

Screening for Urban Flood Potential

Evaluation of CSOP Alternatives
(R. Evans, D. Crawford)

Points to cover:

- Model Scale vs
Flood Potential Determination
- When is flooding worse?
- Indications from the 2x2
- Indications from MODBRANCH

Potential of Urban Flooding

Urban flood potential can be estimated by using the CSOP 1st Floor elevation data.

- GIS field survey data collected by USACE contractors in June 2003 for the CSOP project effort.

This data set consists of 3,567 survey points of homes. This represents a sample of about 12% of the total number of residences in the area (total ~29,400).

The data are primarily located in areas where there has been flooding reported.

We must make the assumption that the 1st floor elevations vary consistently throughout the area and were consistent between residence and commercial properties.

Commercial Parcels

- Commercial parcels were identified as those with County Land Use Codes (CLUC) as labeled in the Miami-Dade parcel data base with the following CLUC's.
- 0011 Total Retail Outlet
- 0012 Total Repairs
- 0013 Total Office
- 0014 Total Wholesale
- 0015 Total Entertainment
- 0019 Total Automotive Marine
- 0021 Total Hotel
- 0022 Total Motel
- 0026 Total Service Station
- 0029 Total Mixed Commercial
- 0031 Total Mineral Processing
- 0032 Total Light MFG Food Processing
- 0034 Total Canneries
- 0037 Total Warehouse
- 0039 Total Mixed - Industrial

Residential Parcels

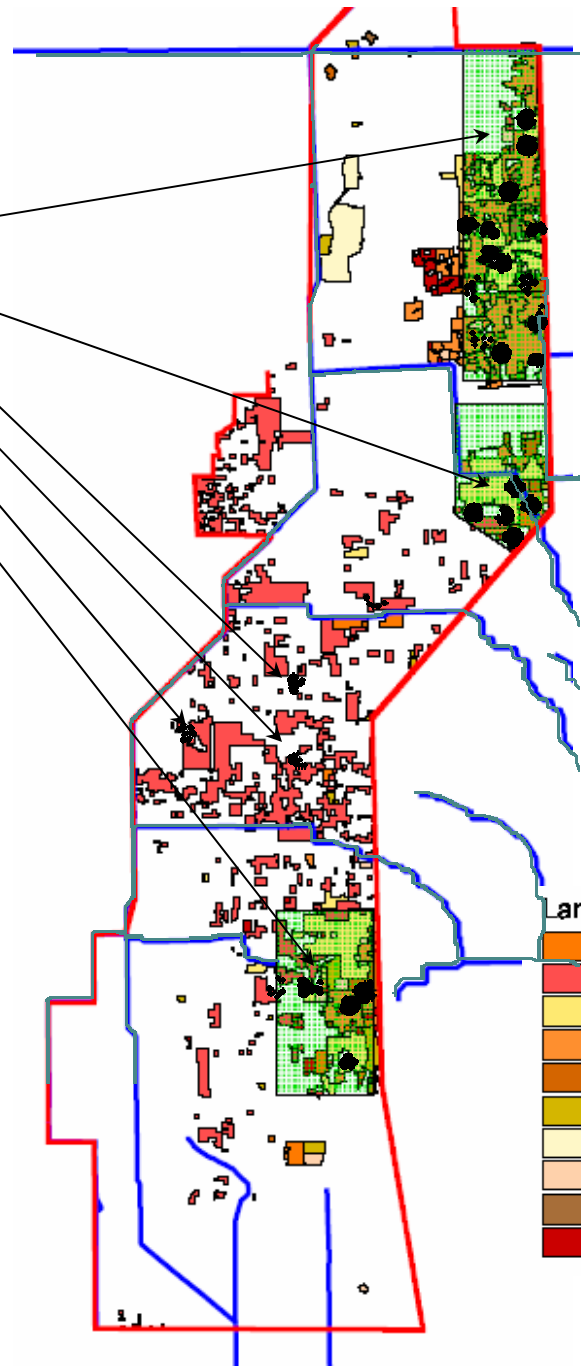
- Residential parcels were identified as those with County Land Use Codes (CLUC) as labeled in the Miami-Dade parcel data base with the following CLUC's.
- 0001 Total Residential
- 0002 Total Duplex
- 0003 Total Multifamily
- 0006 Total Mobile Home
- 0009 Total Mixed - Residential











Locations of 1st Floor Survey Data

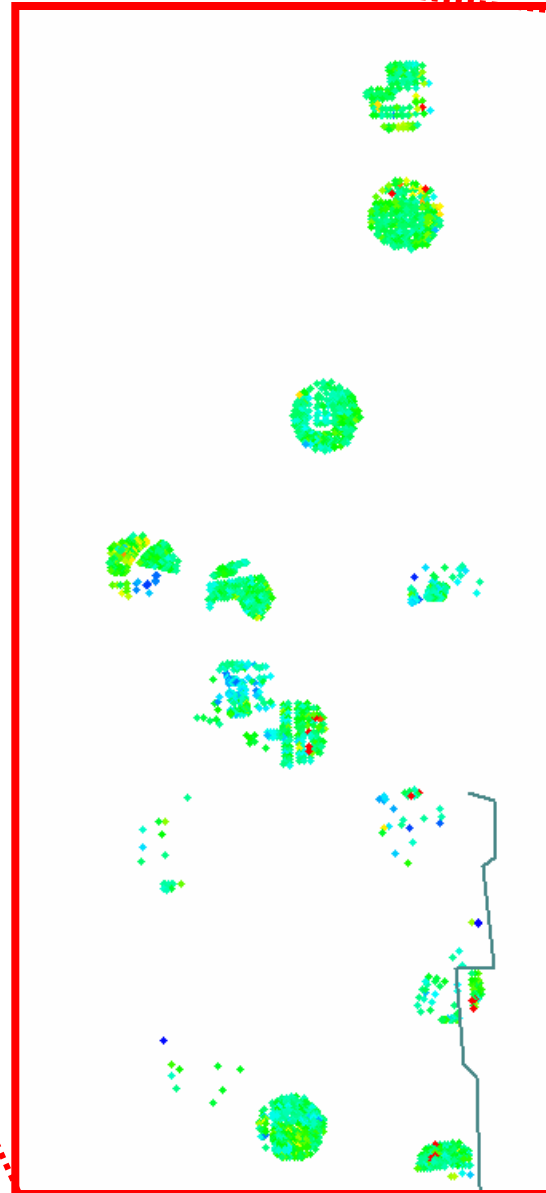
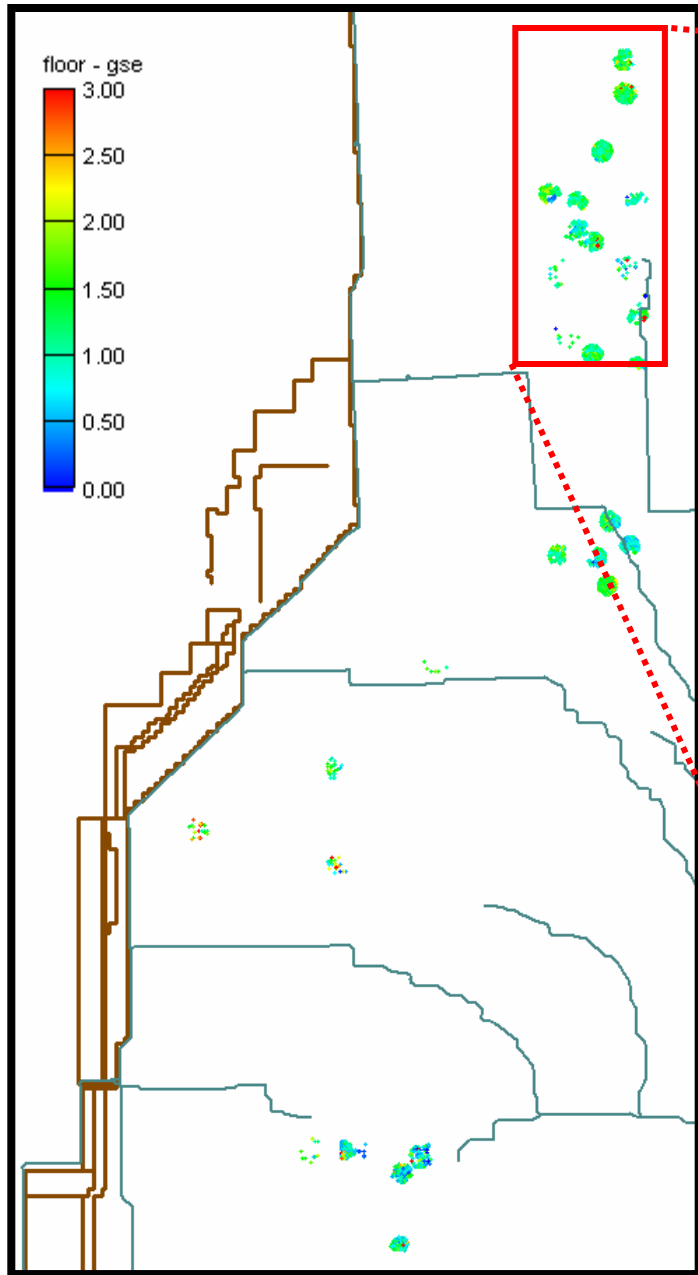
Map of flood prone areas within CSOP.

Based on data from SFWMD (call-ins, After Action Reports, etc.)

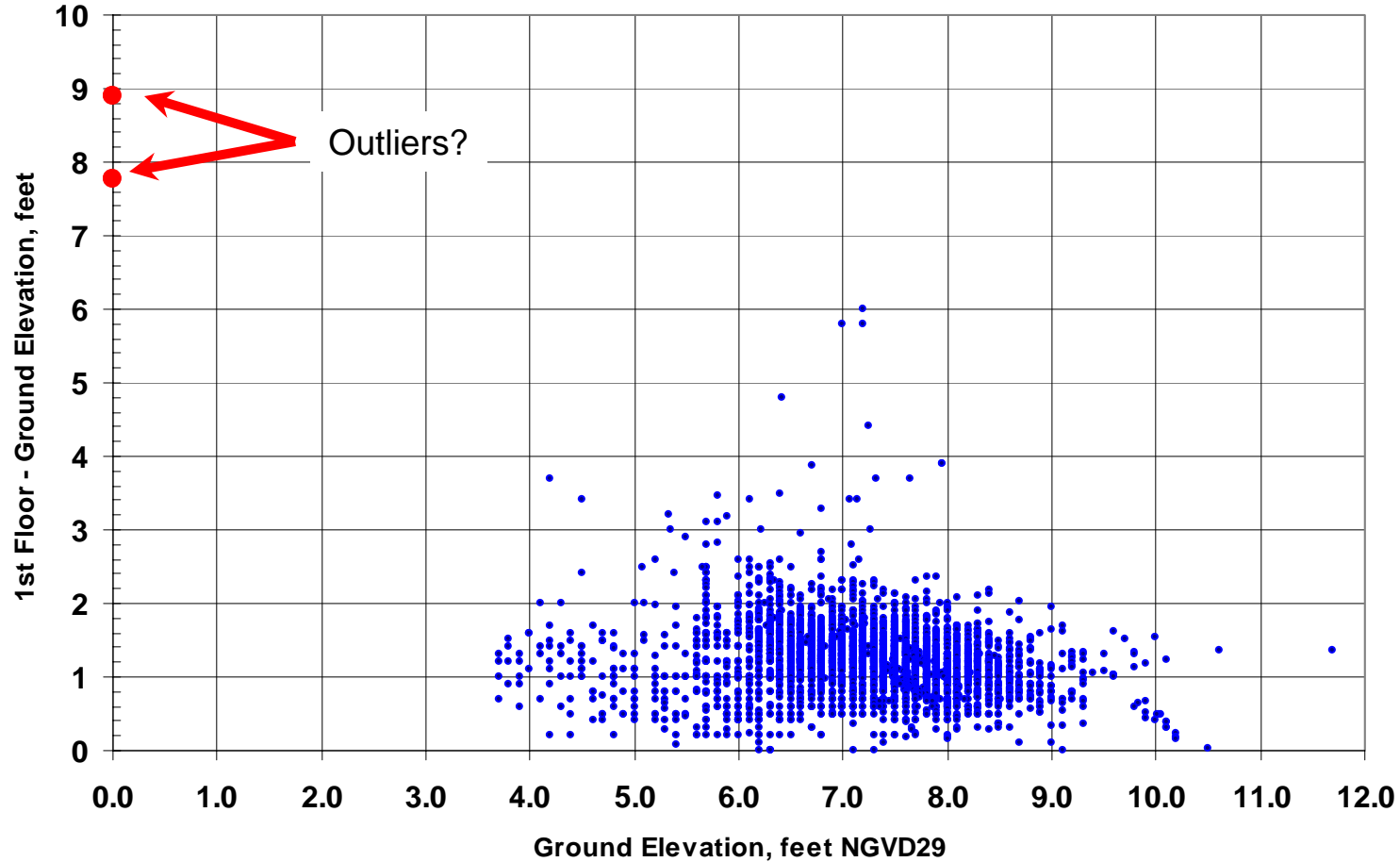
-  CSOP Study Area
-  Flood Prone Areas
-  Canals



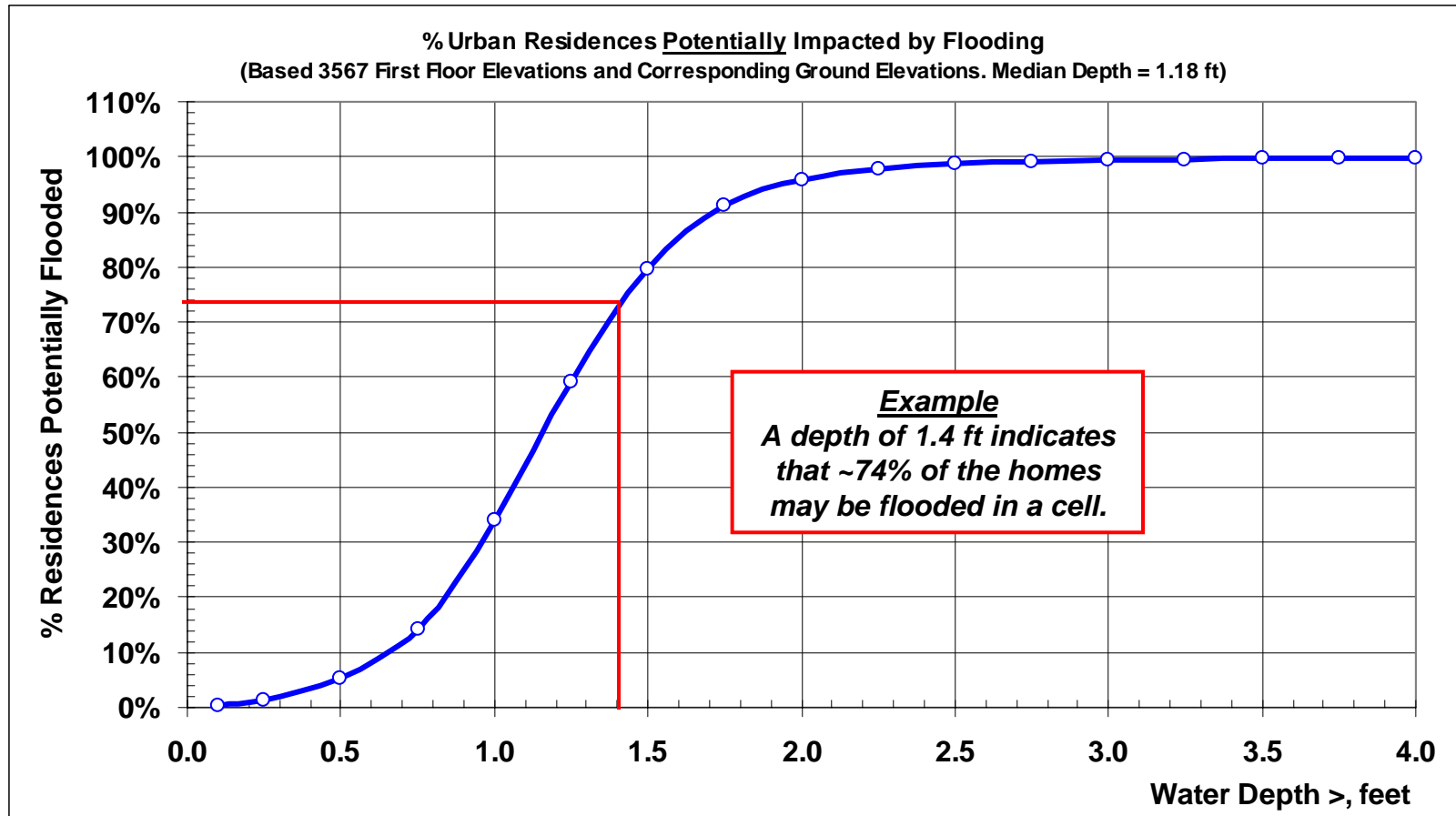
- Landuse (Level II - Urban Breakdown)
-  Urban and Built up
 -  Residential, Low Density
 -  Residential, Medium Density
 -  Residential High Density
 -  Commercial and Services
 -  Industrial
 -  Extractive
 -  Institutional
 -  Recreational
 -  Open Land



Ground Elevation and Height of 1st Floor
Based 3567 First Floor Elevations and Corresponding Ground Elevations.
Median Depth = 1.18 ft



For a given water depth, what is the potential for urban flood impacts?



The probability curve is derived from 3,567 surveyed homes.
(1st floor elevation versus corresponding ground elevation)

A parcel would be considered potentially impacted if
the peak water depth > (1st Floor elevation – local ground elevation)

2x2 Scale Issues

- One 2x2 cell (4 sq mi) can have up to 4300 parcels or as few as 1.
- In 8.5 sma, one cell has 83 parcels
- If the average stage depth in a cell is 0.1 or 0.2 ft above average ground elevation, it does not mean any parcels ARE flooded, but there is a potential for flooding.

2x2 Scale Issues *cont'd*

The following excerpts are from the CSOP Modeling Strategy Paper, regarding SFWMM limitations:

- “The two-mile by two-mile grid cells are described by a single average value for all hydrologic characteristics, including land surface elevation...”
- “Model scale is too coarse for studies/investigations that require finer detail of local hydrologic response...”
- “The coarse scale of SFWMM limits but does not discount its utility for quantifying potential flood impacts.”
- “SFWMM is not appropriate for detailed farm-scale flood analysis but is appropriate for identifying potential regional flooding impacts.”

Modbranch Scale Issues

- Cells may be 500 ft by 1000 ft (<0.02 sq mi)
- Smaller cell size with higher density can provide a stronger indication for flooding potential
- Still, above ground stage does not EQUATE to parcel flooding

Why the discussion...

- Corps Economic Flood damage analysis only on TSP
- Need to identify procedure for determining flood potential from CSOP alternatives
 - Total parcels impacted only previous PM available
- As the team develops alternative 5, we must identify the symptoms of the problem if we are to recommend a remedy (or....maybe Alts 1-4 have no problems?)
- Either model will identify areas of POTENTIAL flooding.

SFWMM Predicted Flood Impacts on Residential & Commercial Parcels

Proposed Screening Approach

- Available model output for all SFWMM cells:
 - # events with continuous stage > GSE
 - Average duration of events with cont. stage > GSE
 - Total number of days in 36-yr POR with stage > GSE
 - Peak stage
 - Number of commercial and residential parcels
- The 1994 GRR is the criteria (USACE) for flood protection (outside of 8.5 SMA), but what parameters should be compared to see if alternatives meet criteria?

