can be incorporated into an overall city-counties-ETJ GIS database.
- Create a database that is managed by city staff.

» Partners?
Comal and Guadalupe Counties

Low Impact Design techniques

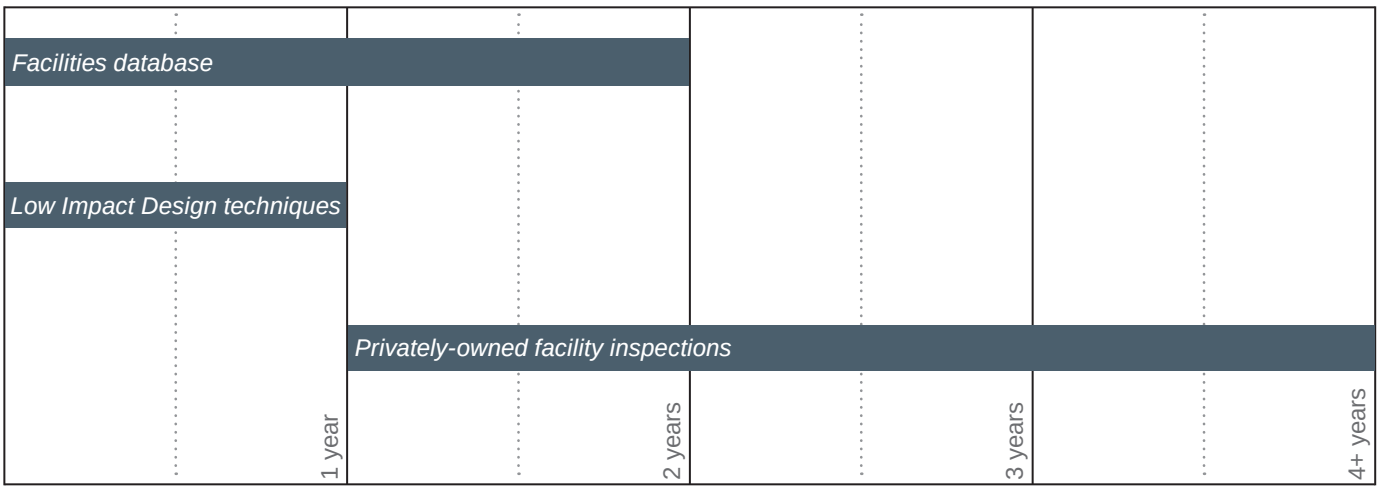
Enact an ordinance that requires the incorporation of Low Impact Design techniques in retrofitted construction projects.

Critical Path Components:

» Cost?
City: $
Developer: $
Landowner: -

» How?
- Education about low impact design methods is critical for maintenance staff.
- Amend building code (Ch. 14) and DCM to require LID techniques, such as downspout disconnection, rain gardens, and vegetated filter strips, in both new and retrofitted projects.

» Partners?
Comal and Guadalupe Counties



Sequencing diagram

Privately-owned facility inspections

Fund and staff City inspections of privately-owned stormwater detention, treatment and conveyance systems. Limit future private systems and gradually acquire existing private systems.

Critical Path Components:

» Cost?
City: $$
Developer: -
Landowner: $

» How?
- Expand the definition of what is included within a drainage easement and how they are to be maintained. (DCM, 2.1.1)
- Allot a portion of the stormwater utility fee to fund the inspections and acquisition of privately-owned stormwater systems. (DCM)
- Prohibit any future privately-owned stormwater detention, treatment and conveyance systems. (DCM)
- Expand the current operations and maintenance plan requirements to include a detailed schedule with regular inspections. (DCM, 2.7)

» Partners?
Comal and Guadalupe Counties

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

7. Construction Control Measures

These measures refer to enhanced seeding, mulching, sediment traps, silt fencing and enforcing a more stringent erosion control plan, all in an effort towards reducing erosion and sedimentation that flows into and blocks waterways.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

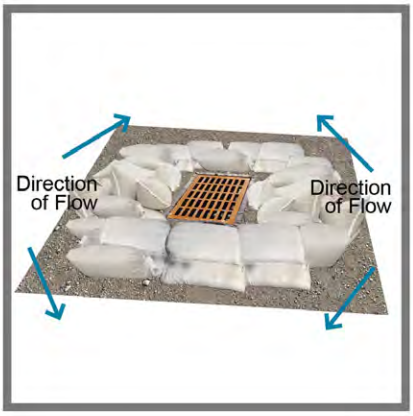
Benefits

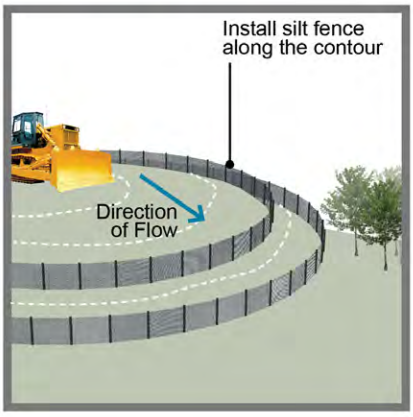
- May be less costly to contractors during construction if implemented from the beginning.
- May reduce sedimentation in waterways.
- May increase water quality.

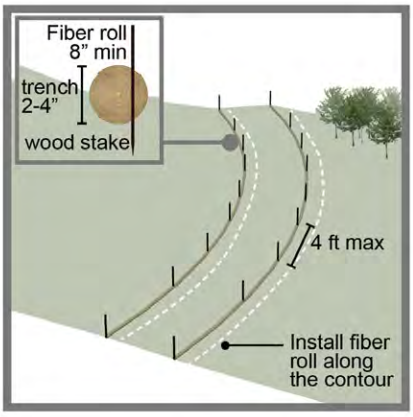
Limitations

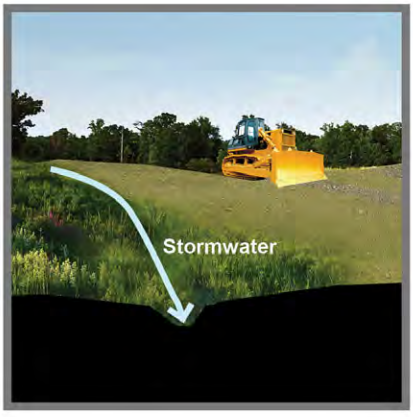
- May be costly for small projects.

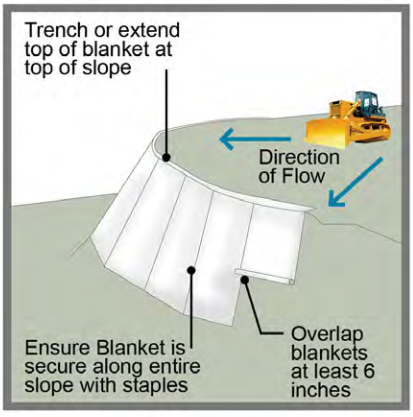
Shown below are just a few of the many construction control measures that prevent erosion and protect water quality. Too much erosion on a construction site can severely impact properties downstream.











How to Get There...

Erosion control standards

All construction activity, regardless of size, must meet minimum erosion and sediment control standards.

Critical Path Components:

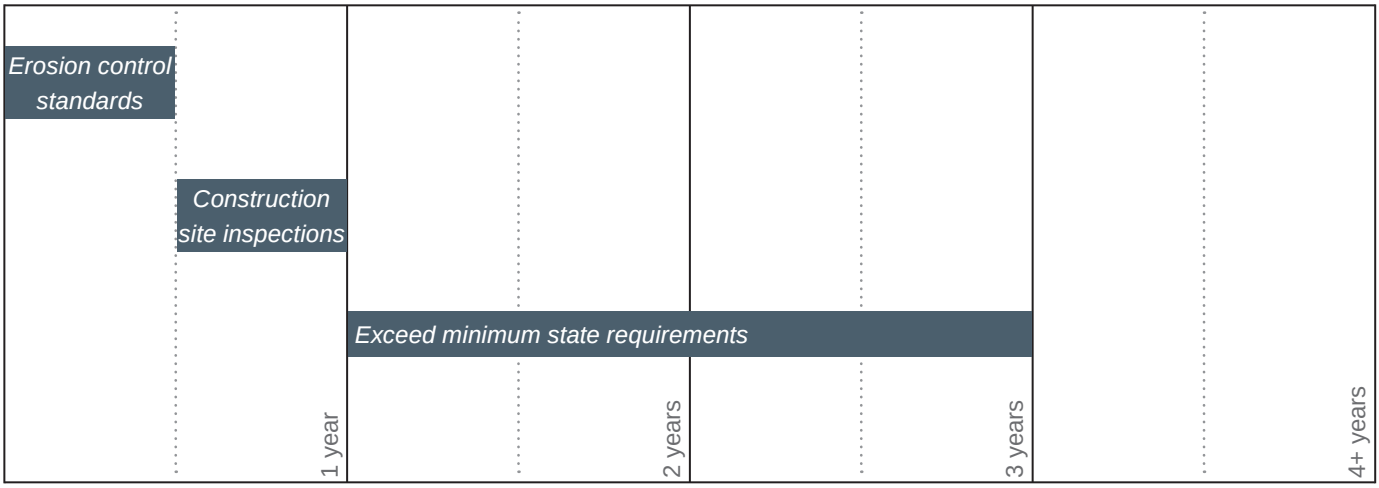
- » Cost?
  City: $
  Developer: $
  Landowner: $
- » How?
  - Currently, only projects of one acre or more have to meet minimum erosion and sediment control standards. Amend the building code to require all construction projects to meet the minimum requirements. (Building Code, Ch 14)
- » Partners?
  Comal and Guadalupe Counties

Construction site inspections

Fund and staff a greater frequency of construction site inspections through permit fees, enforcement and stormwater utility funds.

Critical Path Components:

- » Cost?
  City: $ $
  Developer: $
  Landowner: -
- » How?
  - Institute a tip line for the public to call.
  - Allocate a portion of the stormwater utility fee to fund inspections.
- » Partners?
  TCEQ
  Comal and Guadalupe Counties



Sequencing diagram

Exceed minimum state requirements

Provide benefits for exceeding minimum construction control requirements, such as expedited review time or reduced fee costs.

Critical Path Components:

» Cost?
City: $
Developer: $
Landowner: -

» How?
- Amend ordinance to require more stringent erosion and sediment control requirements. Write a comprehensive Grading, Erosion and Sediment (GESC) Control manual. (Building Code, Ch 14)
- Incentivize developers who exceed the minimum requirements through expedited review time and/or reduced permitting fees.

» Partners?
TCEQ
Comal and Guadalupe Counties

KEY

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

8. Building Runoff Capture

Capture and storage of rainwater from roofs and cisterns.

Benefits

- May mitigate or eliminate increased runoff volume.
- May reduce the required capacity for down-slope retention and sediment control BMPs.

Limitations

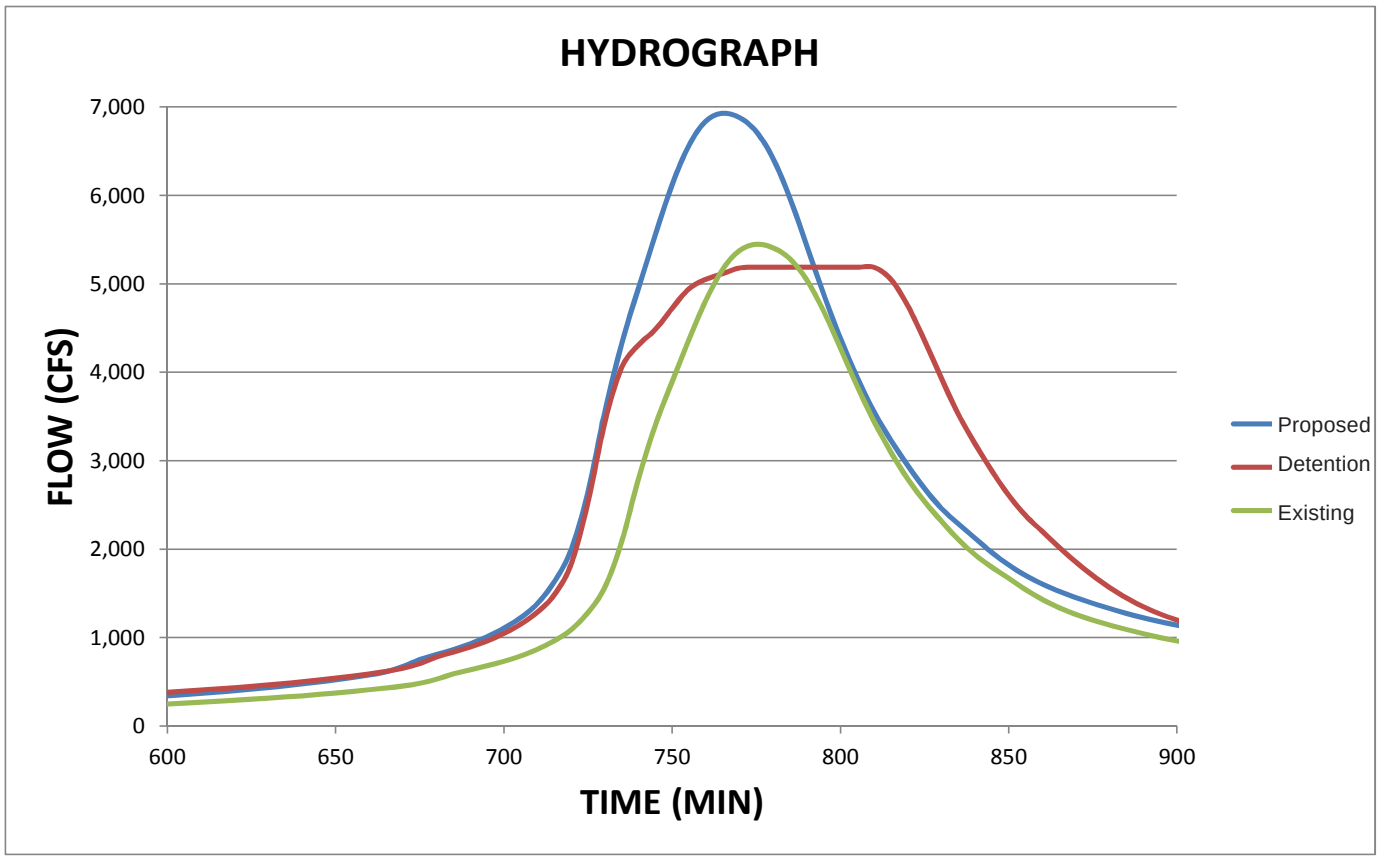
- May increase building costs. For example: green roof installation.
- May not claim flood control credit unless sized properly.
- May be difficult to enforce.

Which Phase in the Project?

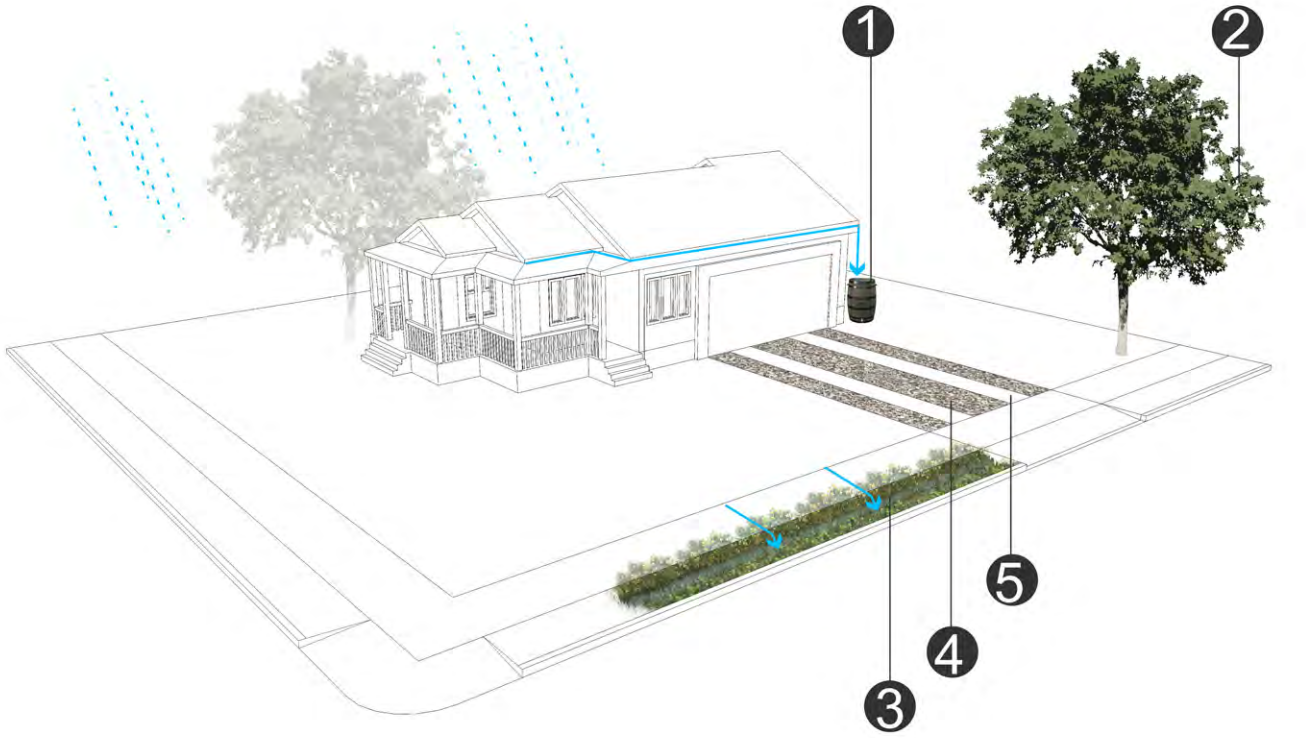
policy | **design & construction** | operations, maintenance and monitoring

At What Scale?

site | community | regional



This graph shows the change in discharge over time in a river, or other channel or conduit carrying flow.



These runoff capture methods can be used in any number of combinations and scales of building types.

1 Capture and use:

Captures and stores runoff from impervious surfaces, reducing volume and overall water quality impairments. Typically used for irrigation.

2 Preserve Native Vegetation:

Enhances the aesthetic quality of community and maintains infiltration and evapotranspiration rates.

3 Vegetated Swale:

Vegetated channels that slow stormwater runoff and promote infiltration, trap sediment and help treat pollutants.

4 Pervious Pavement:

Pavement that allows rain to infiltrate, thereby reducing runoff and promoting groundwater recharge.

5 Reduced Hardscape:

Narrower streets, sidewalks and driveways increases pervious areas and open spaces.

How to Get There...

Cisterns and rain barrels

Expand current City-sponsored cistern program through grants to provide no-cost cisterns or rain barrels.

Critical Path Components:

- » Cost?
  City: $
  Developer: -
  Landowner: -
- » How?
  - Allocate a portion of the stormwater utility fee to fund a portion of the program.
  - Research grant programs.
- » Partners?
  NBU

Disconnect downspouts

Provide permitting or fee incentives for new or retrofitted construction that directs downspouts to rain gardens or pervious cover.

Critical Path Components:

- » Cost?
  City: $
  Developer: -
  Landowner: $
- » How?
  - Amend building code (Ch.14) to incentivize disconnected downspouts.
  - Educate the public via websites on the benefits of disconnecting downspouts.
- » Partners?
  USGBC

Sequencing diagram

Zero Impact development ordinance

Enact a voluntary zero impact development ordinance with incentives. A zero impact development is defined as a development that maintains the natural hydrologic function of the site.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Develop an ordinance that incentivizes zero impact development for new construction or re-development.
- Create an extra incentive for early adopters and even consider a sort of innovative design competition to recognize the early adopters that set a good example for others.

» Partners?
Hill Country Alliance
Hill Country Conservancy

Re-grade to direct stormwater

Provide permitting or fee incentives for retrofitted construction that re-grades paved areas to direct stormwater to detention, open space or bioswales.

Critical Path Components:

» Cost?
City:
Developer: -
Landowner: $

» How?
- Incentivize re-development that directs stormwater to recharge zones with reduced fees and/or expedited permitting.

» Partners?
USGBC

KEY

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

9. Maintenance and Monitoring

This strategy outlines the responsibilities for ensuring that drainage facilities have proper maintenance and that monitoring is not only completed and operating correctly, but also requires regular city maintenance practices to incorporate BMPs.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

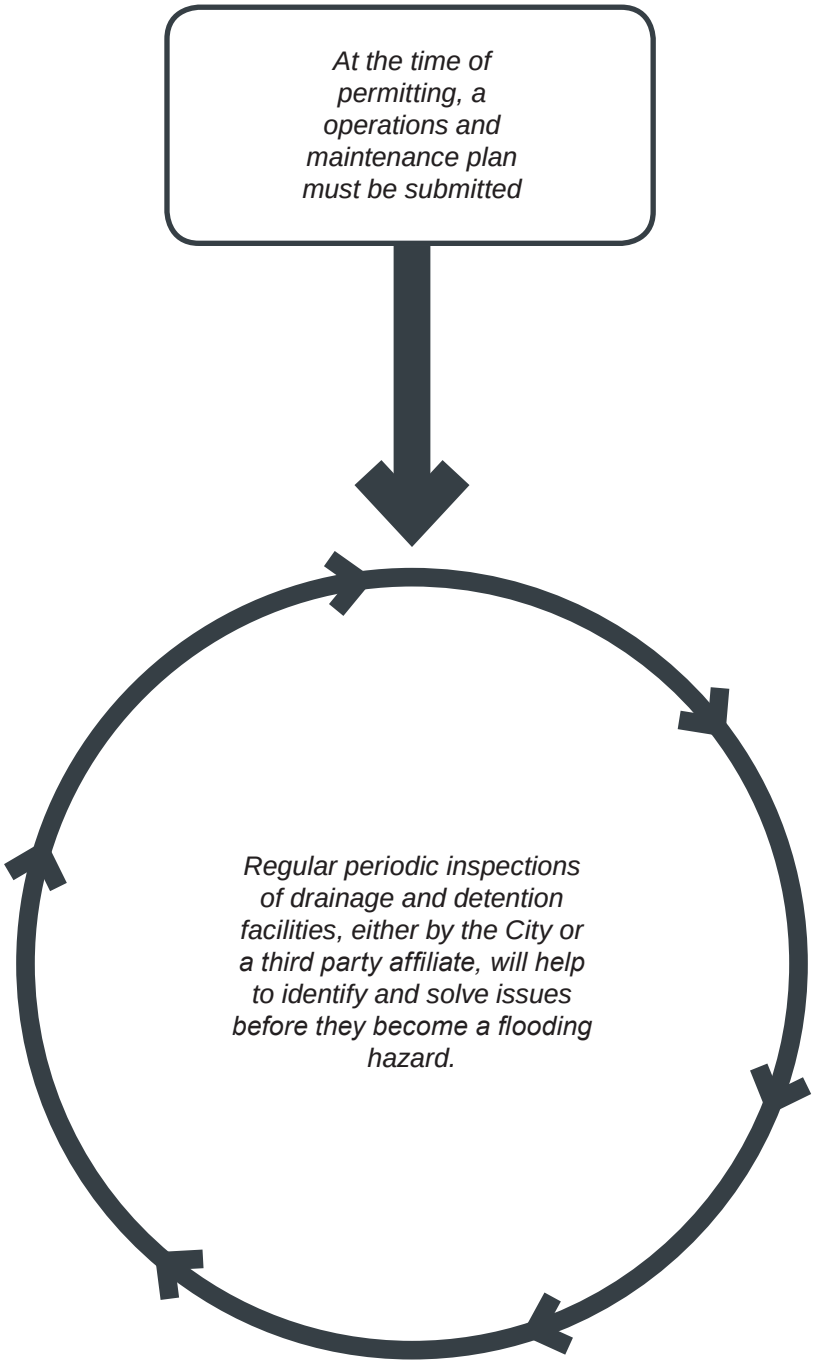
Benefits

- May reduce costs associated with poorly managed facilities.
- May reduce wasted natural resources.

Limitations

- May require on-going staff training.
- May require the creation or revision of a maintenance procedures manual.

TARGET: Develop a plan ensuring operations and maintenance of all stormwater facilities.



How to Get There...

Citizen-based monitoring

Create a citizen-based monitoring program through grants.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Establish a tip line for the public to call to report on flooding issues such as blocked storm drains, illegal dumping, etc.

» Partners?
Local universities
Texas Watch
Texas Stream Team

Maintenance education program

Create a Home Owners Association/ business district/tourist industry maintenance education program through online materials and brochures.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Produce and distribute brochures, informational material and recreational guides about proper maintenance of drainage ways, detention ponds, etc.
- Install signage at tributaries and drainage facilities.

» Partners?
GBRA

Expand city monitoring programs

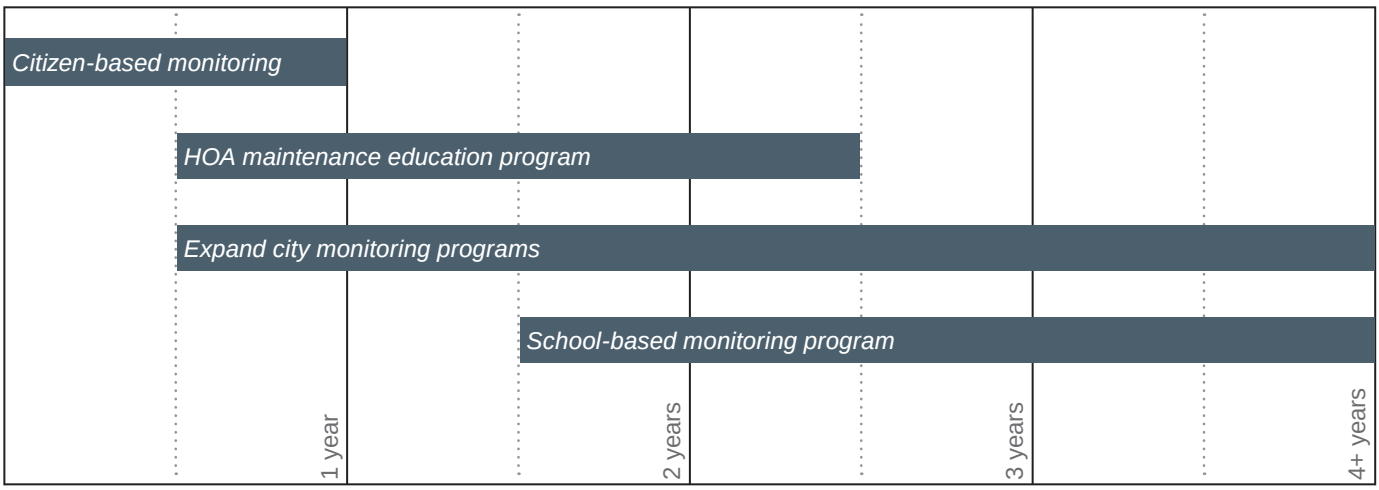
Fund and staff expansion of city monitoring and maintenance programs.

Critical Path Components:

» Cost?
City: $ $
Developer: -
Landowner: -

» How?
- Expand upon the existing maintenance requirements in the DCM to include more detail that allows the city to be more preventative than reactionary. (DCM, 2.7)
- Craft a maintenance schedule with the appropriate staff. Hire additional staff as necessary. (DCM, 2.7)

» Partners?
Comal and Guadalupe Counties



Sequencing diagram

School-based monitoring program

Create a school-based monitoring program and curriculum that teaches children about stormwater issues and provides scientifically-valid data to the city for water quality monitoring purposes.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Create curricula for the Independent School District that involves science classes. Students can take photos of sites that they monitor for class.
- Create a website that is maintained by the city that allows students to upload their information/photos from monitoring projects and the public to view the work.

» Partners?
New Braunfels Independent School District
Local colleges and universities

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

10. Impervious Coverage Reduction

This strategy includes methods like increasing densities, narrowing road sections and reducing parking requirements. The City can establish limits to impervious coverage within City Limits or the extra-territorial jurisdiction (ETJ).

