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2023 TFMA Annual Meeting, Houston

Drainage Improvement Evaluations

C/LOMR Challenges with Urban Drainage Systems

March 9, 2023

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halff Josh Logan, PE, CFM
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Agenda

DRAINAGE IMPROVEMENTS & FLOOD RISK REDUCTIONS

- City of San Antonio Examples
- Drainage Project Development
- Effective FEMA Floodplains (Pre-Project)
- Pre- and Post-2D Modeling Considerations
- New Flood Risk Mapping and C/LOMR Challenges

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City of San Antonio Examples

CHARACTERISTICS, IMPLICATIONS, AND STATUS

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CASE STUDIES

Selection Criteria

1. Fully developed / urban watersheds
2. Effective models using HEC-RAS steady-state 1D
3. Complete drainage project lifecycle
4. C/LOMRs and mapping challenges

- HEC-RAS 1D (Pre-Project)
- XPSWMM 1D/2D (Post-Project)*

- Bexar County & City of San Antonio
- San Antonio River Authority

- Design → CLOMR
- Post-Construction → LOMR

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LADDIE PLACE I, II, & III REGIONAL STORM WATER FACILITIES

Design and construction of four regional detention facilities within urban San Antonio, modeled using an XPSWMM 1D/2D analysis

- Reduction of commercial and residential flood risk
- Removal of 145 structures from FEMA regulatory floodplain
- C/LOMR development for CoSA, SARA, and FEMA
  - Detailed and simplified modeling deliverables
- Construction completed Fall 2015
  - LOMR approved February 2018

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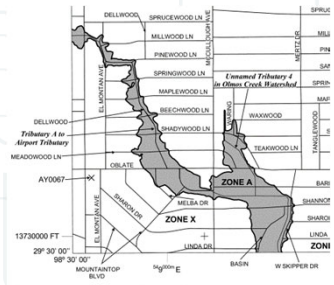
BARBARA DRIVE PHASE 2



Design and construction of ~2,700 LF of 10 x 9 RCBs and ~400 LF of inlet improvements within urban San Antonio, modeled using an XPSWMM 1D/2D analysis

- Reduction of residential flood risk
- Removal of 61 structures from FEMA regulatory floodplain
- C/LOMR development for CoSA, SARA, and FEMA
  - Detailed modeling deliverables
- Construction completed Summer 2022
  - LOMR pending approval

BARBARA DRIVE PHASE 2

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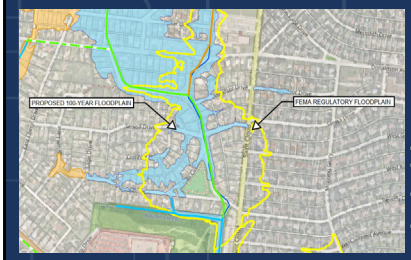
SEELING CHANNEL PHASE IV



Proposal and design of ~3,700 LF of 10 x 10 RCBs, 11 x 9 RCBs, and ~200 LF of inlet improvements within urban San Antonio, modeled using an XPSWMM 1D/2D analysis

- Reduction of commercial and residential flood risk
- Removal of 104 structures from Corrected Effective 100-year floodplain
- C/LOMR development for CoSA, SARA, and FEMA
  - Detailed modeling deliverables
- Design Summer 2023, construction anticipated Fall 2023
  - C/LOMR development pending

Drainage Project Development

PROJECT IDENTIFICATION AND EVALUATION

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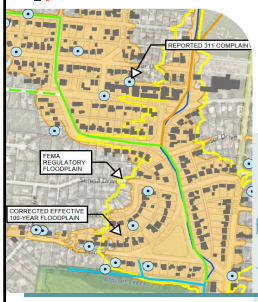
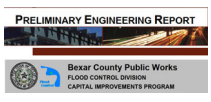
PROJECT IDENTIFICATION



Drainage improvement projects originate and are funded at both the regional and local level but share many similarities