CSOP Performance Measure for Flooding

The initial PM for flooding was a simple binary operation:

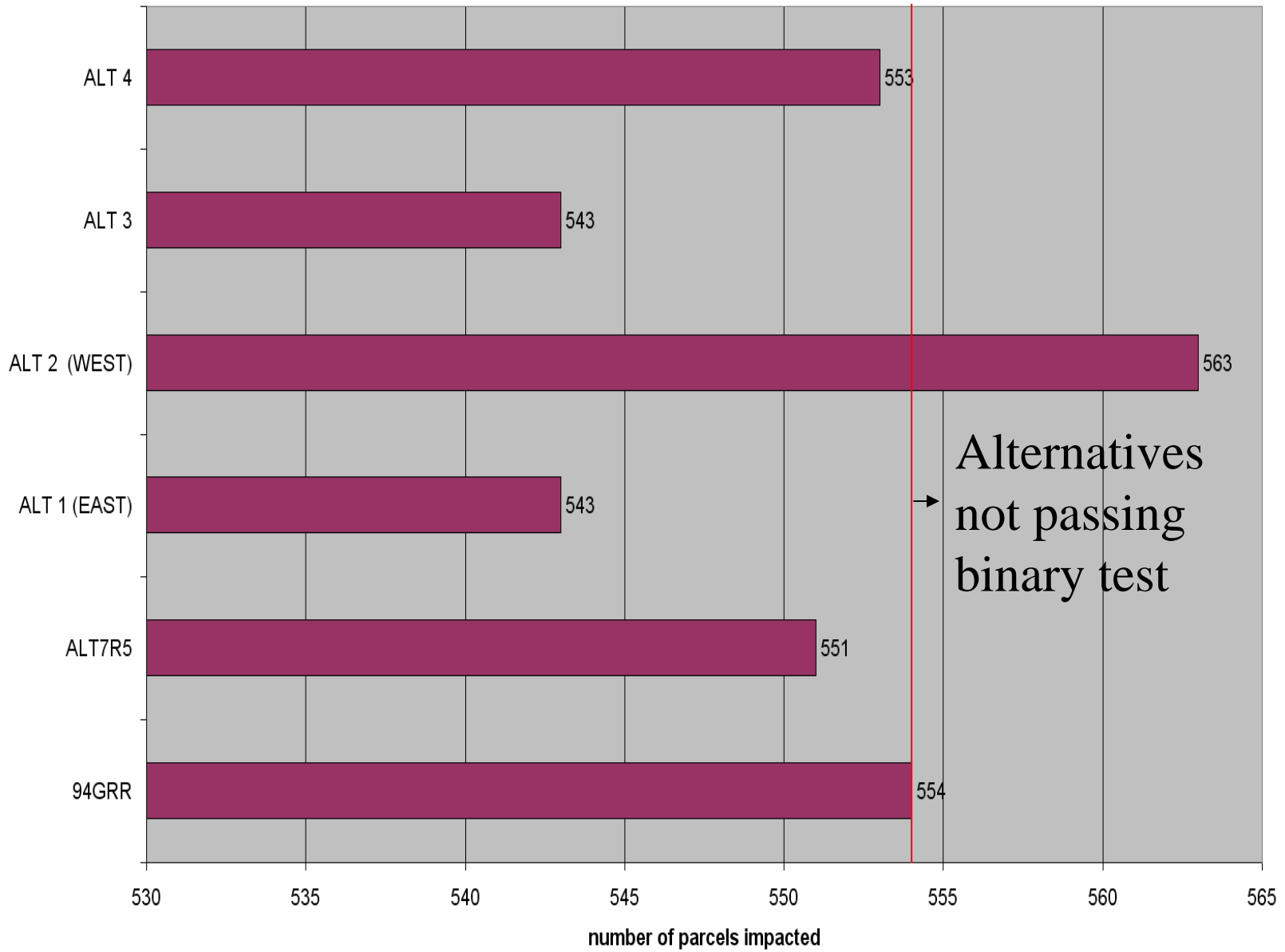
If the water stage is greater than the ground elevation, then there is flooding.

If the water stage is less than the ground elevation, there is no flooding.

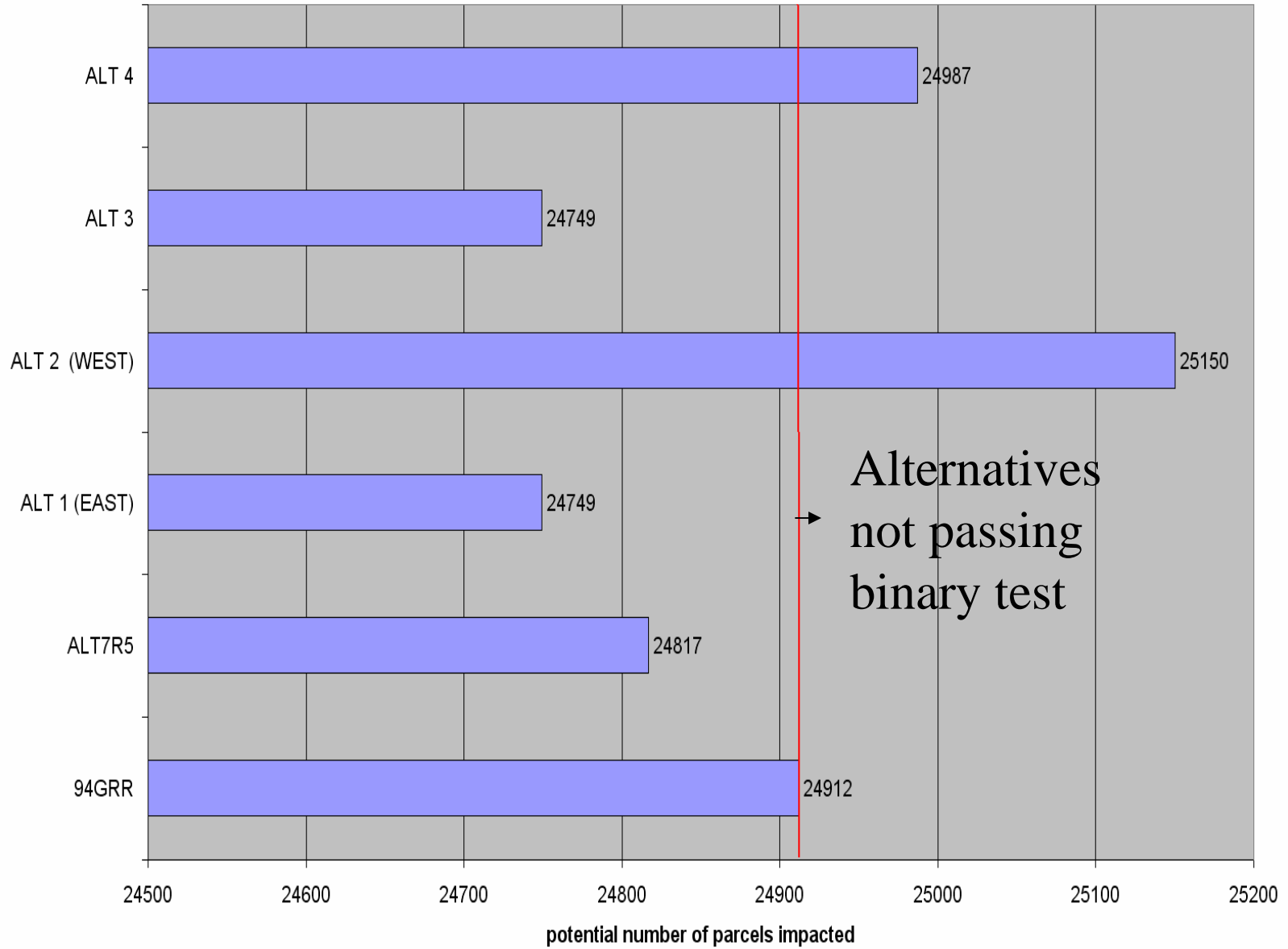
Problem: It may grossly over-predict the areas (total number of parcels) that will be affected.

This does not take into account local variations within the SFWMM cells (i.e. high ground) or local variations between ground elevations and first floor elevations.

SFWMM: Commercial Parcels with Peak Stage above GSE



SFWMM: Residential Parcels with Peak Stage above GSE



What are Flooding Indicators?

- Cell by cell: If one cell is better and another is worse, is there a net zero increase?
 - # parcels varies from cell to cell / residential vs. commercial
- Is one parcel worse off than in another alternative/GRR?
 - peak stage magnitude
 - # of times flooded in period of record (POR) ?
 - Duration of flooding: Ag. vs residential/commercial
- Peak cell stage vs. first floor elevations
- = If (Peak cell stage > ground), add parcels/cell to sum
 - Increased weight based on parcel density?
- Let's make some screening assumptions.....

Preliminary Screening Criteria

- All parcels are not impacted by stage $>$ avg. GSE
 - Screen out impacted areas if peak stage $<$ 0.25 feet
- Assume increase in total duration $>$ GSE above GRR
 - Screen out impacted areas if $\Delta t <$ 100 days (or 0.7% of POR)
- Assume if few parcels in a cell \rightarrow parcels on high ground
 - 2x2 cell = 4 sq. miles = 2560 acres
 - Screen out commercial cells with $<$ 2 parcels
 - Screen out residential cells with $<$ 50 parcels

Preliminary Screening Criteria

- Results of preliminary screening:
 - Cells potentially impacted vary with alternatives
 - Potential Commercial Impacts: 3 grid cells
 - SFWMM ROCO: 09 28; 19, 27; 22, 27
 - Locations: C-111 spreader, G-211, east of S-356
 - Potential Residential Impacts: 4 grid cells
 - SFWMM ROCO: 14 25; 15, 25; 18, 26; 19, 27
 - Locations: L-31S, 8.5 SMA, G-211
 - Note: Preliminary screening leaves only 6 cells potentially impacted by any of the CSOP alternatives + GRR
 - Secondary screening to incorporate peak depth differences and CSOP survey data for parcel first-floor elevations

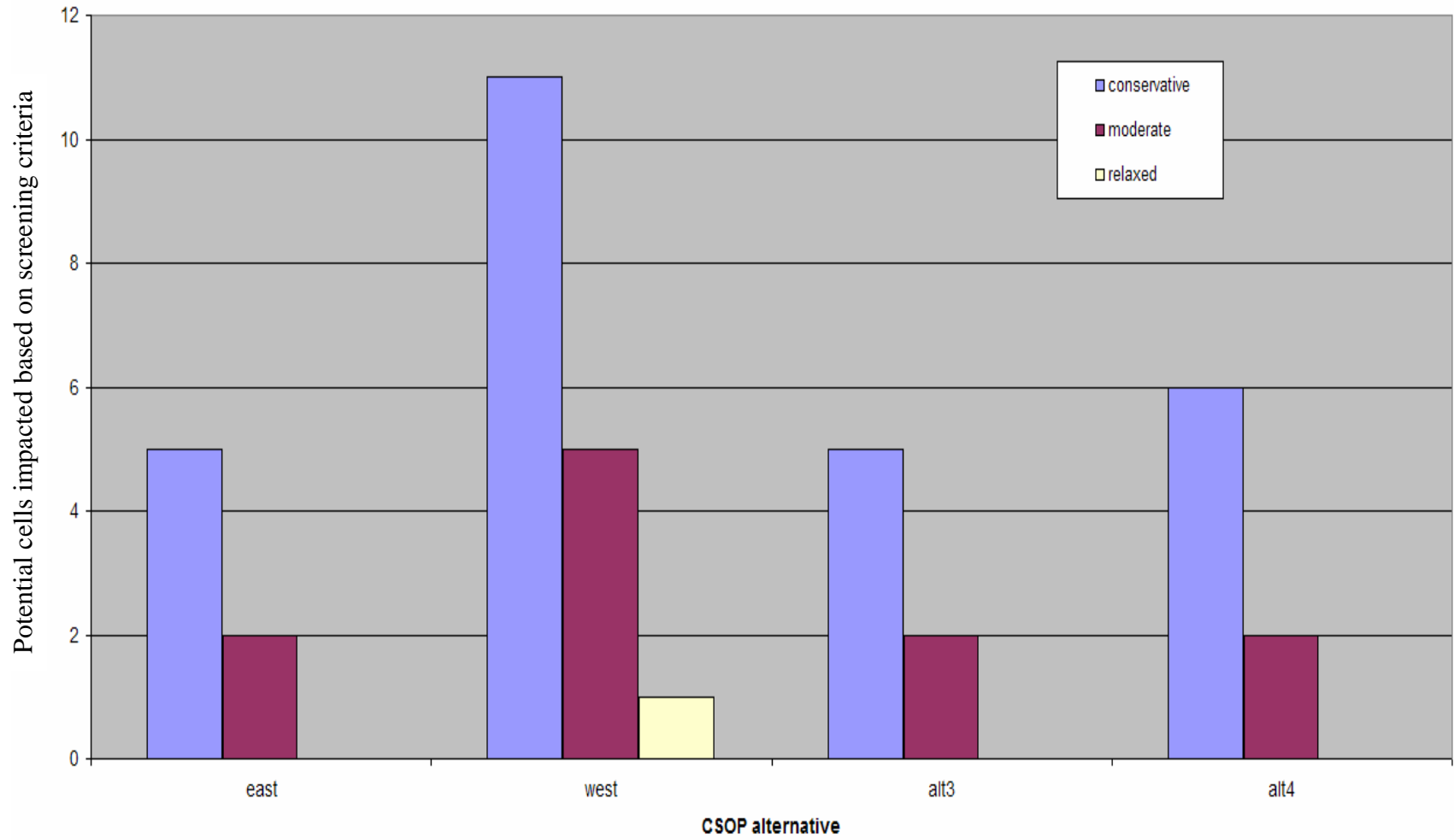
Sensitivity of Screening Criteria

- Conservative screening criteria:
 - Screen out impacted areas if peak stage < 0.10 feet
 - Screen out impacted areas if $\Delta t < 50$ days
 - Screen out commercial cells with < 2 parcels
 - Screen out residential cells with < 50 parcels

Sensitivity of Screening Criteria

- Relaxed screening criteria:
 - Screen out impacted areas if peak stage < 0.50 feet
 - Screen out impacted areas if $\Delta t < 150$ days
 - Screen out commercial cells with < 5 parcels
 - Screen out residential cells with < 100 parcels

Screening for Potential Urban Flood Impacts



Screening sensitivity: east bookend

Conservative:	Proposed screening:	Relaxed:
926	928	no cells
928	2227	
1026		
2027		
2227		

Screening sensitivity: west bookend

Conservative:

926

1325

1425

1525

1626

1725

1826

1927

2027

2028

2227

Proposed screening:

1425

1525

1826

1927

2227

Relaxed:

1525

Screening sensitivity: alternative 3

Conservative:	Proposed screening:	Relaxed:
926	928	no cels
928	2227	
1026		
1725		
2227		

Screening sensitivity: alternative 4

Conservative:	Proposed screening:	Relaxed:
926	928	no cells
928	2227	
1026		
1725		
2027		
2227		

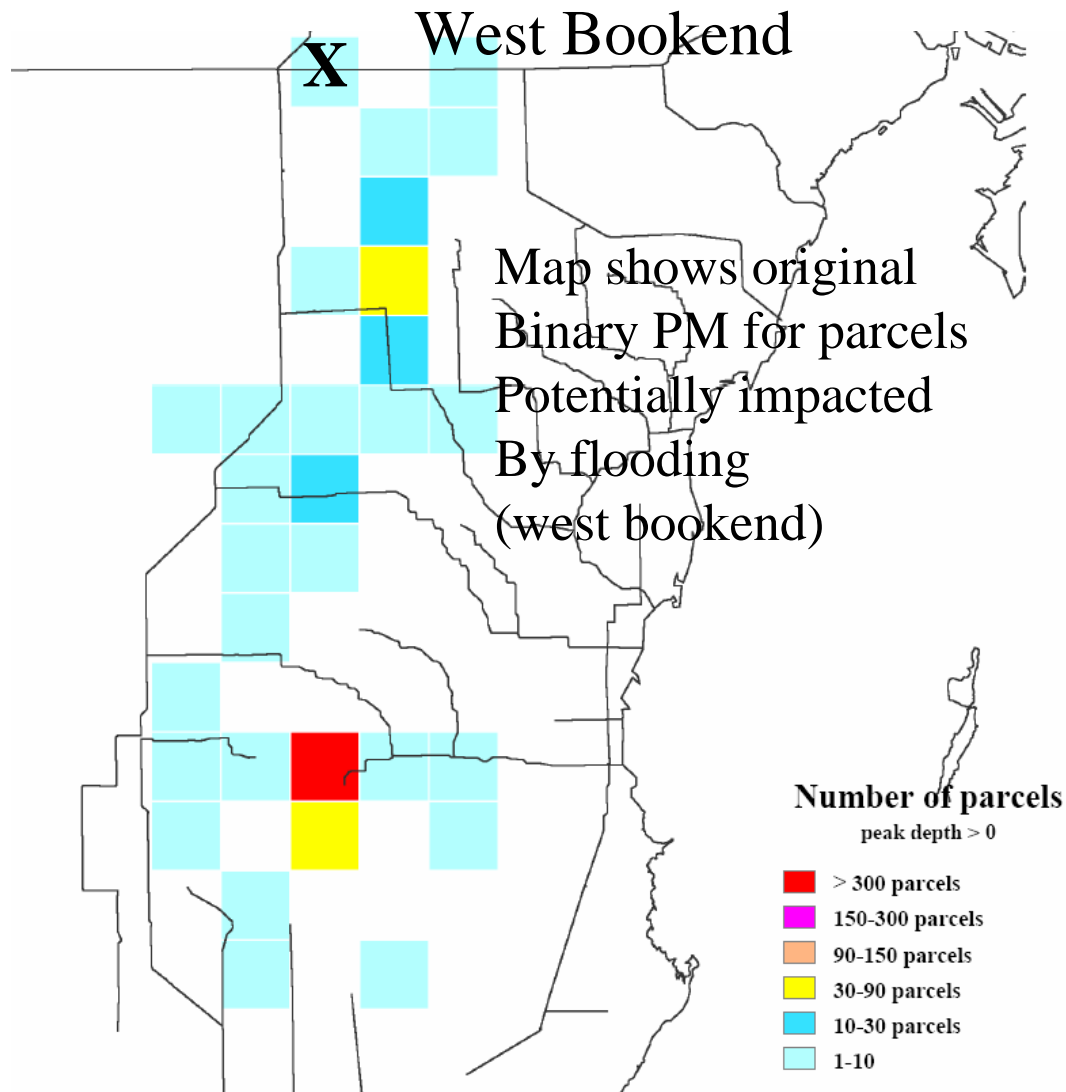
Secondary Screening Criteria

- Utilizing first-floor elevation data collected for CSOP:
 - Start with the screened down list of potential impact areas
 - Percentage of parcels with potential flooding is a function of water depth (peak stage): previously shown
 - Peak stages in each screened cell can be associated with a percentage of parcels impacted by potential first-floor flooding
 - 2 commercial parcels, peak stage 1.03 ft → 37% potential impacts
 - Multiply this percentage by the number of parcels in the cell to estimate the number of parcels potentially impacted by flooding in that cell
 - for above example, 0.7 parcels likely impacted
 - Compute for alternatives and GRR

Secondary Screening Criteria

- Commercial Flooding Potential:
 - Number of parcels > 1
 - Number of parcels $> \text{GRR}$
- Residential Flooding Potential:
 - Number of parcels > 1
 - Number of parcels $> \text{GRR}$
- To tune in to key problem areas

