

Risk Mapping in Twin Creeks Technology that solves our Stormwater needs.

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KANSAS CITY
MISSOURI



KCWATER
SERVICES

Twin Creeks (Second & First Creek) History

No WWTP = No Trunk
Interceptor Sewers.

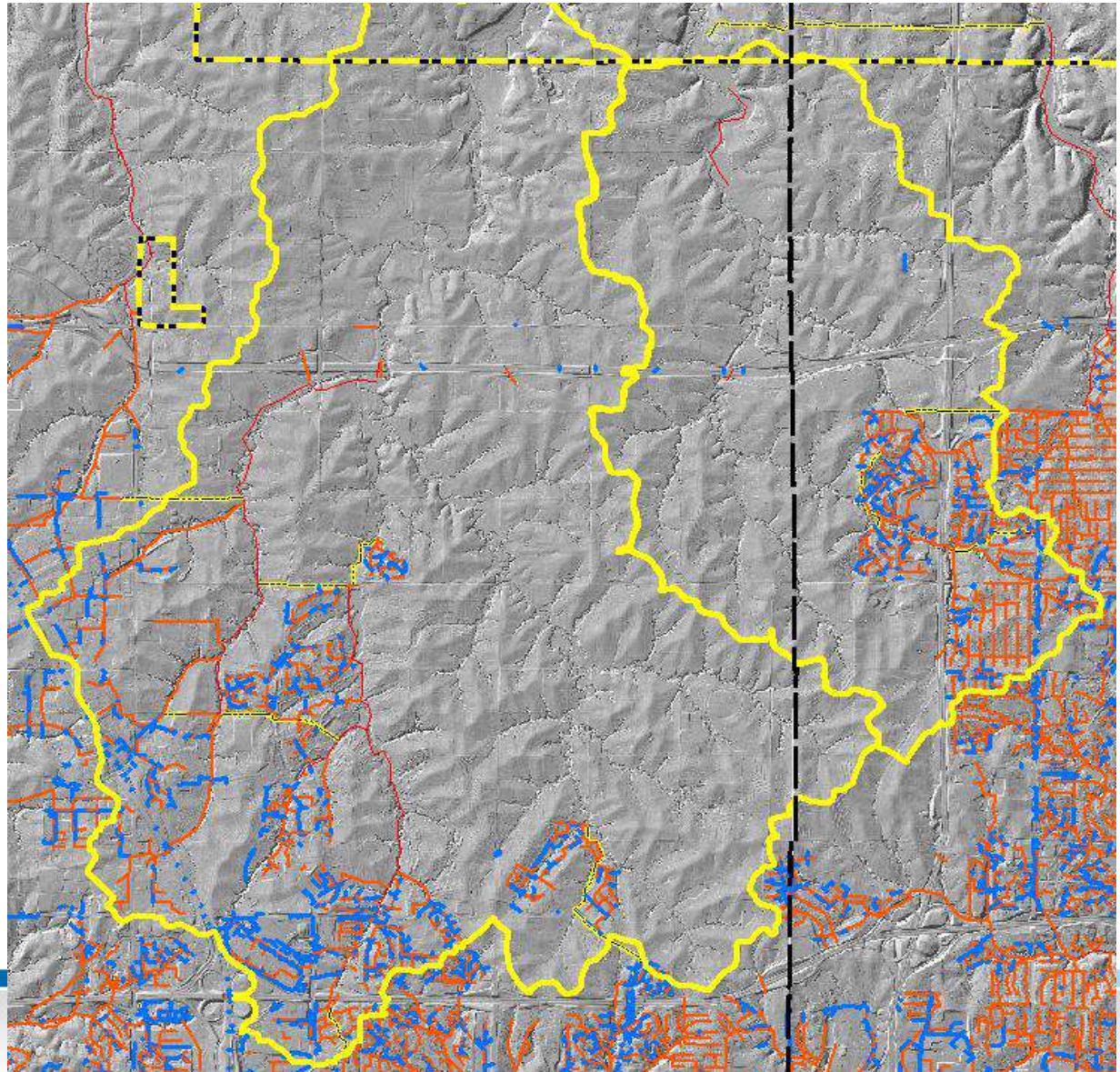
= No Development.

The dashed-yellow lines
are sanitary force mains.

This issue is now History.

Final As-Builts were
received the week of 11-2-
15 for **44.1 million in
sewers & other assets!**

Roads are the “**only**”
remaining hurdle.