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

Benefits

- May be applied at multiple scales with various mechanisms.
- May decrease the peak flow of stormwater runoff.

Limitations

- May require changes in City regulation and standards.
- May require coordination among land owners when implementing at a community scale.

Approximately 94% of downtown New Braunfels is covered with impervious surfaces. When water cannot infiltrate into the ground during storm events, flooding occurs.

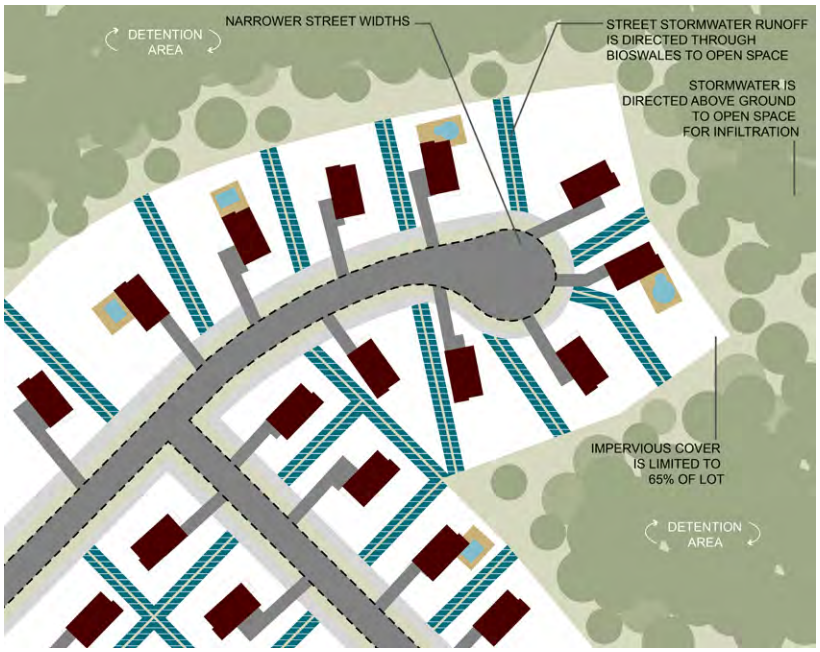
1,611 sq ft

Pervious surface per person in City Limits

TARGET: Establish a ratio of impervious surface per person below the average of other cities at a similar density to New Braunfels.

Traditional Design

Design with Reduced Impervious Cover



How to Get There...

LID requirements

Require Low Impact Design techniques into site and building requirements for new construction and redevelopment.

Critical Path Components:

» Cost?
City: $
Developer: $ $
Landowner: -

» How?
- Amend building code and DCM to require LID techniques in both new and retrofitted projects.
- Require water quality mitigation citywide through criteria similar to or more restrictive than TCEQ for Edwards Aquifer
- Consider using either TCEQ Edwards manual or GEAA draft LID toolbox as primary source material rather than creating a separate manual/list of methods.

» Partners?
EARIP
GEAA

Reduce street lane width

Reduce the street lane width requirement.

Critical Path Components:

» Cost?
City: -
Developer: -
Landowner: -

» How?
- Determine how much different street types would narrow, i.e. major/minor/ arterial types of streets.
- Incentivize narrowing of roads in certain areas of the city, require narrowing in others. (Building Code, Ch. 14)
- Change the requirements for the required number of turn lanes and bike lane widths. (Building Code, Ch. 14)

» Partners?
TxDOT

Limit impervious cover

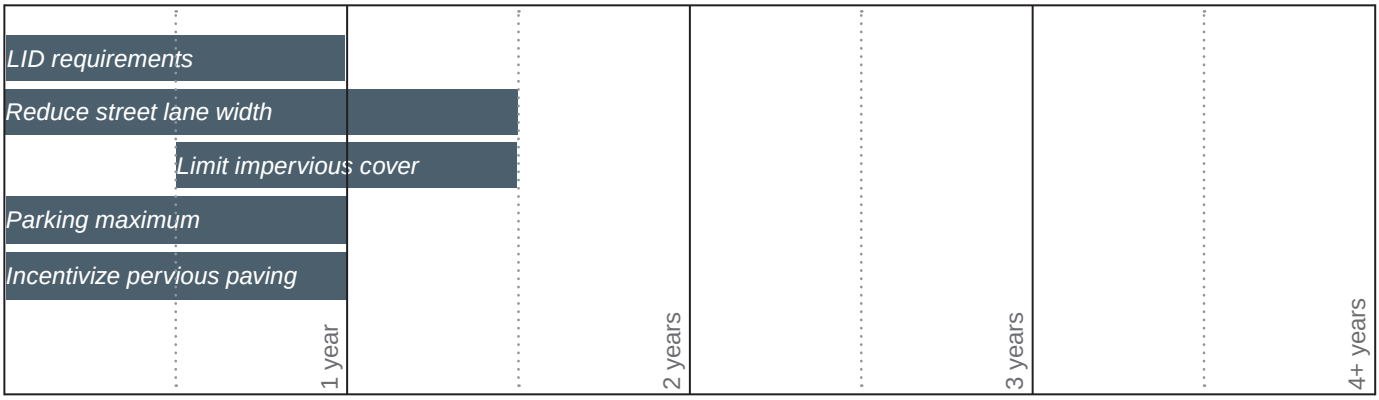
Evaluate, determine and regulate areas of the city that limit the density and amount of impervious cover. Consider developer transfer rights within this zone.

Critical Path Components:

» Cost?
City: -
Developer: $
Landowner: -

» How?
- Determine amount of allowed impervious cover by zoning.
- Suggest maximums, incentivize those who build less impervious cover than the maximum.
- Allow developer transfer rights in zones of limitation.
- Suggestion of impervious coverage limitation: an average of 65% for the city as a whole, but divide the percentages up between land uses.

» Partners?
Comal and Guadalupe Counties



Sequencing diagram

Parking

Require a parking maximum in addition to a parking minimum. Require shared use parking for mixed-use developments.

Critical Path Components:

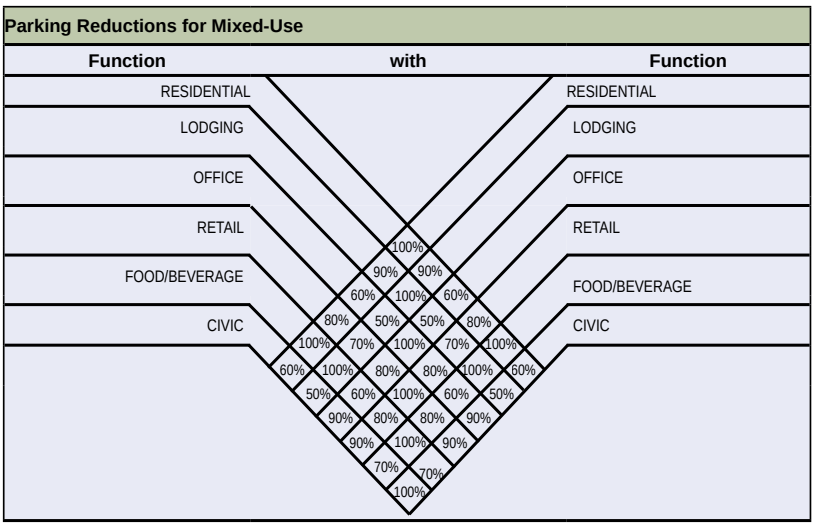
- » Cost?
  City:
  Developer: $
  Landowner: -
- » How?
  - Amend the zoning code to require a parking maximum. Recommended maximum is 1.25 times the parking minimum. (Ch. 144-5.1)
- » Partners?
  Chamber of Commerce

Incentivize pervious paving

Incentivize the use of pervious paving options with expedited review processes or reduction of permitting fees.

Critical Path Components:

- » Cost?
  City: $
  Developer: -
  Landowner: -
- » How?
  - Allow developers to replace impervious cover with porous materials to reduce the impervious cover.
  - Provide permitting or fee incentives for new or retrofitted construction that removes pavement and replaces it with porous materials.
- » Partners?
  TCEQ (allows Permeable Friction Course (PFC) to treat Edwards Aquifer for streets over 55 mph)



This chart represents Shared Use Parking. This methodology of parking requirements takes into account the different building uses, which have users at various times of the day and reduces the amount of required parking.

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
$$$$	+$1 million

Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

11. Detention Basin

Detention basins are a method of stormwater management that temporarily detain a portion of stormwater runoff for a specific length of time and can increase water quality. Examples of multi-use detention facilities include parks, open space, bike paths and fields.

Which Phase in the Project?

policy | **design & construction** | operations, maintenance and monitoring

At What Scale?

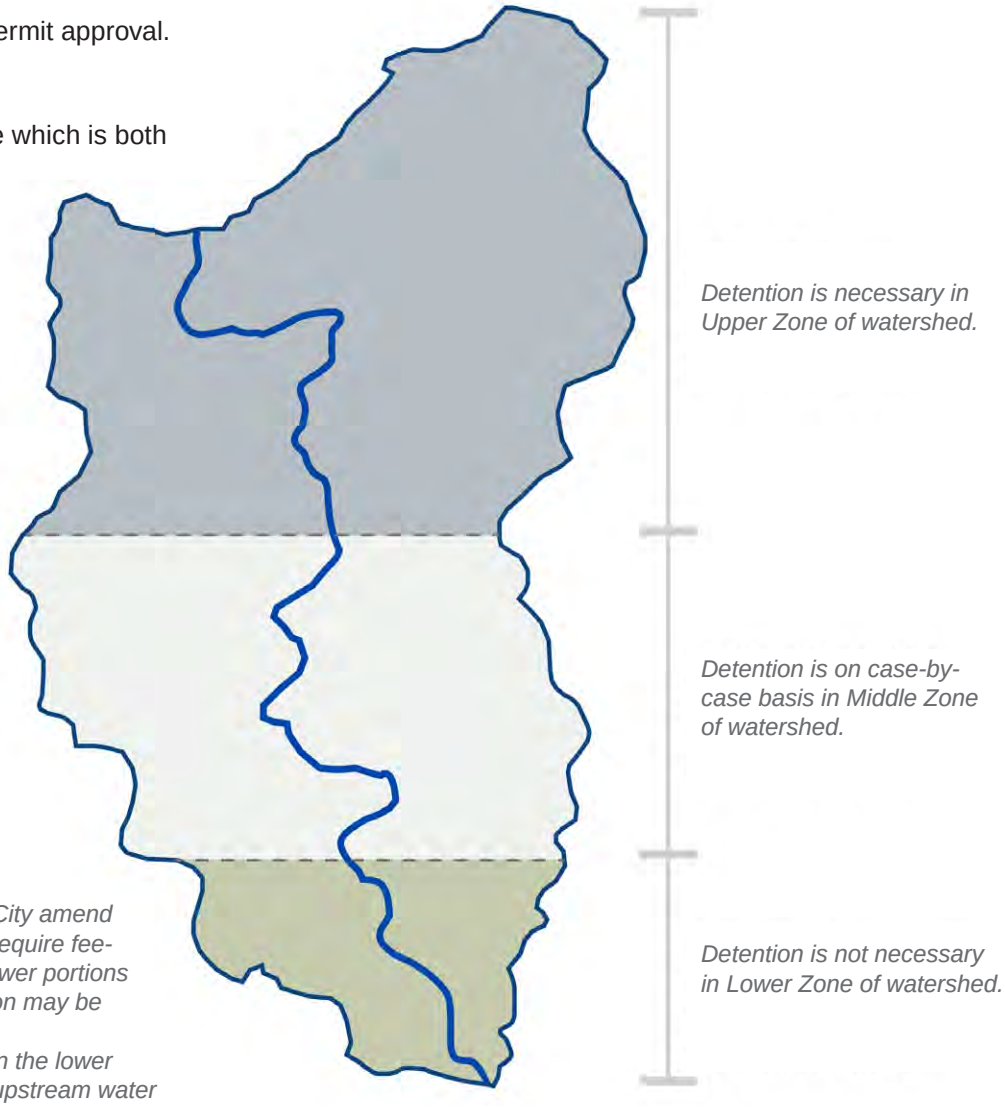
site | **community** | regional

Benefits

- May improve infiltrated water quality.
- May reduce flooding.
- May prevent downstream channel scouring.
- May increase park and open space area.
- May contribute to MS4 permit approval.

Limitations

- May require maintenance which is both essential and costly.



This plan recommends that the City amend the Flood Control Ordinance to require fee-in-lieu rather than detention in lower portions of the watershed, where detention may be counterproductive.
If water is detained for too long in the lower portions of the watershed, than upstream water release takes longer, which leads to flooding.

583 acres

Total area of park

TARGET: Increase stormwater facilities in parks and open space by 5%.

Detention areas don't have to be places that only hold periodic stormwater. They can be used as park facilities, such as baseball, soccer and football fields, with trails and benches.

How to Get There...

Prioritize detention park improvements

In conjunction with the 2010 Open Space Master Plan, prioritize park improvements based upon the possible use as a detention facility, emphasizing multi-use.

Critical Path Components:

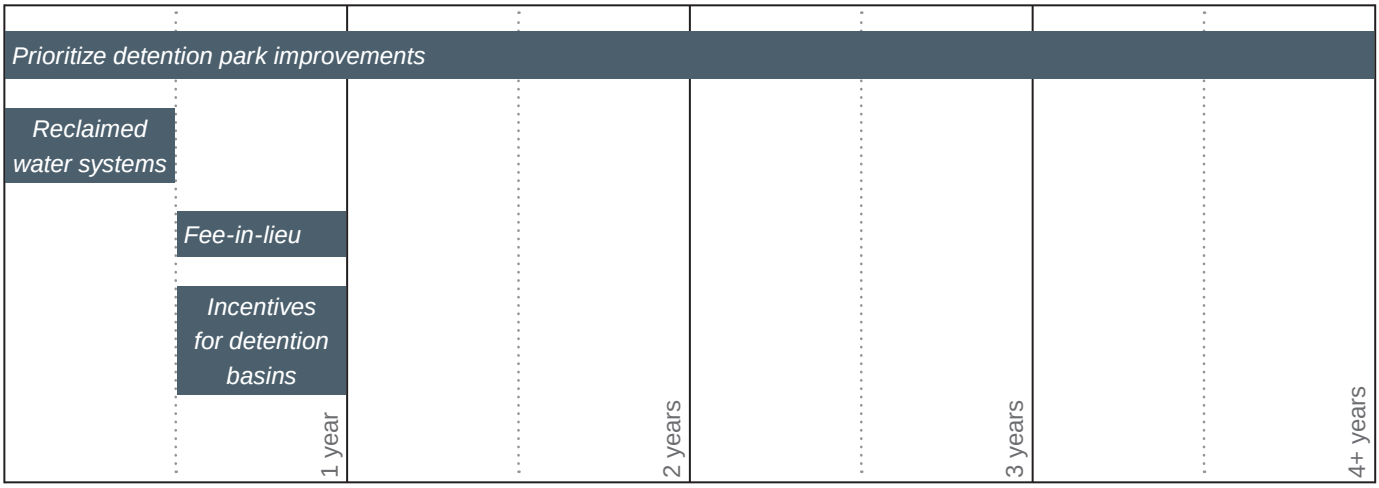
- » Cost?
  City: -
  Developer: -
  Landowner: -
- » How?
  - Prioritize CIP projects that have a multi-use function.
- » Partners?
  Hill Country Conservancy
  Hill Country Alliance
  GBRA

Reclaimed water systems

Update building code to allow the use of detention basin water for irrigation and provide incentives for developers that implement reclaimed water systems.

Critical Path Components:

- » Cost?
  City: $
  Developer: -
  Landowner: -
- » How?
  - Amend the building code to incentivize reclaimed water irrigation systems in new development and retrofitted development. (Design Standards, Ch. 144-5.2)
- » Partners?
  USGBC



Sequencing diagram

Fee-in-lieu

Update ordinances to better define fee-in-lieu (rather than detention) in lower portions of the watershed for all development types, where detention may be counterproductive.

Critical Path Components:

» Cost?
City:
Developer: $
Landowner: -

» How?
- Amend the ordinances to require fee-in-lieu rather than detention in lower portions of the watershed.
- Update the Drainage and Erosion Control Design Manual to require detention or fee-in-lieu for Types 1 and 2 Development.
- Allow/encourage regional water quality controls which serve more than one lot.

» Partners?
Comal and Guadalupe Counties

Incentives for detention basins

Provide incentives for specific design enhancements to detention basins to also improve their water quality functionality.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Incentivize with reduced fees detention basin designs that enhance water quality.

» Partners?
Comal and Guadalupe Counties

KEY

Requires changes to the DCM

Contributes to MS4 permit goals

City/Large Developer Estimated Costs

$	<$50,000
$$	$50-250,000
$$$	$250,000-1 million
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Small Developer/Landowner Estimated Costs

$	0-25% value of property
$$	50-75% value of property
$$$	75-100% value of property
$$$$	100%+ value of property

12. City Tools

This strategy refers to tools that the City can use such as implementing a stormwater utility fee to fund maintenance of stormwater facilities or incentives that provide opportunities for variance from code. For example, developments that achieve a higher standard than required could pay in-lieu fees into watershed for an expedited permitting process.

Which Phase in the Project?

policy | design & construction | operations, maintenance and monitoring

At What Scale?

site | community | regional

Benefits

- May help defray the costs of maintaining existing facilities as the city grows.
- May increase revenue that can be used to finance infrastructure or capital projects.

Limitations

- May inhibit new development if the fee is perceived as too costly.
- May cause development in undesirable areas that may not have an impact fee.

How to Get There...

Stormwater fee based on cover

Base stormwater fees associated with improved land on impervious area.

Critical Path Components:

» Cost?
City: -
Developer: $
Landowner: $

» How?
- Consider allowing LID to reduce impervious cover in fee calculations.

» Partners?
Comal and Guadalupe Counties

Compliance options

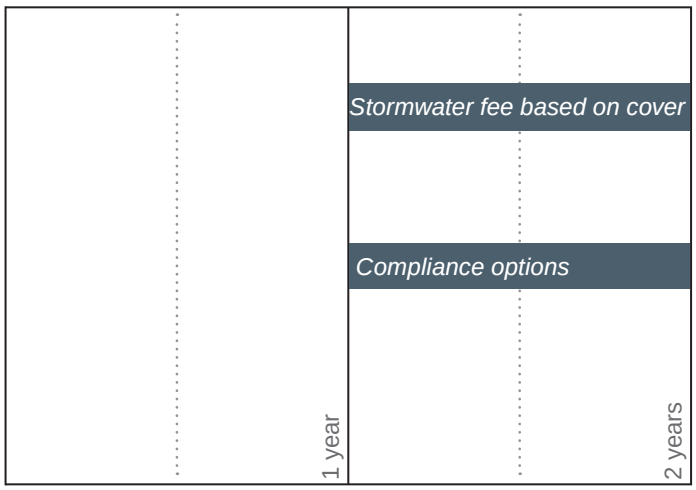
Provide incentives, like a reduced stormwater utility fee rate, to incorporate Low Impact Design methods into new and redevelopment projects.

Critical Path Components:

» Cost?
City: $
Developer: -
Landowner: -

» How?
- Provide incentives to developers who can provide evidence that the incorporation of LID techniques will reduce the impact on stormwater infrastructure.
- Expand or improve City development control over the ETJ to better allow implementation of these strategies.

» Partners?
Comal and Guadalupe Counties



Sequencing diagram

KEY

Requires changes to the DCM

City/Large Developer Estimated Costs

$	<$50,000
$ $	$50-250,000
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$ $ $ $	+$1 million

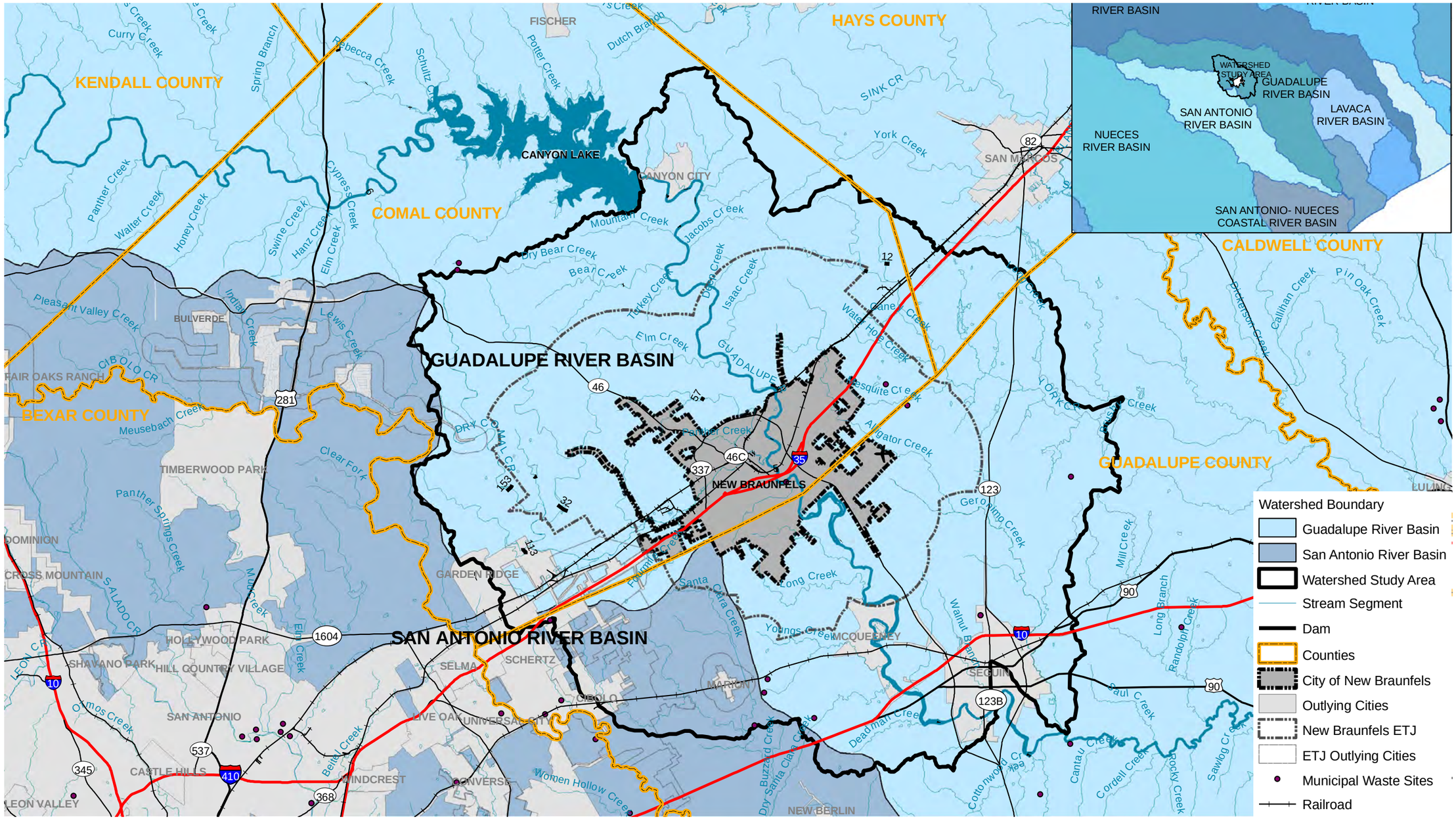
Small Developer/Landowner Estimated Costs

$	0-25% value of property
$ $	50-75% value of property
$ $ $	75-100% value of property
$ $ $ $	100%+ value of property

Appendix

A

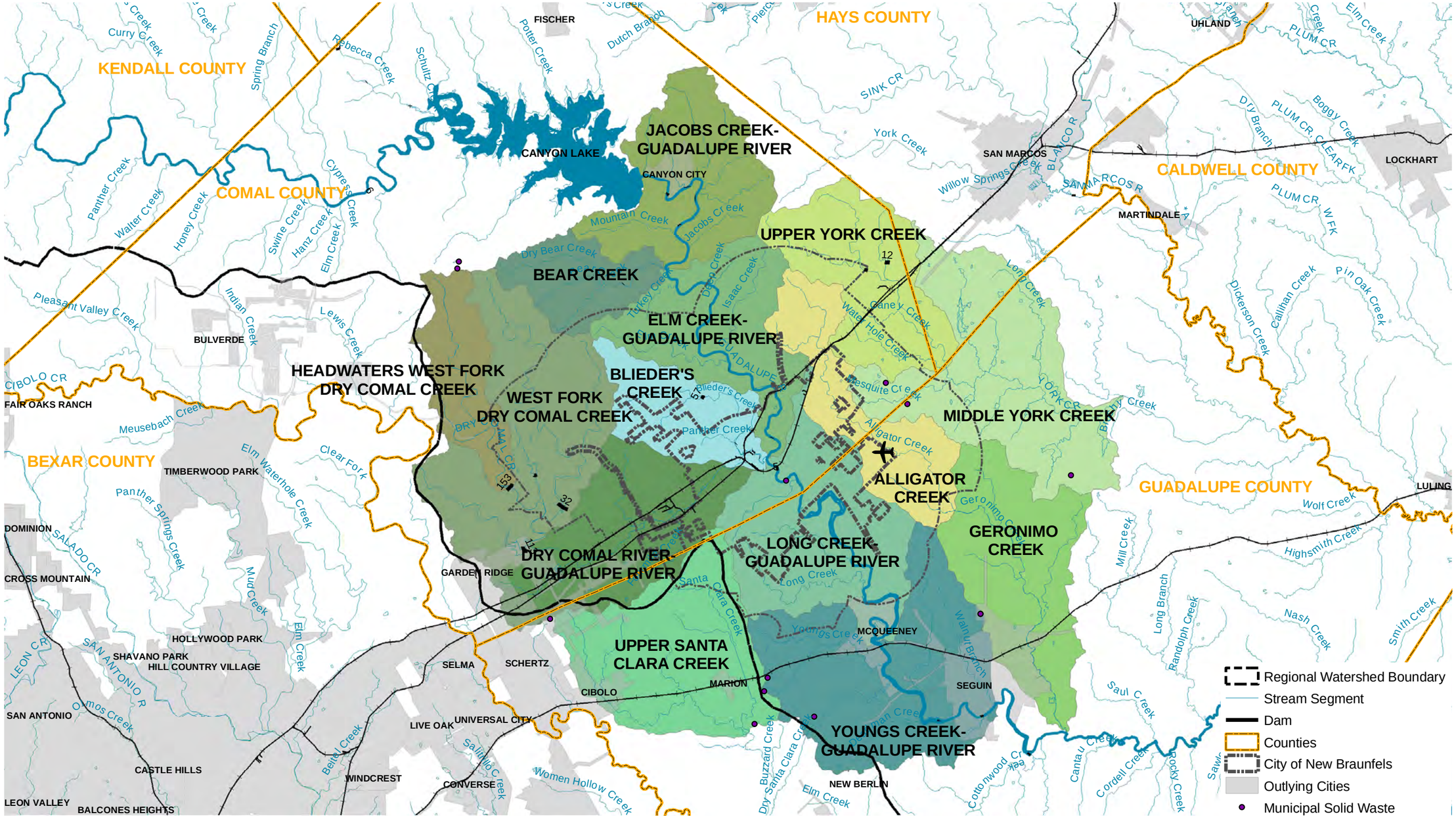
Existing Conditions Maps



NEW BRAUNFELS STORMWATER MASTER PLAN

REGIONAL WATERSHEDS - DRAFT 1.27.11

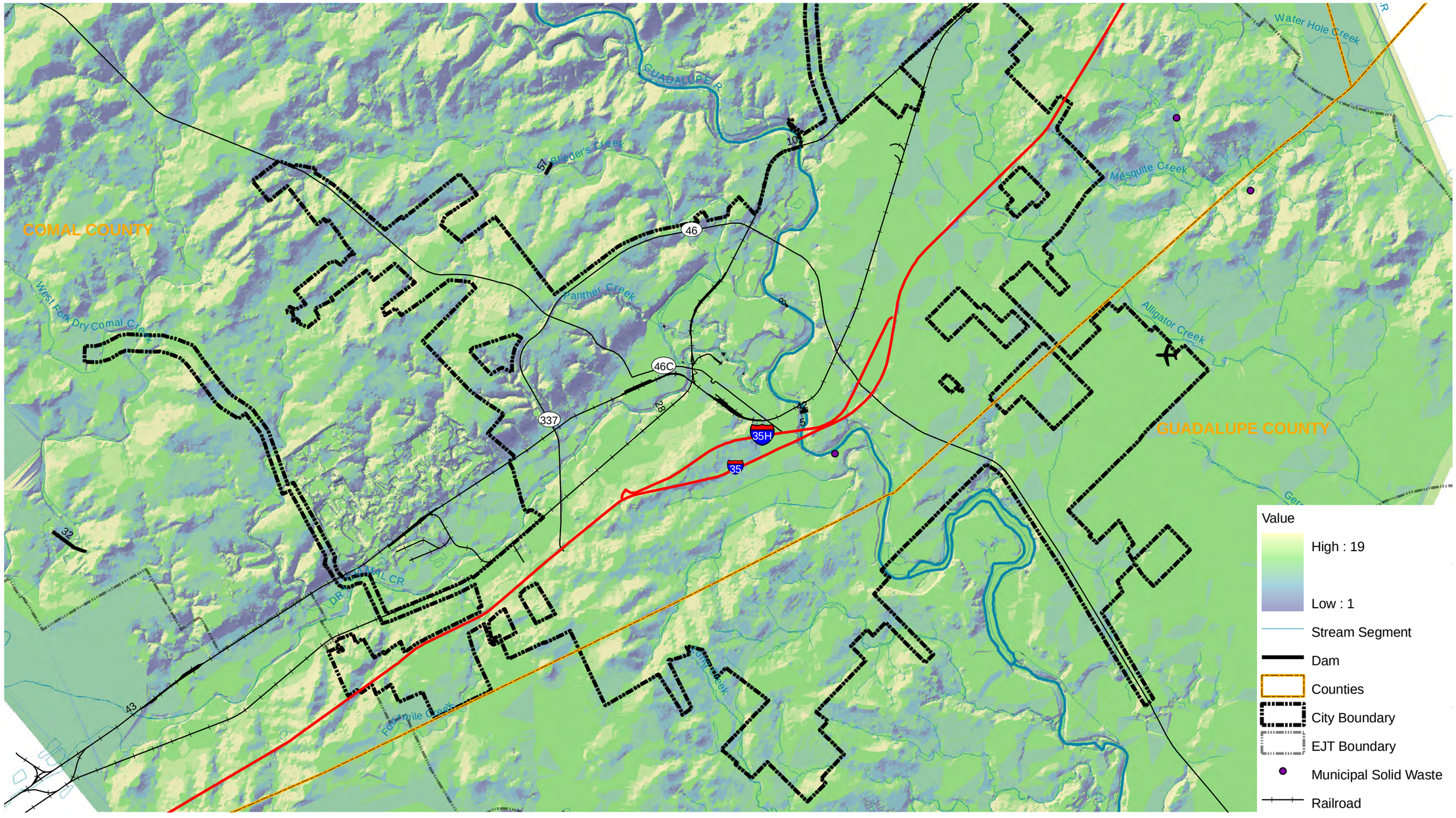
Data Sources: City of New Braunfels,
TX Natural Resources Information System,