Flooding Potential: Screened Commercial Parcels



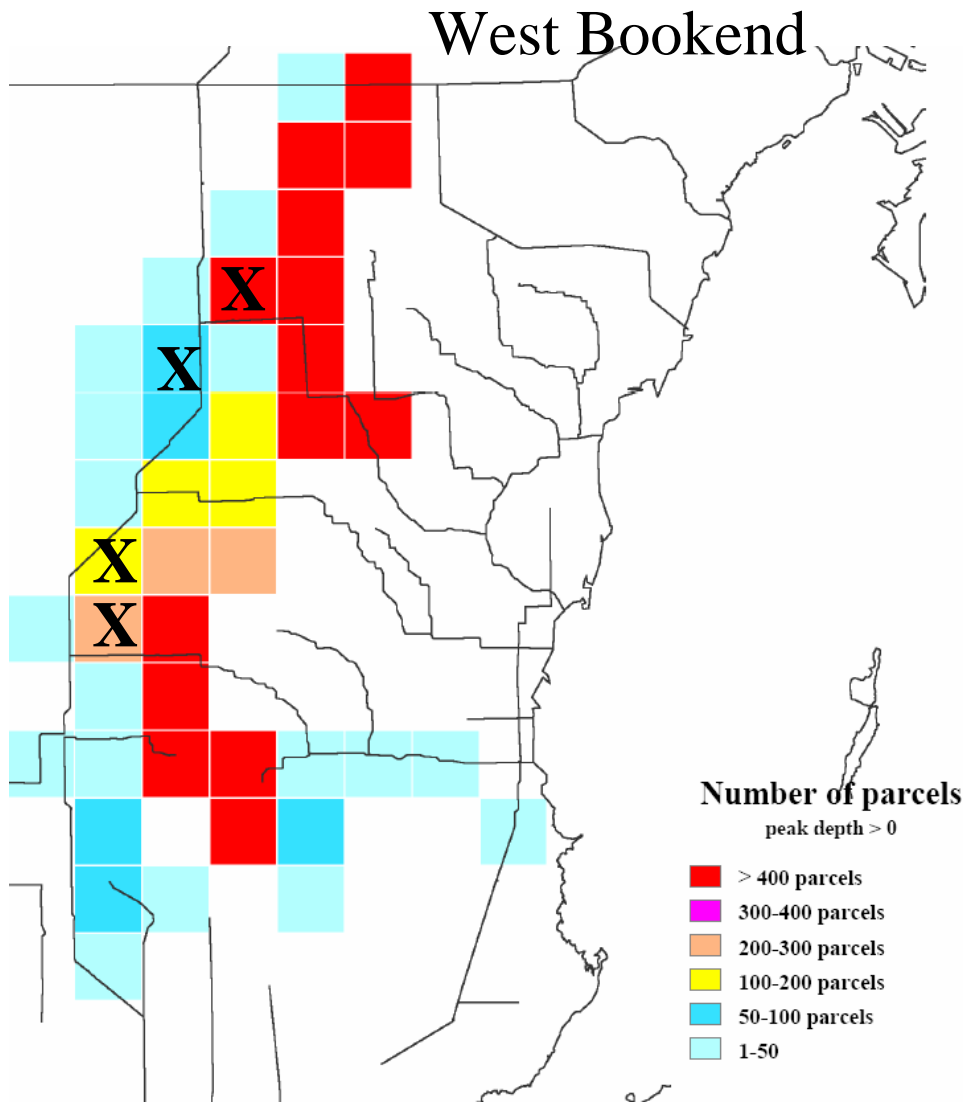
Probability for flood potential less than 1994 GRR based on screening approach:

1. East Bookend
2. Alternative 3
3. Alternative 4

West bookend probability greater than 1994 GRR:

- "X" marks the spot

Flooding Potential: Screened Residential Parcels



Probability for flood potential less than 1994 GRR based on screening approach:

1. East Bookend
2. Alternative 3
3. Alternative 4

West bookend probability greater than 1994 GRR:

- "X" marks the spot

Screening Results.....

- The screening approach provides the CSOP team with specific areas of potential flooding area under a given set of operations, dictated by the alternative.....
- Screening criteria were selected based on engineering judgement, with no knowledge of the the outcome
- Screening criteria are in a spreadsheet environment and sensitivity has been tested
 - Similar analysis to be repeated for IOP ops (ALT7R5)

Where do we go from here?

- SFWMM offers a regional perspective on flooding potential
- MODBRANCH: finer resolution provides a stronger indication for flooding potential

MODBRANCH Potential Flood Impacts on Residential & Commercial Parcels

CSOP Performance Measure for Flooding

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If the water stage is greater than the ground elevation, then there is flooding.

If the water stage is less than the ground elevation, there is no flooding.

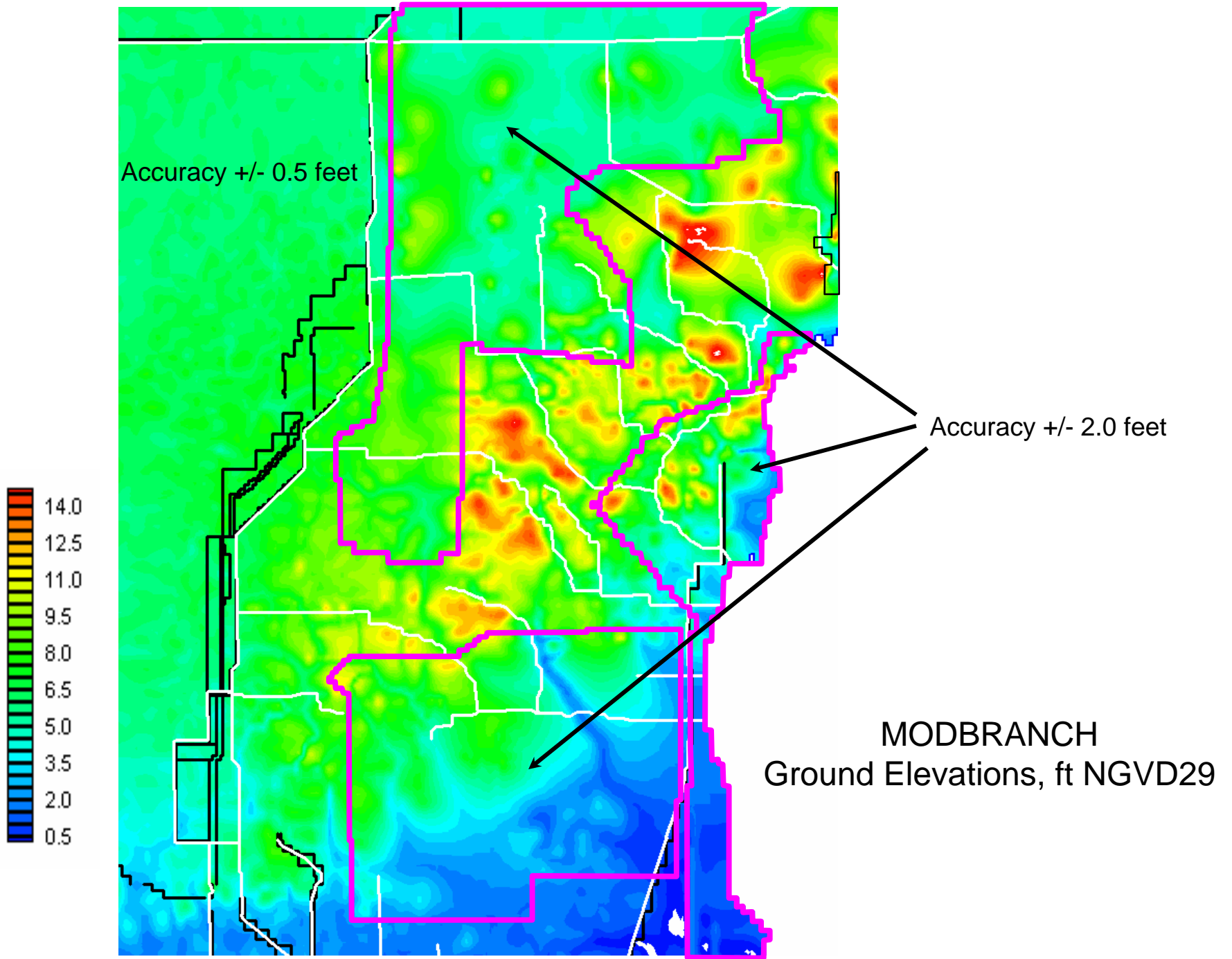
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This does not take into account local variations within the SFWMM cells or local variations between ground elevations and first floor elevations.

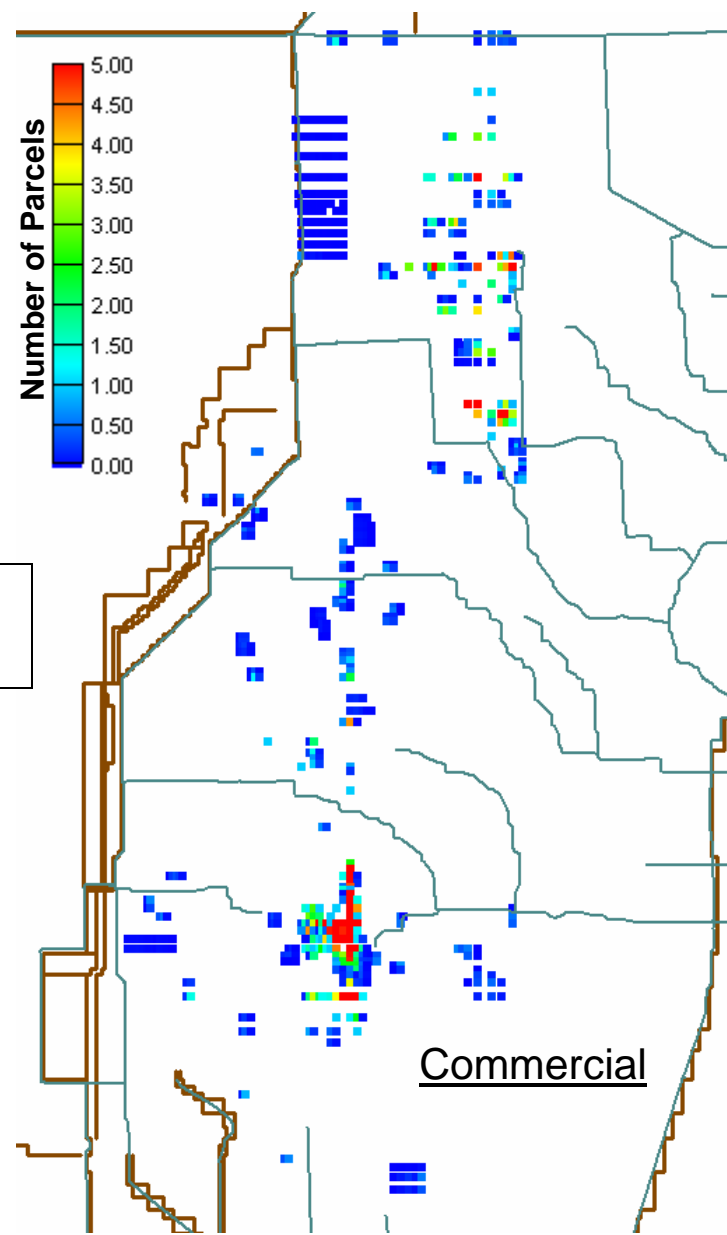
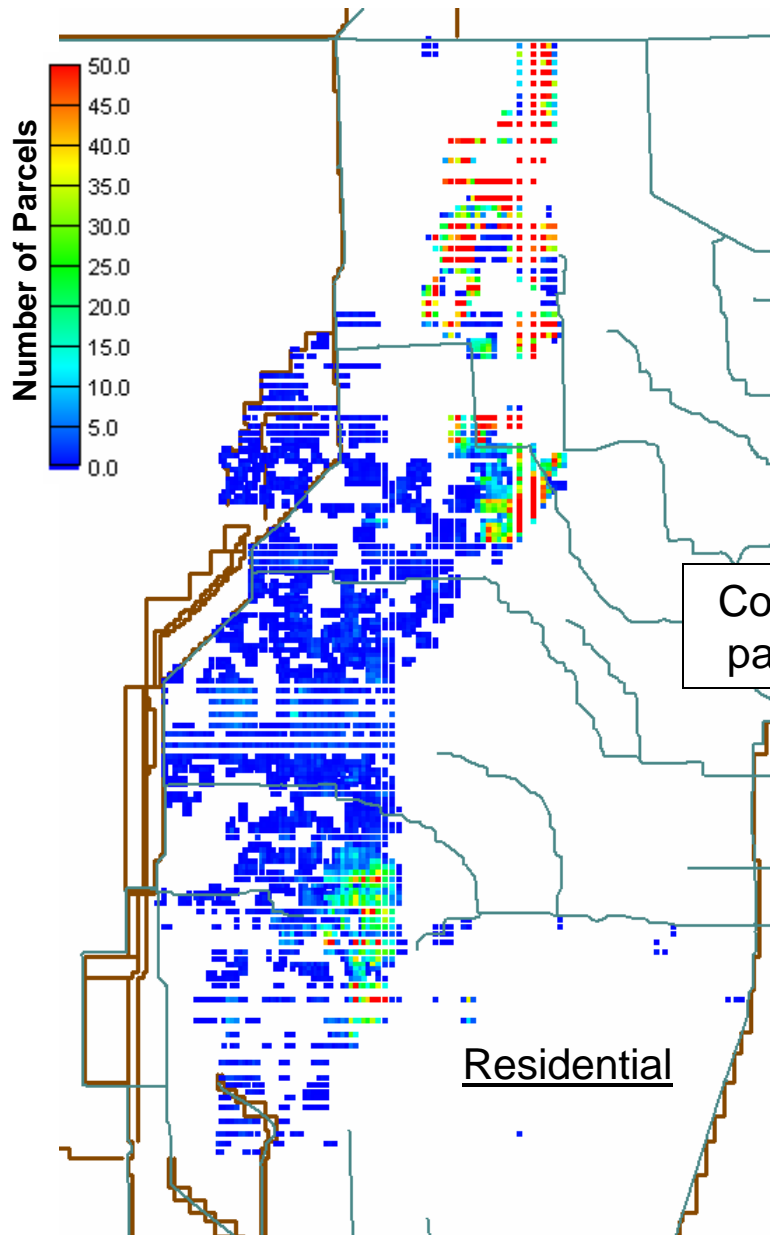
Proposed CSOP Performance Measure for Screening of Flooding Potential

The proposed PM will compare the different simulations by:

- 1- Determining the peak depth of water within a cell.
- 2- Comparing the peak depth to an established relationship between urban flood potential and water depth.
- 3- Multiplying the urban flood potential by the number of parcels in the cell to establish the potential number of urban parcels impacted within that cell.
- 4- Total the potential number of urban parcels impacted for a specific scenario.



Number of Residential and Commercial Parcels referenced to MODBRANCH Cells



Color indicates parcel density

Residential

Commercial

Original CSOP Performance Measure for Flooding Potential

The original PM would compare the different simulations by:

1- determining if a cell was “wet” (stage > g.s.e) or “dry” (stage < g.s.e.).


2- If a cell is “wet”, then add the number of parcels in that cell to the total number of parcels considered to be “flooded”.

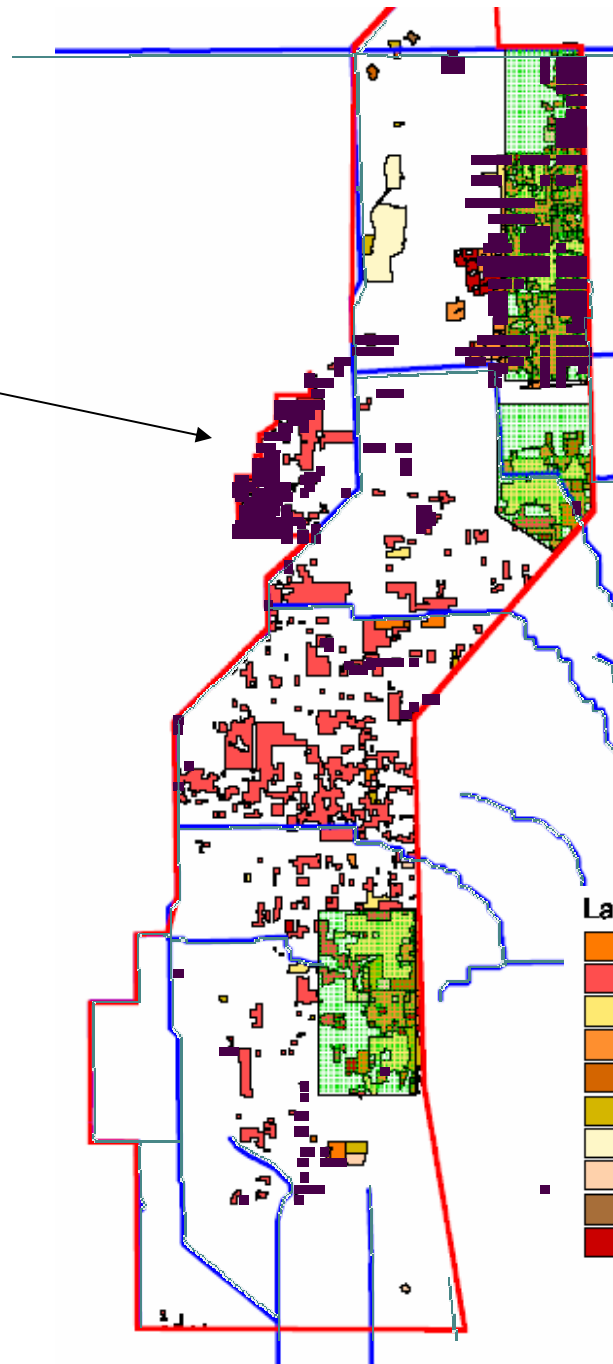
This criteria would most likely over-predict flooding impacts










Alternative 4 (1995)
Locations affected by peak stage.

Map of flood prone areas within CSOP.

Based on data from SFWMD (call-ins,
After Action Reports, etc.)

-  CSOP Study Area
-  Flood Prone Areas
-  Canals

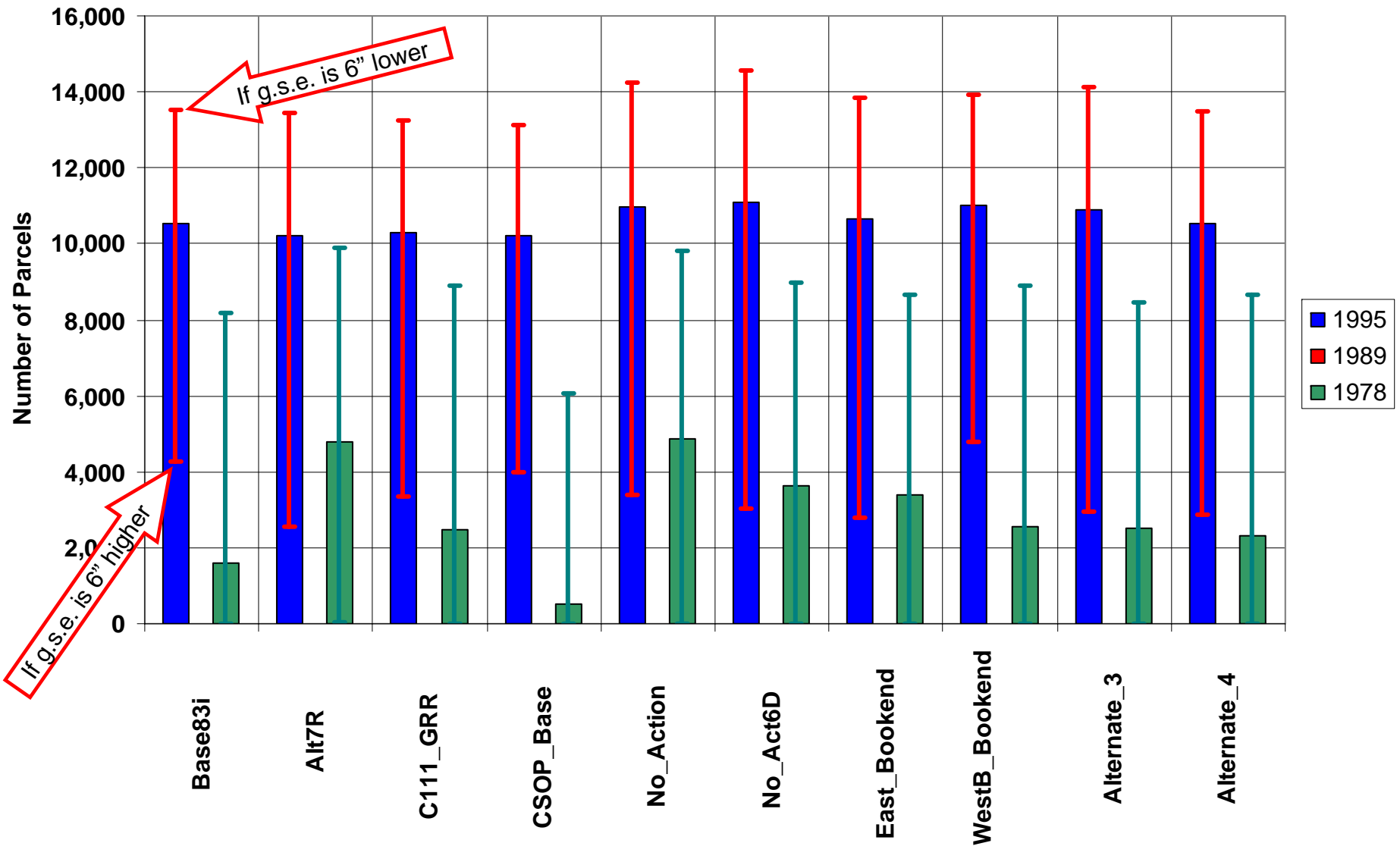


- Landuse (Level II - Urban Breakdown)
-  Urban and Built up
 -  Residential, Low Density
 -  Residential, Medium Density
 -  Residential High Density
 -  Commercial and Services
 -  Industrial
 -  Extractive
 -  Institutional
 -  Recreational
 -  Open Land

Results from original PM that "might" have a flood .