23.1 Square Miles ~ 70,000 people? Are we ready?

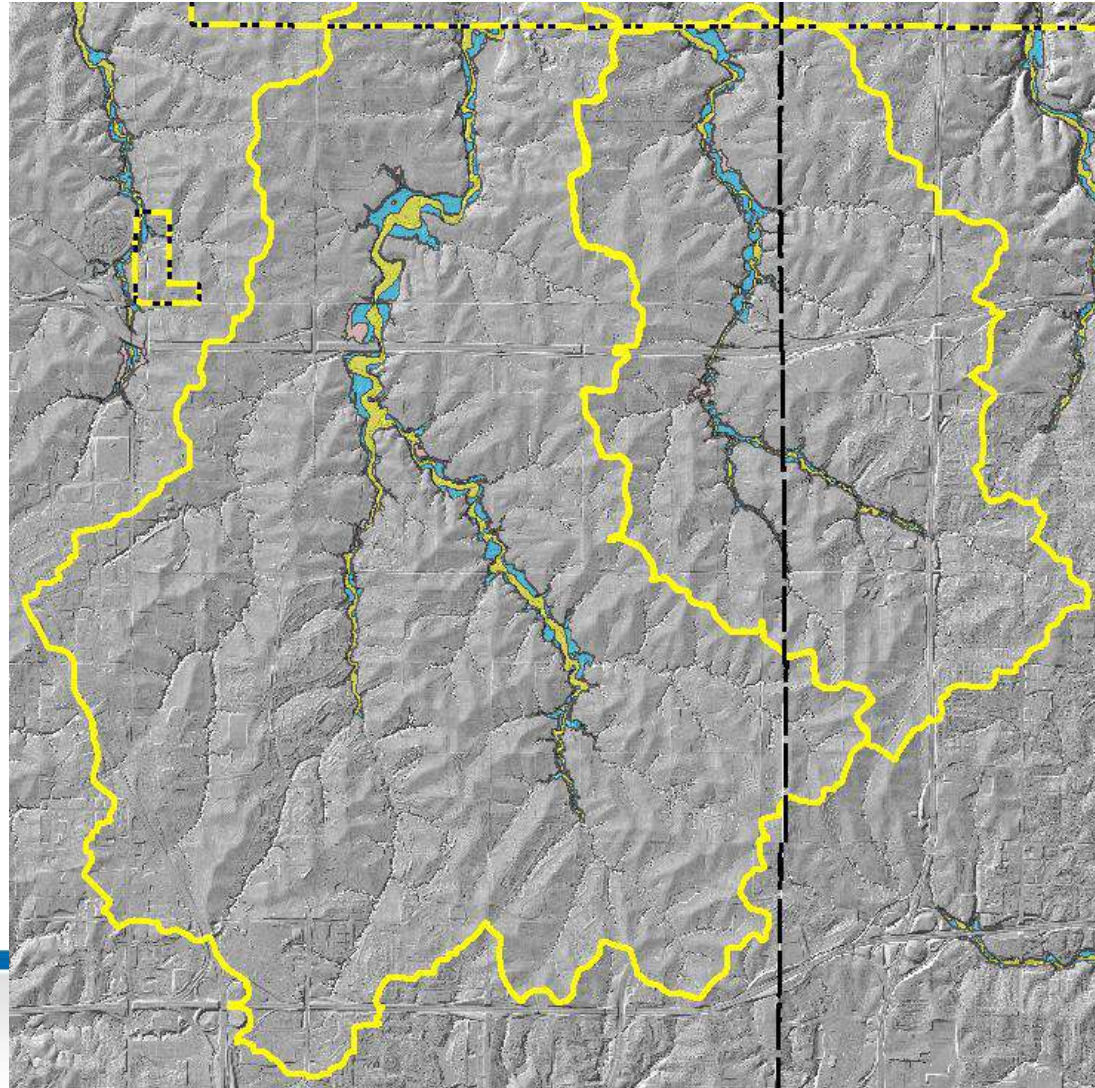
No! Not without resolution!

Here are our Draft FEMA floodplains with Zone A's.

And here is without Zone A's.

Much land has no federal regulation or modeling. The rest is Locally regulated. City modeling goes to ~ 53 acre sub shed sizes on average.

None of this is good enough for storm regulation or review needs!