NEW BRAUNFELS STORMWATER MASTER PLAN

SUB WATERSHEDS - DRAFT 1.27.11

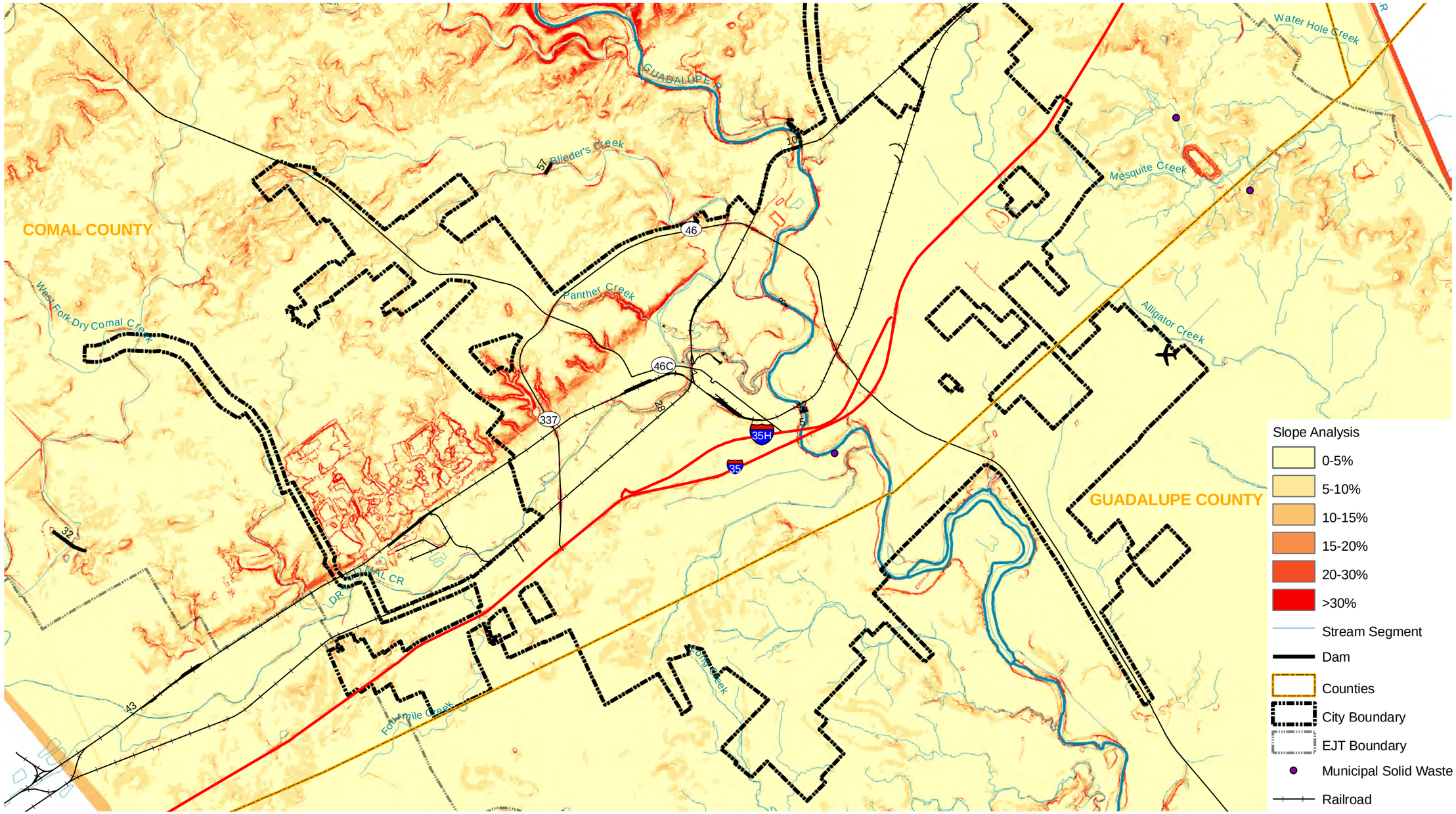
Data Sources: City of New Braunfels,
TX Natural Resources Information System,



NEW BRAUNFELS STORMWATER MASTER PLAN

ELEVATION MODEL - DRAFT 1.27.11

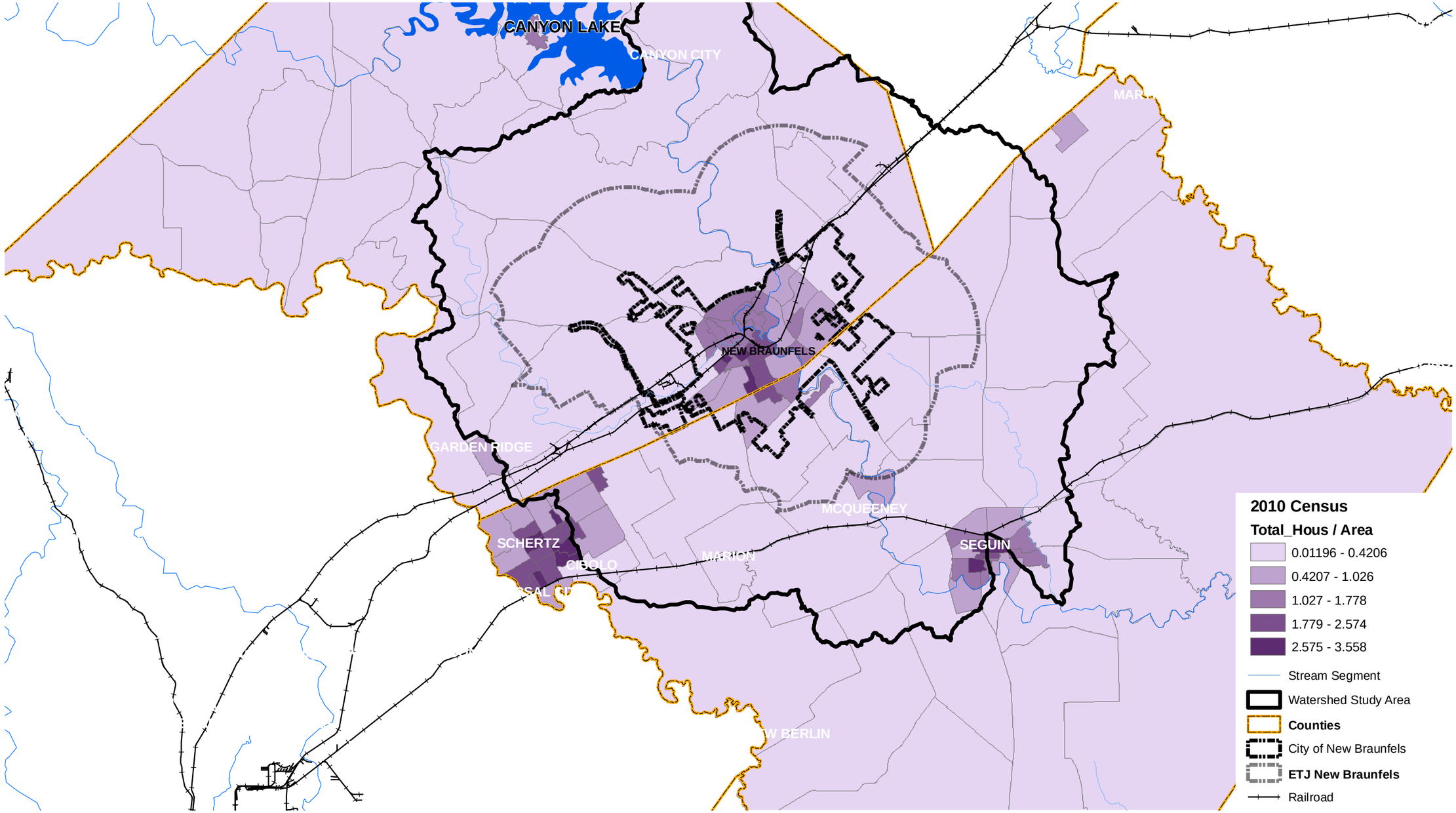
Data Sources: City of New Braunfels, TCEQ, USGS, Comal County



NEW BRAUNFELS STORMWATER MASTER PLAN

SLOPE ANALYSIS - DRAFT 1.27.11

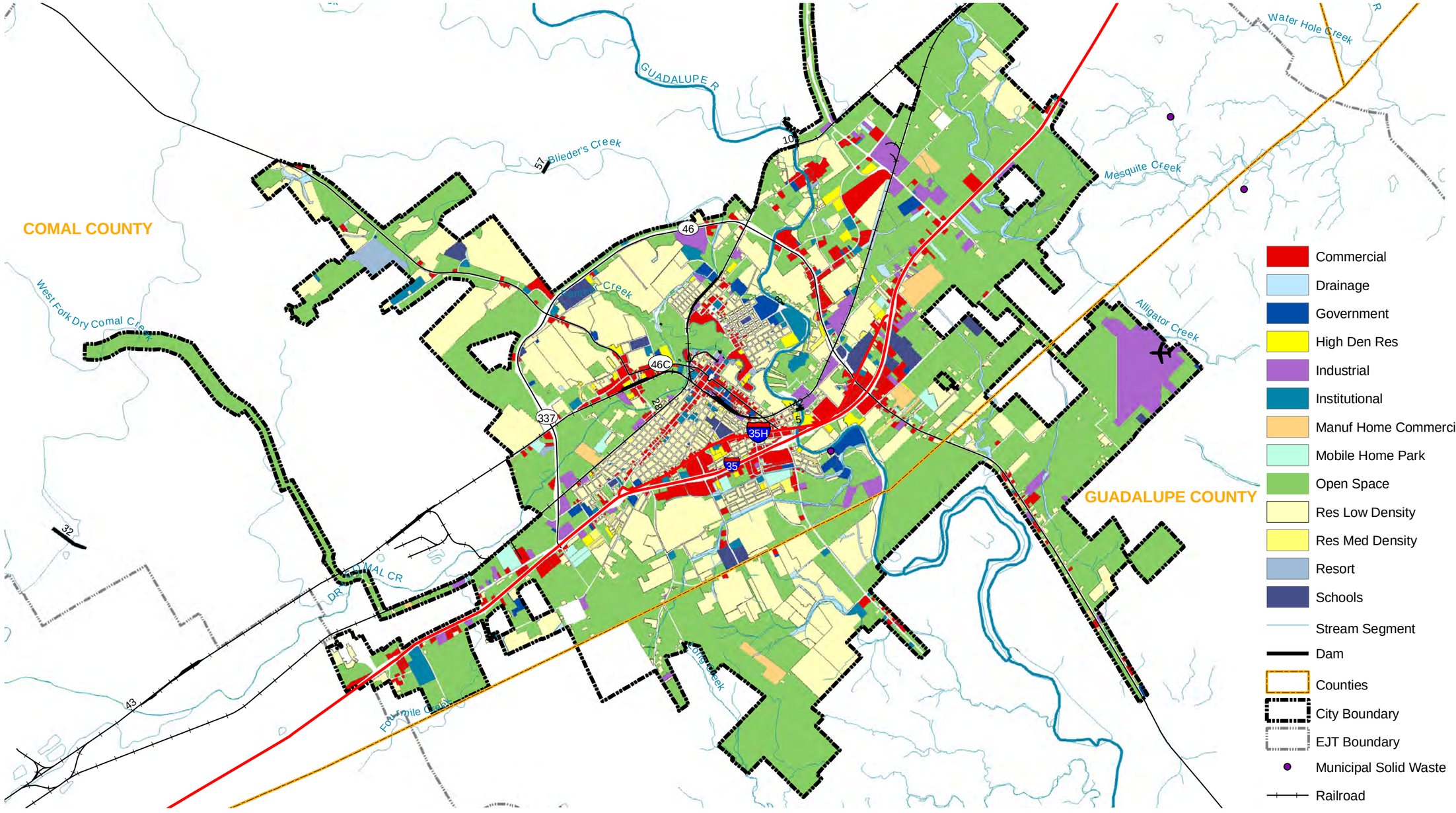
Data Sources: City of New Braunfels, TX Comm. Env. Quality, USGS, Comal County



NEW BRAUNFELS STORMWATER MASTER PLAN

HOUSING UNITS/ ACRE - DRAFT 08/25/11

Data Sources: City of New Braunfels,
TX Natural Resources Information System,

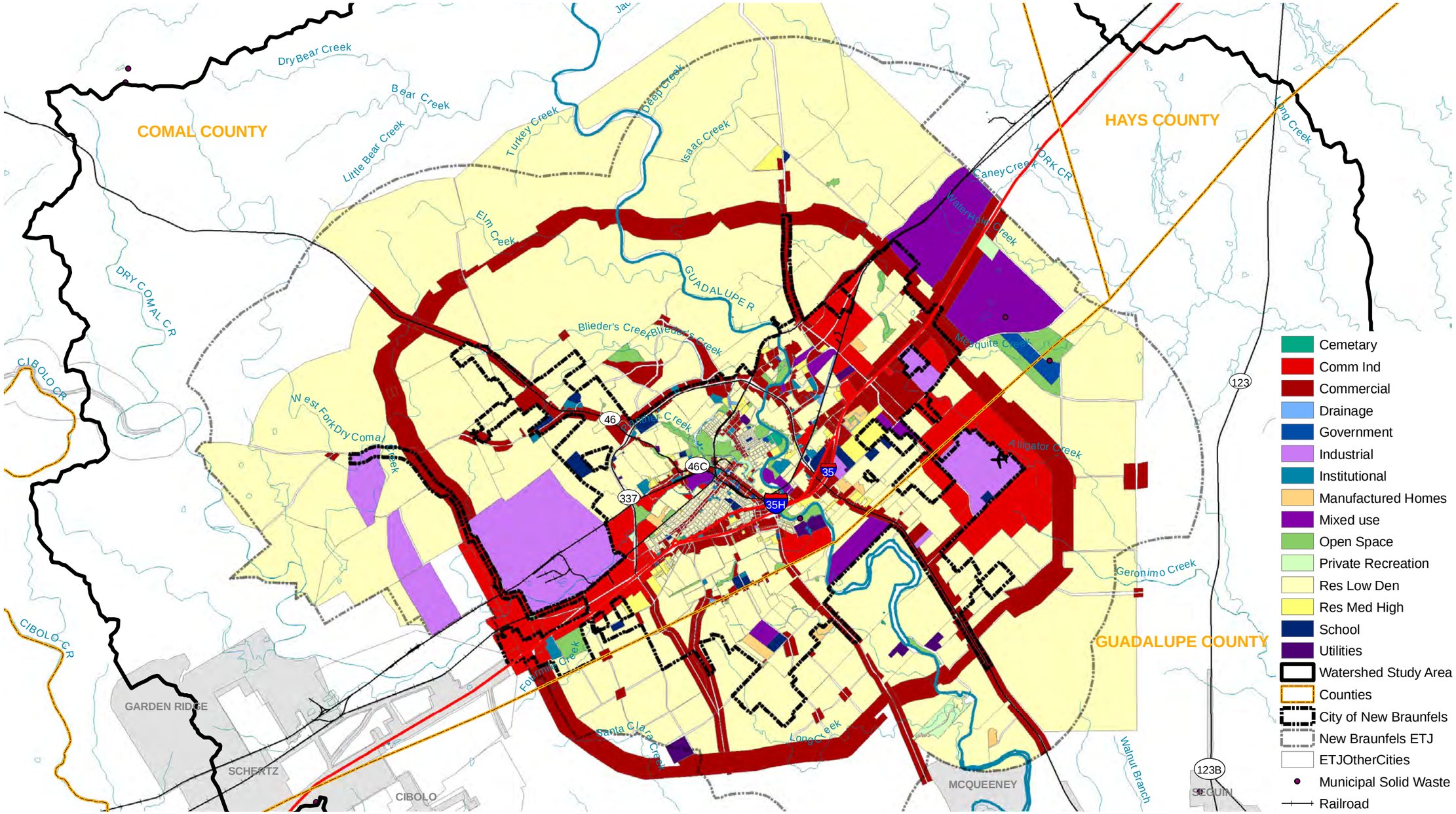


0 3,000 6,000 12,000 18,000 Feet

NEW BRAUNFELS STORMWATER MASTER PLAN

EXISTING LAND USE - DRAFT 1.27.11

Data Sources: City of New Braunfels, TX Comm. Env. Quality, USGS, Comal County

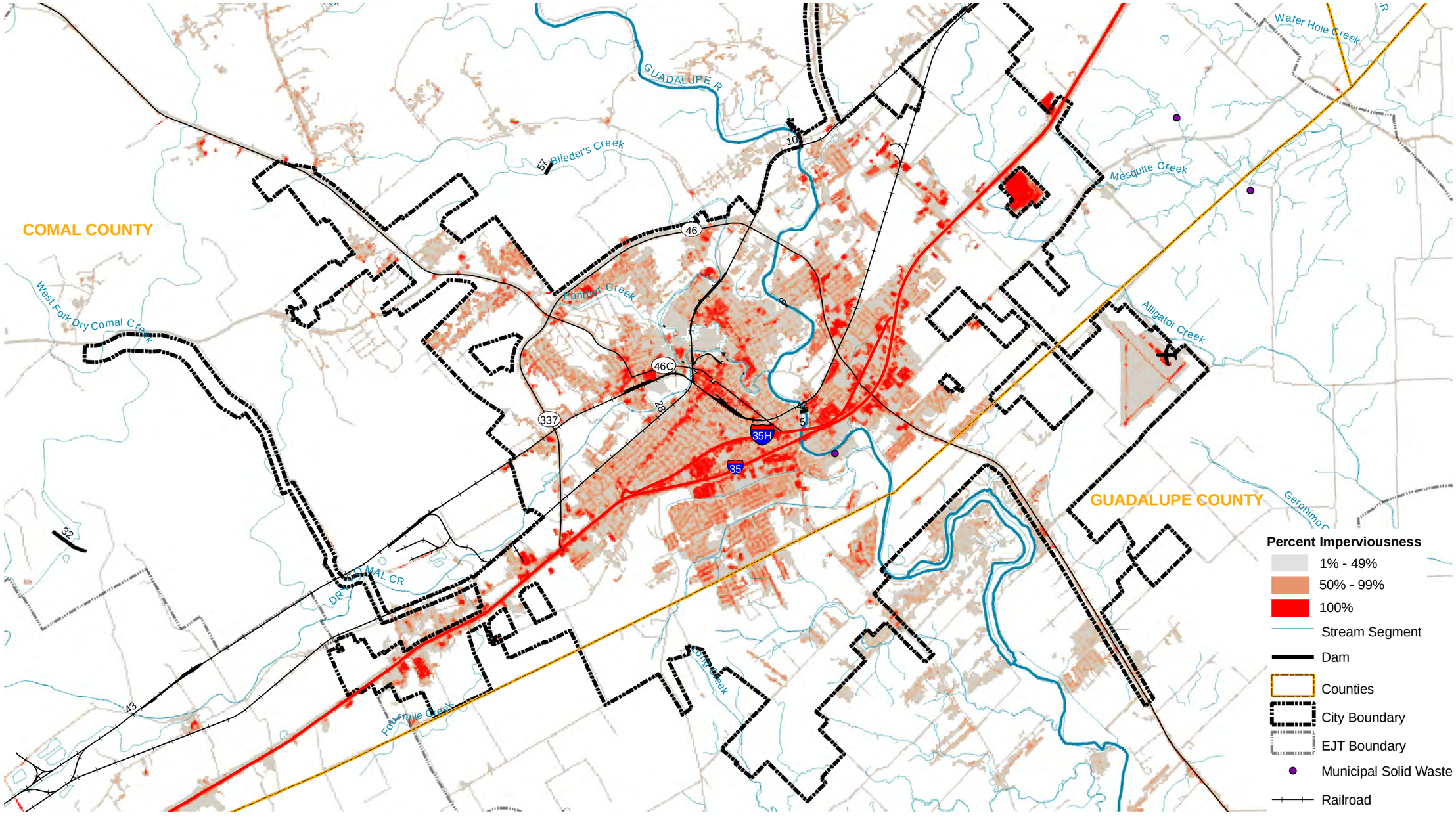


0 5,000 10,000 20,000 30,000 Feet

NEW BRAUNFELS STORMWATER MASTER PLAN

FUTURE LAND USE - DRAFT 1.27.11

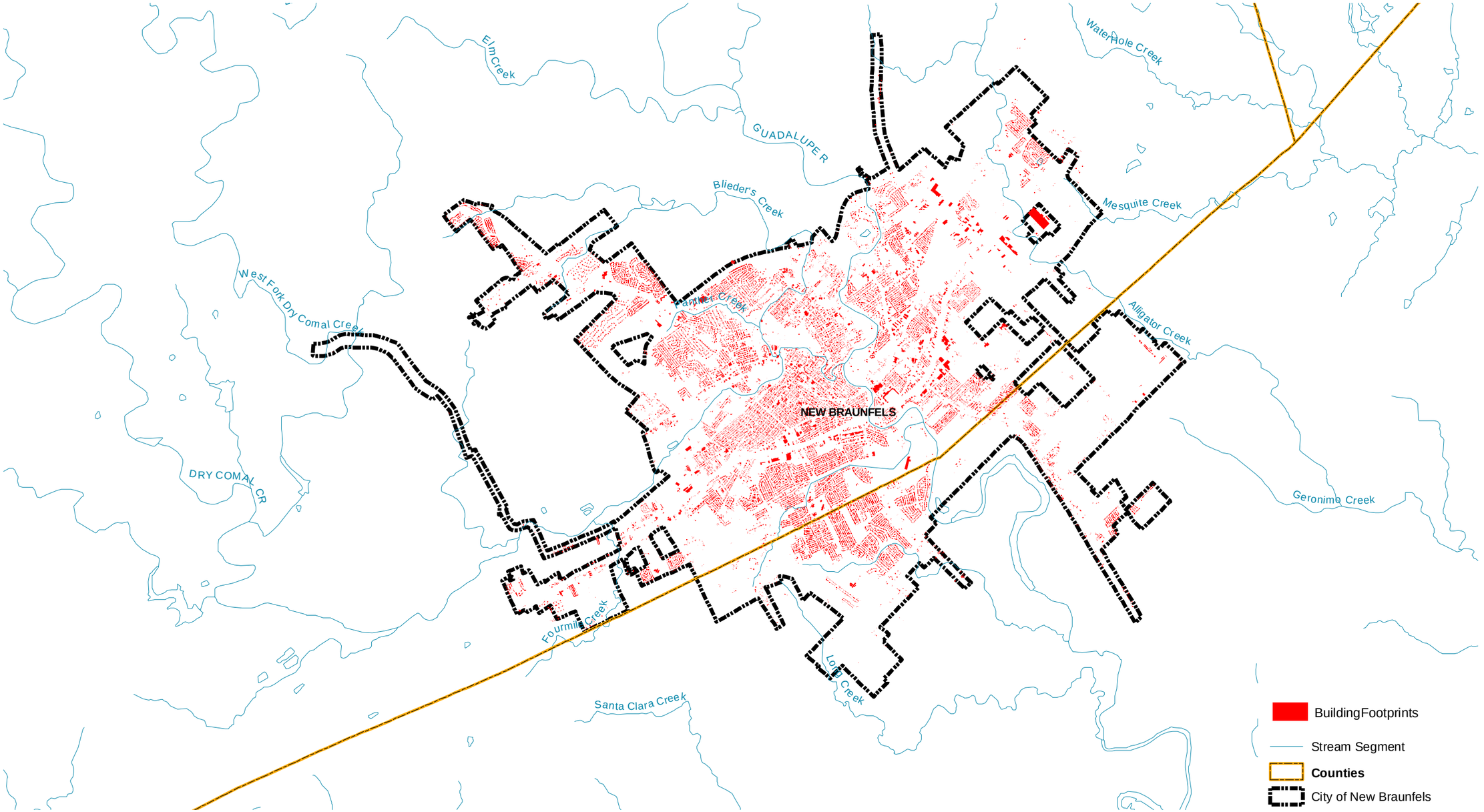
Data Sources: City of New Braunfels, TX NRIS, TX DOT, USGS, State of Texas, TCEQ