Seeling Channel Phase IV Project
Preliminary Engineering Report

Prepared for
City of San Antonio



Bexar County Public Works
FLOOD CONTROL DIVISION
CAPITAL IMPROVEMENTS PROGRAM

REGIONAL

- Texas Water Development Board
- FEMA - NFIP
- Regional Flood Planning Groups
- Community Development Block Grants
- Hazard Mitigation Assistance Grants
- American Rescue Plan Act
- Regional watershed studies
- Base level engineering studies

LOCAL

- Cities and municipalities
- Residential complaints (311)
- City and county complaint data
- Capital improvement plans
- Cooperating technical partners
- Local flood control programs
- Drainage masterplans
- Preliminary engineering studies

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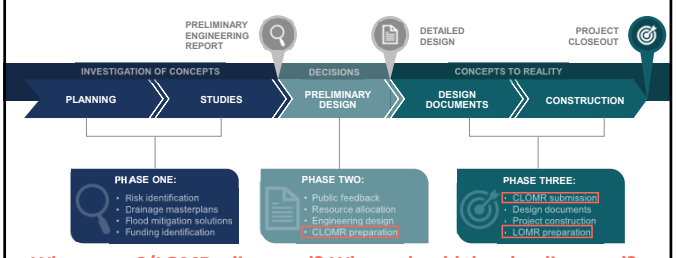
PROJECT TIMELINES AND C/LOMRS



Where *are* C/LOMRs discussed? Where *should* they be discussed?

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REMINDER…

Conditional Letter of Map Revision

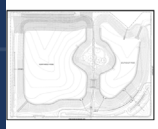
Barbara Drive Capital Improvement Project: Phase 2

CLOMR

Conditional Letter of Map Revision

- Determination that a project, constructed as proposed, would meet the minimum NFIP standards

Letter of Map Revision



Laddie Place Regional Storm Water Facility Phase III SA-2

LOMR

Letter of Map Revision

- Official revision to the current NFIP mapping to reflect post-project floodplains and/or floodways

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Effective FEMA Floodplains

EVALUATING THE PREVIOUS APPROACHES AND RESULTS

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LADDIE PLACE

- East Woodlawn Ditch
- Studied and published Fall 2010
- Designated as a Detailed Study Zone AE

Pre-Project

- Separate H&H models
- Pre-Atlas 14 rainfall data
- HEC-RAS steady-state 1D
- Storm drain limitations
  - Separate capacity calculations and manual changes to flow data

C/LOMR mapping challenges

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BARBARA DRIVE

- Tributary A to Airport Tributary
- Studied and published Fall 2010
- Designated as Zone A

Pre-Project

- Separate H&H models
- Pre-Atlas 14 rainfall data
- HEC-RAS steady-state 1D
- Storm drain limitations
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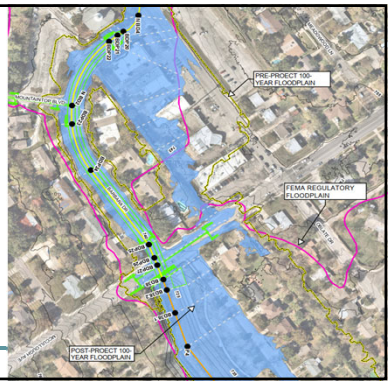
C/LOMR mapping challenges



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SEELING CHANNEL PHASE IV

- Alazan Creek and Alazan Creek Unnamed Tributary
- Studied and published Fall 2010
- Designated as a Detailed Study Zone AE

Pre-Project

- Separate H&H models
- Pre-Atlas 14 rainfall data
- HEC-RAS steady-state 1D
- Storm drain limitations
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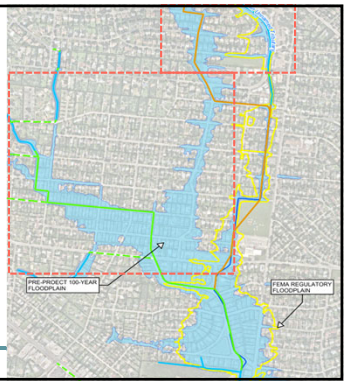
C/LOMR mapping challenges ongoing



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Modeling Considerations

EXPANSION OF MODELING CAPABILITIES AND UPDATED DATA

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MODELING LIMITATIONS

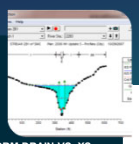
H&H modeling software has continued to improve, most notably during the transition from traditional 1D to combined 1D/2D and full 2D analyses (HEC-HMS, HEC-RAS, SWMM, etc.)