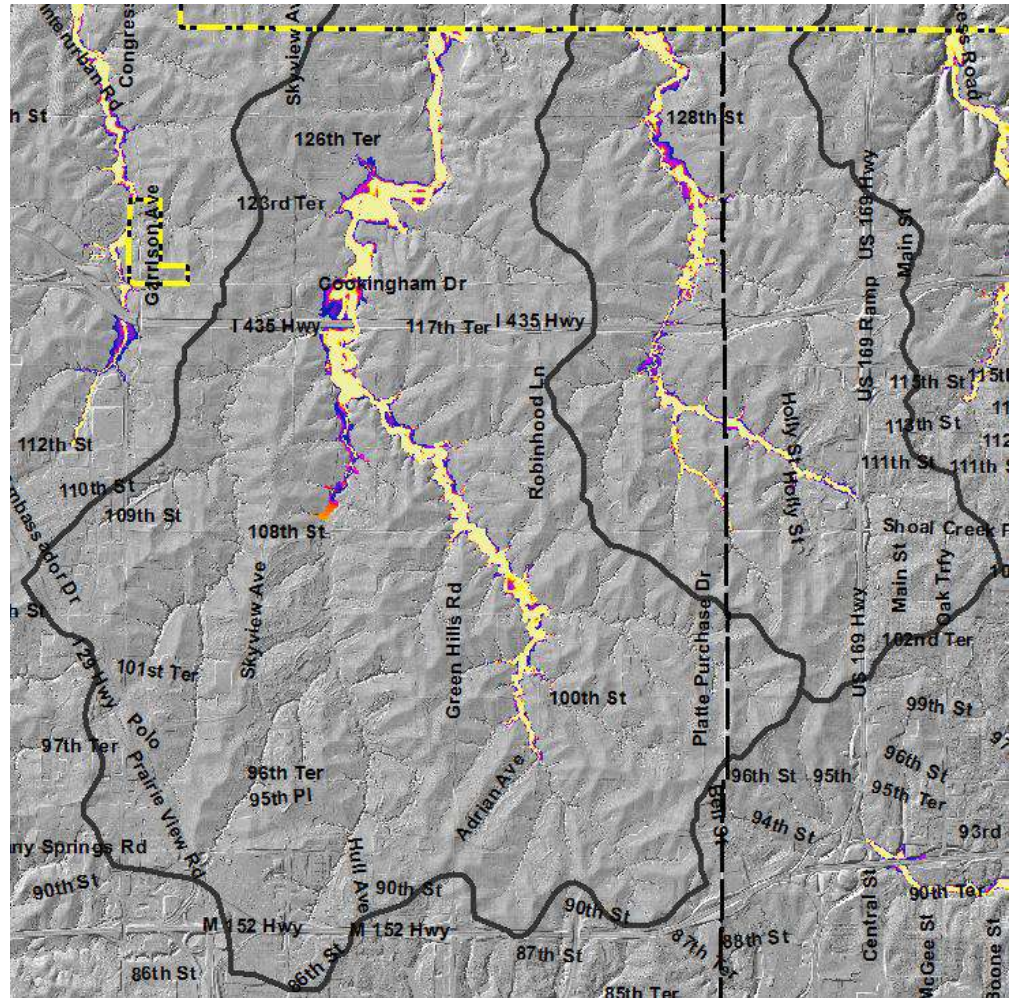


Risk Maps = AE Zones Only

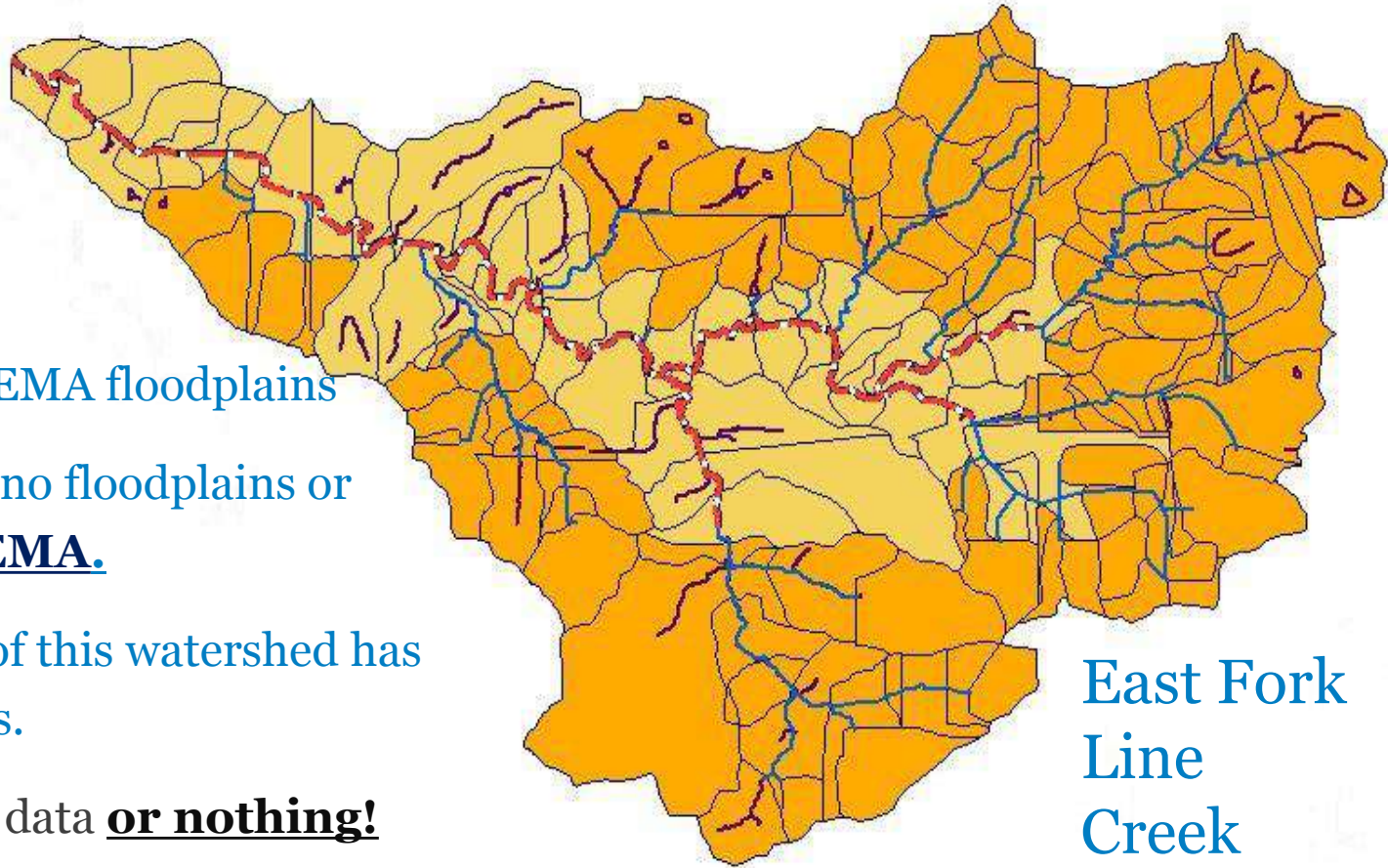
How many streams have no FEMA modeling? How many have no Local modeling?

The average KCMO Plat is **11.7 Acres**. City Hydraulics stop in Twin Creeks at ~ 53 Acre sizes.

These plats will not have what they need. They'll make **their own** data for macro and micro design. Try to review 2 worlds.



This is a stream Resolution Problem. You can't identify change and prevent it without more resolution & indicators to justify Goals/Needs!



- Light Orange = FEMA floodplains
- Deep Orange has no floodplains or Hydraulics **by FEMA.**
- Less than 33.9% of this watershed has FEMA floodplains.
- **66.1%** ... is Local data **or nothing!**

We also know too few of the problems!

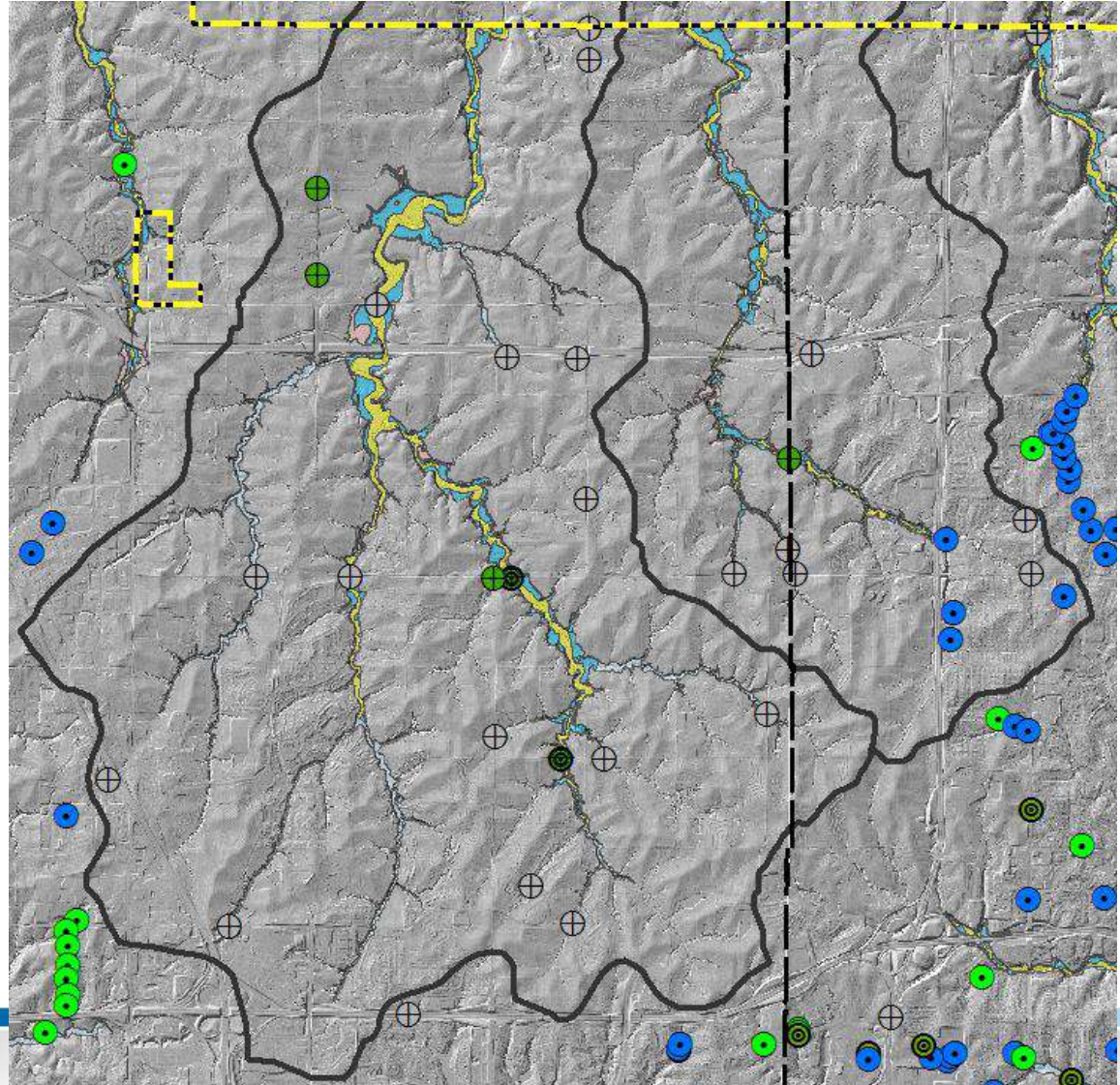
Our Storm CIP is ~ 1.7 billion
in unfunded needs.