NEW BRAUNFELS STORMWATER MASTER PLAN

IMPERVIOUS SURFACES - DRAFT 1.27.11

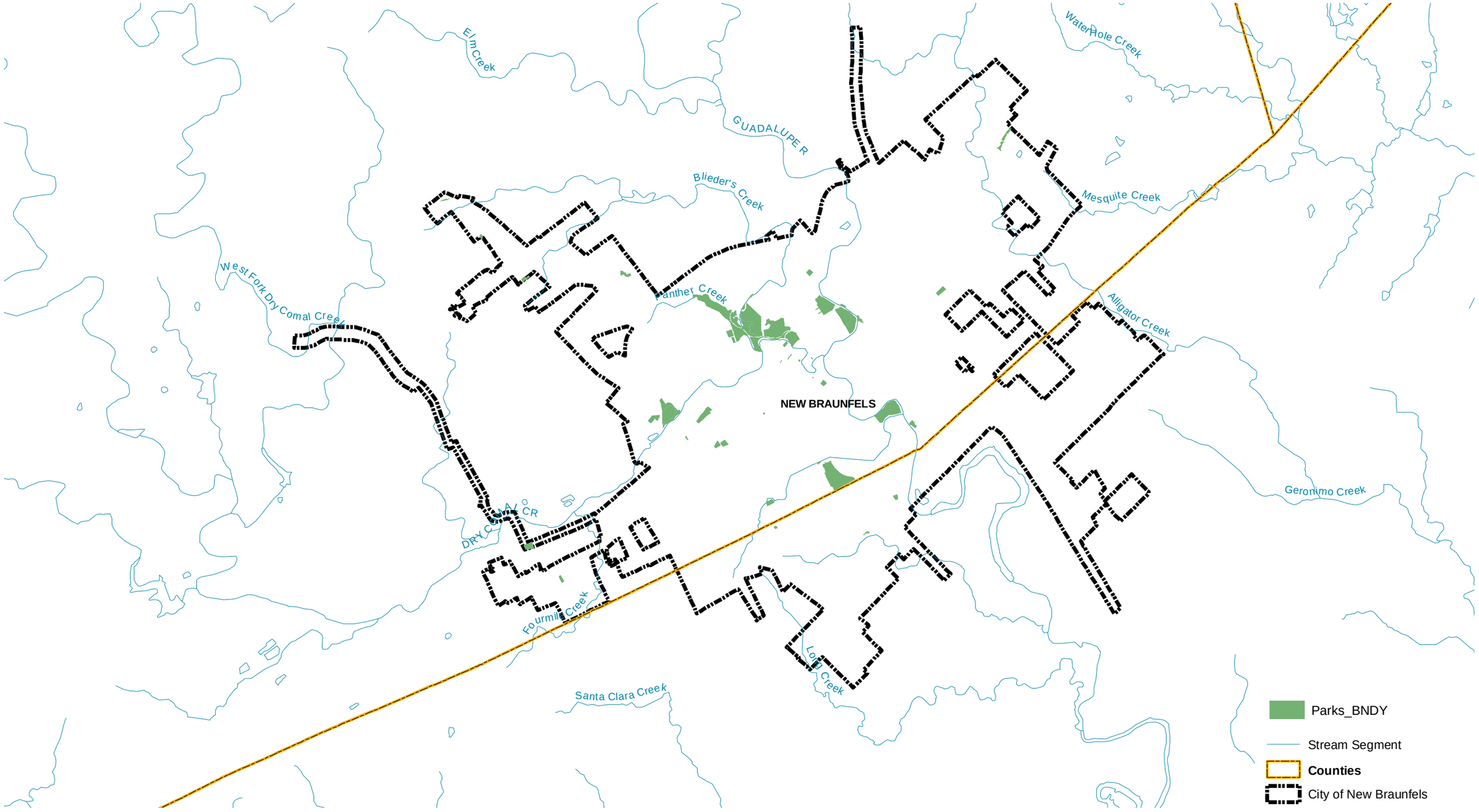
Data Sources: City of New Braunfels, TNRIS, TXDOT, USGS



NEW BRAUNFELS STORMWATER MASTER PLAN

BUILDING FOOTPRINTS - DRAFT 08/25/11

Data Sources: City of New Braunfels,
TX Natural Resources Information System,
TX DOT, USGS, State of Texas, TX Comm Env Quality

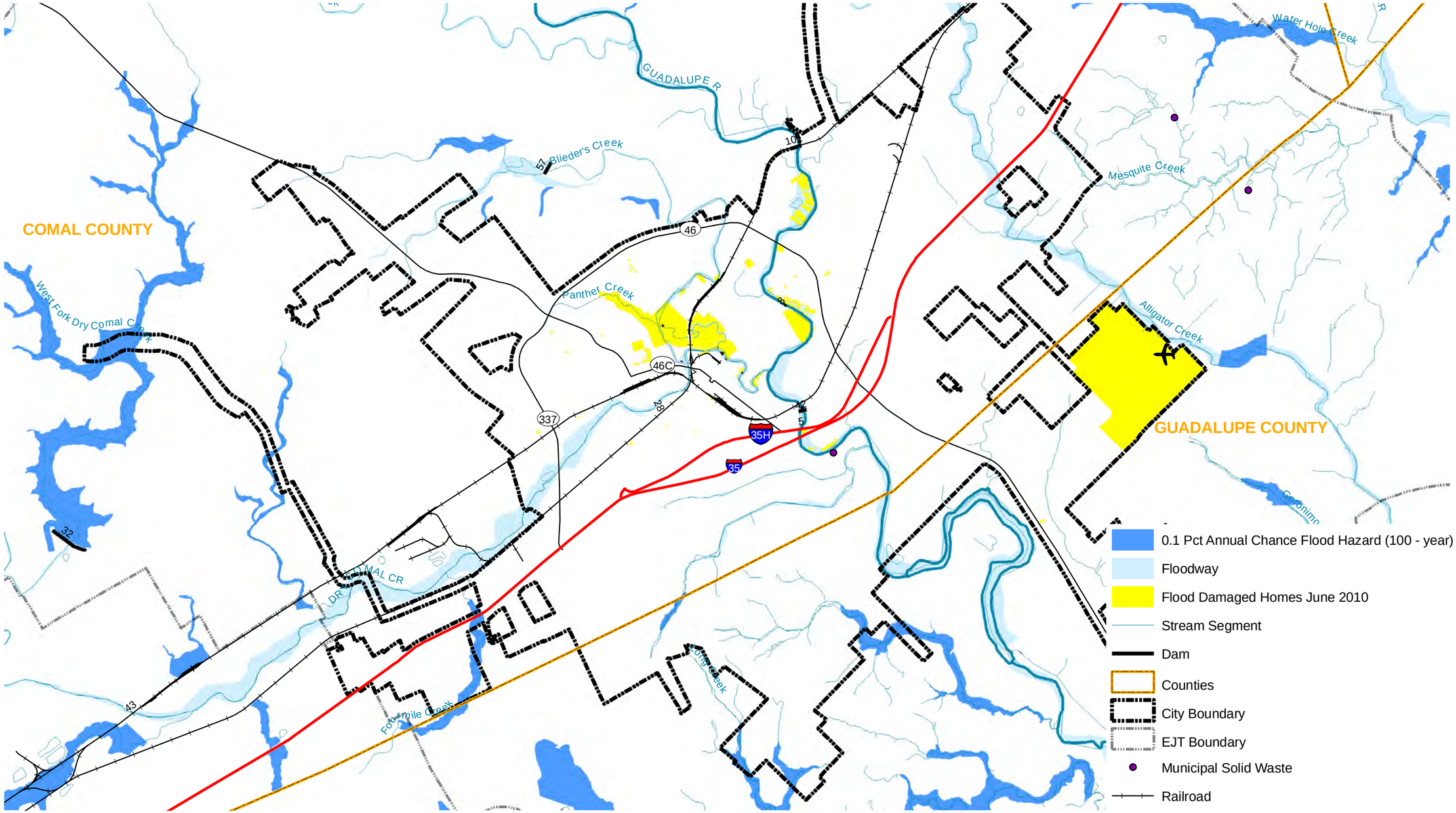


0 4,200 8,400 16,800 25,200 Feet

NEW BRAUNFELS STORMWATER MASTER PLAN

PARKS AND OPEN SPACE - DRAFT 08/25/11

Data Sources: City of New Braunfels,
TX Natural Resources Information System,
TX DOT, USGS, State of Texas, TX Comm Env Quality

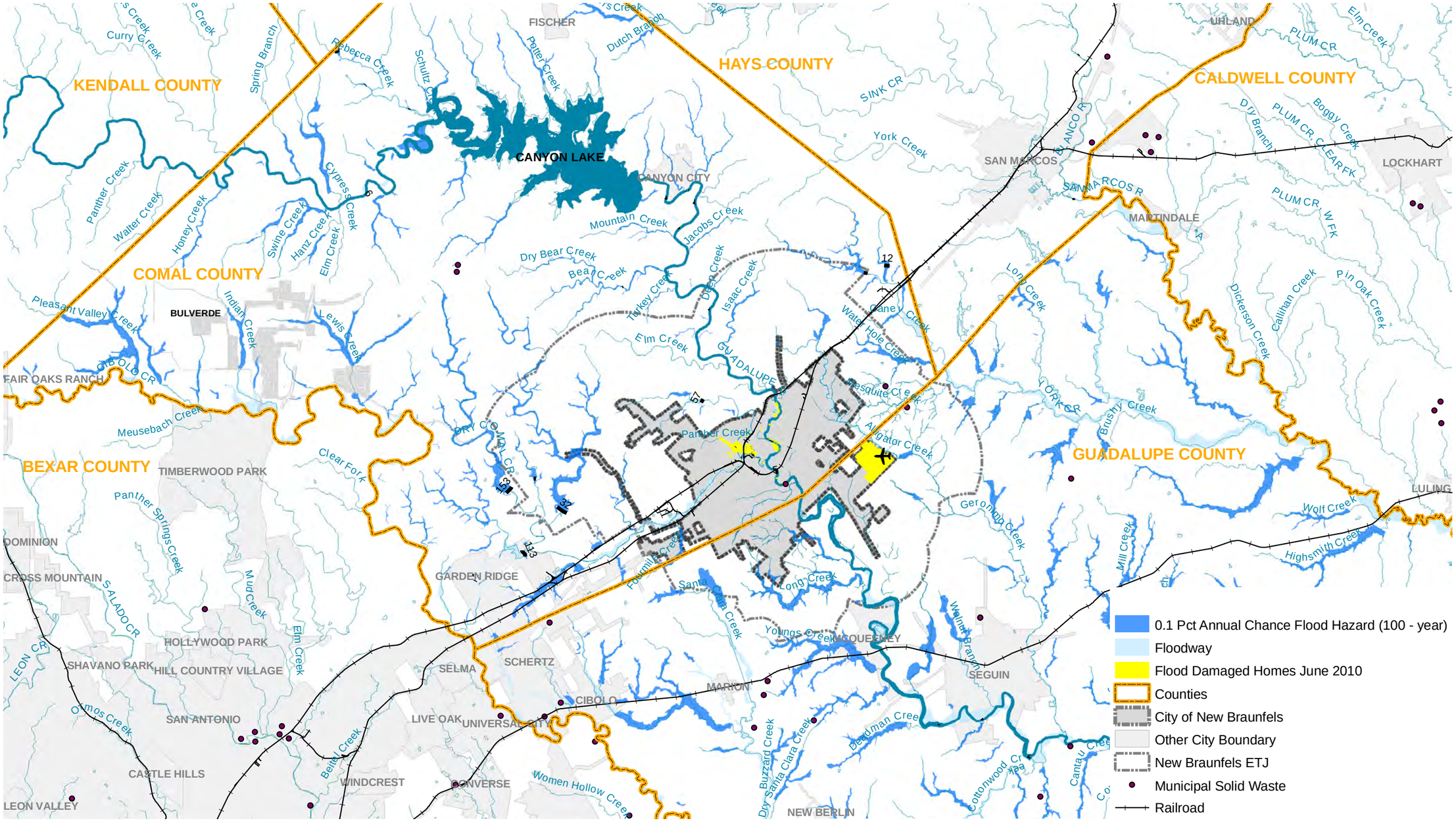


0 3,000 6,000 12,000 18,000 Feet

NEW BRAUNFELS STORMWATER MASTER PLAN

HYDROLOGY AND FLOODPLAINS - DRAFT 1.27.11

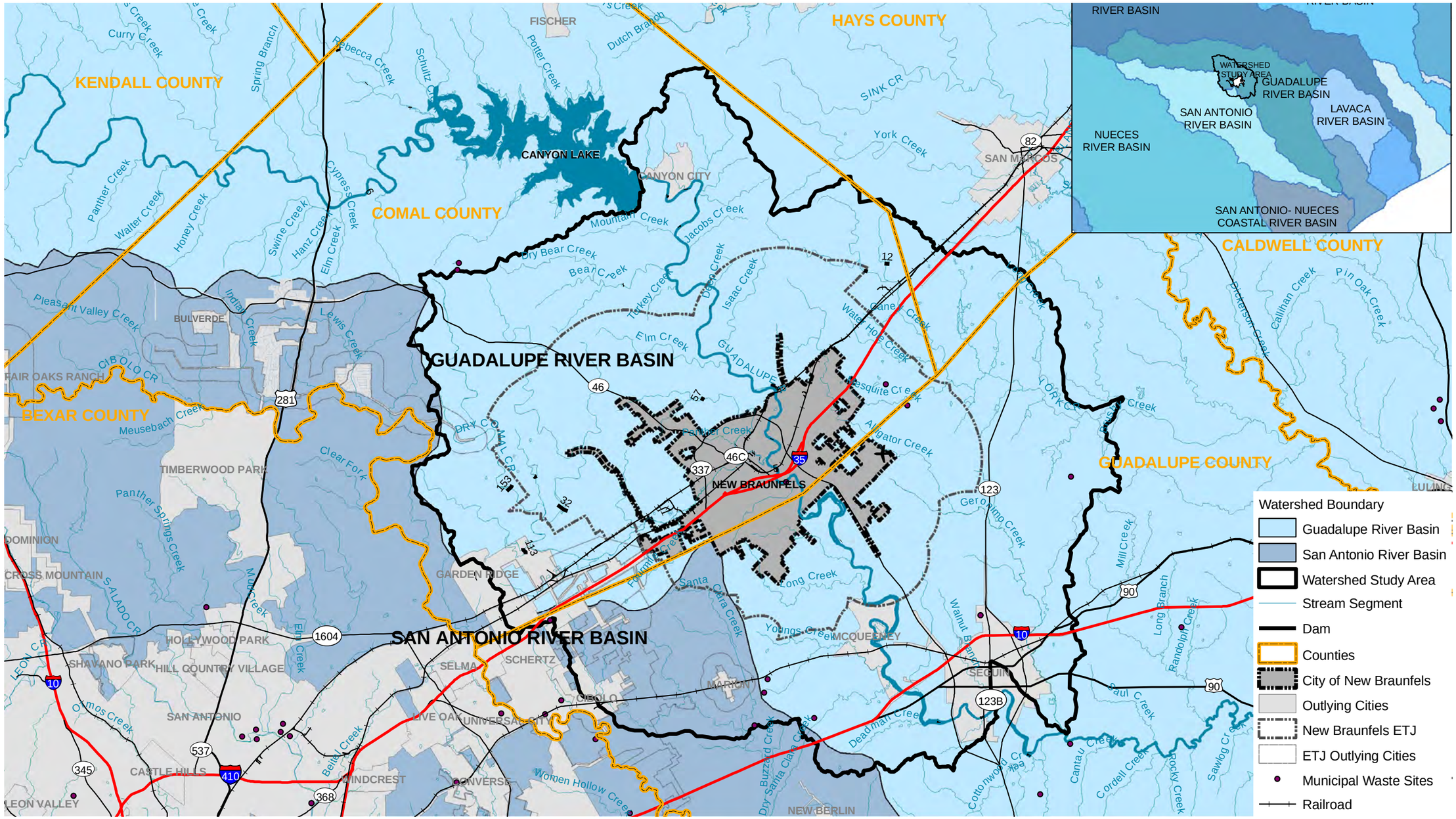
Data Sources: City of New Braunfels, TX Comm. Env. Quality, USGS, Comal County



NEW BRAUNFELS STORMWATER MASTER PLAN

HYDROLOGY AND FLOODPLAINS - DRAFT 1.27.11

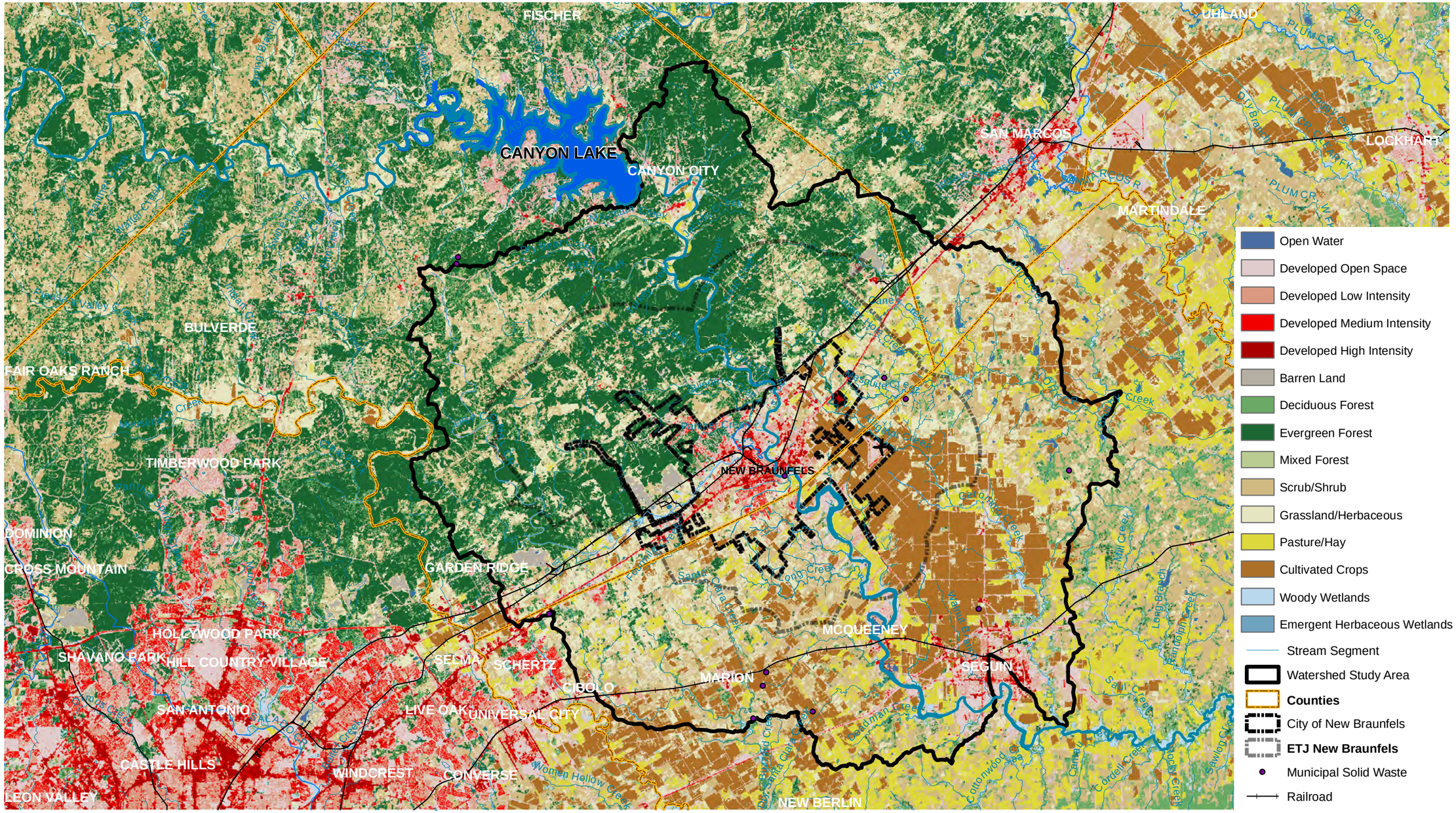
Data Sources: City of New Braunfels,
TX Commission for Environmental Quality,



NEW BRAUNFELS STORMWATER MASTER PLAN

REGIONAL WATERSHEDS - DRAFT 1.27.11

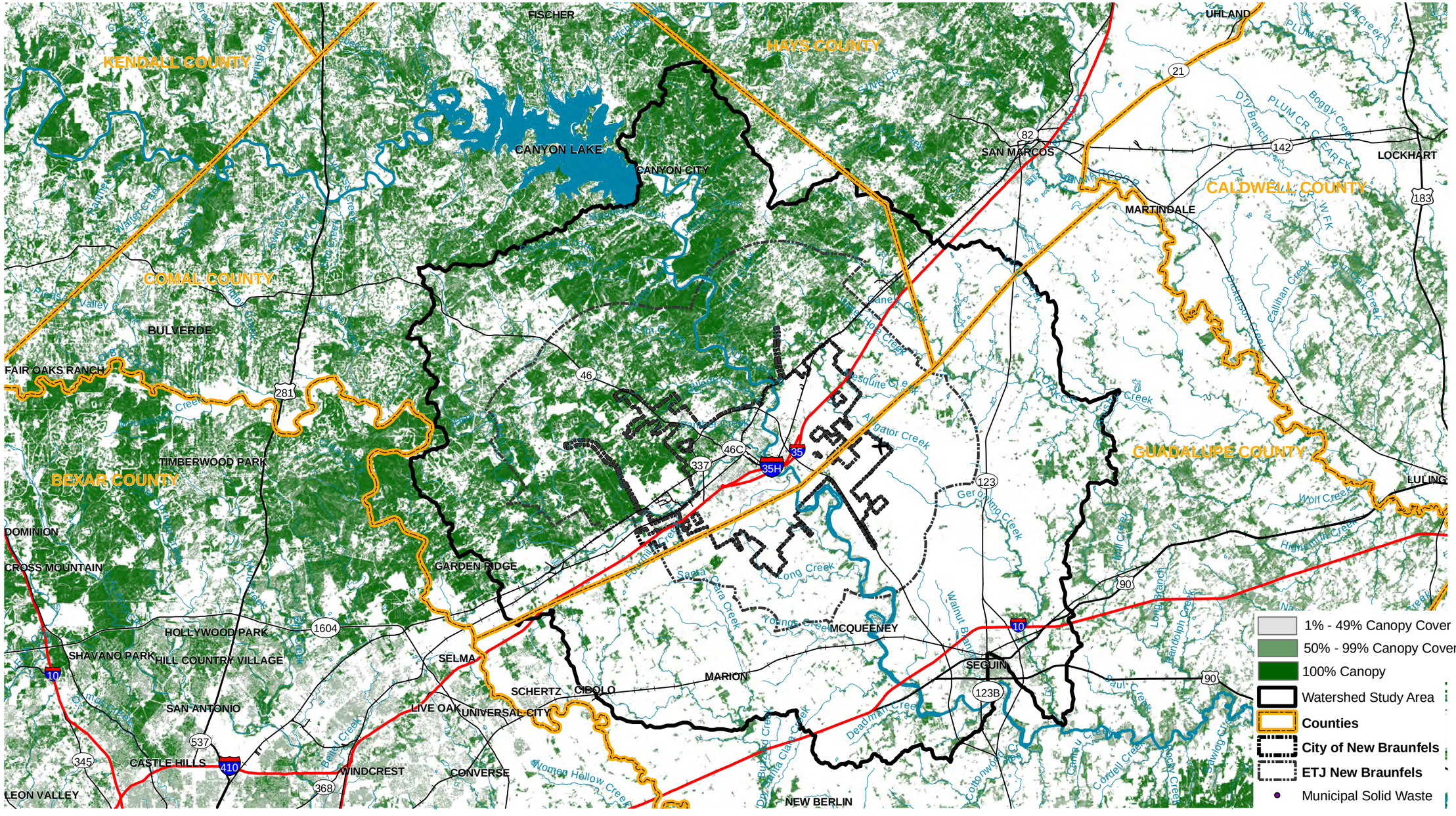
Data Sources: City of New Braunfels,
TX Natural Resources Information System,



NEW BRAUNFELS STORMWATER MASTER PLAN

LAND COVER - DRAFT 1.27.11

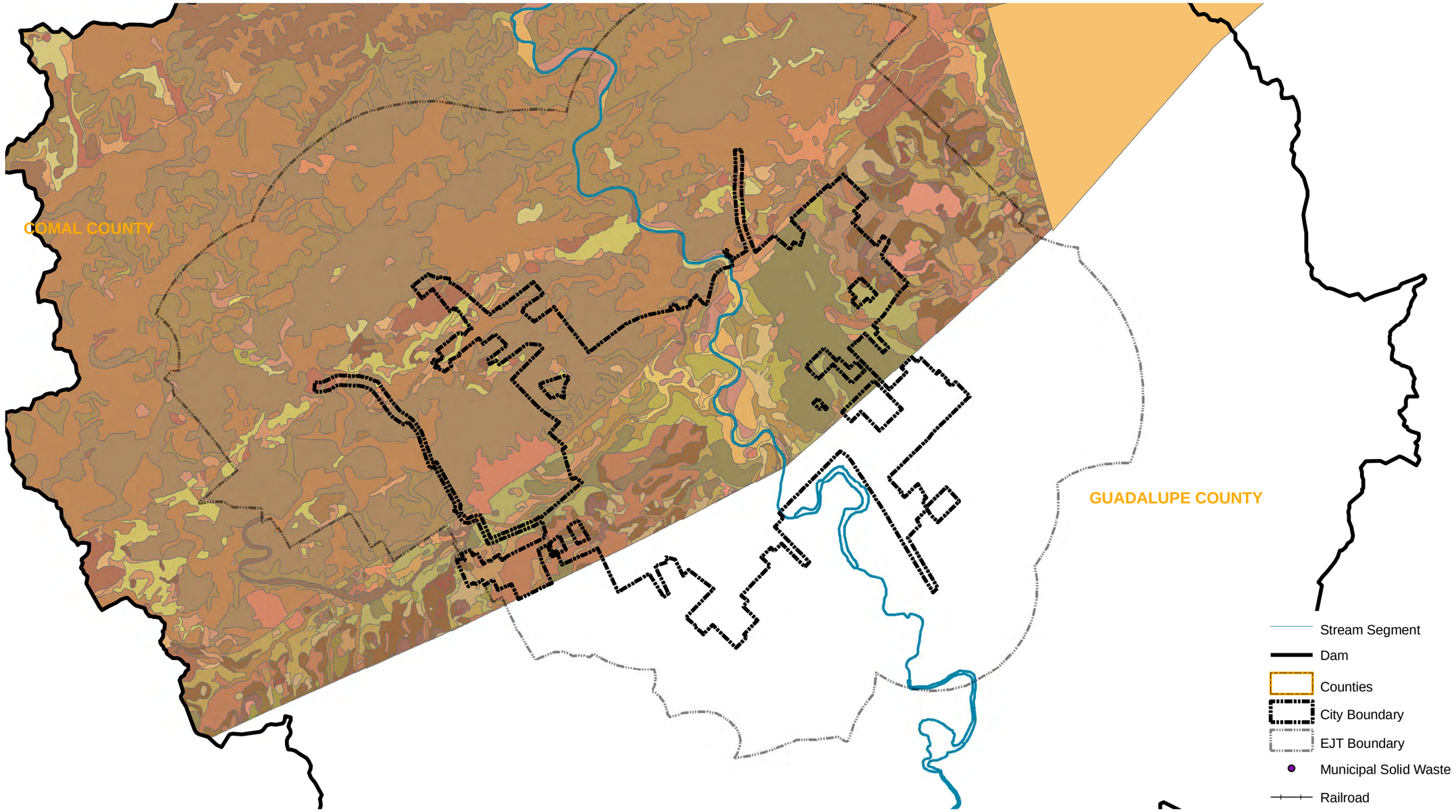
Data Sources: City of New Braunfels,
TX Natural Resources Information System,



NEW BRAUNFELS STORMWATER MASTER PLAN

TREE CANOPY - DRAFT 1.27.11

Data Sources: City of New Braunfels, TX Natural Resources Information System, TX DOT, USGS, TX Comm Env. Quality