Number of Residential Parcels Impacted by Peak Stage

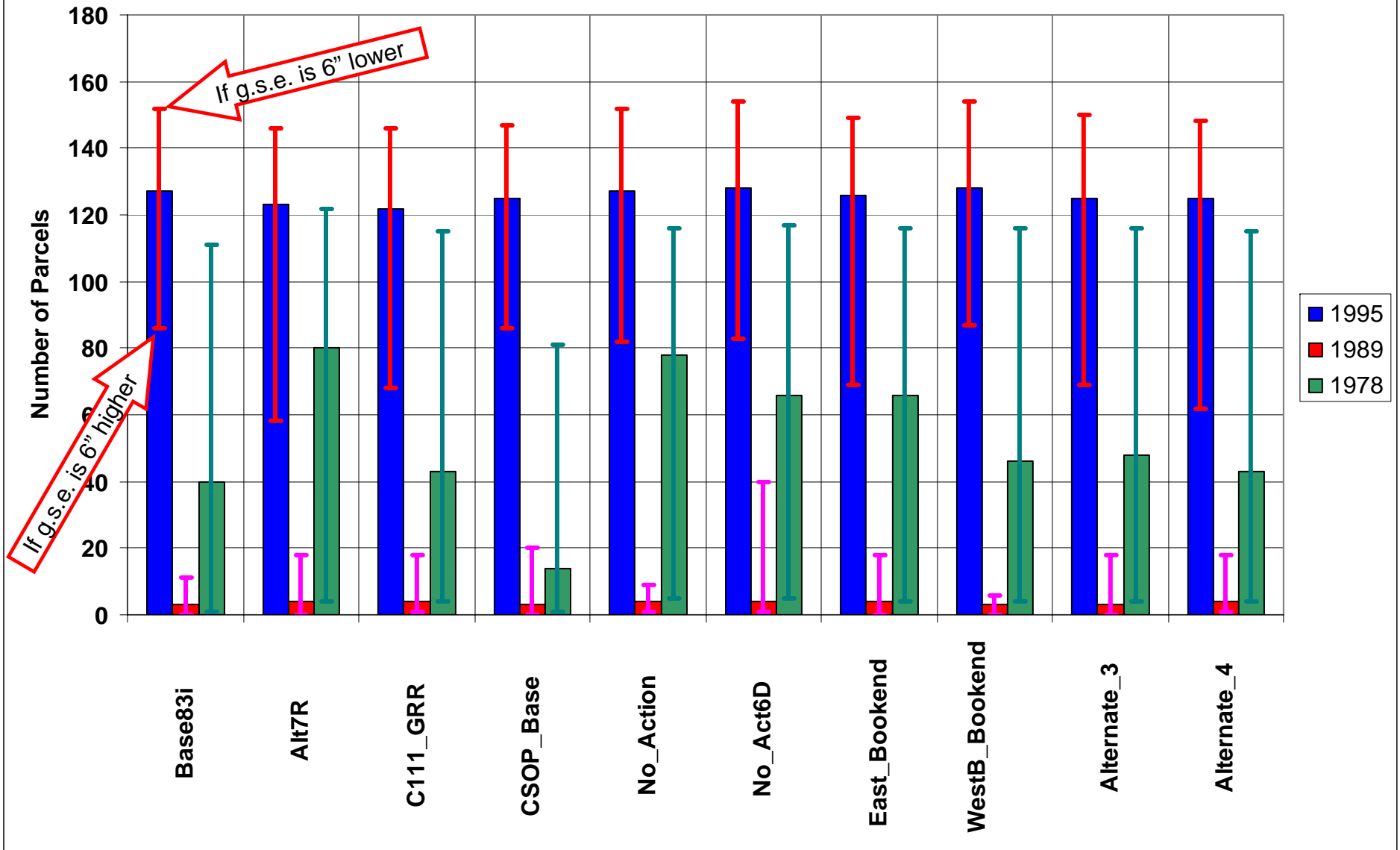
(error bars indicate range of impacted parcels if ground elevations vary +/- 6 inches)



Results from original PM that "might" have a flood.

Number of Commercial Parcels Impacted by Peak Stage

(error bars indicate range of impacted parcels if ground elevations vary +/- 6 inches)

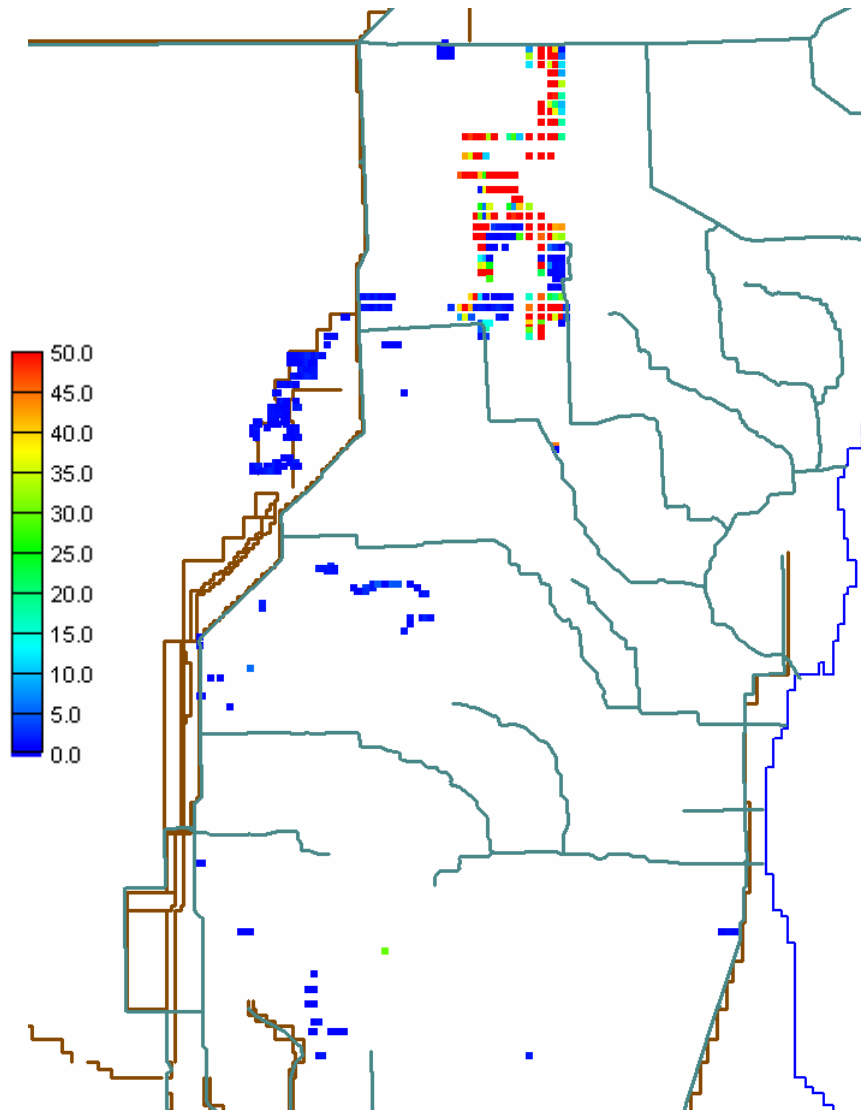


The old CSOP flooding performance measure indicates:

Approximately 34% of the Residential Parcels are potentially flooded in 1995.

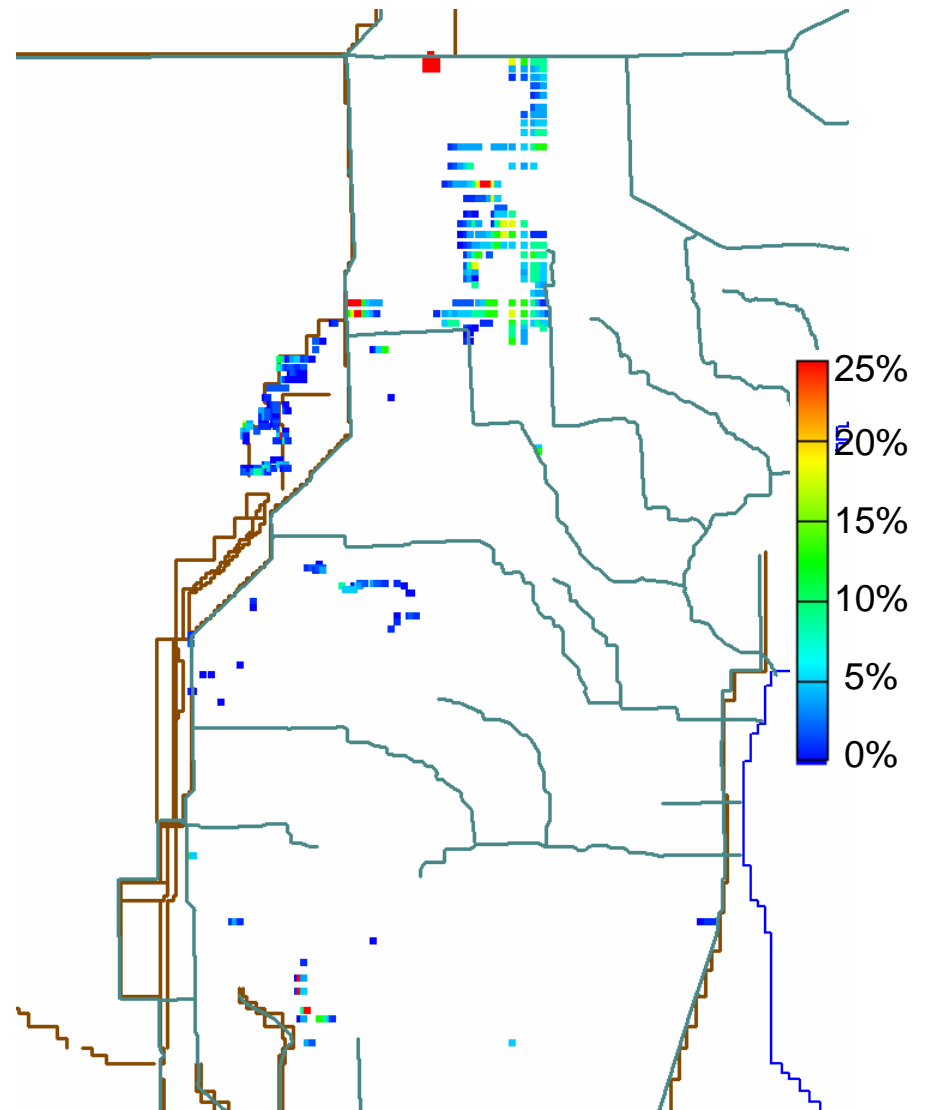
Approximately 18% of the Commercial Parcels are potentially flooded in 1995.