But this suffers from the 53
acre resolution issue, and
focuses on filtered
recommendations by
standards!

What we need is high
resolution risk identification.
Do we know all the risks?

NO WE DO NOT!

We can do much better!



Twin Creek's Contract began September 2015.

There are 9 (10) Key task Areas focused on:

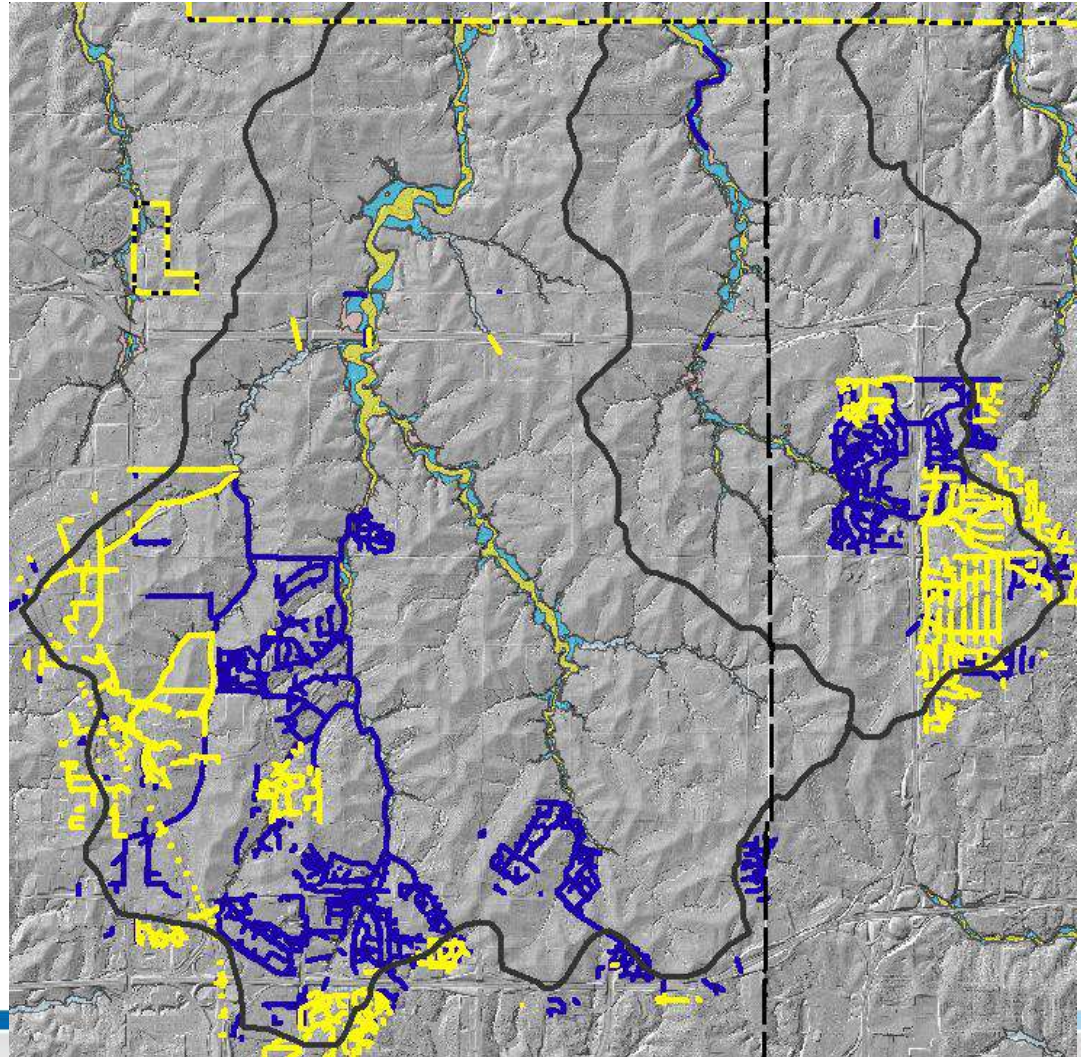
- Task 1 Data Collection and Development
- Task 2 Regulatory and Standard Practices Audit
- Task 3 Hydrology Assessments
- Task 4 Hydraulic Assessments
- Task 5 Stream Stability Assessments
- Task 6 Scientific justifications, Risk Analysis & Associated Products
- Task 7 Risk Assessment Report and Database to FEMA/City
- Task 8 Process & Procedures Integration Plan
- Task 9 Final Master Plan Report
- (Task 10) (Development of Workflows, Tools & Integration into City Process)

Task 1 Data Collection & Development took months! This put us behind schedule.

More than 2,400 plan sheets have been located, provided and/or digitized.

Our in house data is well behind the industry and our neighbors in availability and ability to locate and use.