NEW BRAUNFELS STORMWATER MASTER PLAN

SOILS - DRAFT 1.27.11

Data Sources: City of New Braunfels, TNRIS, TXDOT, USGS

B

Strategy Cards

open space conservation

sets aside land to preserve open space that has high infiltration rates, which contributes to peak flow levels and increased infiltration into underground aquifers

policy | design & construction | operations, maintenance and monitoring | site | community | **regional**

impervious coverage reductions or limits

increased densities, decreased road sections, reduced parking requirements; City can establish limits to impervious cover in city limits or ETJ

policy | **design & construction** | operations, maintenance and monitoring | **site** | **community** | regional

benefits

This strategy may:

- **preserve the character** of the New Braunfels Hill Country
- **maintain (or reduce) pervious** cover existing in watersheds contributing to New Braunfels
- contribute to TCEQ permit approval

limitations

This strategy may:

- not increase infiltration, only maintain existing status
- require funding for potential purchase of land or easements

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- utilize parks and **open space** for stormwater storage and infiltration

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- stormwater infrastructure should be **visually pleasing**

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benefits

This strategy may:

- be applied at multiple scales with various mechanisms
- decrease the peak flow stormwater runoff

limitations

This strategy may:

- require changes in City regulation and standards
- require coordination among land owners when implementing at a community scale

This strategy may help accomplish the following goals:

environment

- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**
- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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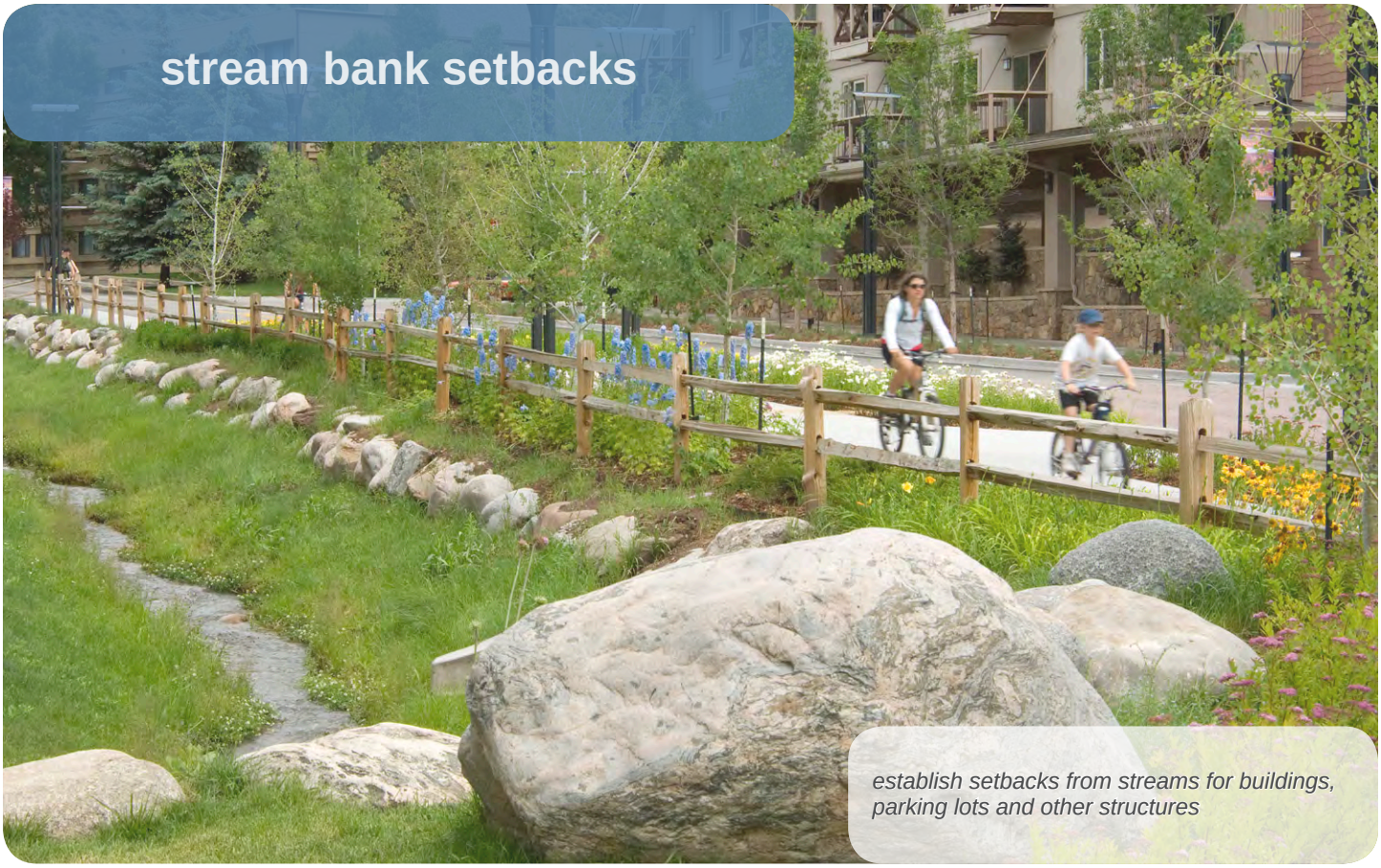
floodway building prohibitions

further limit or restrict new construction in the 100-year floodplain and floodway beyond existing ordinance

policy | design & construction | operations, maintenance and monitoring | site | community | regional

stream bank setbacks



establish setbacks from streams for buildings, parking lots and other structures

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- reduce flood damage and insurance claims
- increase park and open space area

limitations

This strategy may:

- reduce landowners' area of usable land

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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benefits

This strategy may:

- protect waterways from point source pollution
- reduce flood damage and insurance claims
- prevent or minimize erosion and gully formation

limitations

This strategy may:

- reduce direct access to water

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

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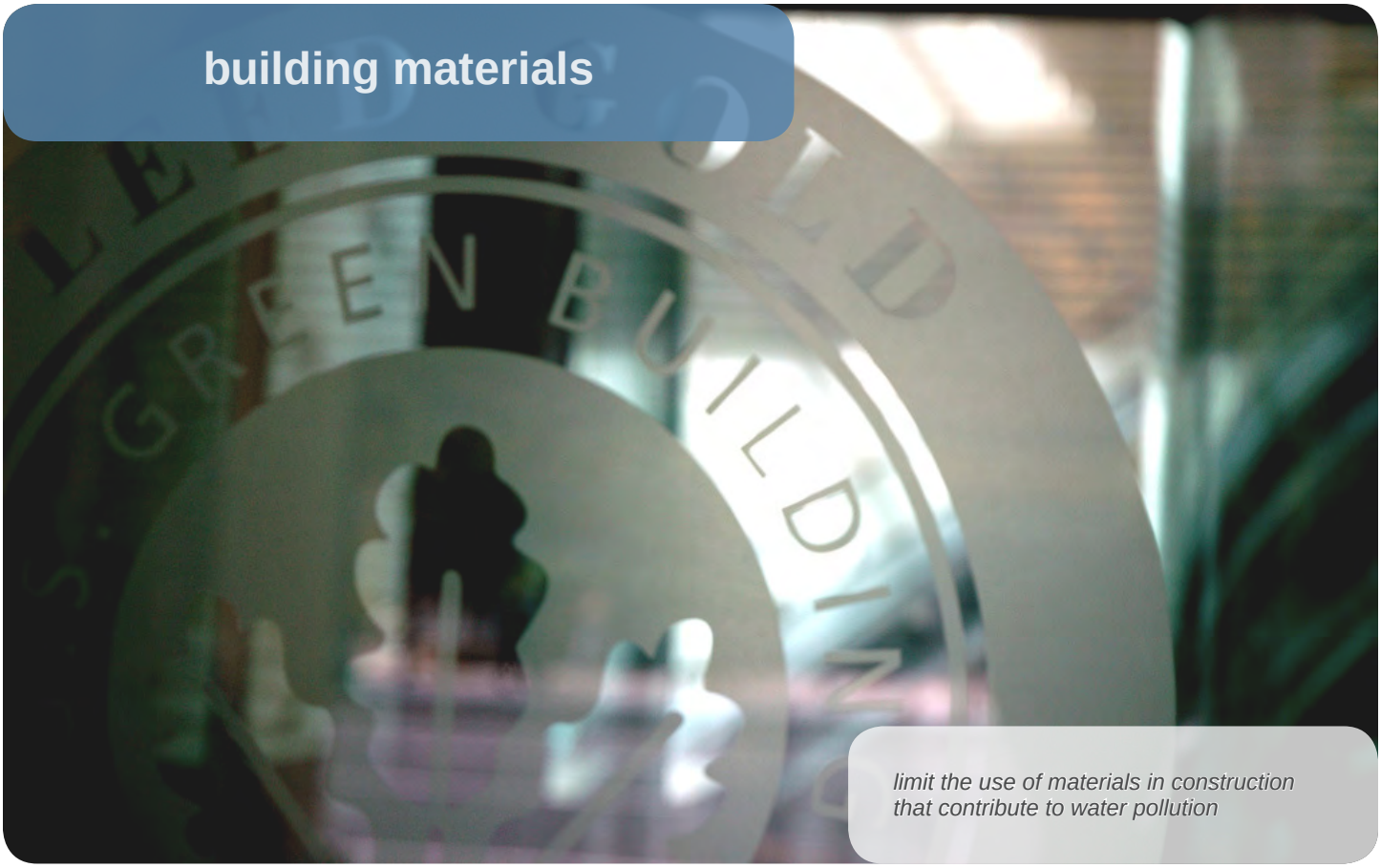
building materials



limit the use of materials in construction that contribute to water pollution

policy | design & construction | operations, maintenance and monitoring | site | community | regional

construction control measures

enhanced seeding, mulching, sediment traps, silt fencing, erosion control plan beyond existing requirements

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- improve downstream water quality
- improve wildlife habitat
- improve drinking water quality
- increase cost savings over time
- increase energy efficiency

limitations

This strategy may:

- be more costly and not as readily available as other strategies

This strategy may help accomplish the following goals:

environment

- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- stormwater infrastructure should be **visually pleasing**
- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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benefits

This strategy may:

- be less costly to contractors during construction if implemented from the beginning
- reduce sedimentation in waterways
- increase water quality

limitations

This strategy may:

- be costly for small projects

This strategy may help accomplish the following goals:

environment

- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake
- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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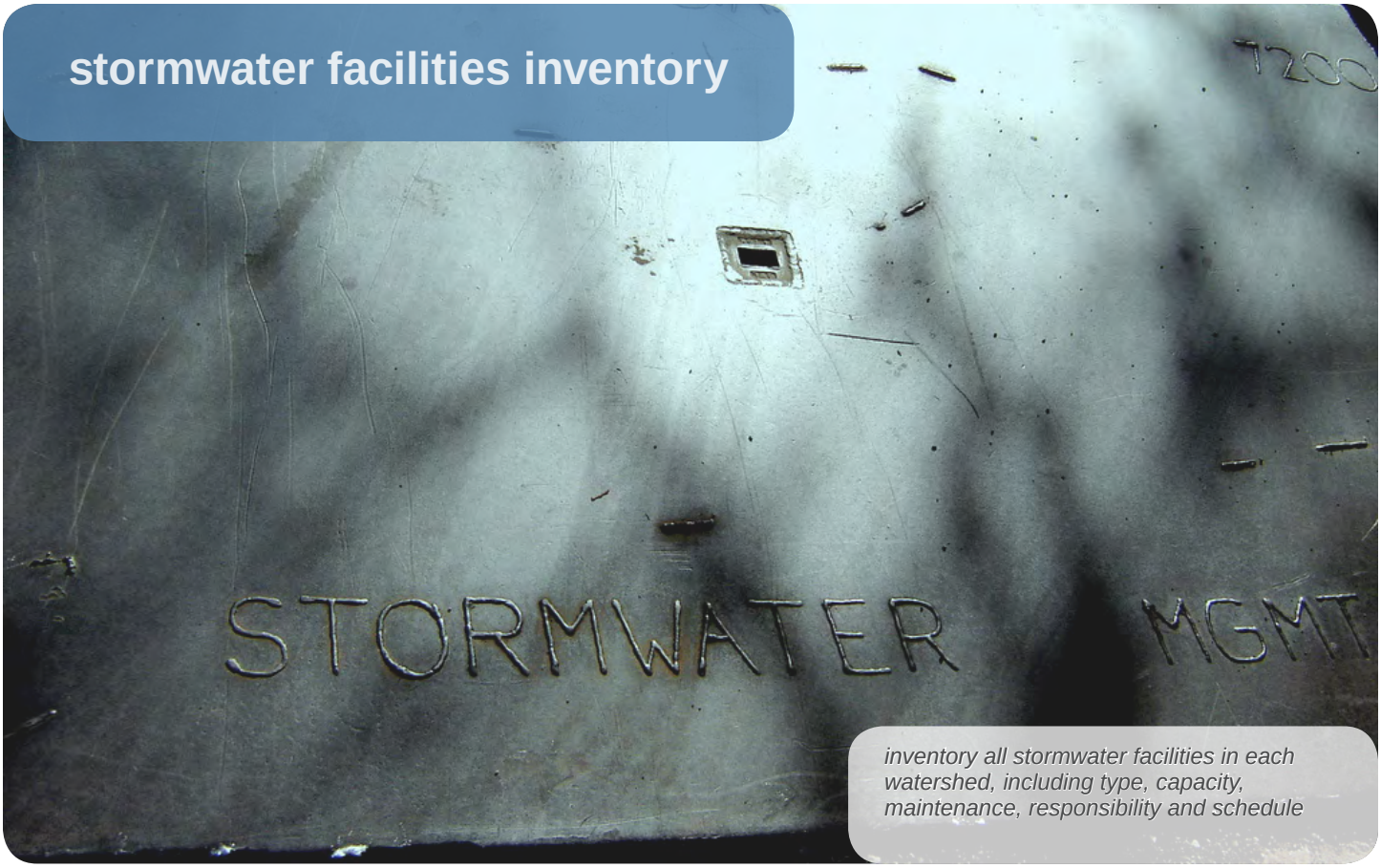
stormwater facilities inventory



inventory all stormwater facilities in each watershed, including type, capacity, maintenance, responsibility and schedule

policy | design & construction | operations, maintenance and monitoring | site | community | regional

maintenance and monitoring

outlines responsibilities for ensuring maintenance and monitoring is not only completed and operating correctly, but also requires regular city maintenance practices to incorporate BMPs

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- be extremely useful for city to have on record and when determining needs for new stormwater facilities

limitations

This strategy may:

- be difficult to keep up to date once in place
- require a time-consuming survey

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities

community

- ensure **stakeholder buy-in** on stormwater strategies
- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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benefits

This strategy may:

- reduce costs associated with poorly managed facilities and infrastructure
- reduce wasted natural resources

limitations

This strategy may:

- require on-going staff training
- require the creation or revision of a maintenance procedures manual

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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density bonuses

incentives and bonuses for increased density in locations close to transit and services in order to preserve open space

policy | design & construction | operations, maintenance and monitoring | site | community | regional

stormwater utility fee

implement fee to fund maintenance of stormwater facilities

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- reduce the impacts such as increased flooding from impervious cover
- allow the City to incentivize increased density in desired areas
- require TCEQ permit approval

limitations

This strategy may:

- require additional study to determine which areas could become more dense

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **minimize impervious** surfaces

community

- utilize parks and **open space** for stormwater storage and infiltration

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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benefits

This strategy may:

- help defray the costs of maintaining existing facilities as the city grows

limitations

This strategy may:

- inhibit new development if fee is perceived as too costly

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

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city incentives or fees

opportunities for variance from code for a fee for developments that achieve a higher standard than required. examples: buy into watersheds to pay in lieu of expedited permitting process

policy | design & construction | operations, maintenance and monitoring | site | community | regional

porous pavement

increase use of pervious paving materials by amending code to allow for the use of such materials in roadways and parking lots

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- increase revenue that can be used to finance infrastructure or capital projects

limitations

This strategy may:

- inhibit new development if fee is perceived as too costly
- cause development in undesirable areas that may not have an impact fee

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**
- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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benefits

This strategy may:

- reduce volume of runoff
- reduce delivery of associated pollutants to warm water bodies
- reduce need for more involved stormwater drainage, conveyance and treatment systems
- contribute to TCEQ permit approval

limitations

This strategy may:

- be costlier than traditional materials
- is typically used for more lightly-trafficked (vehicular) sites
- require frequent maintenance
- offer different TCEQ benefits depending on concrete or asphalt
- not be applicable for curb and gutter roadway sections

This strategy may help accomplish the following goals:

environment

- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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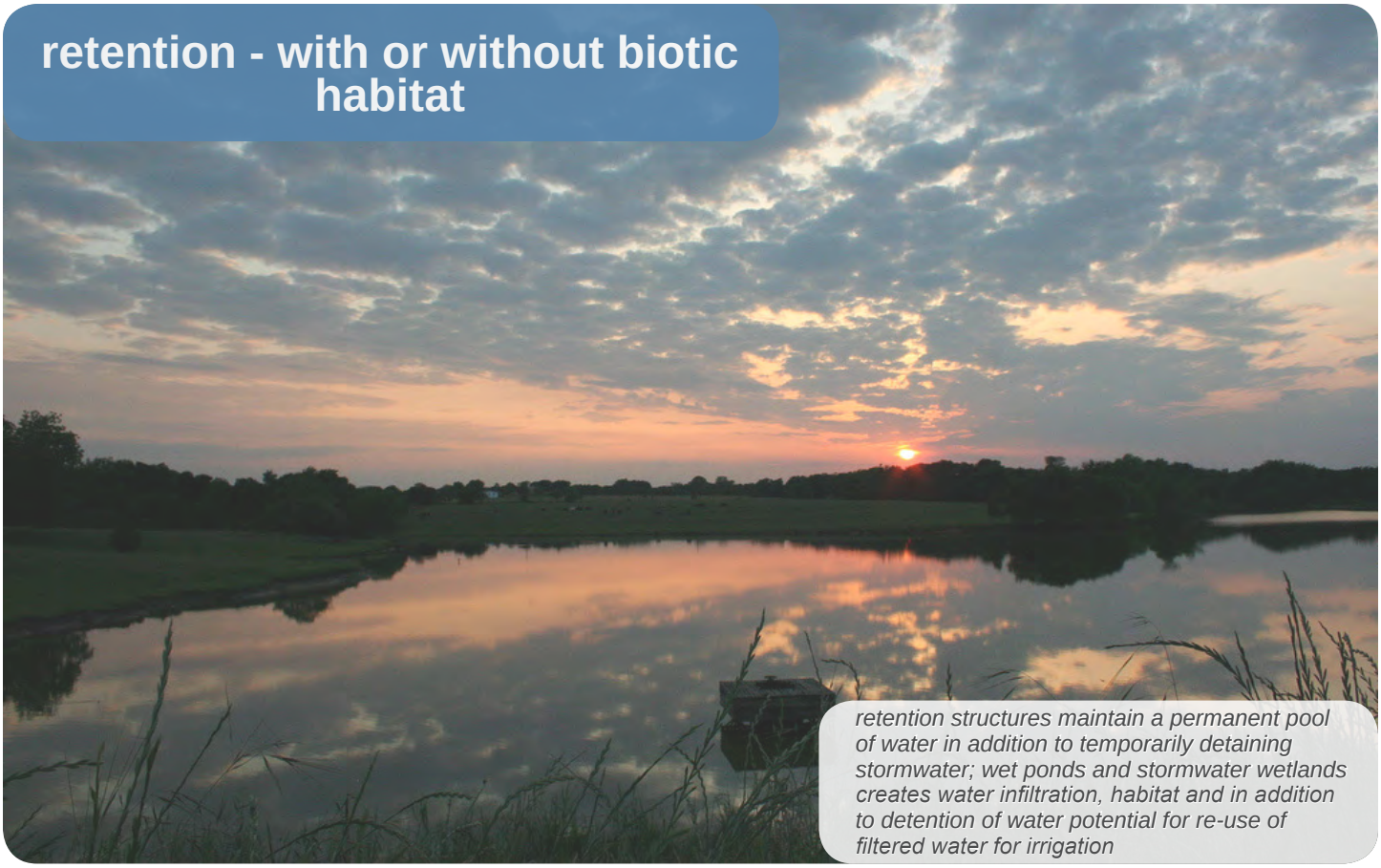
retention - with or without biotic habitat



retention structures maintain a permanent pool of water in addition to temporarily detaining stormwater; wet ponds and stormwater wetlands creates water infiltration, habitat and in addition to detention of water potential for re-use of filtered water for irrigation

policy | **design & construction** | operations, maintenance and monitoring | **site** | **community** | **regional**

building runoff capture

capture and storage of rainwater from roofs, cisterns

policy | **design & construction** | operations, maintenance and monitoring | **site** | community | regional

benefits

This strategy may:

- be aesthetically pleasing by adding a water feature and plant material
- remove dissolved nutrients
- contribute to TCEQ permit approval

limitations

This strategy may:

- increase construction costs
- increase maintenance costs
- contribute to thermal pollution and cause downstream warming
- be a safety concern for children
- cause nuisances such as mosquitoes, odor, algae
- have the potential to dry up during drought, without external water source

This strategy may help accomplish the following goals:

environment

- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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benefits

This strategy may:

- mitigate or eliminate increased runoff volume
- reduce the required capacity for down-slope retention and sediment control BMPs
- contribute to TCEQ permit approval

limitations

This strategy may:

- increase building costs, for example: installing a green roof
- not claim flood control credit unless sized properly
- be hard to enforce

This strategy may help accomplish the following goals:

environment

- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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infiltration basin

examples include swales, infiltration basins, rain gardens or shallow excavated trenches filled with gravel or crushed stone that is designed to infiltrate stormwater through permeable soils into the groundwater aquifer; often used to treat runoff from parking lots for sidewalks

policy | **design & construction** | operations, maintenance and monitoring | site | community | regional

biofilter

biofilters may consist of either biological or engineered characteristics that filter various contaminants and pollutants. the use of native plants in stormwater facilities increases habitat and evapotranspiration. examples include grassed channels, swales and filter strips

policy | **design & construction** | **operations, maintenance and monitoring** | site | community | regional

benefits

This strategy may:

- have relatively low costs of construction
- be aesthetically pleasing
- treat certain pollutants
- contribute to TCEQ permit approval

limitations

This strategy may:

- not be appropriate for sites where there is a possibility of groundwater contamination or where there is soil with a high clay content that could clog the trench
- require maintenance
- be subject to additional regulation by EAA

This strategy may help accomplish the following goals:

environment

- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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benefits

This strategy may:

- improve infiltrated water quality
- contribute to TCEQ permit approval

limitations

This strategy may:

- require periodic maintenance

This strategy may help accomplish the following goals:

environment

- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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detention basin (including multi-use stormwater detention facilities)

basins that temporarily detain a portion of stormwater runoff for a specific length of time and can increase water quality. examples of multi-use detention facilities include parks, open space, bike paths and fields

policy | **design & construction** | operations, maintenance and monitoring | site | **community** | regional

wetland basin or channel

engineered systems intended to perform the water purification functions of natural wetlands. best when used in conjunction with other BMPs, such as minimization of initial runoff volumes and use of pervious pavement or swales. may also be restored wetlands

policy | **design & construction** | operations, maintenance and monitoring | **site** | **community** | **regional**

benefits

This strategy may:

- improve infiltrated water quality
- reduce flooding
- prevent downstream channel scouring
- increase park and open space area
- contribute to TCEQ permit approval

limitations

This strategy may:

- require maintenance which is both essential and costly

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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benefits

This strategy may:

- be very effective in removing pollutants
- decrease irrigation needs
- provide groundwater recharge
- contribute to TCEQ permit approval

limitations

This strategy may:

- contribute to thermal pollution and cause downstream warming if shallow water is present
- be a safety concern for children
- require frequent and intensive maintenance
- cause nuisances such as mosquitoes, odor, algae
- limit nearby future development due to wetland regulations

This strategy may help accomplish the following goals:

environment

- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- align the city's **tourism** industry practices with sensible **stormwater management**
- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

DESIGNWORKSHOP Lockwood, Andrews & Newnam, Inc. A LEO A DALY COMPANY

litter control

clean up or minimization of litter in rivers, stormdrain facilities and along streets to reduce the amount of debris in the rivers, creeks and detention basins

policy | design & construction | operations, maintenance and monitoring | site | community | regional

retrofit existing stormwater facilities

upgrade existing facilities in need of repair to current standards and low impact development techniques

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- be a cost effective strategy
- reduce maintenance of other stormwater structures
- reduce chances of localized flooding due to drainage blocks

limitations

This strategy may:

- require on-going efforts in the community
- limit the use of disposable materials in key locations

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- ensure **construction** does not create environmental degradation, even on a temporary basis

community

- ensure **stakeholder buy-in** on stormwater strategies
- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**
- ensure that the public investment in infrastructure proves to have a **positive return on investment** for the community

aesthetics

- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

DESIGNWORKSHOP Lockwood, Andrews & Newnam, Inc. A LEO A DALY COMPANY

benefits

This strategy may:

- reduce future maintenance costs post-retrofitting
- improve functionality of unmaintained facilities

limitations

This strategy may:

- require costly upgrades

This strategy may help accomplish the following goals:

environment

- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- make sure **responsibility** for operations and management of stormwater infrastructure is **clear**

economics

- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**
- ensure **craftsmanship** of stormwater infrastructure will result in **permanence**

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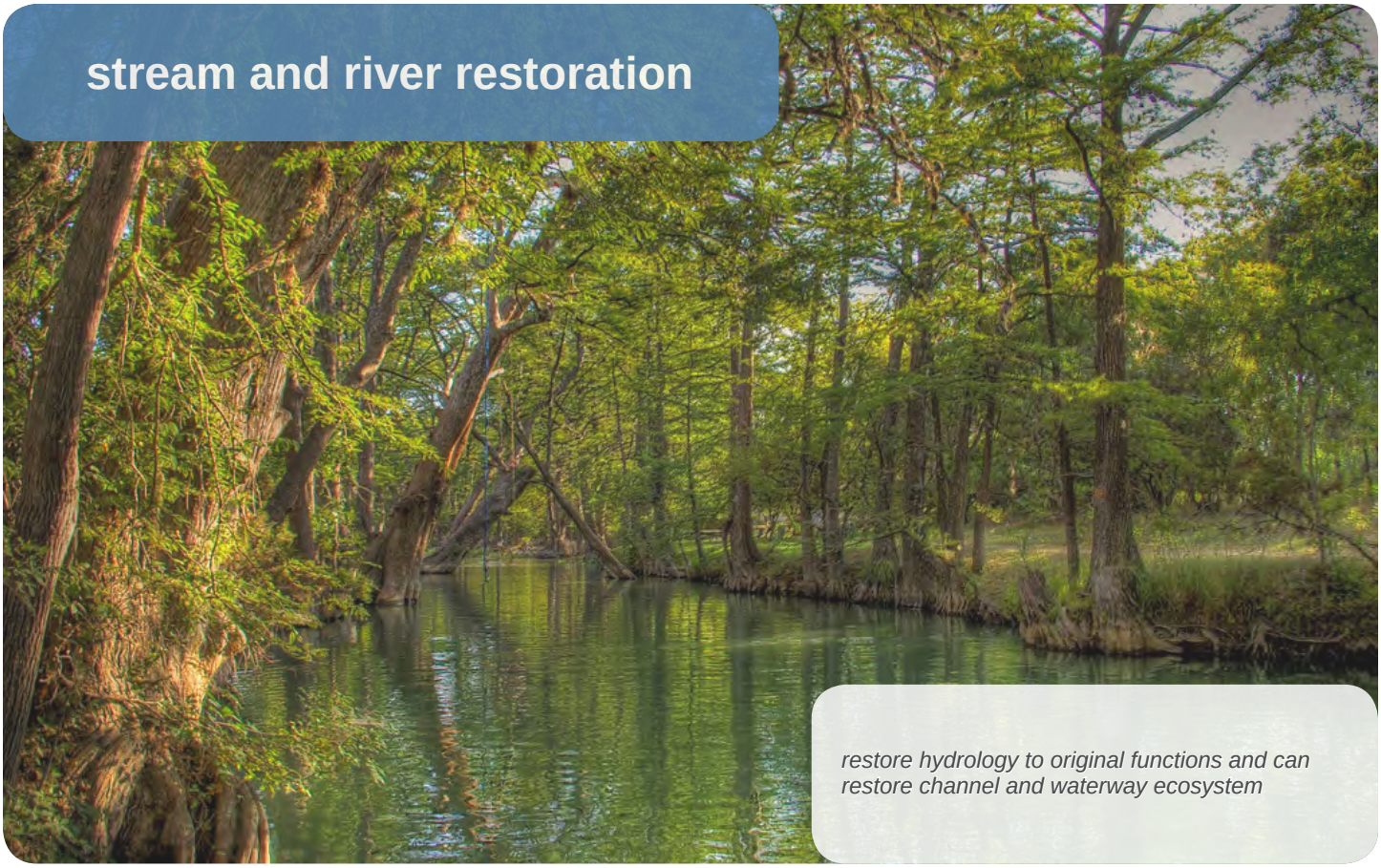
stream and river restoration



restore hydrology to original functions and can restore channel and waterway ecosystem

policy | design & construction | operations, maintenance and monitoring | site | community | regional

clustering

groups houses on smaller lots in concentrated areas, while maintaining the same amount of houses on the site as a traditionally allowed. large areas of open space are preserved where structures may never be built