Potential Number of Parcels Impacted



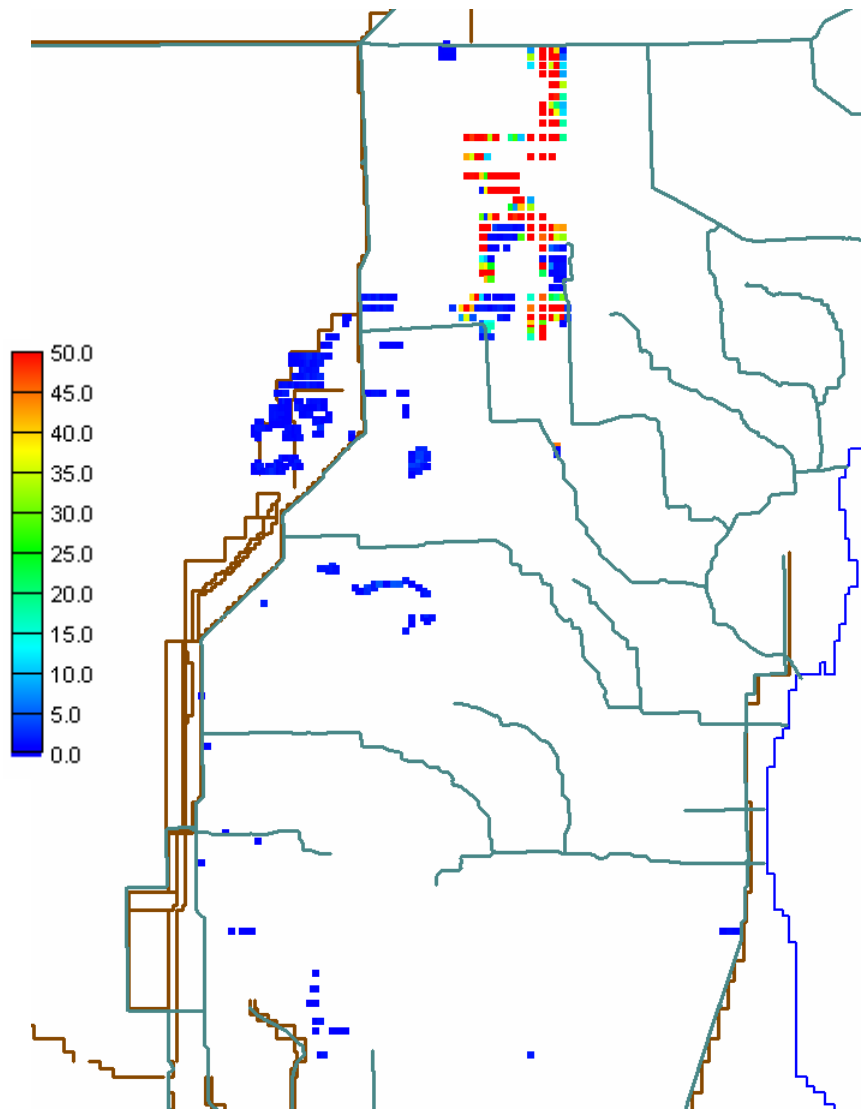
Alt7R

Potential for urban flood impacts



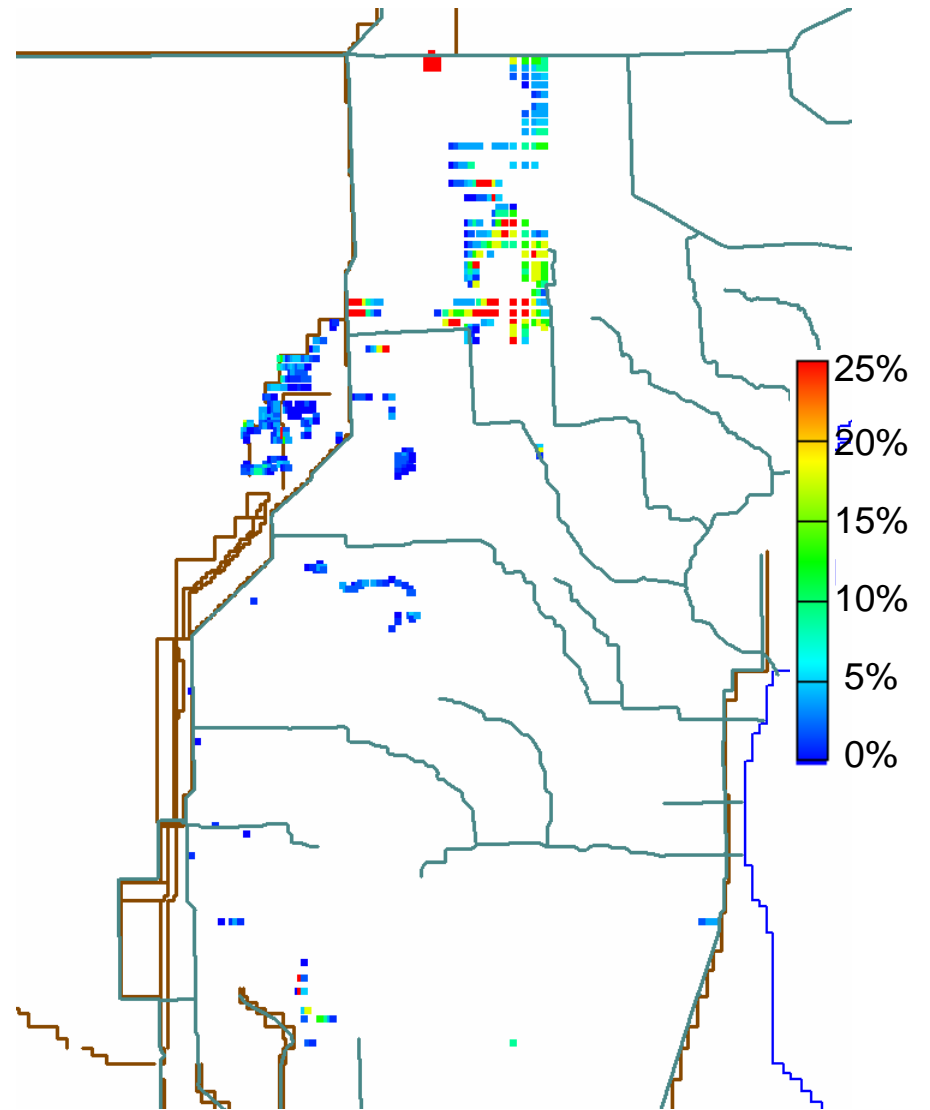
1995 Results

Potential Number of Parcels Impacted



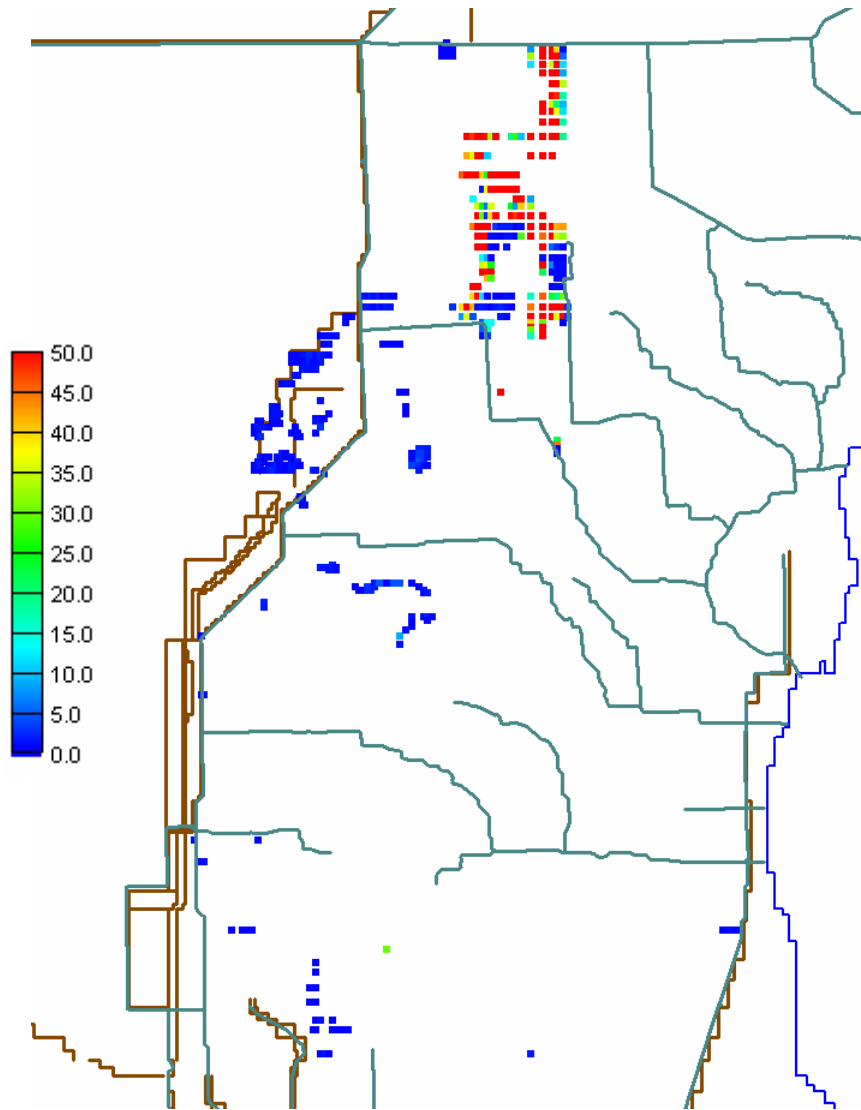
CSOP Base

Potential for urban flood impacts



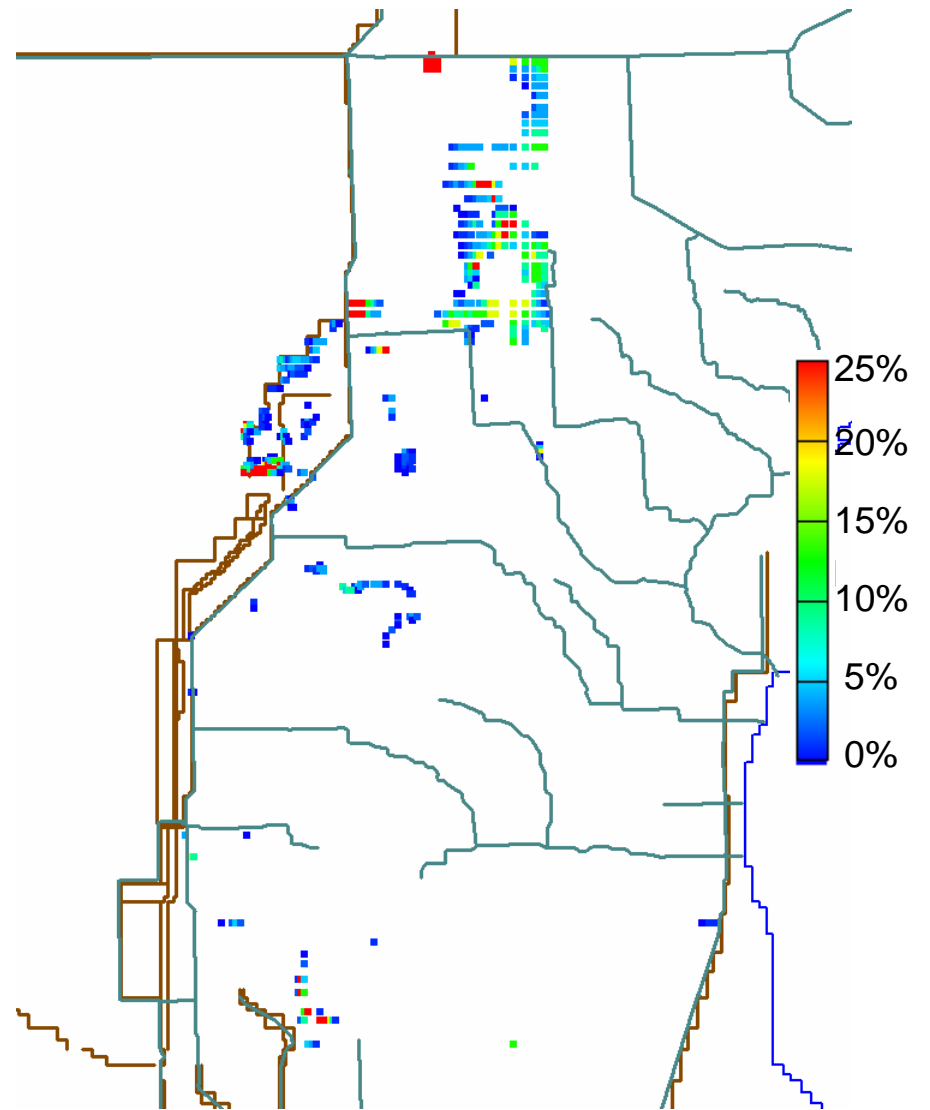
1995 Results

Potential Number of Parcels Impacted



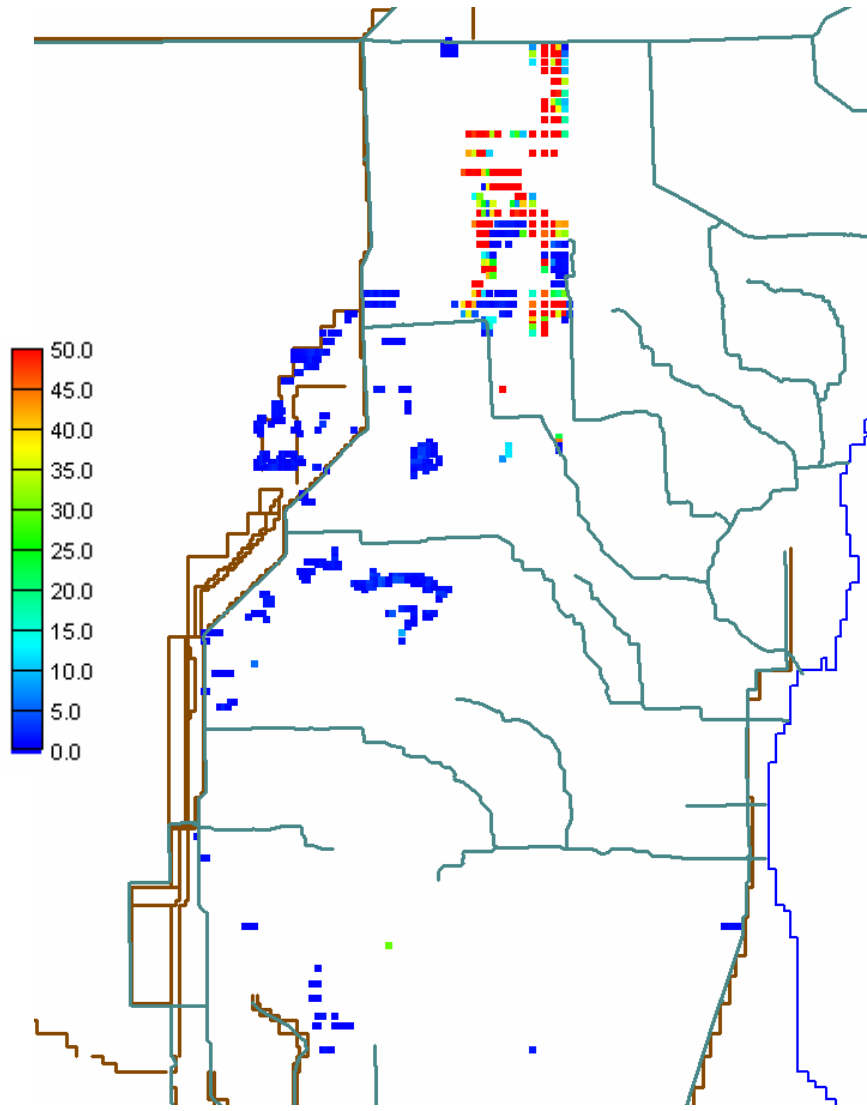
No Action

Potential for urban flood impacts



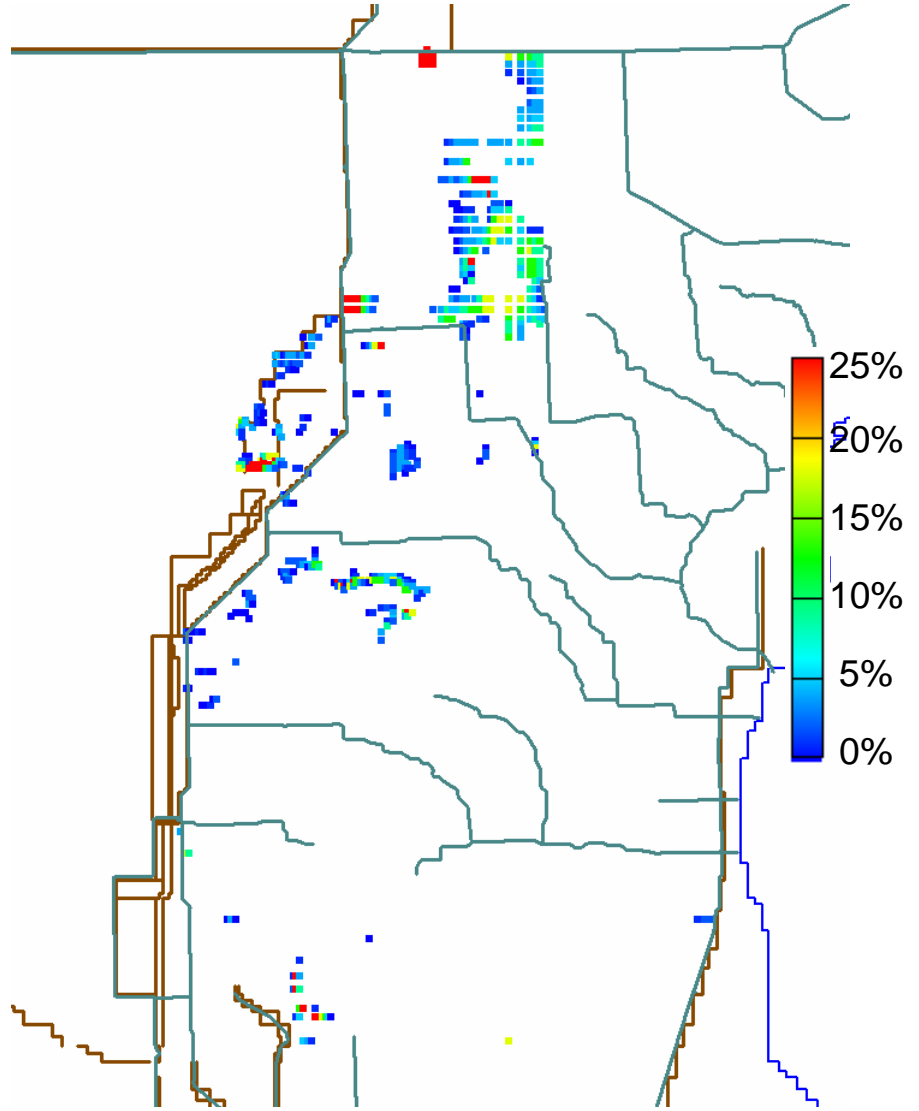
1995 Results

Potential Number of Parcels Impacted



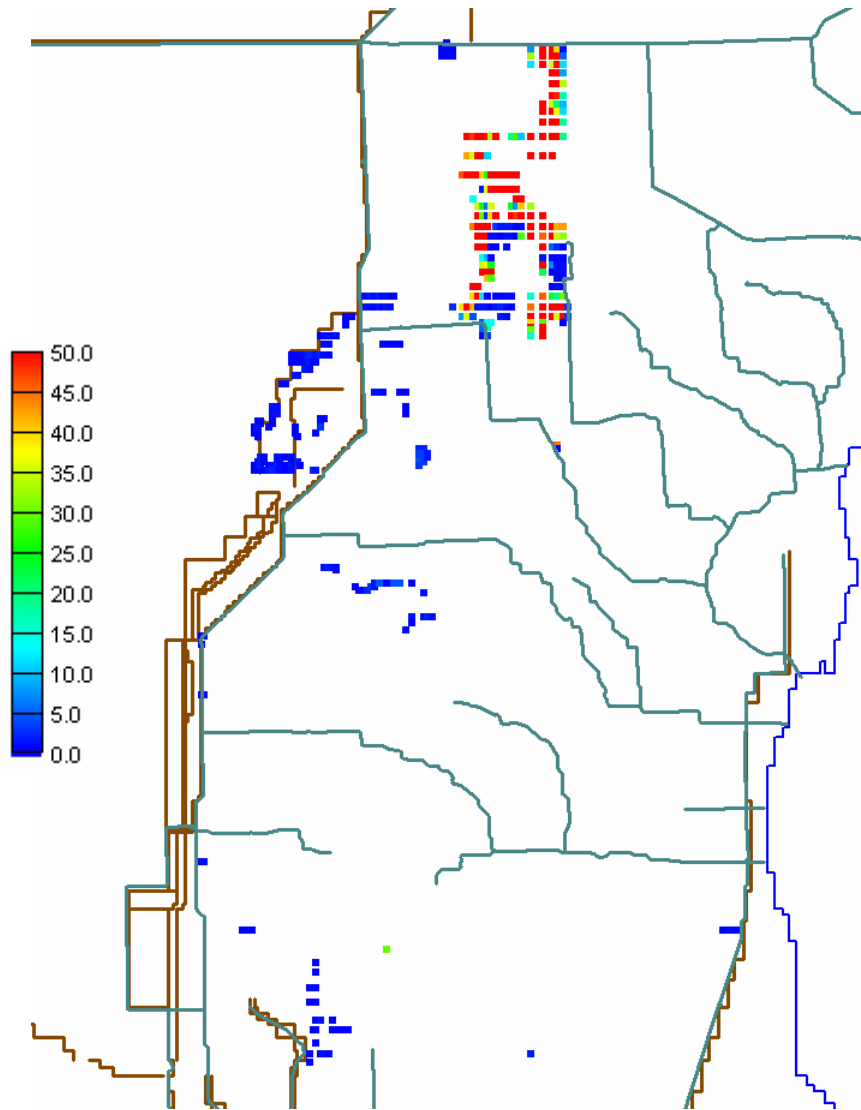