1

STEADY VS. UNSTEADY

- More attenuation and storage considerations
- Spatial and temporal variability in results

2



STORM DRAIN VS. XS

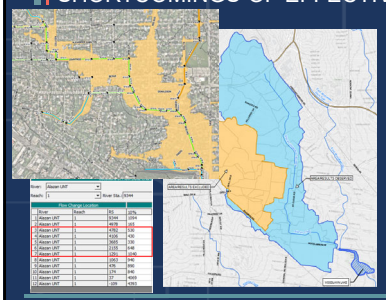
- Traditional hydraulic modeling via 1D cross sections
- Inability to accurately model storm drain conveyance

3

2D FLOW ROUTING

- ROG/ROM analyses
- Accurately model 2D flow behaviors and overbanks

SHORTCOMINGS OF EFFECTIVE MODELS



1. 1D models typically provide insufficient detail in urban environments
2. Most effective models use HEC-RAS 1D
   - Require extensive modeling assumptions and modeling simplifications
   - Require external results files for storm drain
3. Oversimplification of rainfall → to overland runoff patterns → to discharge point(s)
   - User defined "Flow Change Locations"
   - Not always considering what happens from point A → to B → to C and the risk in between

MODELING EXPANSIONS

H&H methodologies have been refined and traditional hydrologic applications are continuing to be replaced by more accurate, developed, and supported datasets.

1

HYDROLOGIC UPDATES

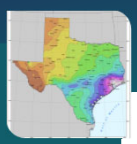
- More variability in infiltration methods (SCS vs. Green/Ampt)
- Directly vs. indirectly connected impervious areas

2

LESS HMS DEPENDENCE

- Routing developed and calculated in hydraulics model
- Fewer models and more consolidated user-interfaces

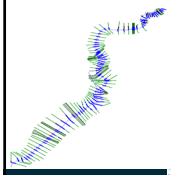
3



UPDATED RAINFALL

- Atlas 14 being incorporated into updated H&H studies
- Greater rainfall typically resulting in larger floodplains

WEIGHING 1D VS. 2D

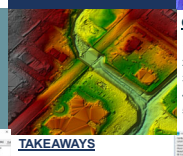


CONS OF 1D

1. More manual adjustments
2. More user assumptions
3. Limited in overbank areas
4. More program interpolations
5. Limited in urban areas

PROS OF 2D

1. Easy to develop*
2. Capable of modeling 1D and 2D flow patterns
3. Storm drain capabilities*
4. More calculation points
5. More intuitive output / results

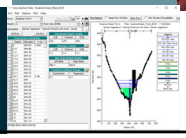


CONS OF 2D

1. Longer run times
2. Stability concerns
3. "No-adverse impact" challenges
4. Less familiarity for C/LOMR
5. Expensive licenses (non-RAS)

PROS OF 1D

1. Easy to develop
2. Quicker run times
3. Highly stable
4. Valuable for true riverine / conveyance studies
5. More familiarity for C/LOMR



TAKEAWAYS

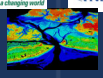
1. Reevaluate previous studies
2. Terrain-specific applications
3. Understand levels of detail
   - Risk mapping → BLE
   - C/LOMR →Design
4. Know your audience

FINDING THE BALANCE

Improved Data 1
- LiDAR Terrain
- Land cover / use
- Rainfall

USGS science for a changing world

TNRIS



US Army Corps of Engineers®

RAS

Accessibility 2
- SARA D2MR
- FEMA FIS
- FEMA NFHL

Modeling Capabilities 3
- High-level analyses (ROM)
- Detailed design (Storm drain)
- Continued 1D vs. 2D exchange

Higher Standards 4
- Continued expansion of NFIP
- Identifying risk vs. mitigating risk
- Improving guidelines & regulations

Funding 5
- Planning
- Prioritization
- Execution

InfoWorks

KPSWMM

STREAMLINE TECHNOLOGIES

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C/LOMR Challenges

WHAT TO EXPECT, THINGS TO CONSIDER, AND WHAT'S NEXT?