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- alleviate issues of increased sediment accumulation and nutrient loading
- restore wildlife habitat
- contribute to TCEQ permit approval

limitations

This strategy may:

- be a very costly process
- require land use changes

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- align the city's **tourism** industry practices with sensible **stormwater management**
- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

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benefits

This strategy may:

- increase open space by focusing development
- manage stormwater more effectively than in conventional developments
- contribute to TCEQ permit approval

limitations

This strategy may:

- inhibit development through restrictions

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities
- **minimize impervious** surfaces
- **prevent flooding** and erosion caused by stormwater runoff
- **protect** water **quality** of receiving waters, particularly the streams of Landa Lake

community

- ensure **stakeholder buy-in** on stormwater strategies
- utilize parks and **open space** for stormwater storage and infiltration

economics

- **stormwater management**
- develop **stronger** stormwater strategies without stifling **growth** and **development**

aesthetics

- stormwater infrastructure should be **visually pleasing**

DESIGNWORKSHOP Lockwood, Andrews & Newnam, Inc. A LEO A DALY COMPANY

flood hazard mitigation

prepare to minimize, expedite communication during and swiftly recover after a flood hazard event

policy | design & construction | operations, maintenance and monitoring | site | community | regional

benefits

This strategy may:

- put a plan in place for recovery post hazard events
- minimize risk of property and life in flood prone areas
- be prepared for flood events

limitations

This strategy may:

- limit development in high risk areas
- require a network of communication with additional infrastructure

This strategy may help accomplish the following goals:

environment

- **encourage** development **patterns** that improve stormwater management opportunities

community

- ensure **stakeholder buy-in** on stormwater strategies

economics

- **stormwater management**

C

Keypad Polling Results

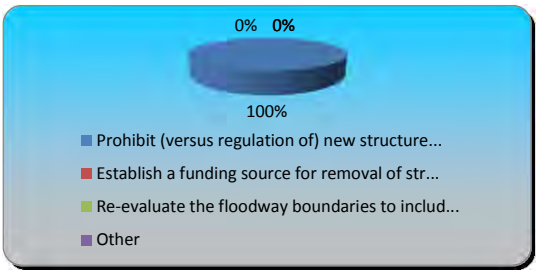
Strategy Prioritization

Turning Graphical Results by Question

Session Name: Stormwater 3-6-2012 3-02 PM - Engineers
Created: 4/20/2012 12:12 PM

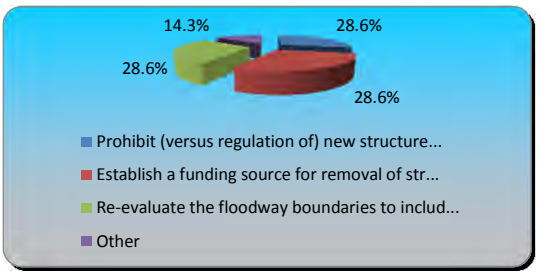
1.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Prohibit (versus regulation of) new structure...	2	100%
Establish a funding source for removal of str...	0	0%
Re-evaluate the floodway boundaries to includ...	0	0%
Other	0	0%
Totals	**2**	**100%**



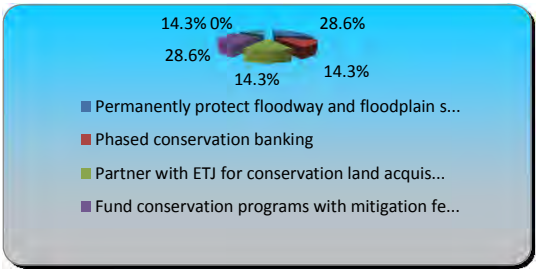
2.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Prohibit (versus regulation of) new structure...	2	28.57%
Establish a funding source for removal of str...	2	28.57%
Re-evaluate the floodway boundaries to includ...	2	28.57%
Other	1	14.29%
Totals	**7**	**100%**



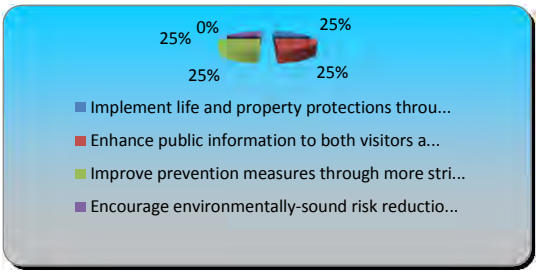
3.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Permanently protect floodway and floodplain s...	2	28.57%
Phased conservation banking	1	14.29%
Partner with ETJ for conservation land acquis...	1	14.29%
Fund conservation programs with mitigation fe...	2	28.57%
Increase floodwater conveyance capability thr...	1	14.29%
Other	0	0%
Totals	**7**	**100%**



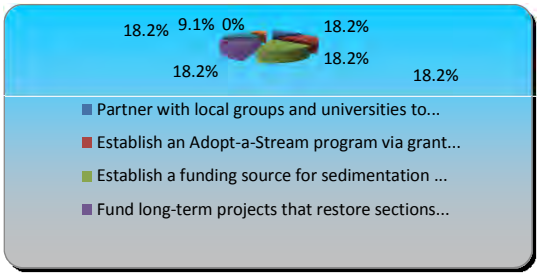
4.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Implement life and property protections throu...	2	25%
Enhance public information to both visitors a...	2	25%
Improve prevention measures through more stri...	2	25%
Encourage environmentally-sound risk reductio...	2	25%
Other	0	0%
Totals	**8**	**100%**



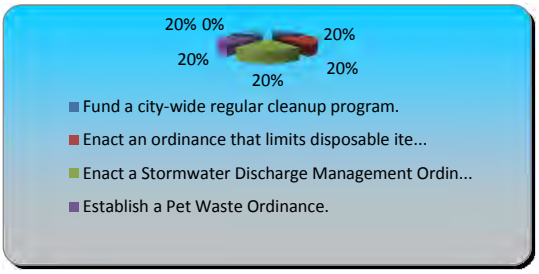
5.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Partner with local groups and universities to...	2	18.18%
Establish an Adopt-a-Stream program via grant...	2	18.18%
Establish a funding source for sedimentation ...	2	18.18%
Fund long-term projects that restore sections...	2	18.18%
Create a stream and riparian corridor setback...	2	18.18%
Add an additional buffer for impervious surfa...	1	9.09%
Other	0	0%
Totals	**11**	**100%**



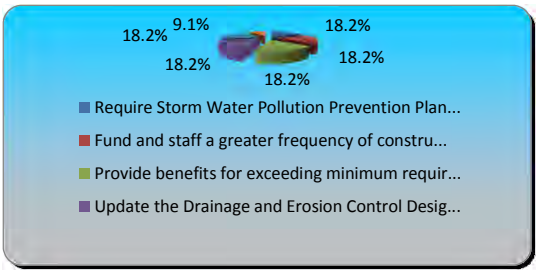
6.) Choose the Litter control Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Fund a city-wide regular cleanup program.	2	20%
Enact an ordinance that limits disposable ite...	2	20%
Enact a Stormwater Discharge Management Ordin...	2	20%
Establish a Pet Waste Ordinance.	2	20%
Require Stormwater Pollution Prevention Plans...	2	20%
Other	0	0%
Totals	**10**	**100%**



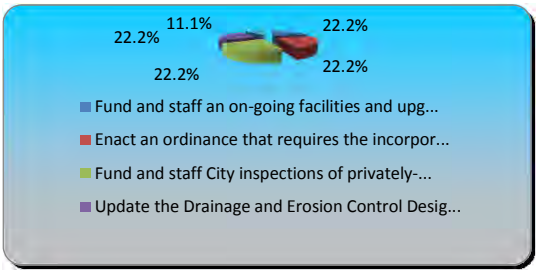
7.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Require Storm Water Pollution Prevention Plan...	2	18.18%
Fund and staff a greater frequency of constru...	2	18.18%
Provide benefits for exceeding minimum requir...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Other	1	9.09%
Totals	**11**	**100%**



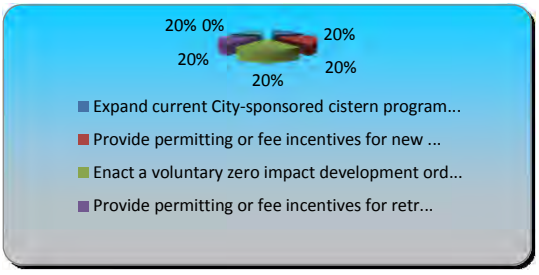
8.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)

Responses		
Fund and staff an on-going facilities and upg...	2	22.22%
Enact an ordinance that requires the incorpor...	2	22.22%
Fund and staff City inspections of privately-...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Other	1	11.11%
Totals	**9**	**100%**



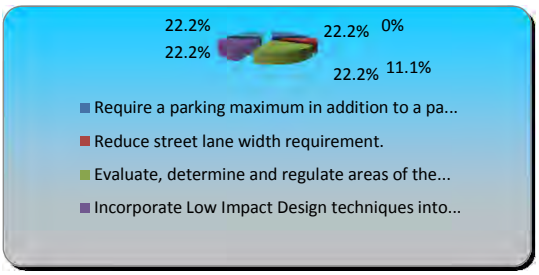
9.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)

Responses		
Expand current City-sponsored cistern program...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Enact a voluntary zero impact development ord...	2	20%
Provide permitting or fee incentives for retr...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Other	0	0%
Totals	**10**	**100%**



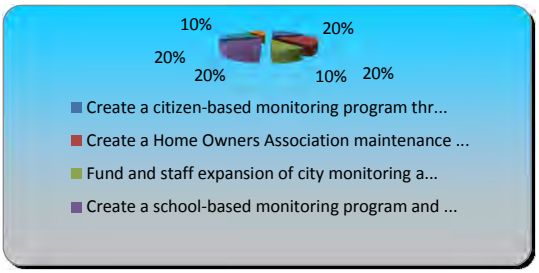
10.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Require a parking maximum in addition to a pa...	2	22.22%
Reduce street lane width requirement.	1	11.11%
Evaluate, determine and regulate areas of the...	2	22.22%
Incorporate Low Impact Design techniques into...	2	22.22%
Incentivize the use of pervious paving option...	2	22.22%
Other	0	0%
Totals	**9**	**100%**



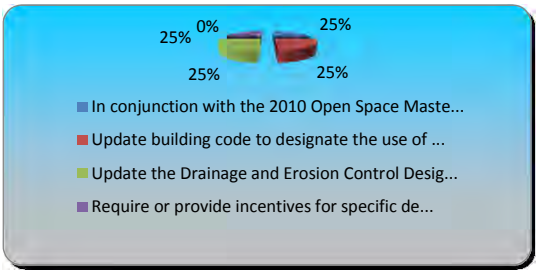
11.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Create a citizen-based monitoring program thr...	2	20%
Create a Home Owners Association maintenance ...	2	20%
Fund and staff expansion of city monitoring a...	1	10%
Create a school-based monitoring program and ...	2	20%
Update the Drainage and Erosion Control Desig...	2	20%
Other	1	10%
Totals	**10**	**100%**



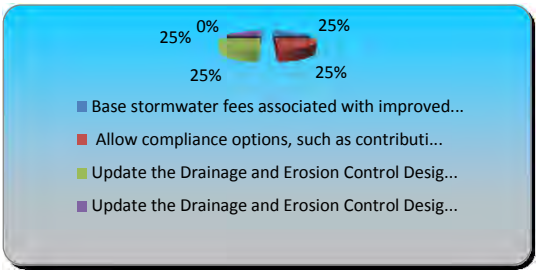
12.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)

	Responses	
In conjunction with the 2010 Open Space Maste...	2	25%
Update building code to designate the use of ...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Require or provide incentives for specific de...	2	25%
Other	0	0%
Totals	**8**	**100%**



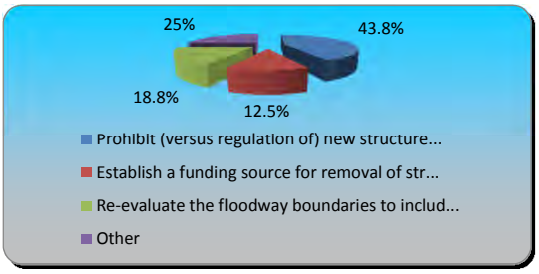
13.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Base stormwater fees associated with improved...	2	25%
Allow compliance options, such as contributi...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Other	0	0%
Totals	**8**	**100%**



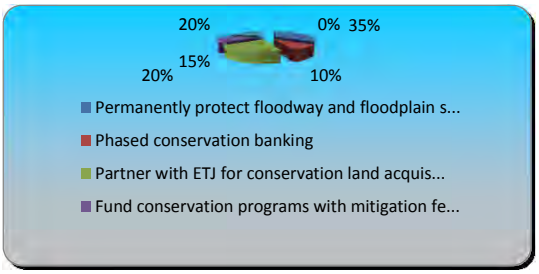
14.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Prohibit (versus regulation of) new structure...	7	43.75%
Establish a funding source for removal of str...	2	12.50%
Re-evaluate the floodway boundaries to includ...	3	18.75%
Other	4	25%
Totals	**16**	**100%**



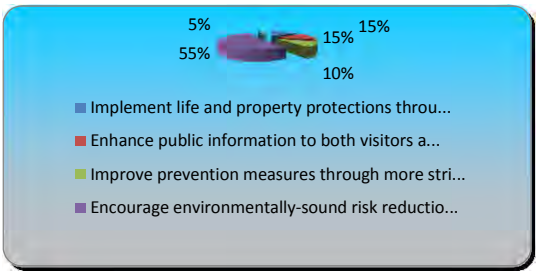
15.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Permanently protect floodway and floodplain s...	7	35%
Phased conservation banking	2	10%
Partner with ETJ for conservation land acquis...	4	20%
Fund conservation programs with mitigation fe...	3	15%
Increase floodwater conveyance capability thr...	4	20%
Other	0	0%
Totals	**20**	**100%**



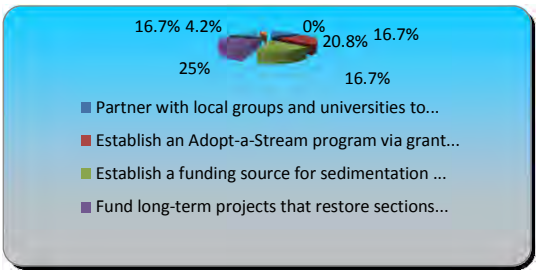
16.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Implement life and property protections throu...	3	15%
Enhance public information to both visitors a...	3	15%
Improve prevention measures through more stri...	2	10%
Encourage environmentally-sound risk reductio...	11	55%
Other	1	5%
Totals	**20**	**100%**



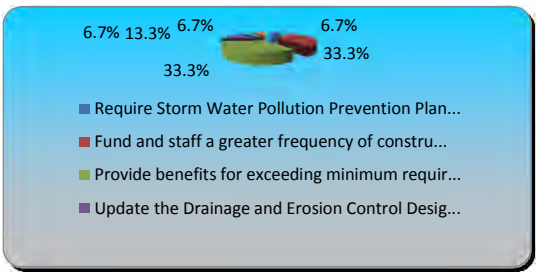
17.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Partner with local groups and universities to...	4	16.67%
Establish an Adopt-a-Stream program via grant...	5	20.83%
Establish a funding source for sedimentation ...	4	16.67%
Fund long-term projects that restore sections...	6	25%
Create a stream and riparian corridor setback...	4	16.67%
Add an additional buffer for impervious surfa...	1	4.17%
Other	0	0%
Totals	**24**	**100%**

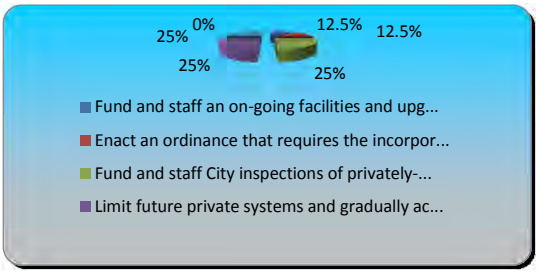


18.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)

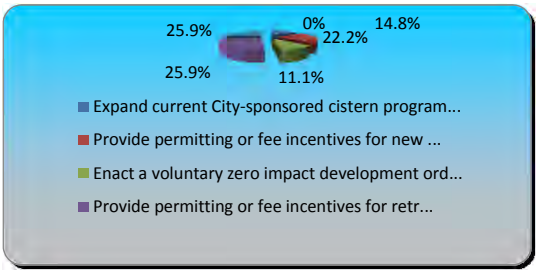
	Responses	
Require Storm Water Pollution Prevention Plan...	1	6.67%
Fund and staff a greater frequency of constru...	5	33.33%
Provide benefits for exceeding minimum requir...	5	33.33%
Update the Drainage and Erosion Control Desig...	2	13.33%
Update the Drainage and Erosion Control Desig...	1	6.67%
Other	1	6.67%
Totals	**15**	**100%**



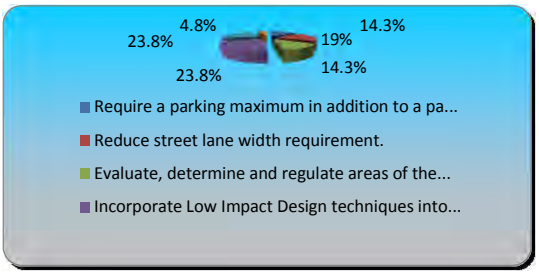
19.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)	Responses	
Fund and staff an on-going facilities and upg...	2	12.50%
Enact an ordinance that requires the incorpor...	2	12.50%
Fund and staff City inspections of privately-...	4	25%
Limit future private systems and gradually ac...	4	25%
Update the Drainage and Erosion Control Desig...	4	25%
Other	0	0%
Totals	**16**	**100%**



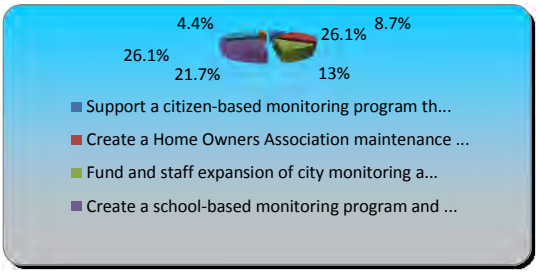
20.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)	Responses	
Expand current City-sponsored cistern program...	4	14.81%
Provide permitting or fee incentives for new ...	6	22.22%
Enact a voluntary zero impact development ord...	3	11.11%
Provide permitting or fee incentives for retr...	7	25.93%
Provide permitting or fee incentives for new ...	7	25.93%
Other	0	0%
Totals	**27**	**100%**



21.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)	Responses	
Require a parking maximum in addition to a pa...	3	14.29%
Reduce street lane width requirement.	4	19.05%
Evaluate, determine and regulate areas of the...	3	14.29%
Incorporate Low Impact Design techniques into...	5	23.81%
Incentivize the use of pervious paving option...	5	23.81%
Other	1	4.76%
Totals	**21**	**100%**

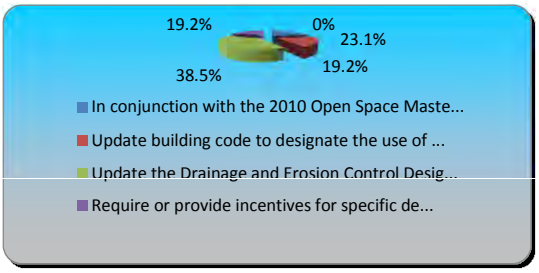


22.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)	Responses	
Support a citizen-based monitoring program th...	2	8.70%
Create a Home Owners Association maintenance ...	6	26.09%
Fund and staff expansion of city monitoring a...	3	13.04%
Create a school-based monitoring program and ...	5	21.74%
Update the Drainage and Erosion Control Desig...	6	26.09%
Other	1	4.35%
Totals	**23**	**100%**



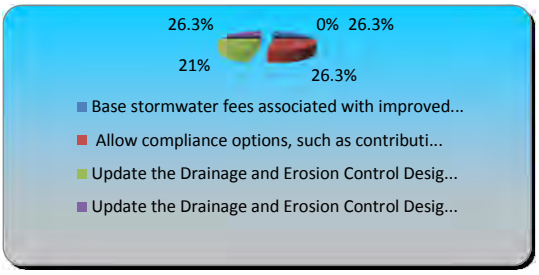
23.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)

	Responses	
In conjunction with the 2010 Open Space Maste...	6	23.08%
Update building code to designate the use of ...	5	19.23%
Update the Drainage and Erosion Control Desig...	10	38.46%
Require or provide incentives for specific de...	5	19.23%
Other	0	0%
Totals	**26**	**100%**



24.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)

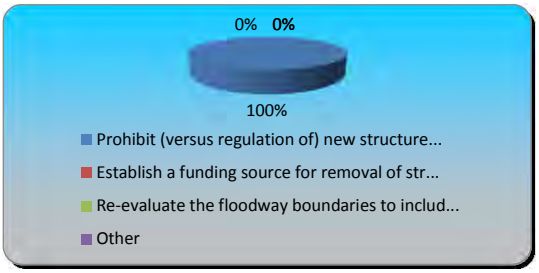
	Responses	
Base stormwater fees associated with improved...	5	26.32%
Allow compliance options, such as contributi...	5	26.32%
Update the Drainage and Erosion Control Desig...	4	21.05%
Update the Drainage and Erosion Control Desig...	5	26.32%
Other	0	0%
Totals	**19**	**100%**



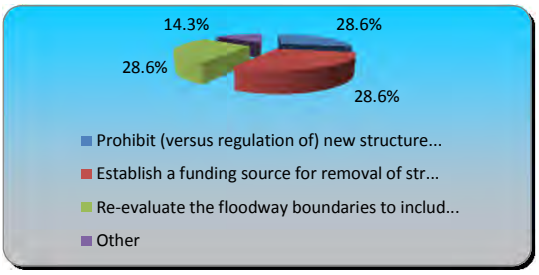
Turning Graphical Results by Question

Session Name: Stormwater 3-6-2012 12-36 PM - Environment
Created: 4/20/2012 12:19 PM

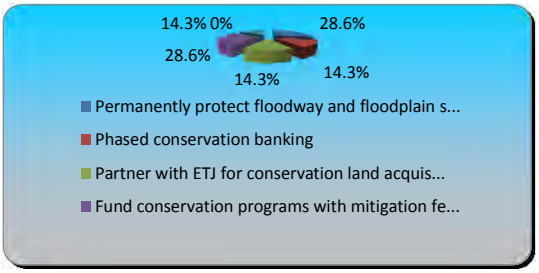
1.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Prohibit (versus regulation of) new structure...	2	100%
Establish a funding source for removal of str...	0	0%
Re-evaluate the floodway boundaries to includ...	0	0%
Other	0	0%
Totals	**2**	**100%**



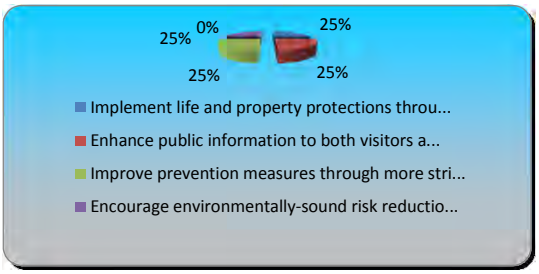
2.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Prohibit (versus regulation of) new structure...	2	28.57%
Establish a funding source for removal of str...	2	28.57%
Re-evaluate the floodway boundaries to includ...	2	28.57%
Other	1	14.29%
Totals	**7**	**100%**



3.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Permanently protect floodway and floodplain s...	2	28.57%
Phased conservation banking	1	14.29%
Partner with ETJ for conservation land acquis...	1	14.29%
Fund conservation programs with mitigation fe...	2	28.57%
Increase floodwater conveyance capability thr...	1	14.29%
Other	0	0%
Totals	**7**	**100%**

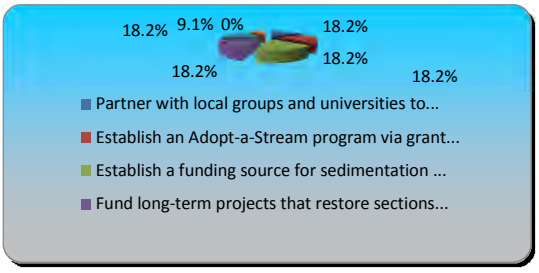


4.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Implement life and property protections throu...	2	25%
Enhance public information to both visitors a...	2	25%
Improve prevention measures through more stri...	2	25%
Encourage environmentally-sound risk reductio...	2	25%
Other	0	0%
Totals	**8**	**100%**



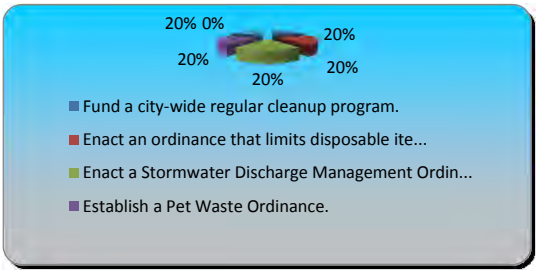
5.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Partner with local groups and universities to...	2	18.18%
Establish an Adopt-a-Stream program via grant...	2	18.18%
Establish a funding source for sedimentation ...	2	18.18%
Fund long-term projects that restore sections...	2	18.18%
Create a stream and riparian corridor setback...	2	18.18%
Add an additional buffer for impervious surfa...	1	9.09%
Other	0	0%
Totals	**11**	**100%**



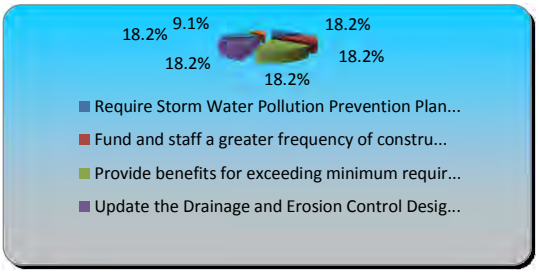
6.) Choose the Litter control Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Fund a city-wide regular cleanup program.	2	20%
Enact an ordinance that limits disposable ite...	2	20%
Enact a Stormwater Discharge Management Ordin...	2	20%
Establish a Pet Waste Ordinance.	2	20%
Require Stormwater Pollution Prevention Plans...	2	20%
Other	0	0%
Totals	**10**	**100%**