No Action 6D

Potential for urban flood impacts



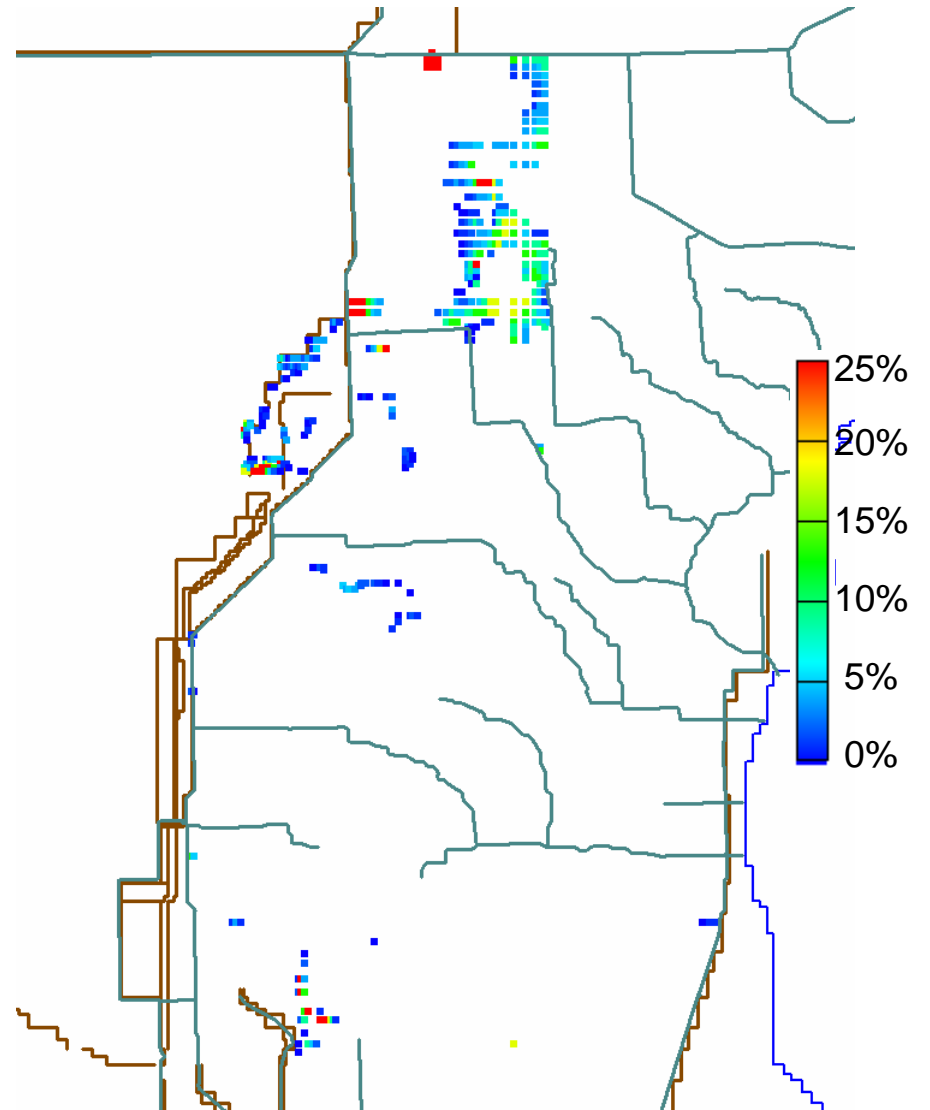
1995 Results

Potential Number of Parcels Impacted



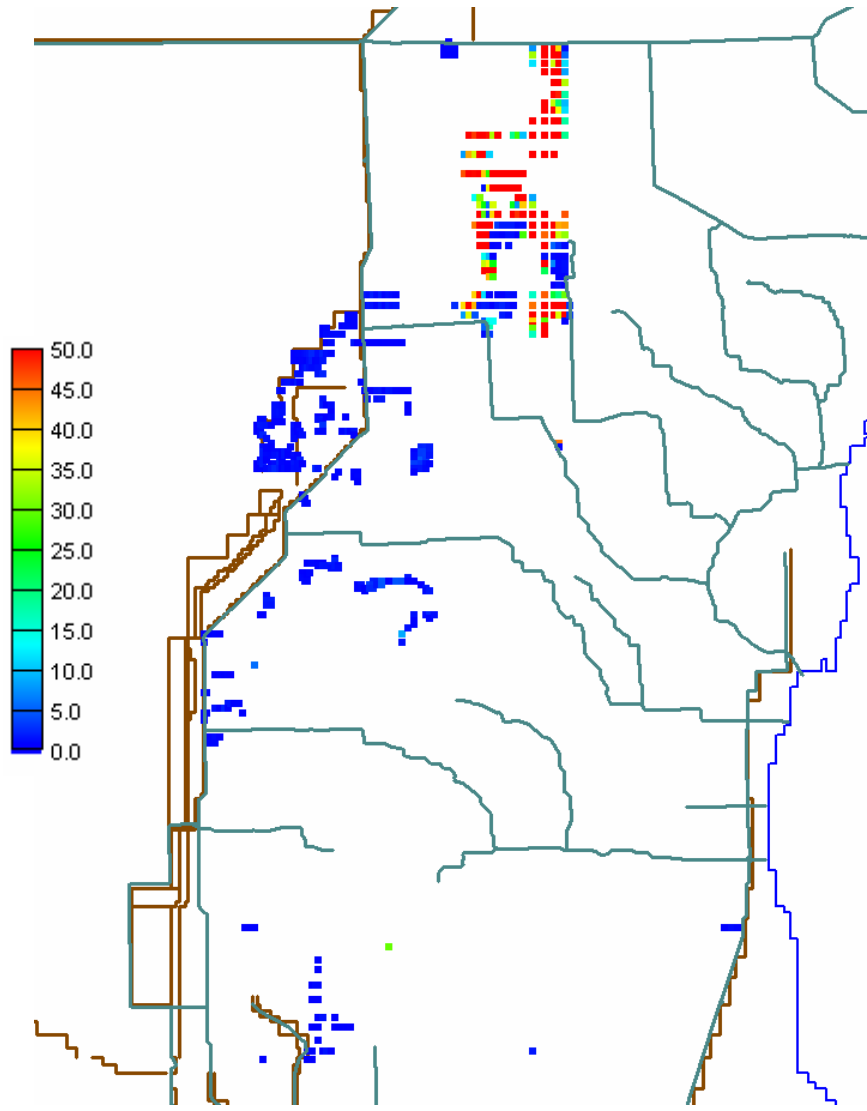
East Bookend

Potential for urban flood impacts

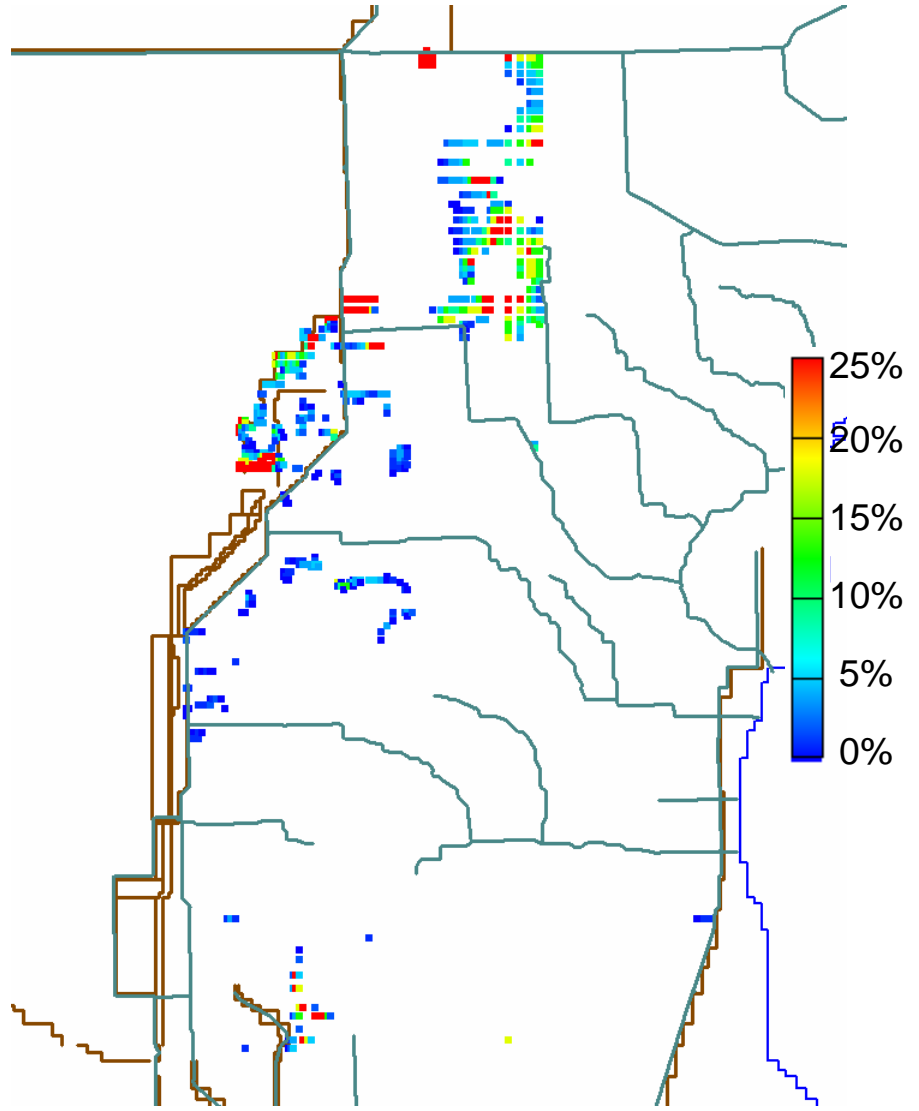


1995 Results

Potential Number of Parcels Impacted



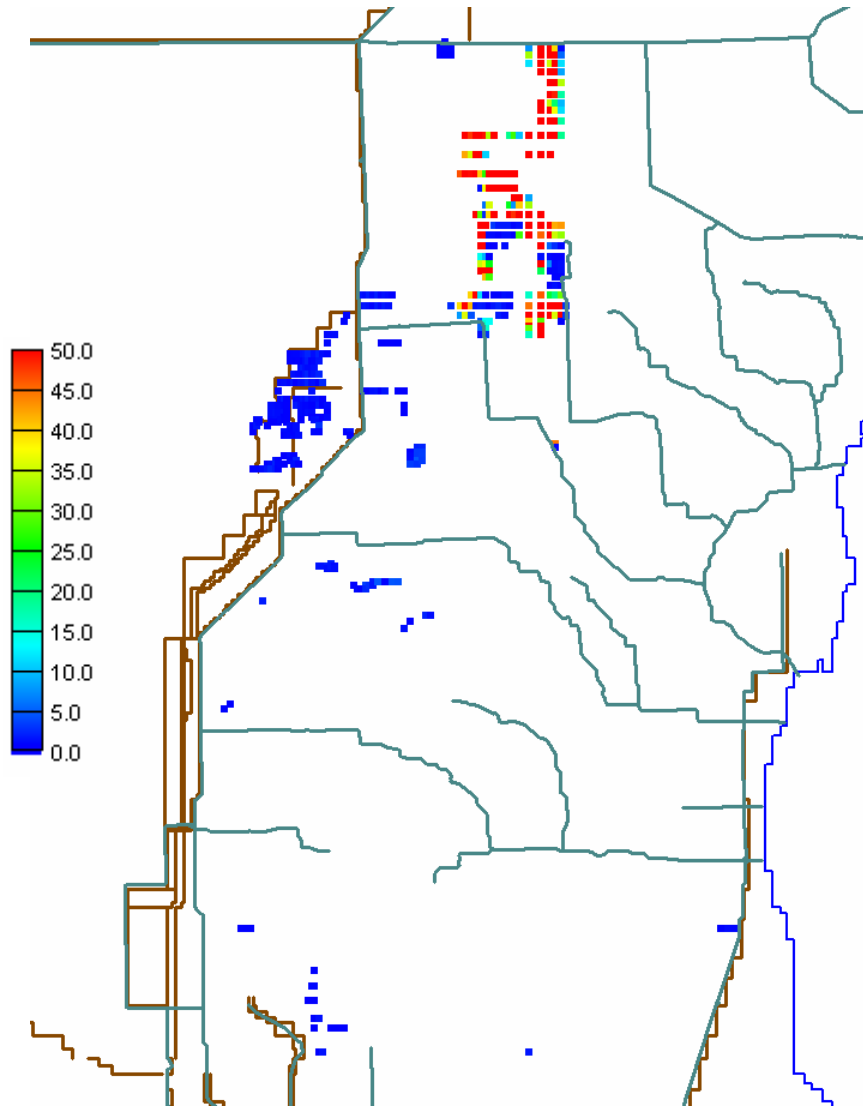
Potential for urban flood impacts



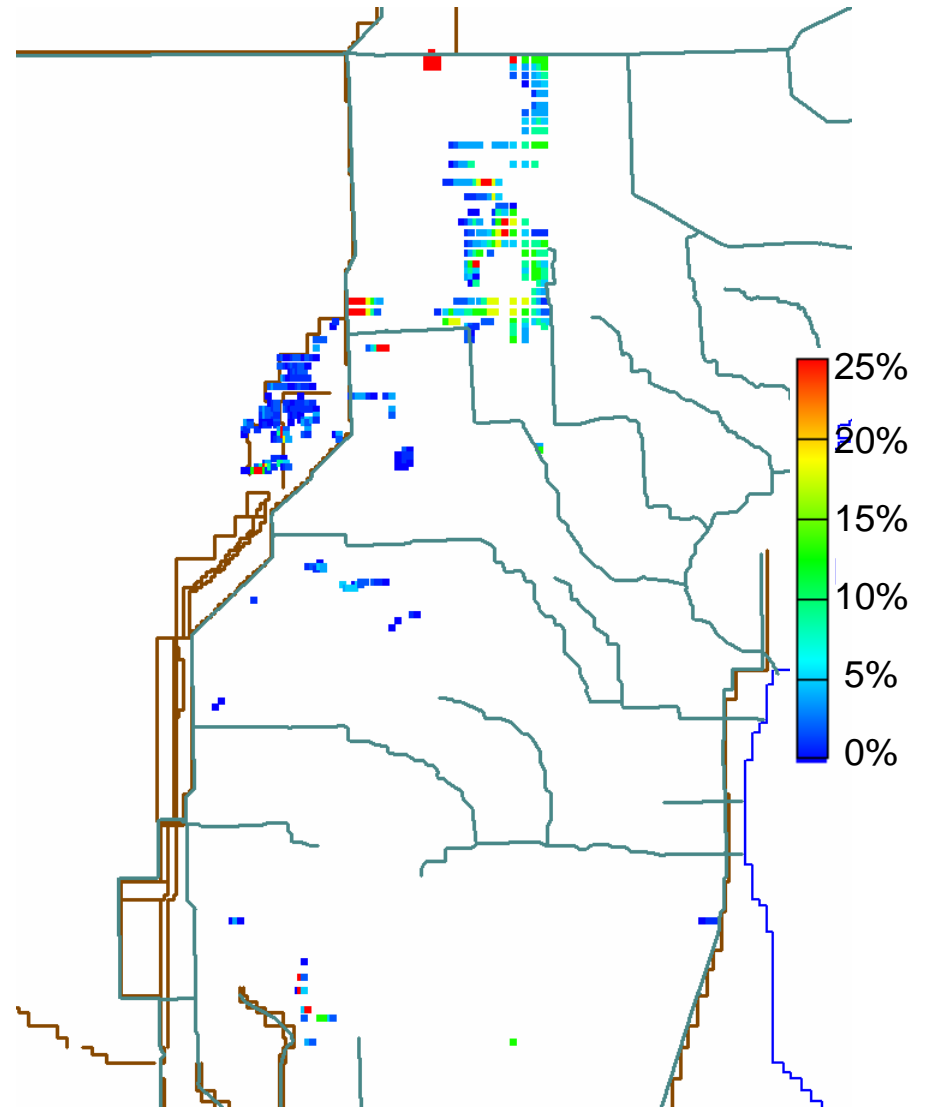
WestB Bookend

1995 Results

Potential Number of Parcels Impacted



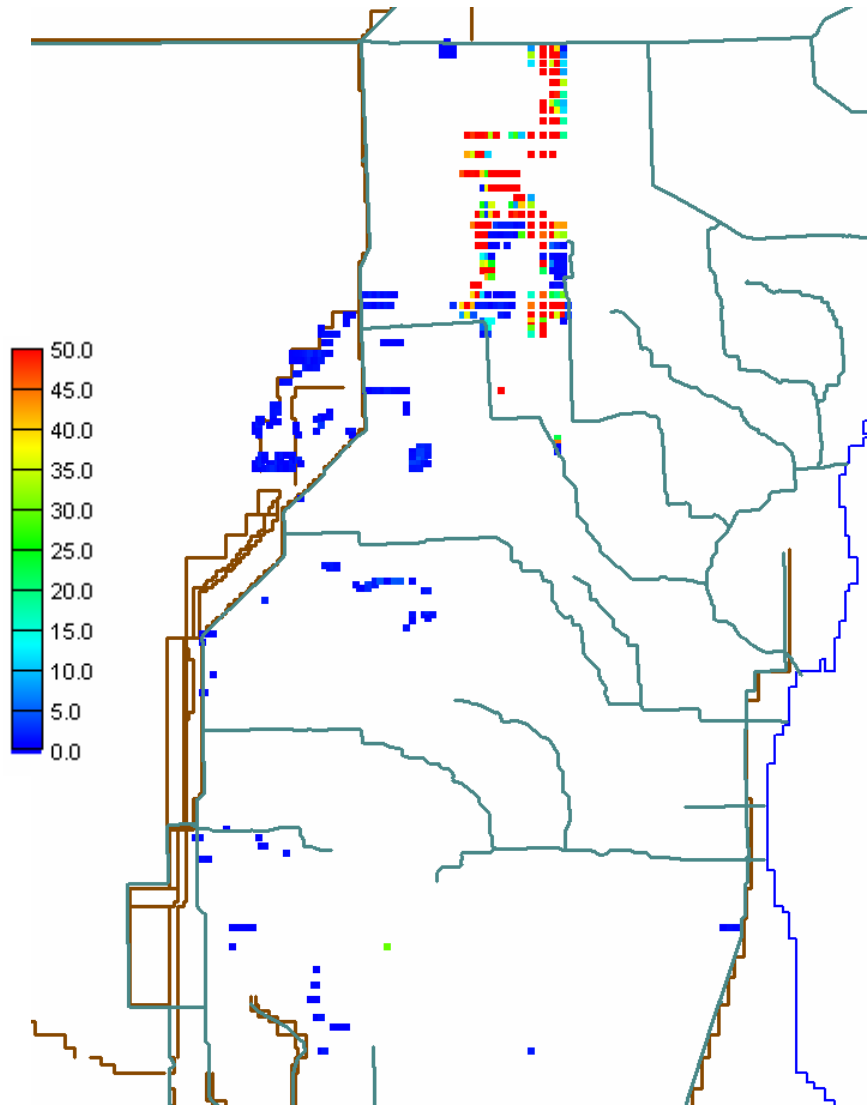
Potential for urban flood impacts



1994 C111 GRR