Annexation, the existence of storm water in 4 departments historically **and to present day... Does not help!**



Task 1 Data Provided to AMEC Foster Wheeler

FEMA hydrologic and hydraulic models plus support data

Drainage inventory data – including As-Builts

Complaint file(s) and locations

Repetitive Loss Data from CRS

Stream assessment reports for water quality/stability

Historic Digital Aerials for Stream Sinuosity to 1969

Historic Topography for Stream Degradation Tracking

Farm Service Crop Coverage's

MARC Raster based Natural Resources Inventory 2.0

Infrastructure improvements since Watershed and FEMA studies

Site Drainage studies that are more recent than any data above

Watershed Study models

Terrain data

Raw LiDAR LAS files

Existing Land Use data

Future Land Use data

303d Stream Data

KCMO Impervious areas

Building Footprints

Soils Data

Task 2 Regulatory and Standard Practices

Part APWA Storm standards, part local process. Stakeholder efforts to come!

Regulatory Audit

Twin Creek Watershed Mgmt Plan

#	Regulatory and Standard Practice Requirements	Type	Resource Document	Science
155	The stormwater management study for a development shall include an analysis of the existing downstream drainage systems to the point the development's land mass is less than 10% of the total watershed, unless waived by KCMO.	Peak	APWA 5600	VD Volume Discharge
157	For dry detention basins, the design shall allow for discharge of at least 80 percent of the detention storage volume within 24 hours after the peak or center of mass of the inflow has entered the detention basin.	Volume	APWA 5600	VD Volume Discharge
158	Draw down of a facility shall be completed within 72 hours of less when required for maintenance or inspection.	Volume	APWA 5600	VD Volume Discharge
163	The watershed plan manages runoff from all storms up to and including the 5-day event.	CRS Program	Series 400	VR Volume Retention
165	If flooding problem occur, runoff from the development shall be controlled by limiting the storm water release rates for the 1%, 10% and 100% storms to the <u>predevelopment peak flow rates</u> . <i>Artificial Volume Mitigation Effect</i>	Peak	APWA 5600	VR Volume Retention
167	KCMO is a Class 9 Community which reduces flood insurance within the City limits by 5%.	Peak	https://www.kcwaterservices.org/crs/	
168	The use of the Rational Method for drainage areas greater than 5 acres is not appropriate.	Peak	APWA Supplement No. 2	VD Volume Discharge
169	SWMM is the preferred method for Drainage Masterplans.	Peak	APWA Supplement No. 2	NA
170	Small urban area, less than 10 acres of drainage shall use a 100-year, pre-existing discharge rate.	Peak	APWA Supplement No. 2	VD Volume Discharge
171	Large urban area, greater than 10 acres of drainage, shall use a peak discharge of the 100-year, pre-existing discharge rate, may be less if flooding is downstream.	Peak	APWA Supplement No. 2	VD Volume Discharge
172	For any development the City may impose prescribed discharge rates based on a Master Watershed study.	Peak	APWA Supplement No. 2	VD Volume Discharge
173	The maximum size for use in the Rational Method in a watershed is reduced from 200 acres to 5 acres.	Peak	APWA Supplement No. 1	VD Volume Discharge
174	The SCS curve numbers may be adjusted from a Type C, if the engineer can justify other soil types.	Peak	APWA Supplement No. 1	VD Volume Discharge
175	Q100 = 3cfs/ac; Q10 = 2cfs/ac; Q2 = 0.5 cfs/ac, Allowable Peak Discharge for new development	Peak	APWA 5600, 2011 Ver.	VD Volume Discharge

If you start by the Regulations & Process you will “die” by it. You will never get to your real storm water needs this way! You cannot steer through this regulatory forest and “see” or likely reach your needs on the other side! 1.) Start with the Technologies capabilities to help you identify your real core community storm needs. 2.) Use the needs and technology to reshape the regulations and process to be as simple **and as directly linked to real storm water needs and goals as possible.**

You can: Give developers/owners far better knowledge and identify far more risks for them in advance to meet real short & long term storm needs at high resolution and potentially save money and improve value!



Money & time can be saved & change justified!

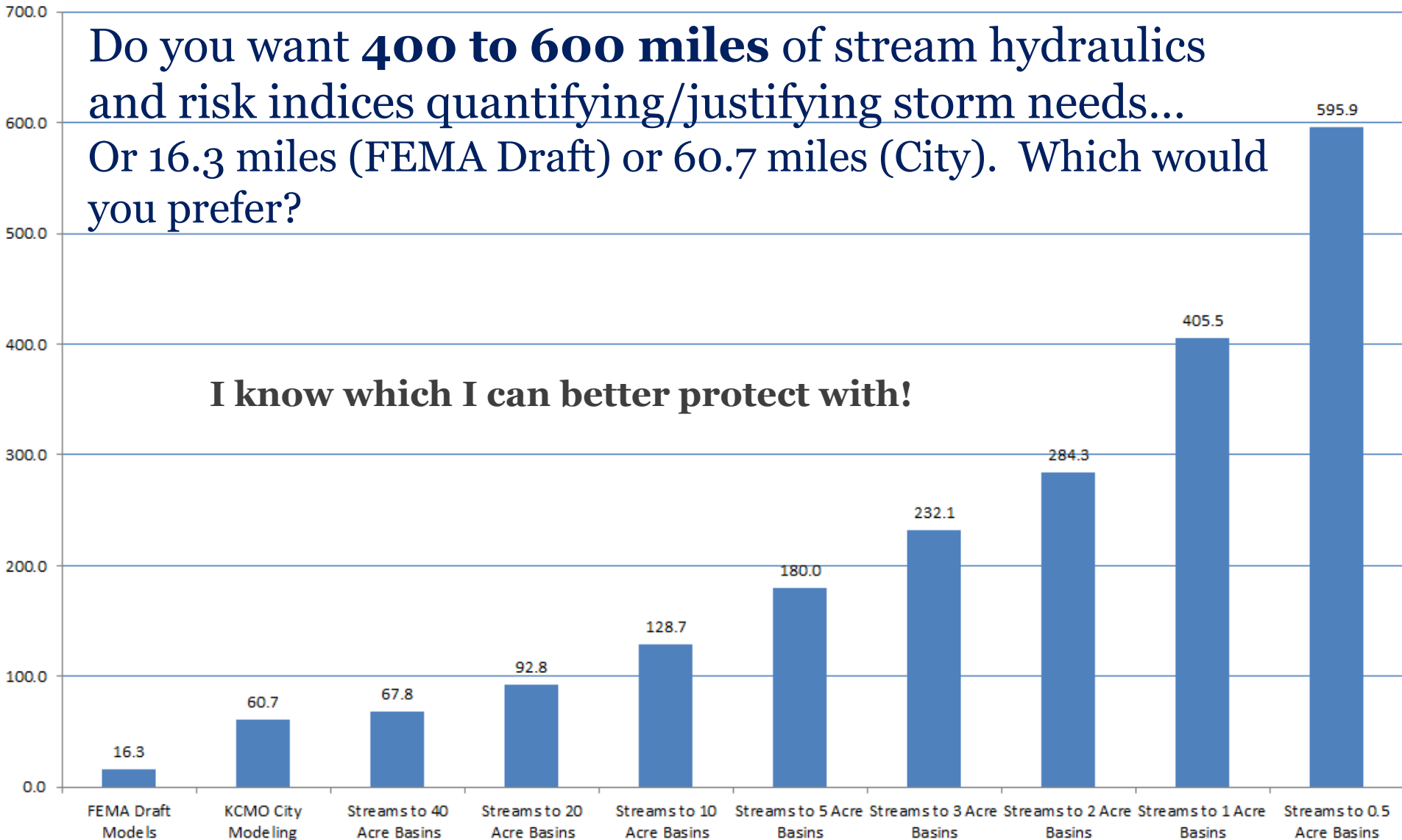
Task 3 & 4. Your Hydrology will limit Hydraulics