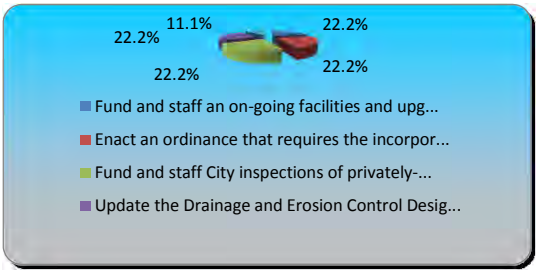
7.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)

Responses		
Require Storm Water Pollution Prevention Plan...	2	18.18%
Fund and staff a greater frequency of constru...	2	18.18%
Provide benefits for exceeding minimum requir...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Other	1	9.09%
Totals	**11**	**100%**

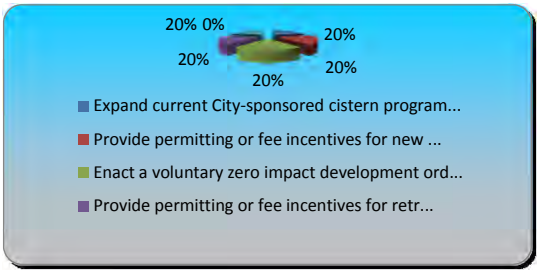


8.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)

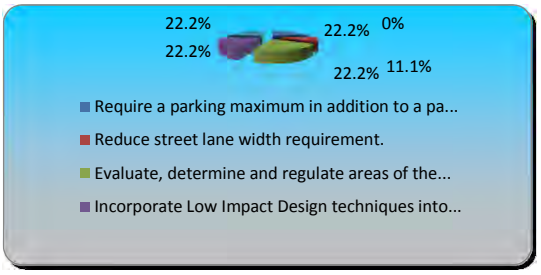
Responses		
Fund and staff an on-going facilities and upg...	2	22.22%
Enact an ordinance that requires the incorpor...	2	22.22%
Fund and staff City inspections of privately-...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Other	1	11.11%
Totals	**9**	**100%**



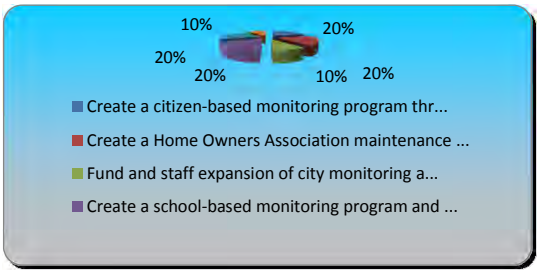
9.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)	Responses	
Expand current City-sponsored cistern program...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Enact a voluntary zero impact development ord...	2	20%
Provide permitting or fee incentives for retr...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Other	0	0%
Totals	**10**	**100%**



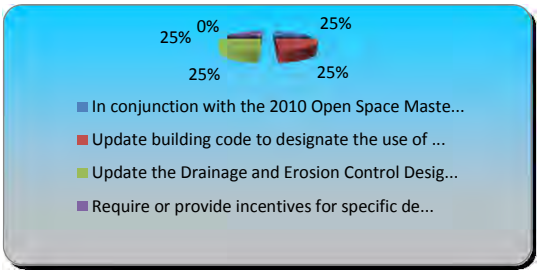
10.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)	Responses	
Require a parking maximum in addition to a pa...	2	22.22%
Reduce street lane width requirement.	1	11.11%
Evaluate, determine and regulate areas of the...	2	22.22%
Incorporate Low Impact Design techniques into...	2	22.22%
Incentivize the use of pervious paving option...	2	22.22%
Other	0	0%
Totals	**9**	**100%**



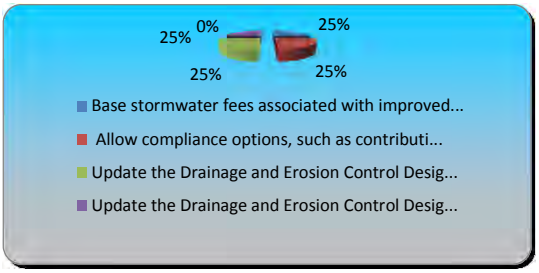
11.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)	Responses	
Create a citizen-based monitoring program thr...	2	20%
Create a Home Owners Association maintenance ...	2	20%
Fund and staff expansion of city monitoring a...	1	10%
Create a school-based monitoring program and ...	2	20%
Update the Drainage and Erosion Control Desig...	2	20%
Other	1	10%
Totals	**10**	**100%**



12.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)	Responses	
In conjunction with the 2010 Open Space Maste...	2	25%
Update building code to designate the use of ...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Require or provide incentives for specific de...	2	25%
Other	0	0%
Totals	**8**	**100%**



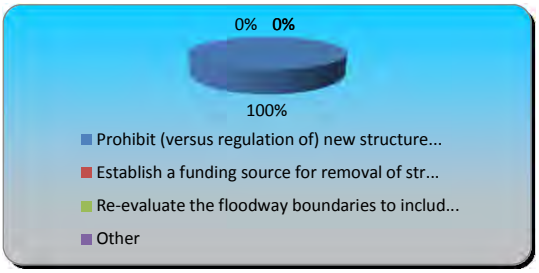
13.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)	Responses	
Base stormwater fees associated with improved...	2	25%
Allow compliance options, such as contributi...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Other	0	0%
Totals	**8**	**100%**



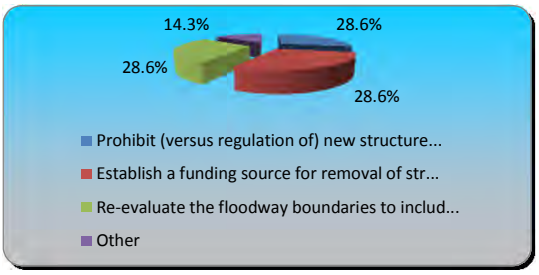
Turning Graphical Results by Question

Session Name: Stormwater 3-6-2012 7-00 PM - Public
Created: 4/20/2012 12:15 PM

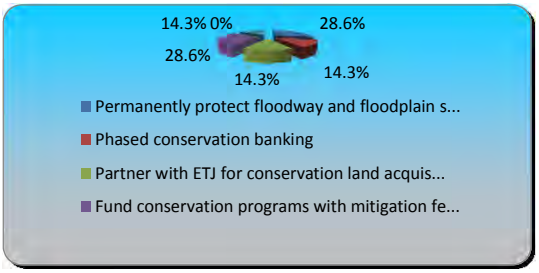
1.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Prohibit (versus regulation of) new structure...	2	100%
Establish a funding source for removal of str...	0	0%
Re-evaluate the floodway boundaries to includ...	0	0%
Other	0	0%
Totals	**2**	**100%**



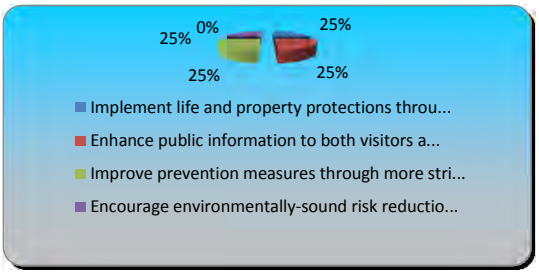
2.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Prohibit (versus regulation of) new structure...	2	28.57%
Establish a funding source for removal of str...	2	28.57%
Re-evaluate the floodway boundaries to includ...	2	28.57%
Other	1	14.29%
Totals	**7**	**100%**



3.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Permanently protect floodway and floodplain s...	2	28.57%
Phased conservation banking	1	14.29%
Partner with ETJ for conservation land acquis...	1	14.29%
Fund conservation programs with mitigation fe...	2	28.57%
Increase floodwater conveyance capability thr...	1	14.29%
Other	0	0%
Totals	**7**	**100%**

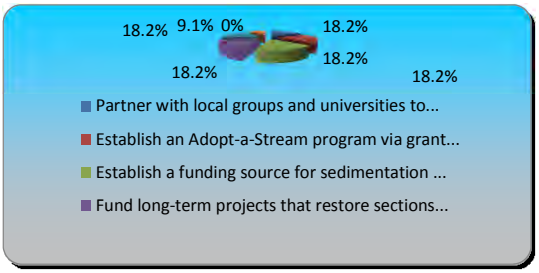


4.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Implement life and property protections throu...	2	25%
Enhance public information to both visitors a...	2	25%
Improve prevention measures through more stri...	2	25%
Encourage environmentally-sound risk reductio...	2	25%
Other	0	0%
Totals	**8**	**100%**



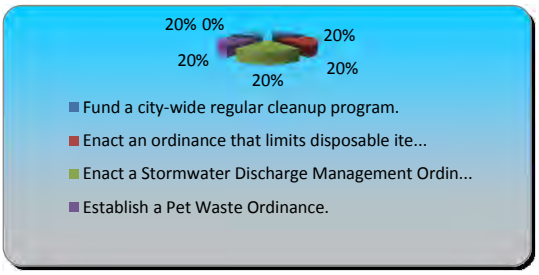
5.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Partner with local groups and universities to...	2	18.18%
Establish an Adopt-a-Stream program via grant...	2	18.18%
Establish a funding source for sedimentation ...	2	18.18%
Fund long-term projects that restore sections...	2	18.18%
Create a stream and riparian corridor setback...	2	18.18%
Add an additional buffer for impervious surfa...	1	9.09%
Other	0	0%
Totals	**11**	**100%**



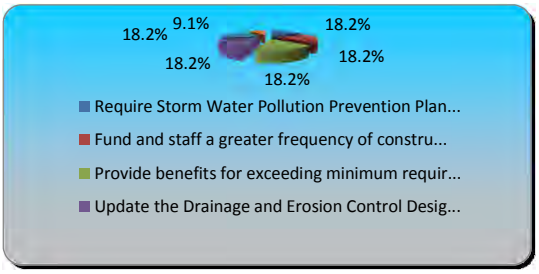
6.) Choose the Litter control Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Fund a city-wide regular cleanup program.	2	20%
Enact an ordinance that limits disposable ite...	2	20%
Enact a Stormwater Discharge Management Ordin...	2	20%
Establish a Pet Waste Ordinance.	2	20%
Require Stormwater Pollution Prevention Plans...	2	20%
Other	0	0%
Totals	**10**	**100%**



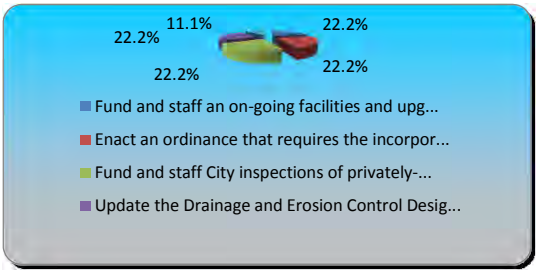
7.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Require Storm Water Pollution Prevention Plan...	2	18.18%
Fund and staff a greater frequency of constru...	2	18.18%
Provide benefits for exceeding minimum requir...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Update the Drainage and Erosion Control Desig...	2	18.18%
Other	1	9.09%
Totals	**11**	**100%**

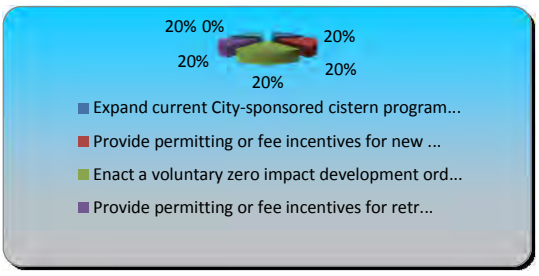


8.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)

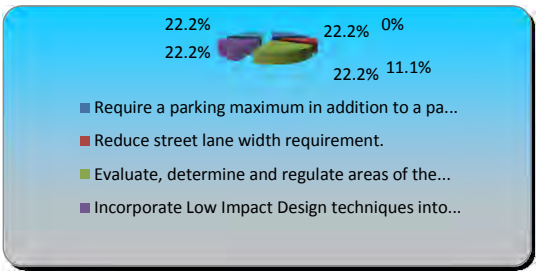
	Responses	
Fund and staff an on-going facilities and upg...	2	22.22%
Enact an ordinance that requires the incorpor...	2	22.22%
Fund and staff City inspections of privately-...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Other	1	11.11%
Totals	**9**	**100%**



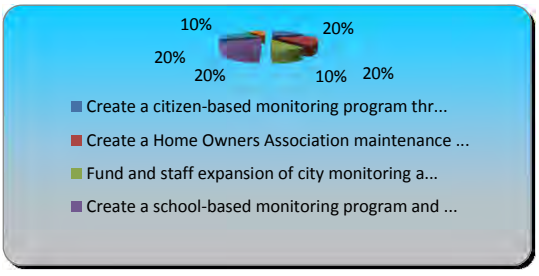
9.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)	Responses	
Expand current City-sponsored cistern program...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Enact a voluntary zero impact development ord...	2	20%
Provide permitting or fee incentives for retr...	2	20%
Provide permitting or fee incentives for new ...	2	20%
Other	0	0%
Totals	**10**	**100%**



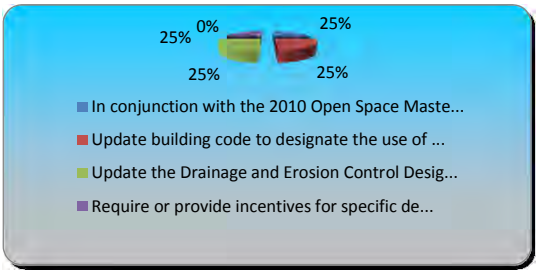
10.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)	Responses	
Require a parking maximum in addition to a pa...	2	22.22%
Reduce street lane width requirement.	1	11.11%
Evaluate, determine and regulate areas of the...	2	22.22%
Incorporate Low Impact Design techniques into...	2	22.22%
Incentivize the use of pervious paving option...	2	22.22%
Other	0	0%
Totals	**9**	**100%**



11.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)	Responses	
Create a citizen-based monitoring program thr...	2	20%
Create a Home Owners Association maintenance ...	2	20%
Fund and staff expansion of city monitoring a...	1	10%
Create a school-based monitoring program and ...	2	20%
Update the Drainage and Erosion Control Desig...	2	20%
Other	1	10%
Totals	**10**	**100%**

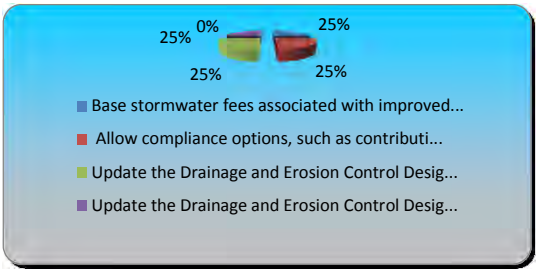


12.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)	Responses	
In conjunction with the 2010 Open Space Maste...	2	25%
Update building code to designate the use of ...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Require or provide incentives for specific de...	2	25%
Other	0	0%
Totals	**8**	**100%**



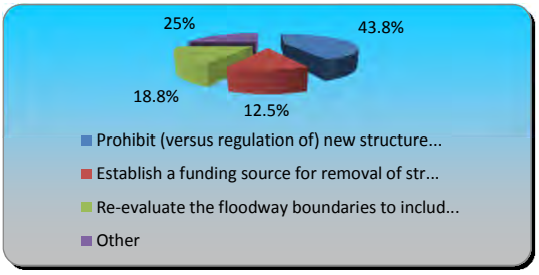
13.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Base stormwater fees associated with improved...	2	25%
Allow compliance options, such as contributi...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Update the Drainage and Erosion Control Desig...	2	25%
Other	0	0%
Totals	**8**	**100%**



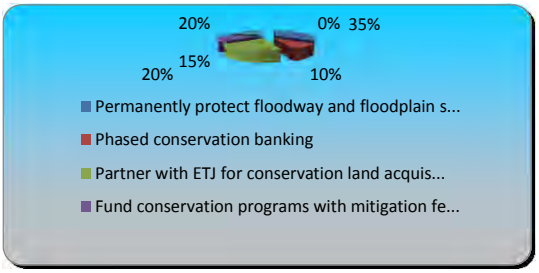
14.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Prohibit (versus regulation of) new structure...	7	43.75%
Establish a funding source for removal of str...	2	12.50%
Re-evaluate the floodway boundaries to includ...	3	18.75%
Other	4	25%
Totals	**16**	**100%**



15.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)

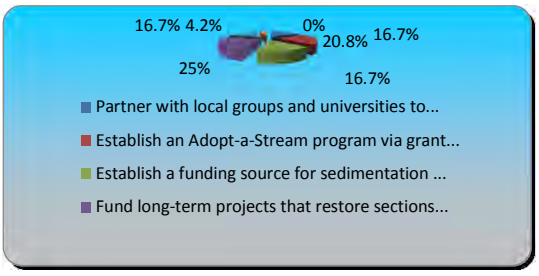
	Responses	
Permanently protect floodway and floodplain s...	7	35%
Phased conservation banking	2	10%
Partner with ETJ for conservation land acquis...	4	20%
Fund conservation programs with mitigation fe...	3	15%
Increase floodwater conveyance capability thr...	4	20%
Other	0	0%
Totals	**20**	**100%**



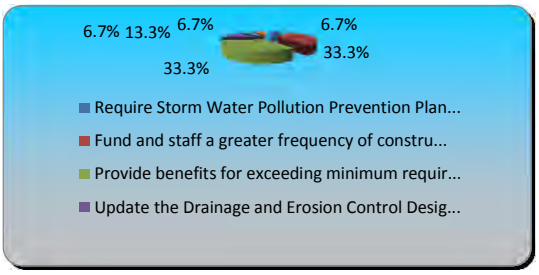
16.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Implement life and property protections throu...	3	15%
Enhance public information to both visitors a...	3	15%
Improve prevention measures through more stri...	2	10%
Encourage environmentally-sound risk reductio...	11	55%
Other	1	5%
Totals	**20**	**100%**

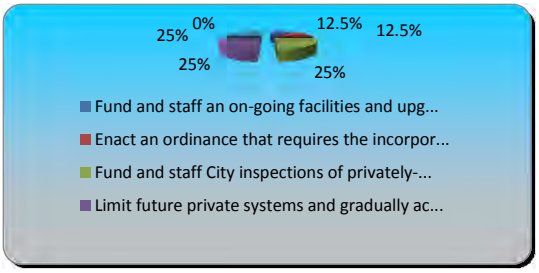
17.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Partner with local groups and universities to...	4	16.67%
Establish an Adopt-a-Stream program via grant...	5	20.83%
Establish a funding source for sedimentation ...	4	16.67%
Fund long-term projects that restore sections...	6	25%
Create a stream and riparian corridor setback...	4	16.67%
Add an additional buffer for impervious surfa...	1	4.17%
Other	0	0%
Totals	**24**	**100%**



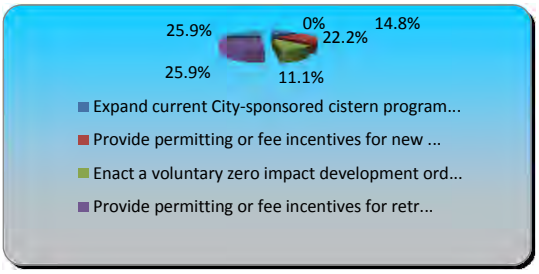
18.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)	Responses	
Require Storm Water Pollution Prevention Plan...	1	6.67%
Fund and staff a greater frequency of constru...	5	33.33%
Provide benefits for exceeding minimum requir...	5	33.33%
Update the Drainage and Erosion Control Desig...	2	13.33%
Update the Drainage and Erosion Control Desig...	1	6.67%
Other	1	6.67%
Totals	**15**	**100%**



19.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)	Responses	
Fund and staff an on-going facilities and upg...	2	12.50%
Enact an ordinance that requires the incorpor...	2	12.50%
Fund and staff City inspections of privately-...	4	25%
Limit future private systems and gradually ac...	4	25%
Update the Drainage and Erosion Control Desig...	4	25%
Other	0	0%
Totals	**16**	**100%**

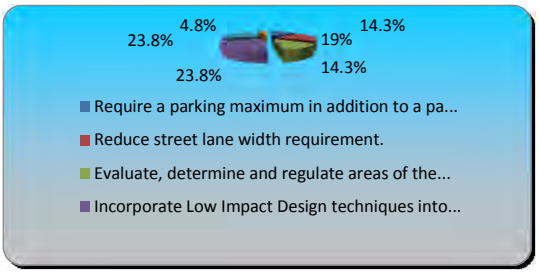


20.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)	Responses	
Expand current City-sponsored cistern program...	4	14.81%
Provide permitting or fee incentives for new ...	6	22.22%
Enact a voluntary zero impact development ord...	3	11.11%
Provide permitting or fee incentives for retr...	7	25.93%
Provide permitting or fee incentives for new ...	7	25.93%
Other	0	0%
Totals	**27**	**100%**



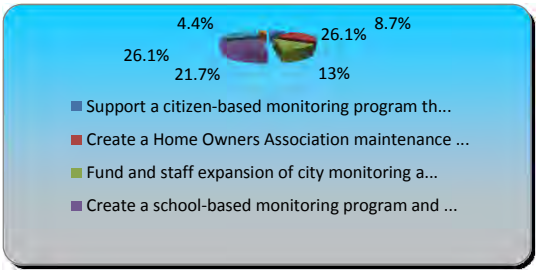
21.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Require a parking maximum in addition to a pa...	3	14.29%
Reduce street lane width requirement.	4	19.05%
Evaluate, determine and regulate areas of the...	3	14.29%
Incorporate Low Impact Design techniques into...	5	23.81%
Incentivize the use of pervious paving option...	5	23.81%
Other	1	4.76%
Totals	**21**	**100%**



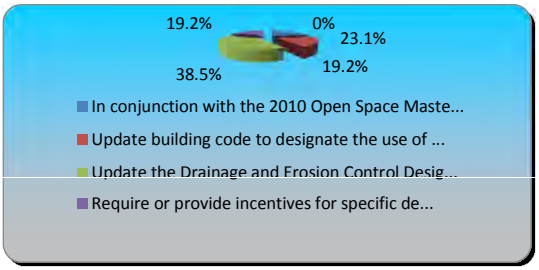
22.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Support a citizen-based monitoring program th...	2	8.70%
Create a Home Owners Association maintenance ...	6	26.09%
Fund and staff expansion of city monitoring a...	3	13.04%
Create a school-based monitoring program and ...	5	21.74%
Update the Drainage and Erosion Control Desig...	6	26.09%
Other	1	4.35%
Totals	**23**	**100%**



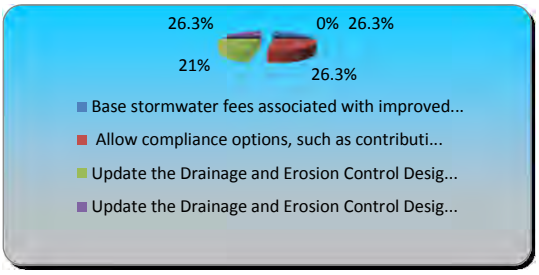
23.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)

	Responses	
In conjunction with the 2010 Open Space Maste...	6	23.08%
Update building code to designate the use of ...	5	19.23%
Update the Drainage and Erosion Control Desig...	10	38.46%
Require or provide incentives for specific de...	5	19.23%
Other	0	0%
Totals	**26**	**100%**



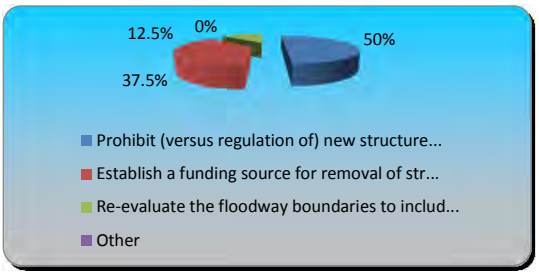
24.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Base stormwater fees associated with improved...	5	26.32%
Allow compliance options, such as contributi...	5	26.32%
Update the Drainage and Erosion Control Desig...	4	21.05%
Update the Drainage and Erosion Control Desig...	5	26.32%
Other	0	0%
Totals	**19**	**100%**



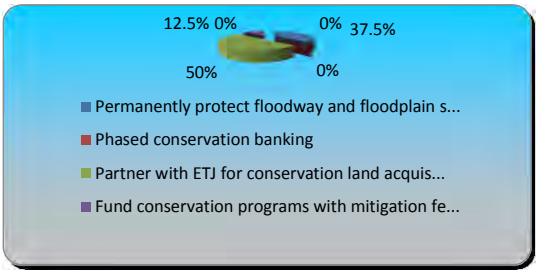
25.) Choose the Floodway building prohibitions Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Prohibit (versus regulation of) new structure...	4	50%
Establish a funding source for removal of str...	3	37.50%
Re-evaluate the floodway boundaries to includ...	1	12.50%
Other	0	0%
Totals	**8**	**100%**



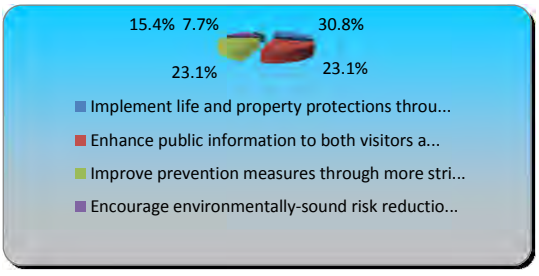
26.) Choose the Open space conservation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Permanently protect floodway and floodplain s...	3	37.50%
Phased conservation banking	0	0%
Partner with ETJ for conservation land acquis...	4	50%
Fund conservation programs with mitigation fe...	1	12.50%
Increase floodwater conveyance capability thr...	0	0%
Other	0	0%
Totals	**8**	**100%**



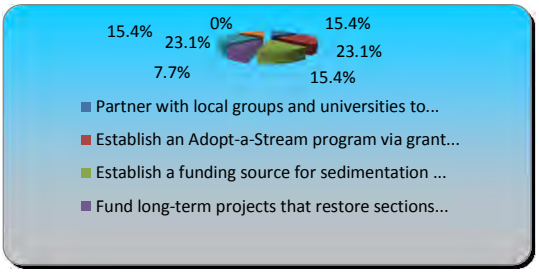
27.) Choose the Flood hazard mitigation Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Implement life and property protections throu...	4	30.77%
Enhance public information to both visitors a...	3	23.08%
Improve prevention measures through more stri...	3	23.08%
Encourage environmentally-sound risk reductio...	2	15.38%
Other	1	7.69%
Totals	**13**	**100%**



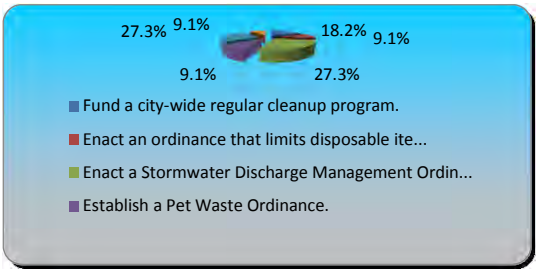
28.) Choose the stream and river restoration Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Partner with local groups and universities to...	2	15.38%
Establish an Adopt-a-Stream program via grant...	3	23.08%
Establish a funding source for sedimentation ...	2	15.38%
Fund long-term projects that restore sections...	1	7.69%
Create a stream and riparian corridor setback...	3	23.08%
Add an additional buffer for impervious surfa...	2	15.38%
Other	0	0%
Totals	**13**	**100%**



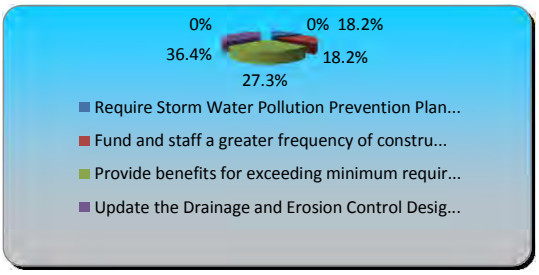
29.) Choose the Litter control Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Fund a city-wide regular cleanup program.	2	18.18%
Enact an ordinance that limits disposable ite...	1	9.09%
Enact a Stormwater Discharge Management Ordin...	3	27.27%
Establish a Pet Waste Ordinance.	1	9.09%
Require Stormwater Pollution Prevention Plans...	3	27.27%
Other	1	9.09%
Totals	**11**	**100%**