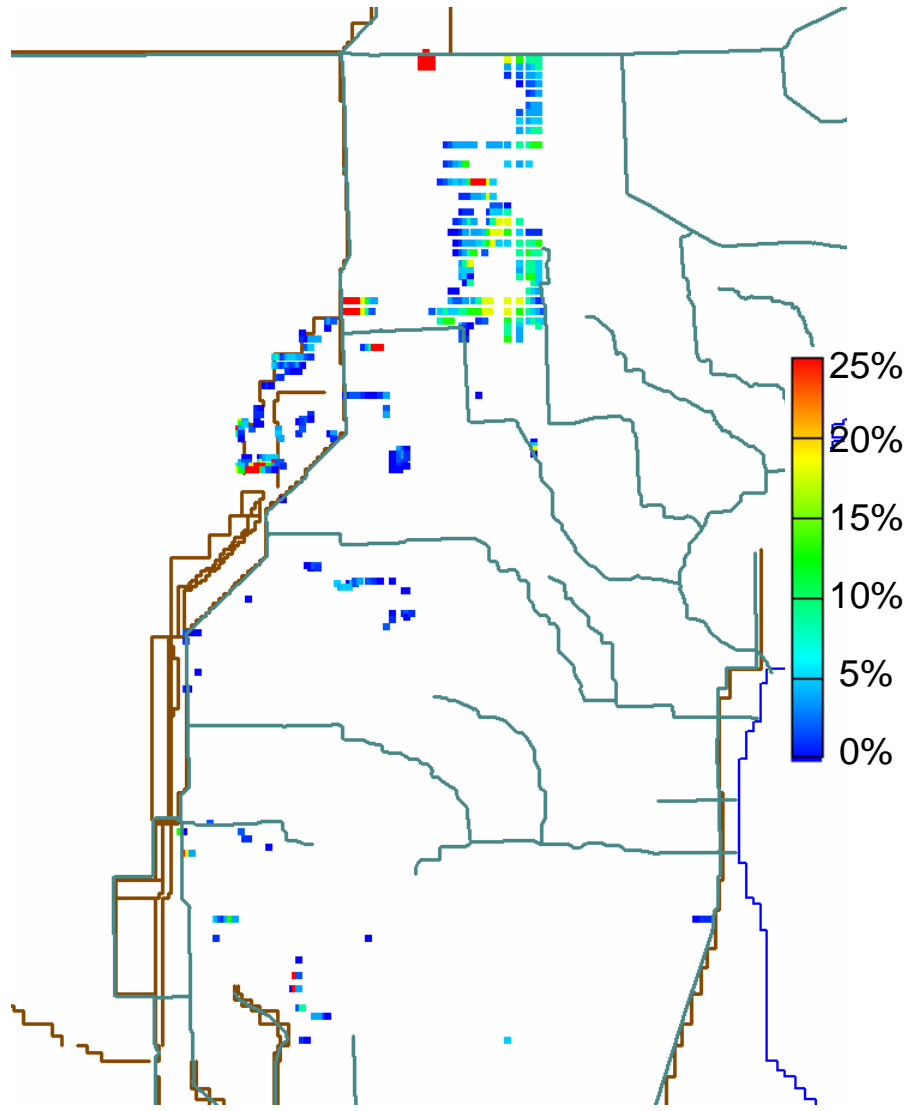
1995 Results

Potential Number of Parcels Impacted



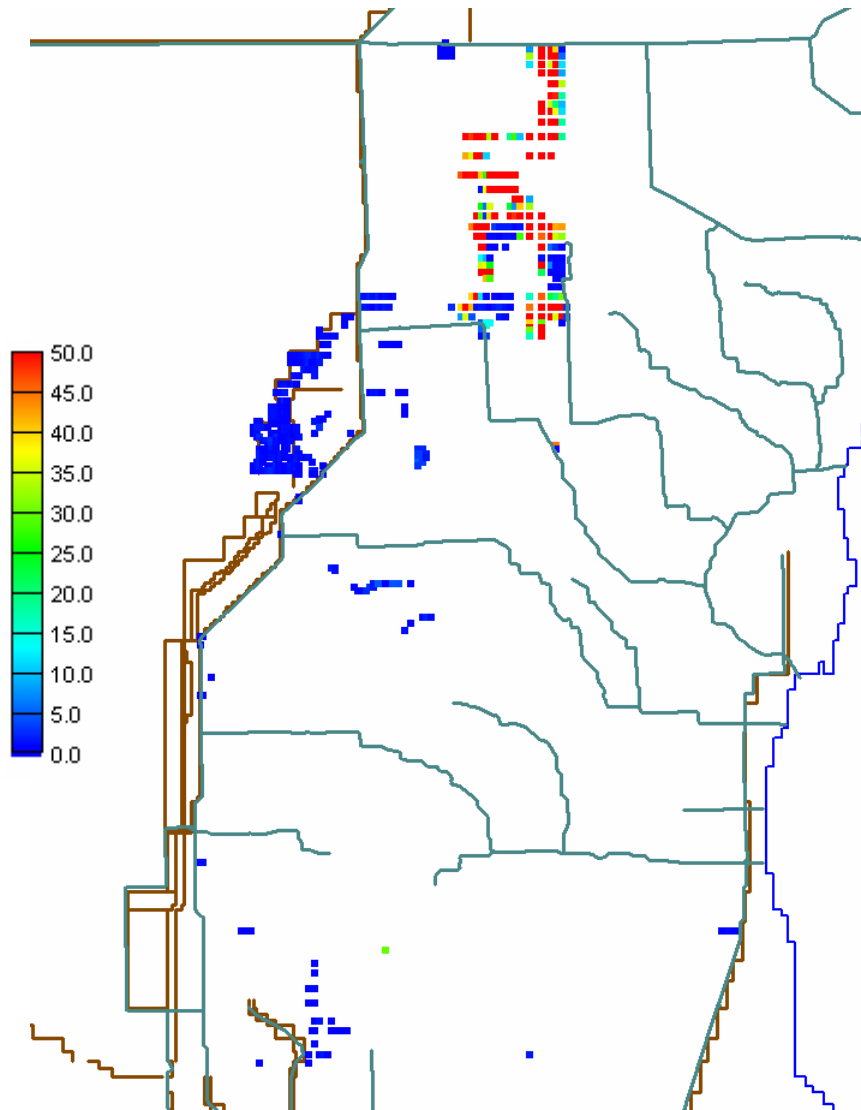
Alternative 3

Potential for urban flood impacts



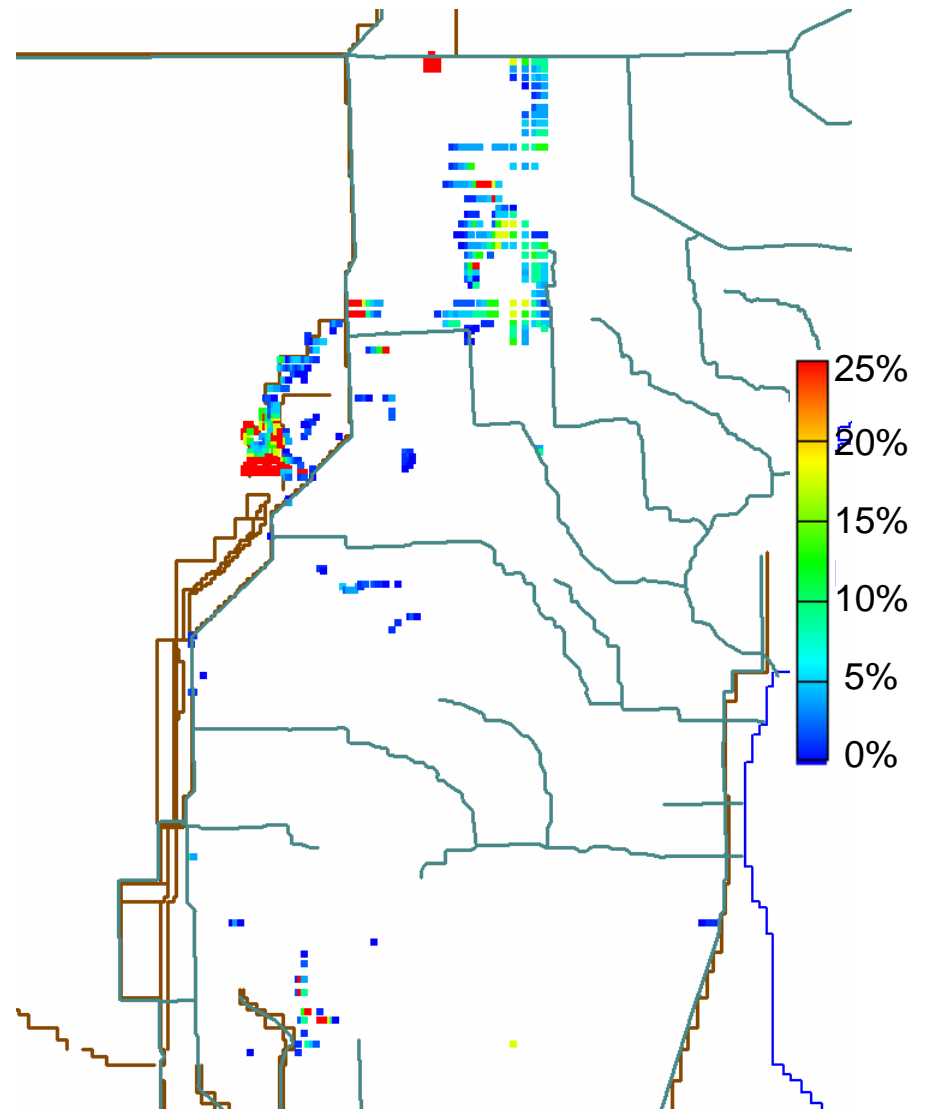
1995 Results

Potential Number of Parcels Impacted



Alternative 4

Potential for urban flood impacts

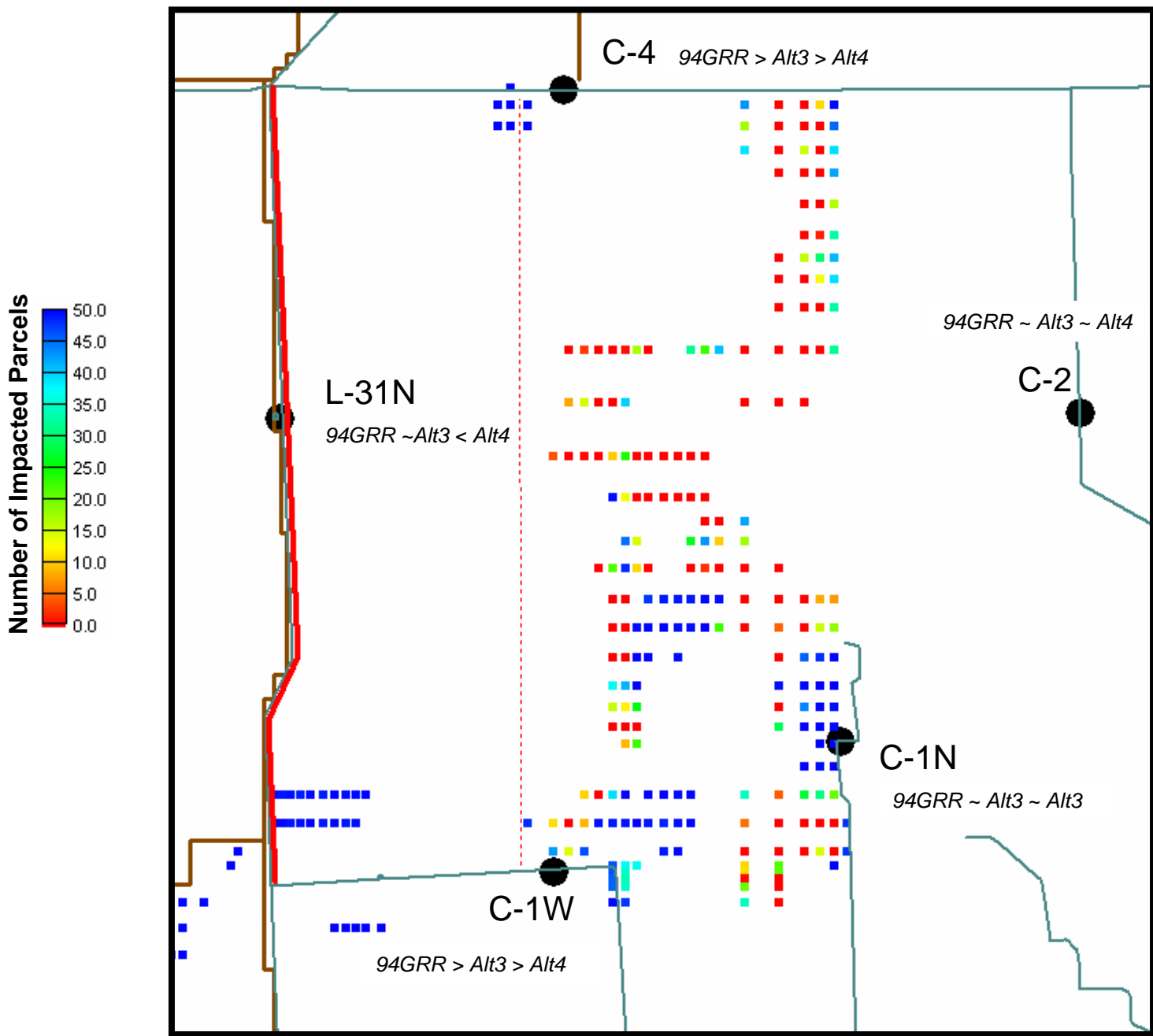


1995 Results

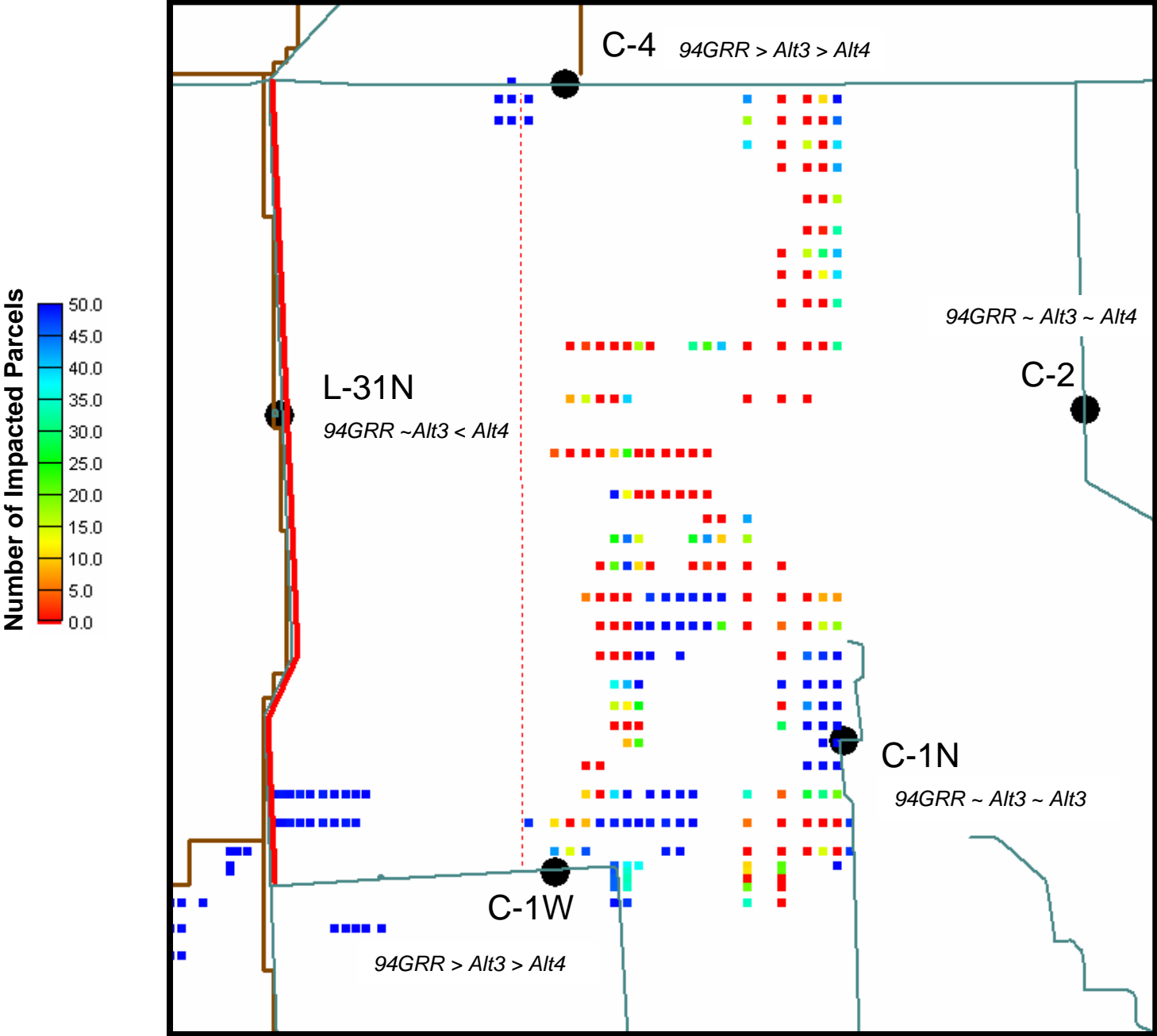
First Area of Interest:

Bird Drive Basin

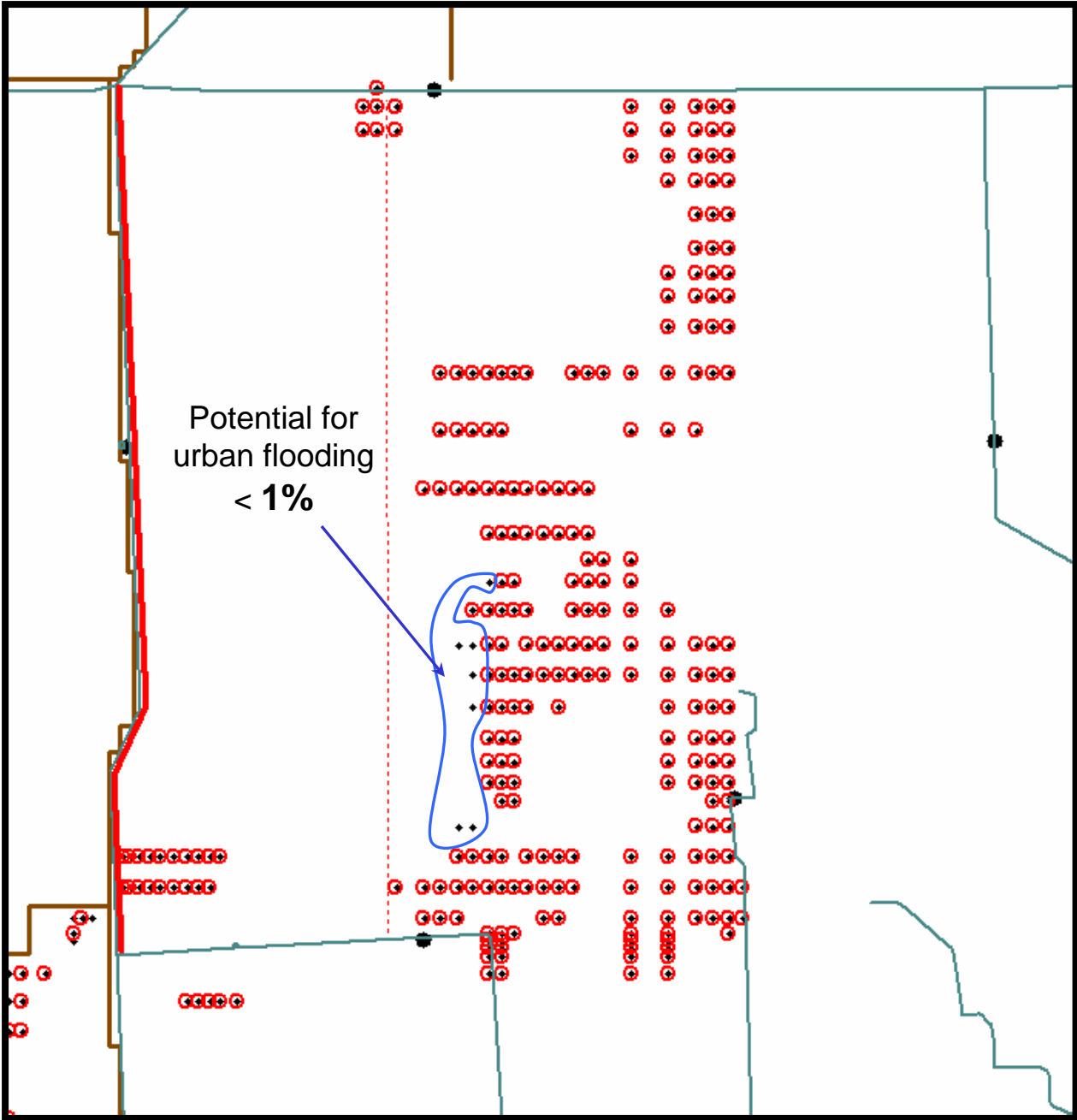
Potentially Impacted Parcels, C111 GRR (1995)



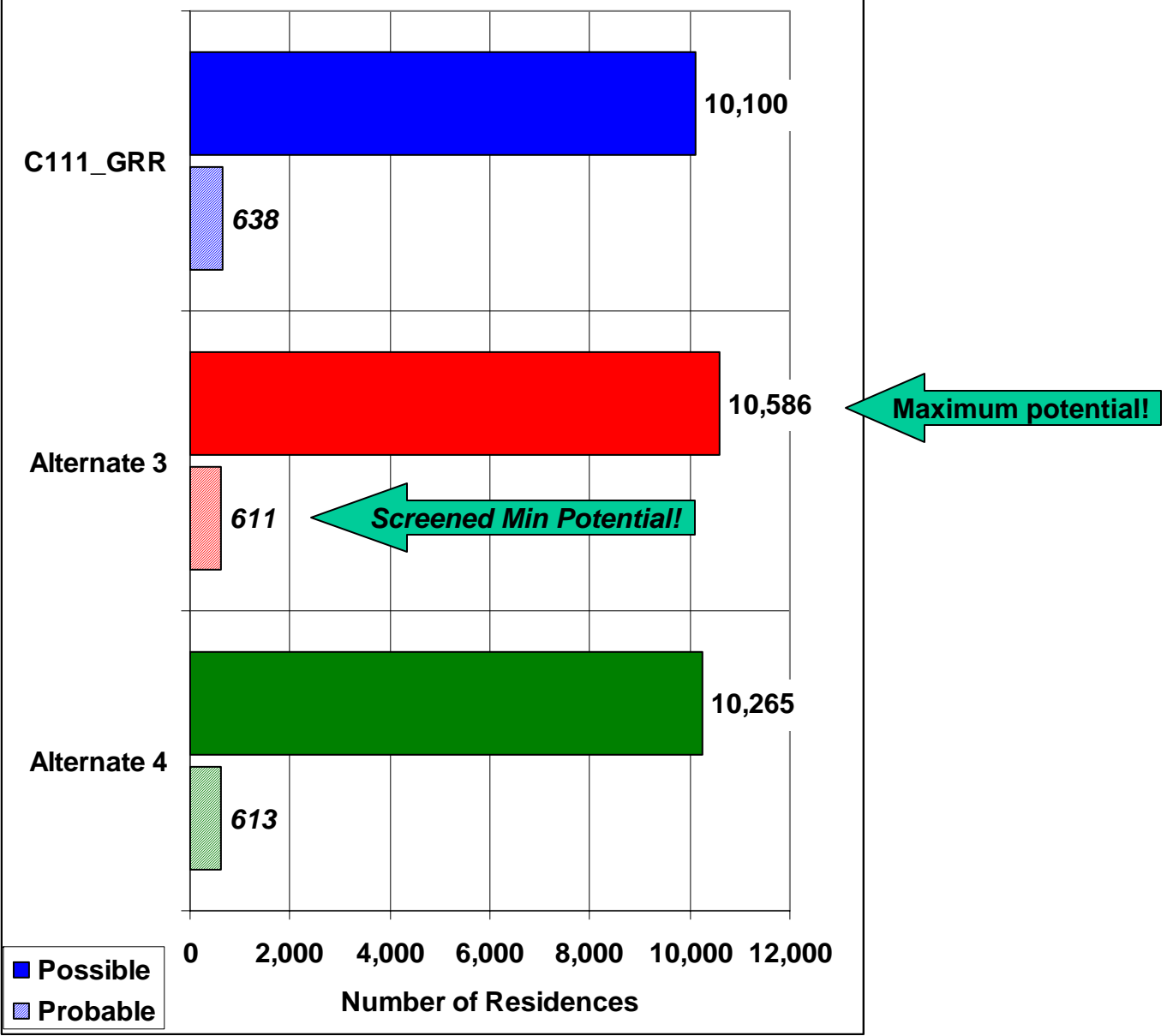
Potentially Impacted Parcels, Alt 3 (1995)