Miles of Stream Modeled

Do you want **400 to 600 miles** of stream hydraulics and risk indices quantifying/justifying storm needs...

Or 16.3 miles (FEMA Draft) or 60.7 miles (City). Which would you prefer?

I know which I can better protect with!



Task 3/4 Hydro & Hydraulics

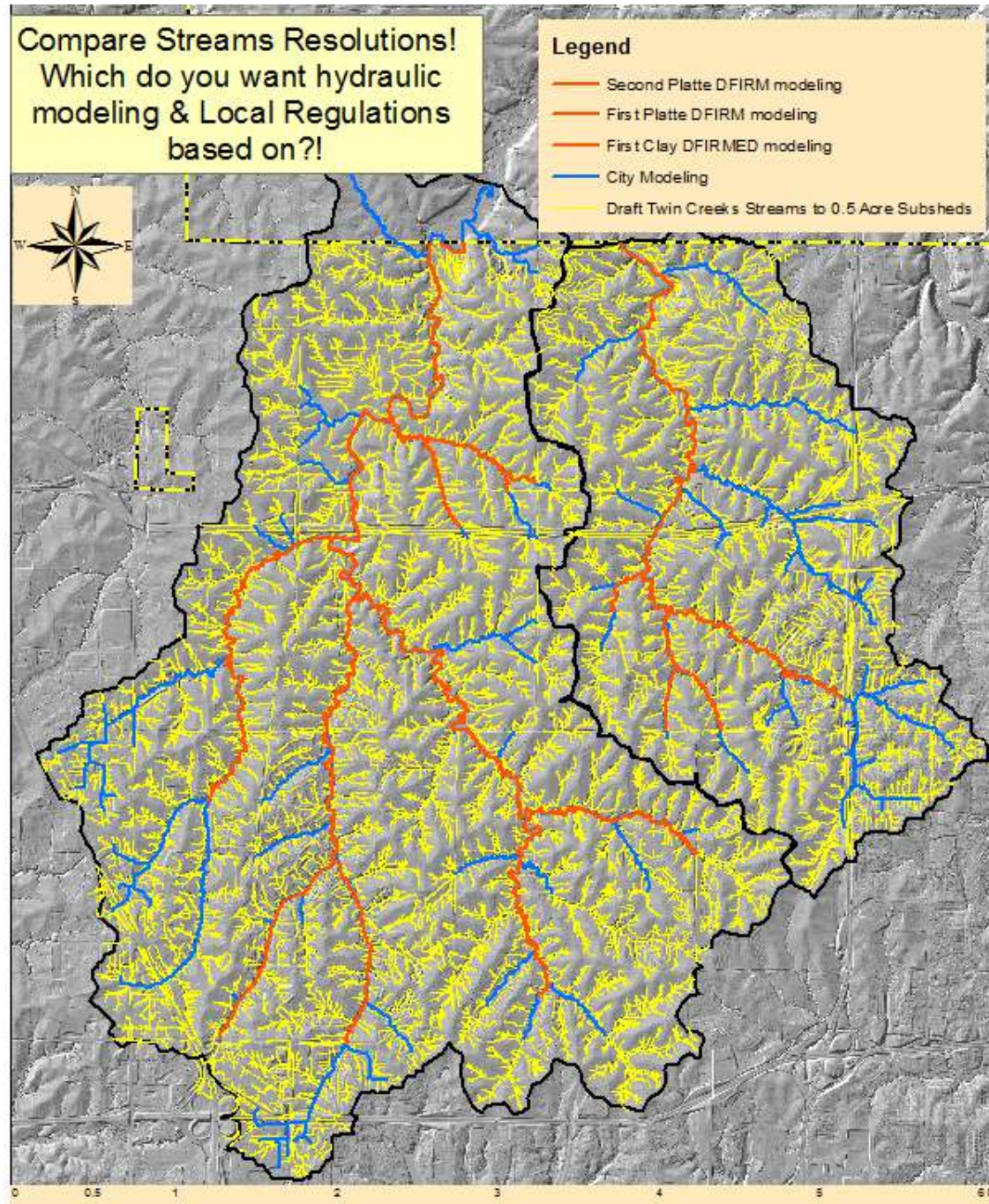
Red = FEMA Regulatory (A zone also).

Blue = City modeled Hydraulics

Yellow = Uses 'As-Built' + 1 Meter DEM + more automated Hec Ras methods for up to 535 cheaper miles of hydraulics.

Every mile with far more Risk Map products.

Cost is ~ \$750 per stream mile.
KCMO's past models ~ \$9,000/mile! (1991 to 2006).



Tasks 3 & 4 Hydrology and Hydraulics Products

- Flow paths for runoff from 1 acre sub-basins in geodatabase forms.
- Hydraulic models, SWMM and Hec-Ras in our case
- Flow Rates along stream paths for input into Hydraulics computations between the FEMA floodplains and extents of stream network in geo-database form.
- Flood Depths & Volume Grids and flow Accumulation Grids (in GIS)
- Velocity Distributions (Grids) Which leads into Task 5 efforts!
- Infiltration Grids
- Identify virtually all Flooded Areas
- All of these indices for: 100%, 50%, 20%,10%, 4%, 2%, 1% and 0.2% storms
- Oh... also all of those indices... for all of those storm events for:
- Native, Existing and Future Conditions. 24 rasters per indice! 5ft cell grid resolution ~ \$750 per mile.
- For 23.1 square miles to 1 to 0.5 acre drainage area resolution or better.