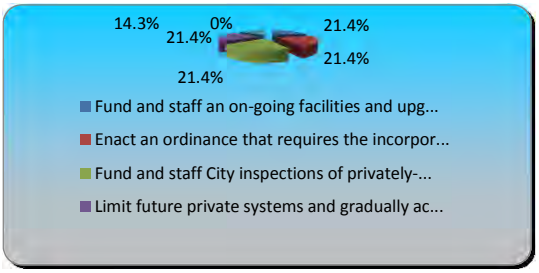
30.) Choose the Construction Control measures Options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Require Storm Water Pollution Prevention Plan...	2	18.18%
Fund and staff a greater frequency of constru...	2	18.18%
Provide benefits for exceeding minimum requir...	3	27.27%
Update the Drainage and Erosion Control Desig...	4	36.36%
Update the Drainage and Erosion Control Desig...	0	0%
Other	0	0%
Totals	**11**	**100%**



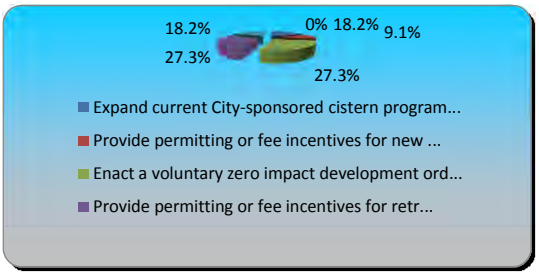
31.) Choose the Retrofit existing stormwater facilities that are most appropriate for new braunfels: (multiple choice)

	Responses	
Fund and staff an on-going facilities and upg...	3	21.43%
Enact an ordinance that requires the incorpor...	3	21.43%
Fund and staff City inspections of privately-...	3	21.43%
Limit future private systems and gradually ac...	3	21.43%
Update the Drainage and Erosion Control Desig...	2	14.29%
Other	0	0%
Totals	**14**	**100%**



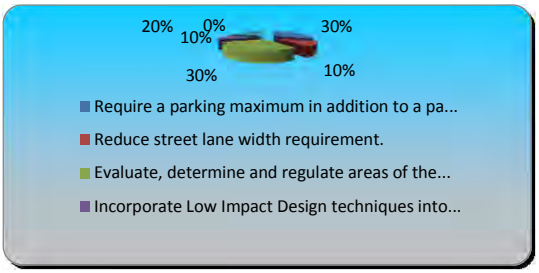
32.) Choose the Building runoff capture options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Expand current City-sponsored cistern program...	2	18.18%
Provide permitting or fee incentives for new ...	1	9.09%
Enact a voluntary zero impact development ord...	3	27.27%
Provide permitting or fee incentives for retr...	3	27.27%
Provide permitting or fee incentives for new ...	2	18.18%
Other	0	0%
Totals	**11**	**100%**



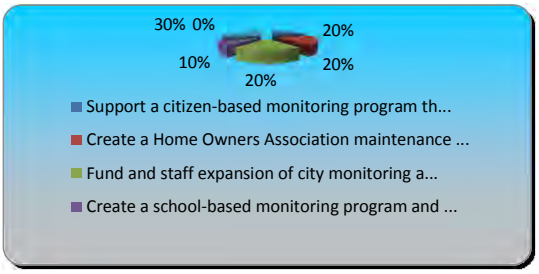
33.) Choose the impervious coverage reduction options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Require a parking maximum in addition to a pa...	3	30%
Reduce street lane width requirement.	1	10%
Evaluate, determine and regulate areas of the...	3	30%
Incorporate Low Impact Design techniques into...	1	10%
Incentivize the use of pervious paving option...	2	20%
Other	0	0%
Totals	**10**	**100%**



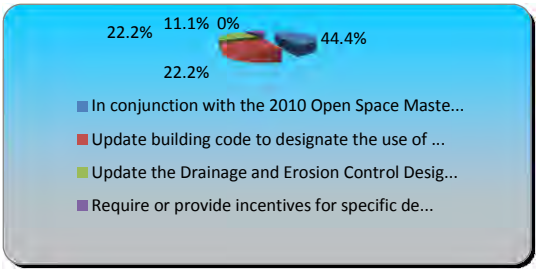
34.) Choose the maintenance and monitoring options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Support a citizen-based monitoring program th...	2	20%
Create a Home Owners Association maintenance ...	2	20%
Fund and staff expansion of city monitoring a...	2	20%
Create a school-based monitoring program and ...	1	10%
Update the Drainage and Erosion Control Desig...	3	30%
Other	0	0%
Totals	**10**	**100%**



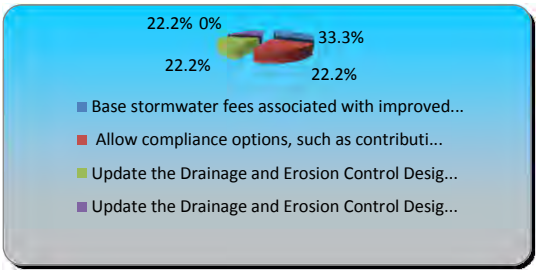
35.) Choose the detention basin options that are most appropriate for new braunfels: (multiple choice)

	Responses	
In conjunction with the 2010 Open Space Maste...	4	44.44%
Update building code to designate the use of ...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Require or provide incentives for specific de...	1	11.11%
Other	0	0%
Totals	**9**	**100%**



36.) Choose the implementation tool options that are most appropriate for new braunfels: (multiple choice)

	Responses	
Base stormwater fees associated with improved...	3	33.33%
Allow compliance options, such as contributi...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Update the Drainage and Erosion Control Desig...	2	22.22%
Other	0	0%
Totals	**9**	**100%**



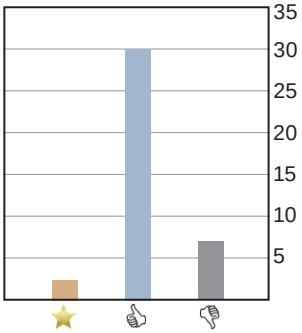
D

Metroquest Results

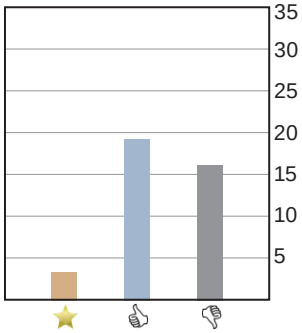
Appendix D - Metroquest Results

Flood Hazard Mitigation

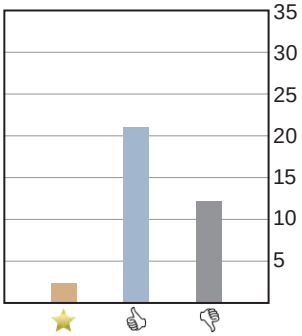
Fund additional long-term, multi-benefit flood risk reduction structural projects such as regional detention and channel improvements.



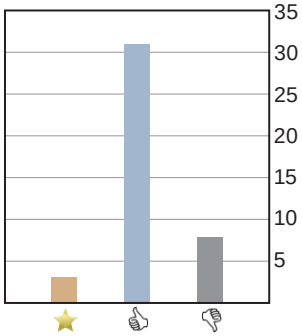
Implement life and property protections through a land acquisition program.



Enhance public information to both visitors and property owners about hazards.

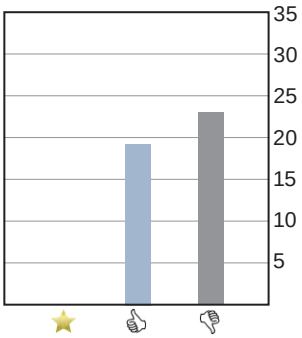


Improve prevention measures through more stringent building elevation and flood proofing requirements.

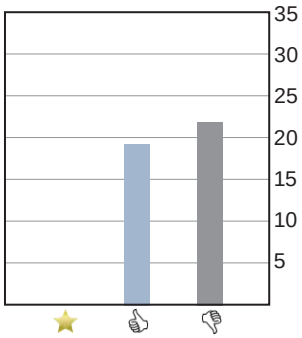


Maintenance and Monitoring

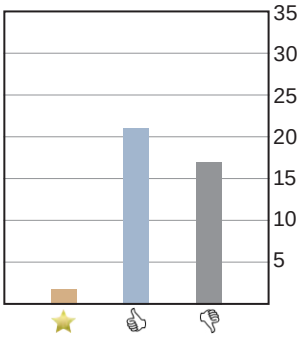
Create a citizen-based monitoring program through grants.



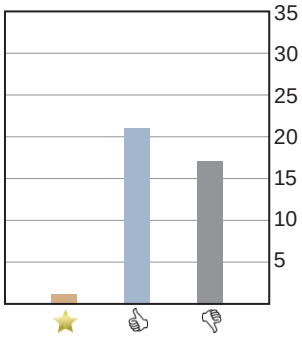
Create a Home Owners Association maintenance education program through online materials and brochures.



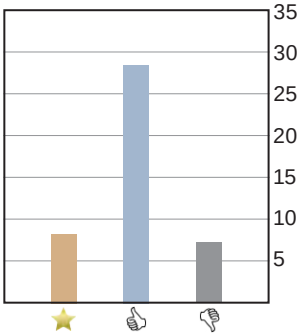
Fund and staff expansion of city monitoring and maintenance programs.



Create a school-based monitoring program and curriculum that teaches children about stormwater issues and collects water quality data.

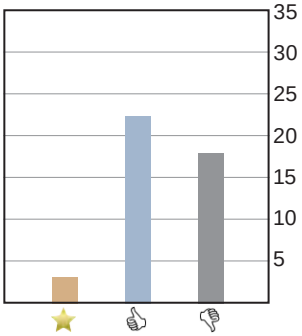


Update the Drainage and Erosion Control Design Manual to identify maintenance standards.

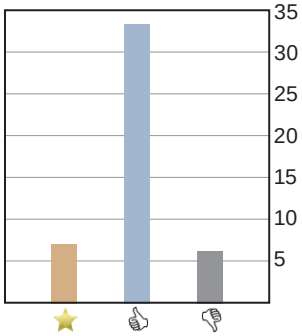


Open Space Conservation

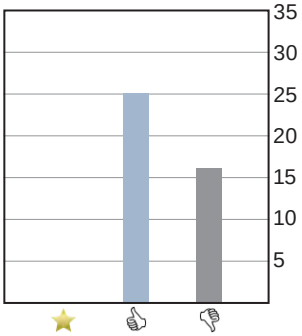
Create a city program (staff and funding source) for conservation banking of floodway and floodplains.



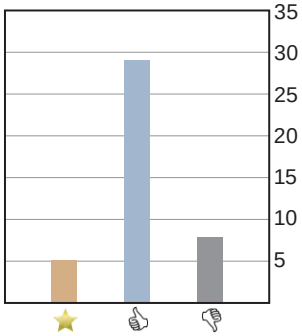
Partner with Comal and Guadalupe Counties for conservation land acquisition of sensitive recharge areas and other open space.



Fund existing conservation programs (i.e. Hill Country Alliance) with mitigation fees and agency grants.

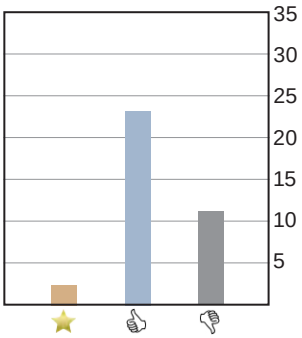


Encourage responsible infiltration to the Aquifer Recharge Zones per the efforts of TCEQ through education and incentives.

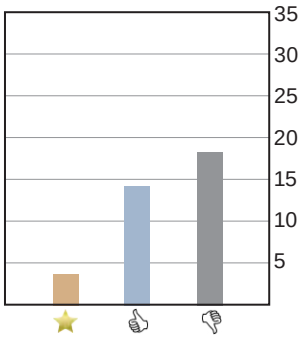


Litter Control

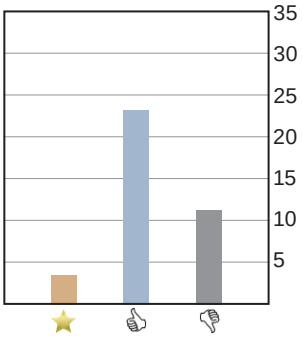
Fund a city-wide regular cleanup program.



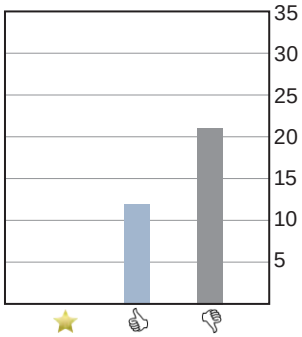
Enact an ordinance that limits disposable items, such as bags or cups.



Enact a Stormwater Discharge Management Ordinance to regulate illicit discharges.

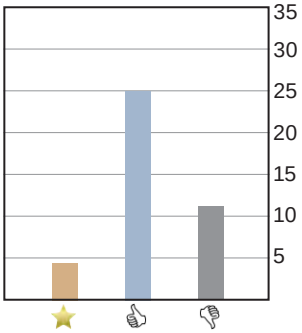


Establish a Pet Waste Ordinance.

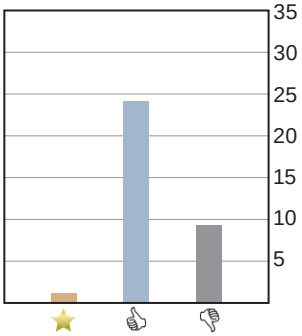


Building Runoff Capture

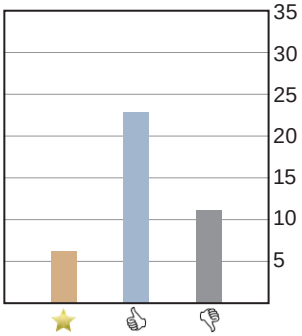
Expand current City-sponsored cistern program through grants to provide no-cost cisterns or rain barrels.



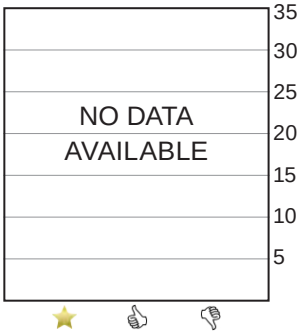
Enact voluntary “zero effective impervious surface” ordinance that provides developers with incentives to maintain hydrologic function after development.



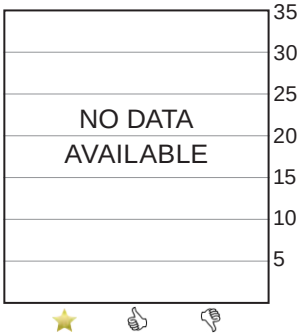
Provide permitting or fee incentives for new or retrofitted construction that removes pavement and replaces it with porous materials.



Provide permitting or fee incentives for new or retrofitted construction that directs downspouts to rain gardens.

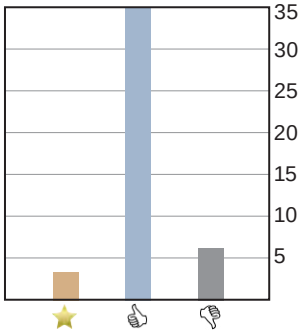


Provide permitting or fee incentives for retrofitted construction that re-grades paved areas to direct stormwater to detention.

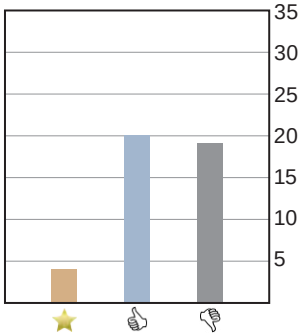


Construction Control Measures

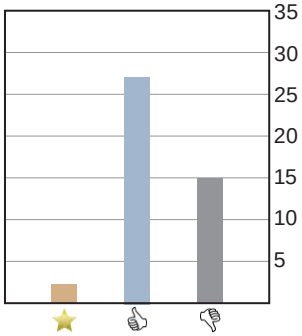
Require Storm Water Pollution Prevention Plans that produce outcome-based performance measures specific to each project.



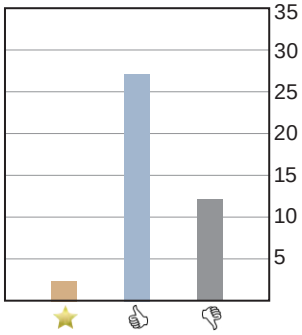
Fund and staff a greater frequency on construction site inspections through permit fees, enforcement and stormwater utility funds.



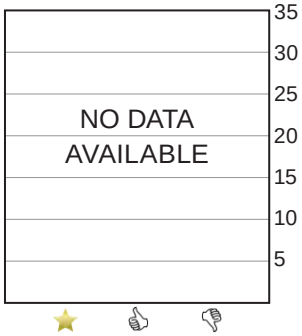
Provide benefits to developers for exceeding minimum construction control measures, such as expedited review time or reduced fees cost.



Update the Drainage and Erosion Control Design Manual to be more specific regarding the use of sediment fencing.

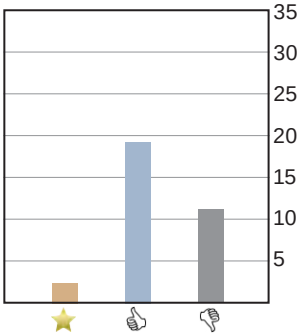


Update the Drainage and Erosion Control Design Manual to exceed EPA standards.

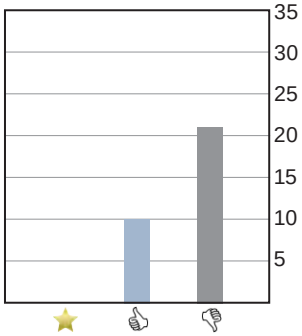


Impervious Coverage Reduction

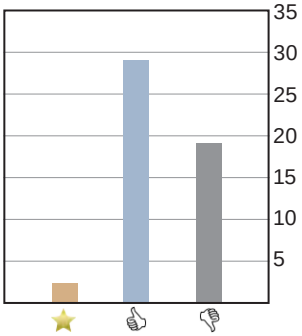
Require a parking maximum in addition to a parking minimum.



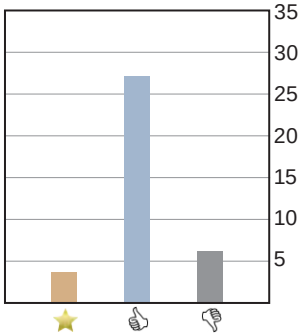
Reduce street lane width requirement.



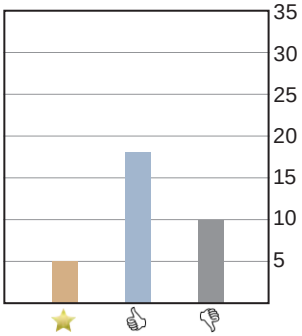
Evaluate, determine and regulate areas of the city that limit the density and amount of impervious cover. Consider developer transfer rights within this zone.



Incorporate Low Impact Design techniques into building requirements.

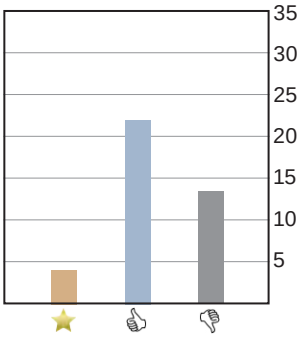


Incentivize the use of pervious paving options with expedited review processes or reduction of permitting fees.

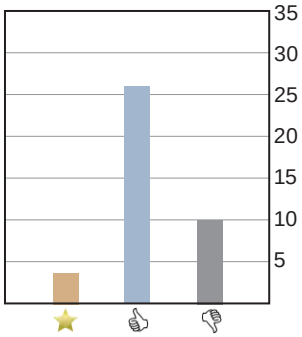


Retrofit Stormwater Facilities

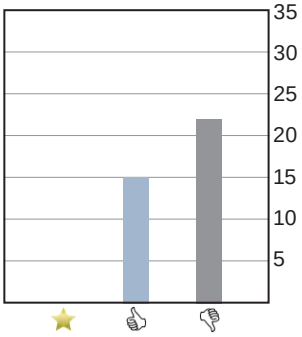
Fund and staff an on-going facilities and upgrades needs database. Require digital submissions for all drainage reports and design/as-built plans.



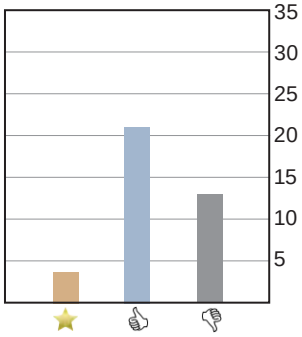
Enact an ordinance that requires the incorporation of Low Impact Design techniques in new and retrofitted construction projects.



Fund and staff City inspections of privately owned stormwater systems and gradually acquire existing private systems.

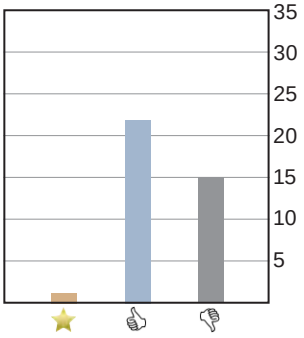


Update the Drainage and Erosion Control Design Manual to define the minimum slope and velocity and have minimum size of pipes to be 18 inches.

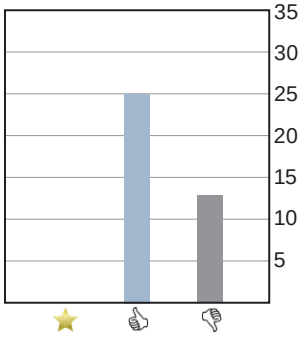


Stream and River Restoration

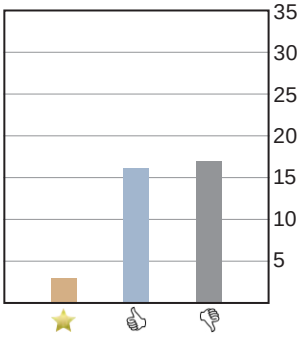
Partner with local groups and universities to implement ecological and habitat restoration projects, research and studies.



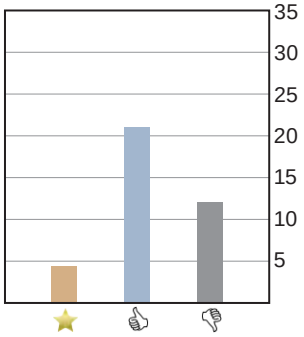
Establish and Adopt-a-Stream program via grants.



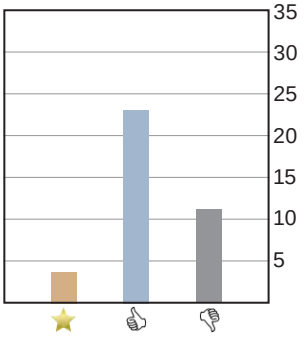
Establish a funding source for sedimentation and invasive vegetation removal.



Fund long-term projects that restore sections of the streams that have degraded or have been diverted through underground pipes.

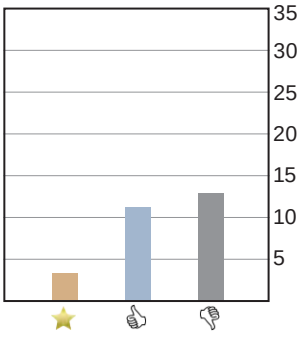


Create a stream and riparian corridor setback requirement and ad an additional buffer for impervious surfaces.

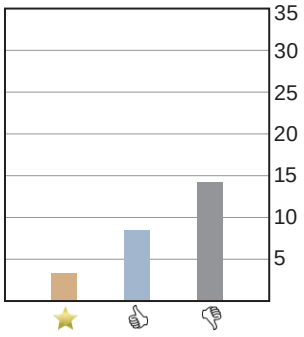


Implementation Tools

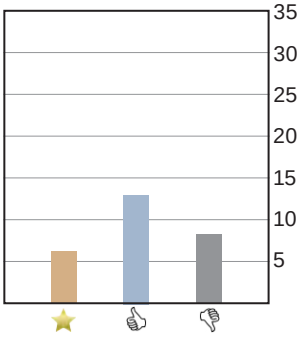
Base stormwater fees for improved land on the ratio of built impervious area to the entire property.



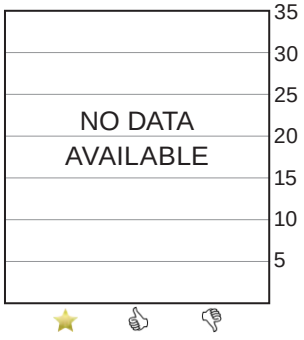
Establish a baseline fee for stormwater management, but allow compliance options for developments, such as contribution to a fund or additional on or off site.



Update the Drainage and Erosion Control Design Manual to require detention or fee-in-lieu for Types 1 and 2 Development.

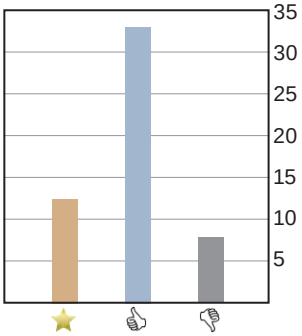


Update the Drainage and Erosion Control Design Manual to include a section delineating Low Impact Design methods.

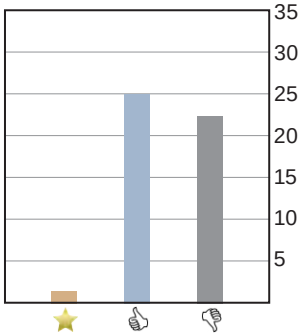


Floodway Building Prohibitions

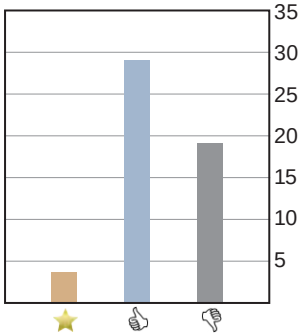
Prohibit (versus regulation of) new habitable structures from being constructed in the floodway.



Establish a funding source for removal of existing buildings from the floodway.

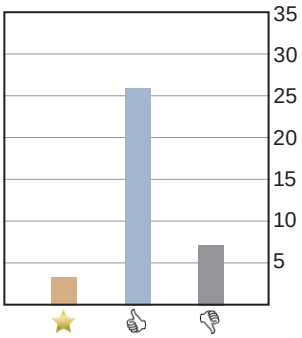


Re-evaluate the floodway boundaries to include more of the floodplain.

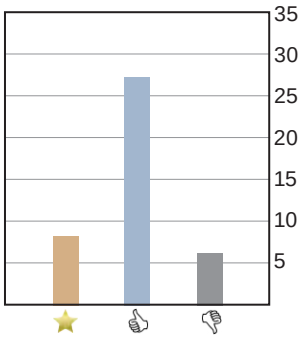


Detention Basin

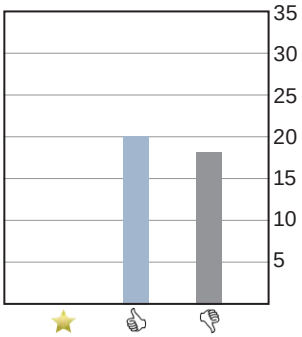
In conjunction with the 2010 Open Space Master Plan, prioritize park improvements based upon the possible use as a detention facility.



Update building code to designate the use of detention basin water for irrigation and provide incentives for developers that implement greywater systems.



Update the Drainage and Erosion Control Design Manual to all for fee-in-lieu (rather than detention) in lower portions of the watershed.



Require or provide incentives for specific design enhancements to detention basins to also improve their water quality functionality.