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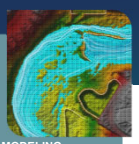
WHAT TO EXPECT

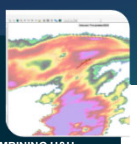
Increasingly complex H&H scenarios will require expansions of currently accepted methodologies as well as require the assimilation of new approaches to best identify practical solutions.



1

2D MODELING

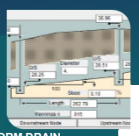
- Improved 2D processes
- Improved spatiotemporal data
- More widespread applications (2D ≥ 1D)



2

COMBINING H&H

- Hydrology | Hydraulics
- Less dependence on HMS
- Gridded precipitation (RAS)
- Subcatchment data (XP)



3

STORM DRAIN

- Increased need for storm drain analyses
- Expansion of storm drain software (RAS, XP, ICM)
- Greater acceptance

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THINGS TO CONSIDER

1 **Increased Coordination**

- Community-specific criteria / challenges
- More complex models = more QA/QC required
- Increased client involvement = more reviews + more feedback

2 **Modeling Challenges**

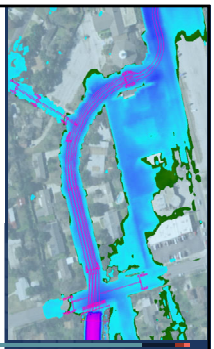
- Justification for changing software and/or approaches
- Simplified vs. detailed (Could it be "duplicated" in HEC-RAS for a C/LOMR?)

3 **Mapping Changes**

- 1D vs. 2D floodplains
- More complex urban 1D/2D models = potential newly identified risk
- Projects might remove ***and*** introduce at-risk structures

4 **Community Involvement**

- Keep stakeholders informed of standards and risk
- "I wasn't in the floodplain before, what changed?"
- "I thought I would be removed from the floodplain, what happened?"



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WHY IT MATTERS

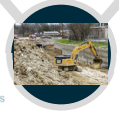
DEPARTMENT OF HOMELAND SECURITY
Federal Emergency Management Agency
FEMA
RIVERINE HYDROLOGY & HYDRAULICS FORM (FORM 2)

PHASE 1

- Need for revisiting outdated studies
- Continued community engagement
- Identifying future funding sources

PHASE 2

- Better identifying public risk
- Utilization of improved datasets
- Broadening technical understandings
- Furthering H&H standards



PHASE 3

- Turning ideas into reality
- Solving more complex problems
- Assuring community compliance

PHASE 4

- Updated C/LOMRs
- Mitigation of flood risk
- Protecting public interests
- Establishing new precedents

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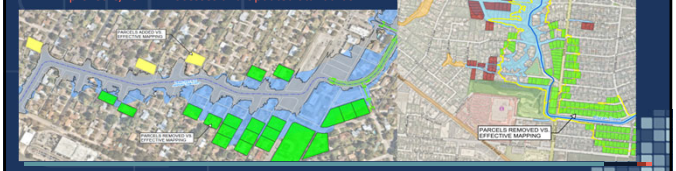
WHAT'S NEXT?

- Revisiting Adverse Impact Analyses
  - What is adverse impact vs. what is the product of updated and/or changes in modeling approach (RAS vs. SWMM)?
- Effective Mapping Overhauls
  - How do we balance showing improvements vs. identifying previously unknown risk?
- Improved C/LOMR Processes and Updated Standards



Q&A

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