Task 5 Stream Stability Assessment

Hec-Ras from Tasks 3 & 4 is Key here along with use of Historic Aerials

- Slope
- Velocity
- Shear Stress
- Stream Power
- Incision & Entrenchment by computation of supporting data from Hec-Ras

Screening parameters for Stability Assessment

- Sinuosity using Historic Aerials from 1964 forward to 2012.
- Drainage Area
- Watershed Impervious and Pervious areas, Vegetation, Forestation
- Erodability of Soils
- Bed material and critical shear stress
- May use Vertical, Lateral Stability and Recovery Potential ratings by Stream segment by numeric scales.

Task 5 Stream Stability Assessment

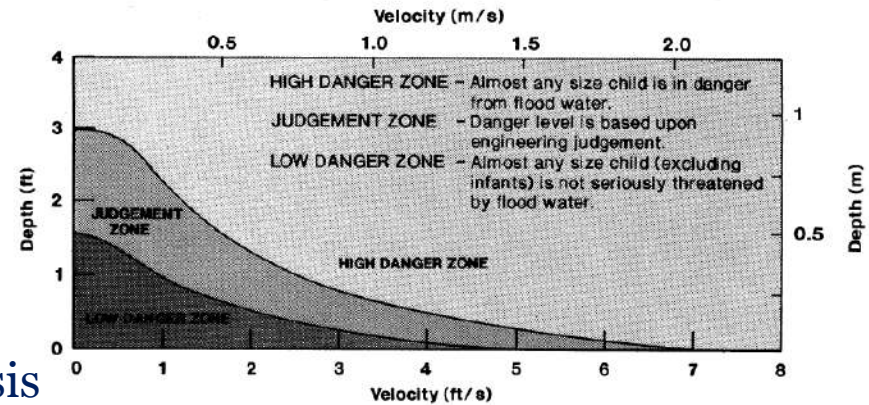
Deliverables

- Brief report summarizing statistical methods and testing results
- List of identified HEC-RAS and GIS screening parameters and products
- **Recommendations on stream buffer criteria for stream erosion.**
- Defined stream erosion indices for regulatory protection



Task 6 Scientific Justifications, Risk Analysis and Associated Products

- Erosion Index
- Depth and volume grids
- Stream Power Index
- Velocity Grids
- Stream sinuosity analysis
- Existing and Future problem spot analysis



- Economic Impacts – average annual loss analysis
- Asset proximity risk analysis
- Risk assessment grids for Child, Adult and Vehicles within inundation areas
- The final lists will be defined during the Task 4 Workshop
- **Rain runoff rate goals based on analysis of Native, Existing, and Future conditions and stream stability and flood risks.**

Task 7 Risk Assessment Report & Database

This will be a report of processes and results from Tasks 1 through 4. The database will be a derivative of FEMA's flood risk database incorporating the additional computations used in the final risk analysis for City in Second and First Creeks.

This will become available on-line by City and used in City process for storm water management and regulations in Twin Creeks in combination with the GIS and model products.



Flood Risk Report

Jackson County, Missouri

Community Names (continued on next page)

Report Number 01

07/31/2013

Task 8 Process and Procedures Integration

Tasks 8 Gets approval to create the Pilot Regulatory Area for Storm Water Management in the 23 Sq. Mi. that is “Twin Creeks”.

All the technology and indices built will be integrated here into a workflow to use in house to provide this data, track it and assure it is well used with help from a large pool of stakeholder groups.

The Technical Stakeholders and Process/Regulatory Stakeholders and key Departmental heads involved in prior Task Meetings, will again be brought together to review the total products in detail and further improve or finalize them. Modifications and final recommendations will be made with Departmental support to Political stakeholders and other key stakeholder groups to finalize support and approval. Task 10 funding must occur here.

A Pilot development review process will begin for Twin Creeks unlike all of the rest of KCMO! With success... it can spread!

Task 10 “Watershed Planning Portal”

Due to funding and questions on “who/how” to departmentally pay for this critical task, it was not funded. This could be our Waterloo.

All this technology needs to be easily available to: Public, Regulators, Decision Makers for storm issues (4 departments minimum). The Private Sector, Developers, Designers, Owners... did I mention the Public which we serve?

The Process needs to be laid out and built into many potential systems such as: EnerGov storm planning and review, web-based data sharing and download!
Many of these will not be done without Task 10!

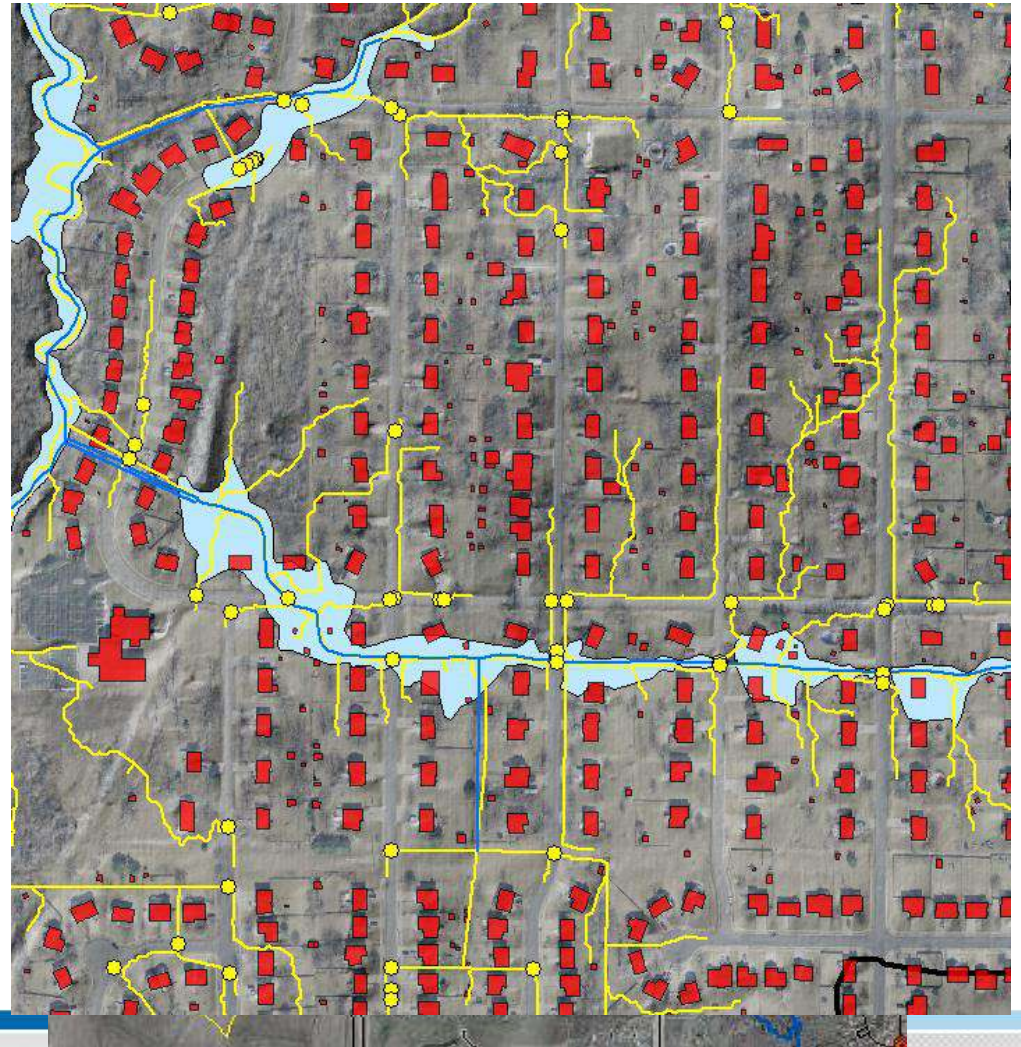
A watershed study, not available or usable by the reviewers/owners/designers... is useless... The information must be easily available, easy to understand, interpret, communicate, provide, **and use.**

Conclusions: Technology changes our Options

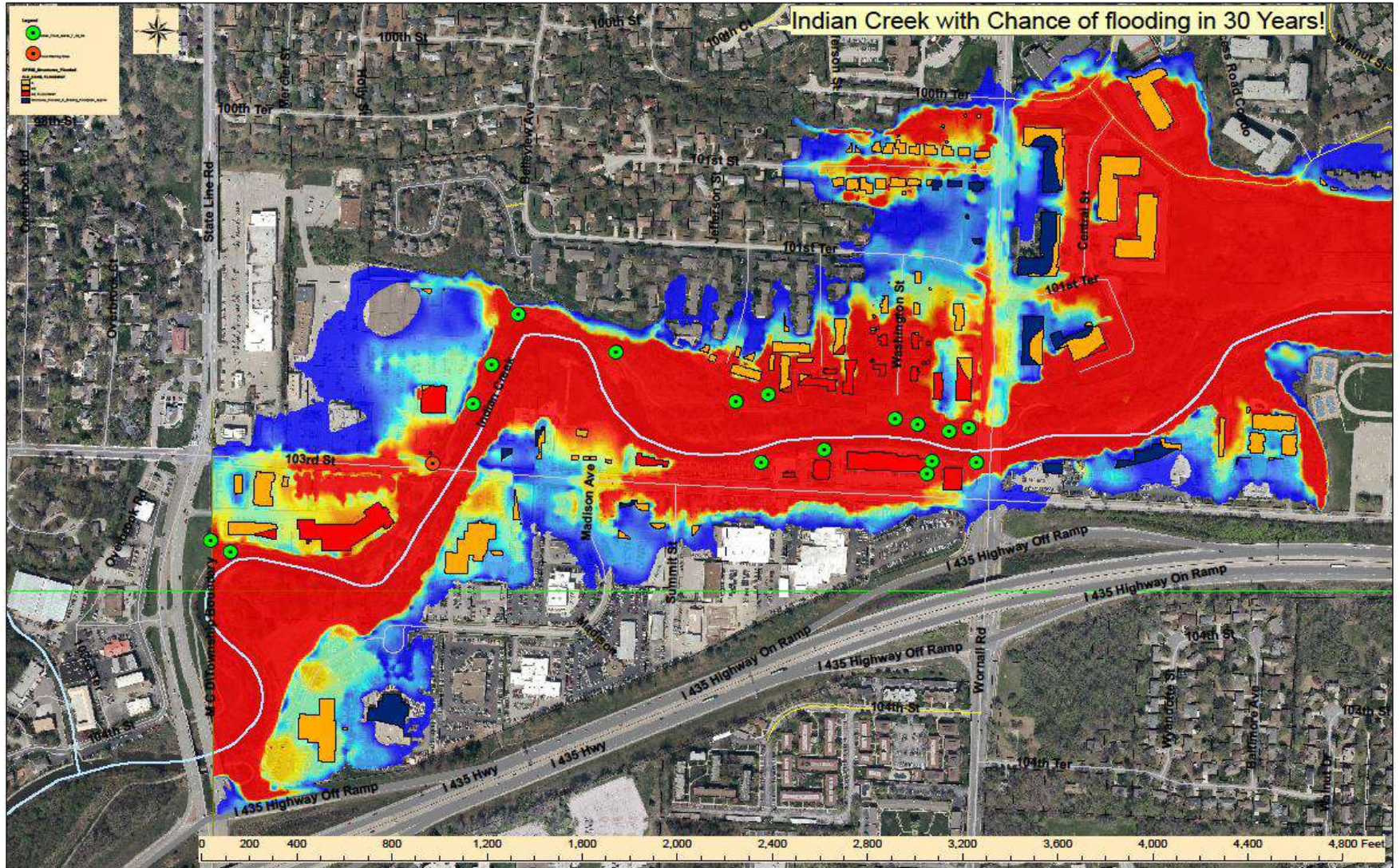
These Twin Creeks products, models, GIS and indices become the facts and information for all to readily use. By visualizing and quantifying this data... process can be improved and reduced.

Ultimately better up front data and storm needs will create better informed development for an area still 70% rural.

And the images to the right from 1954 will not repeat...



If we fail to implement Twin Creek's storm needs, we'll get the below... one ~11 acre plat or lot split at a time upstream of degrading FEMA FIRMS/FIS.



Questions ?!