Potentially Impacted Parcels, C111 GRR and Alt 3 (1995)



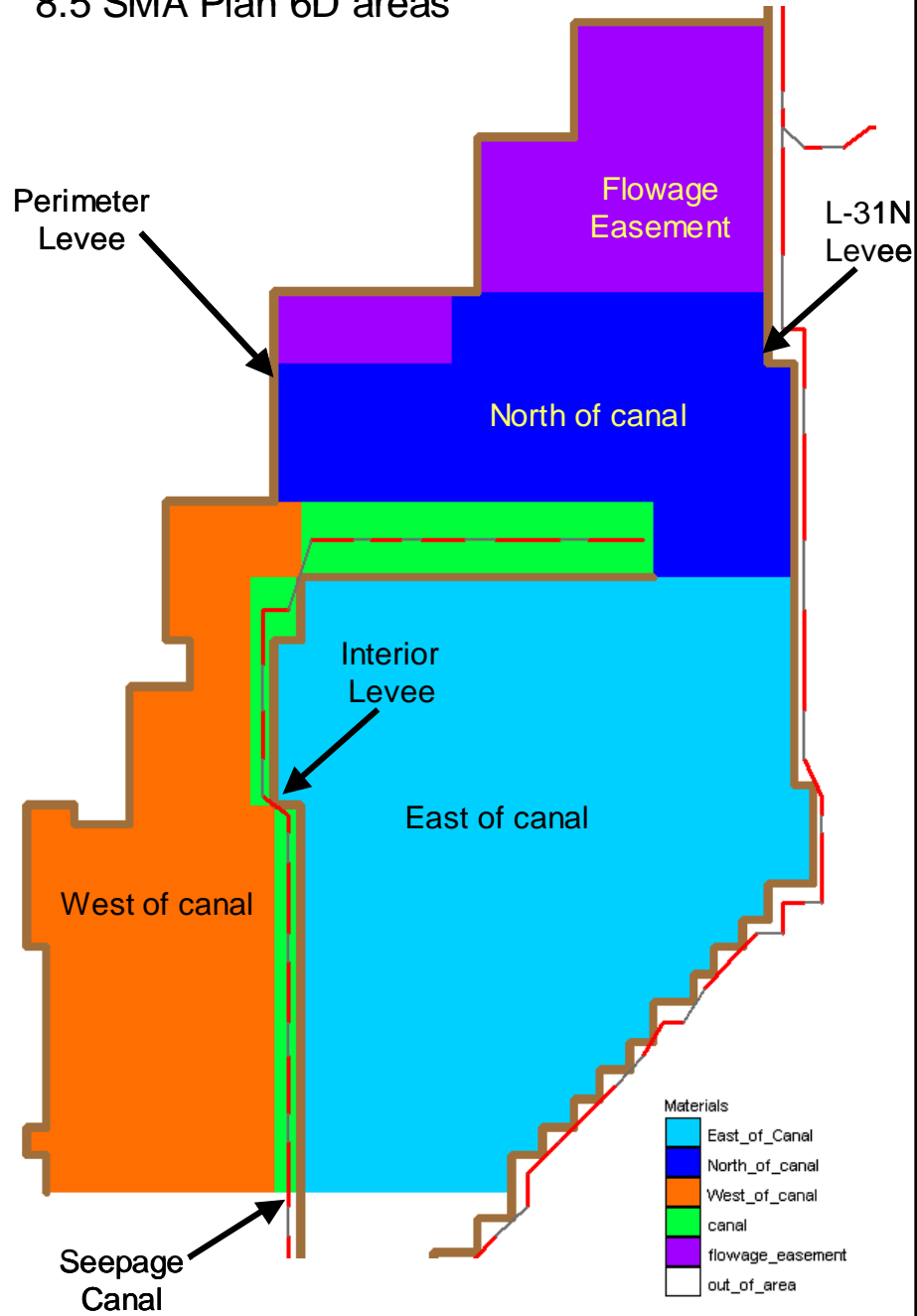
Number of Bird Drive Area Residential Properties Potentially Impacted, 1995



Second Area of Interest:

8.5 Square Mile Area

8.5 SMA Plan 6D areas

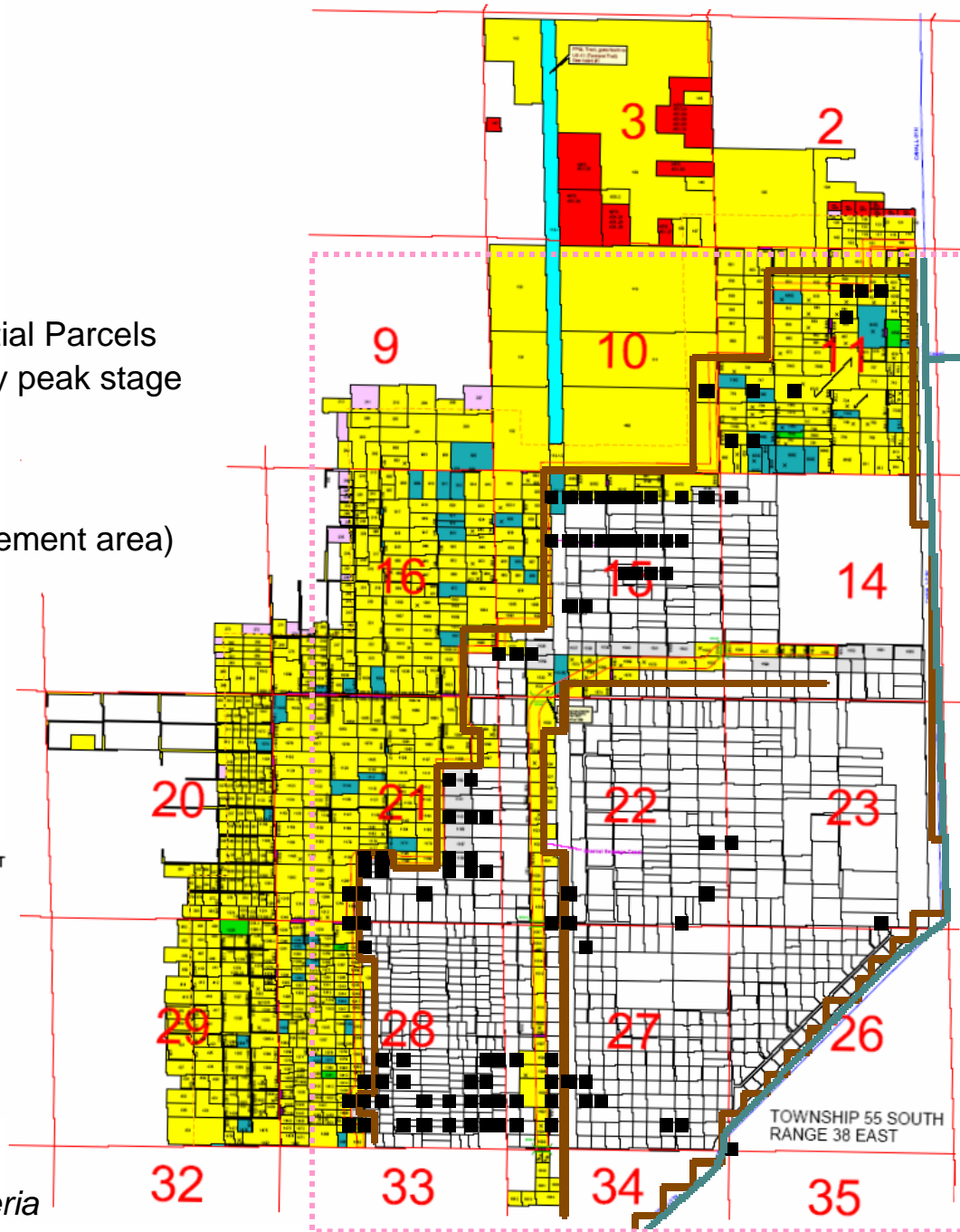


Plan 6D

Number* of Residential Parcels potentially affected by peak stage in 1995:

53 total
45 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS



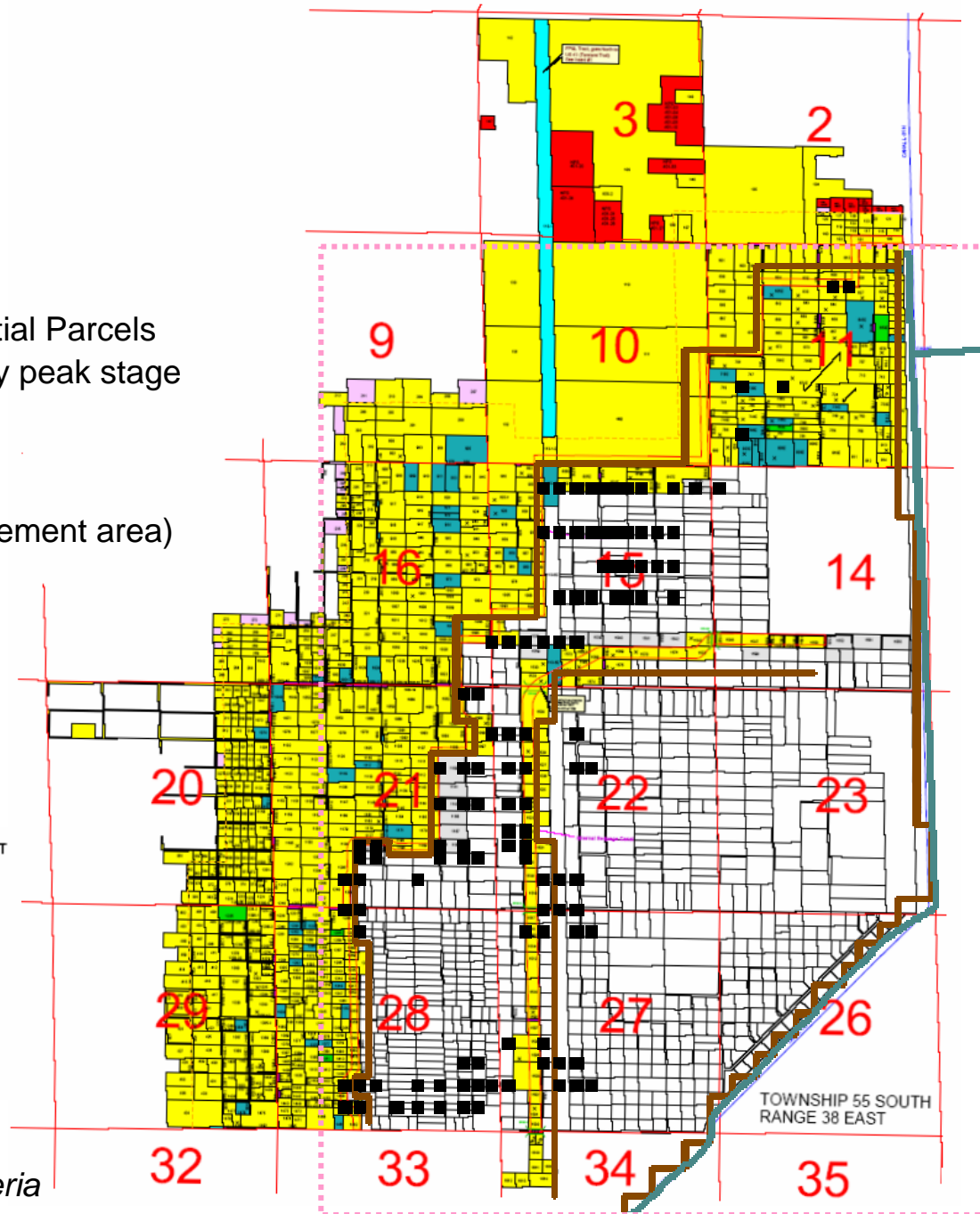
* based on original criteria

Alt7R

Number* of Residential Parcels potentially affected by peak stage in 1995:

57 total
51 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS



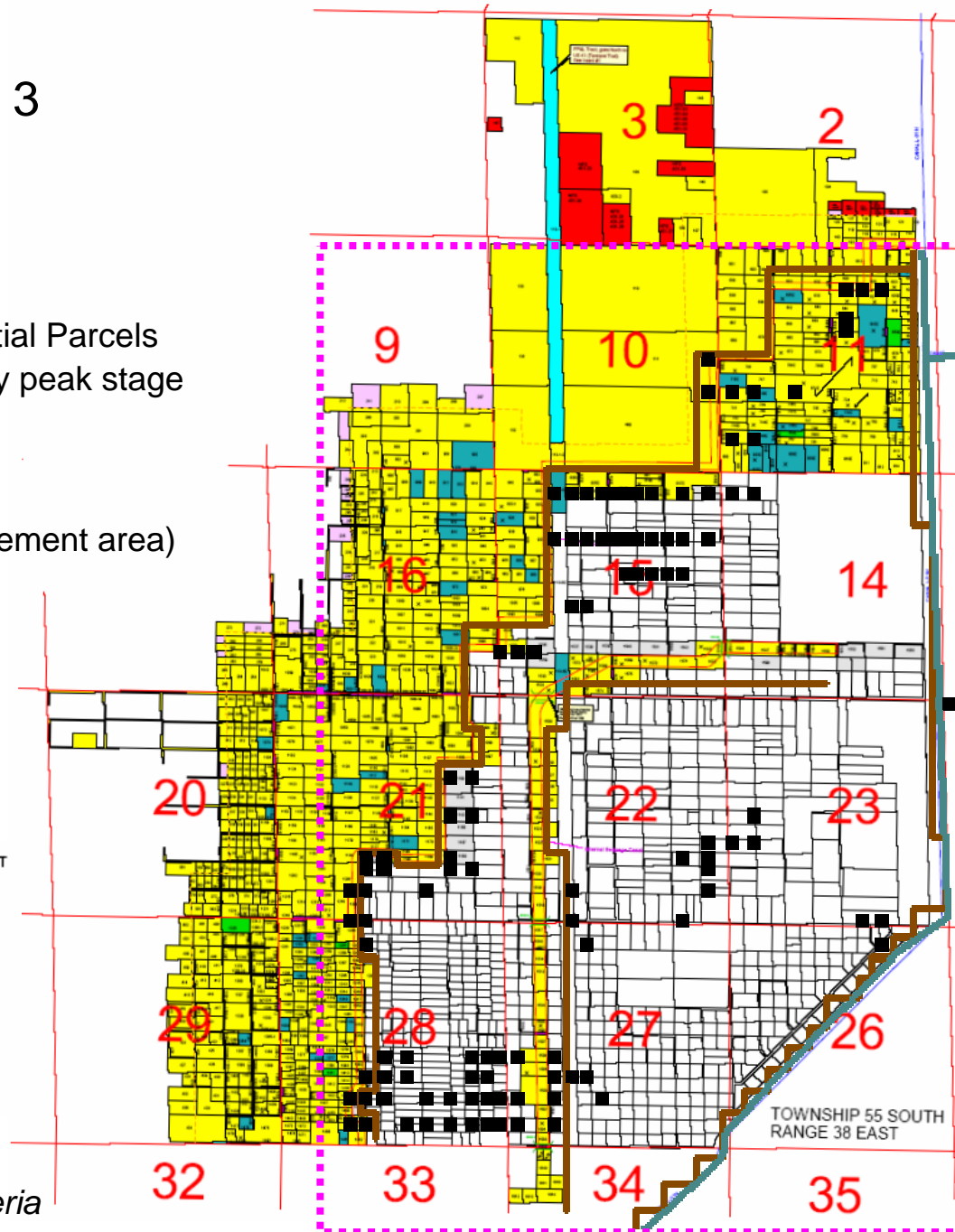
* based on original criteria

Alternative 3

Number* of Residential Parcels potentially affected by peak stage in 1995:

54 total
46 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS



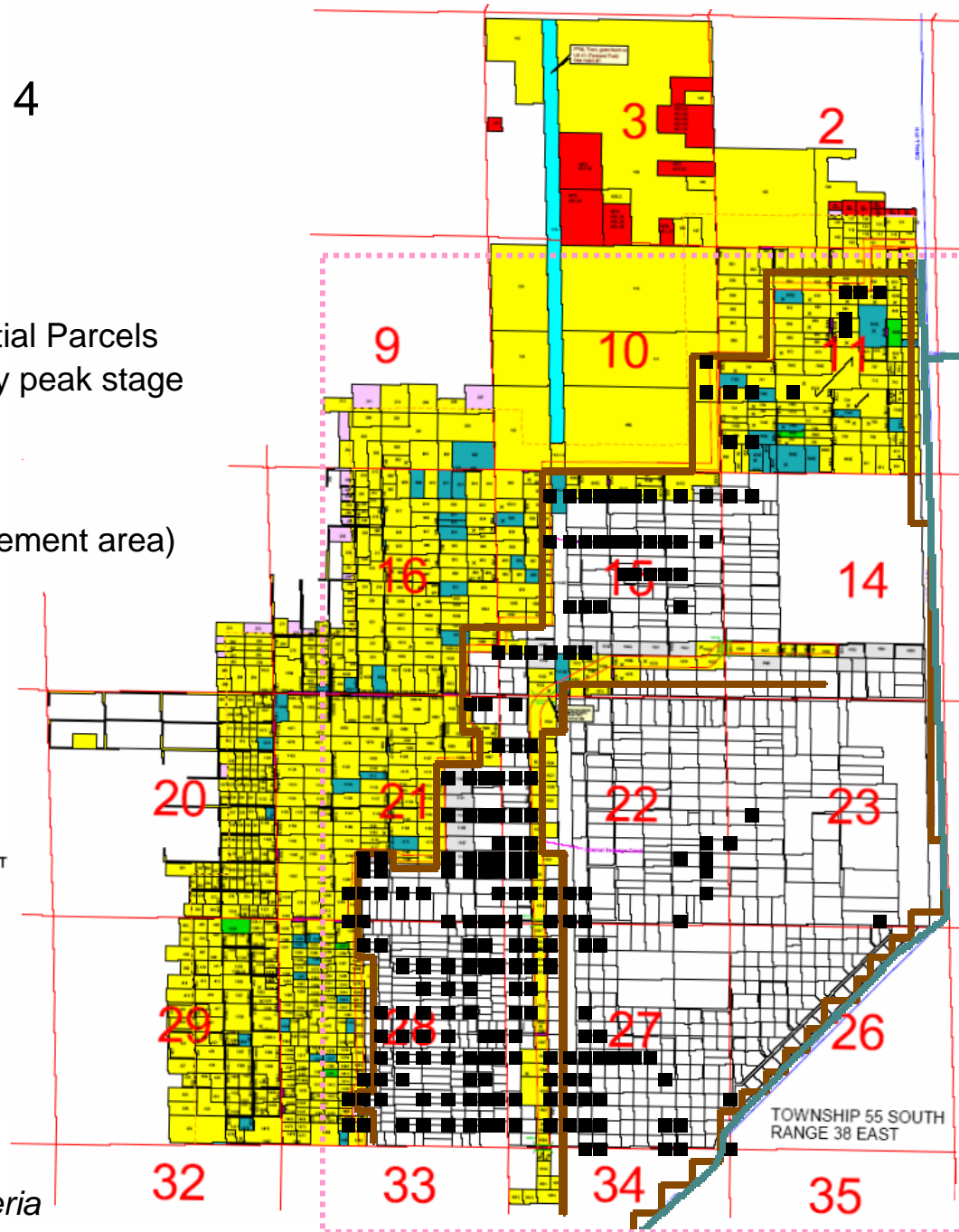
* based on original criteria

Alternative 4

Number* of Residential Parcels potentially affected by peak stage in 1995:

105 total
97 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS



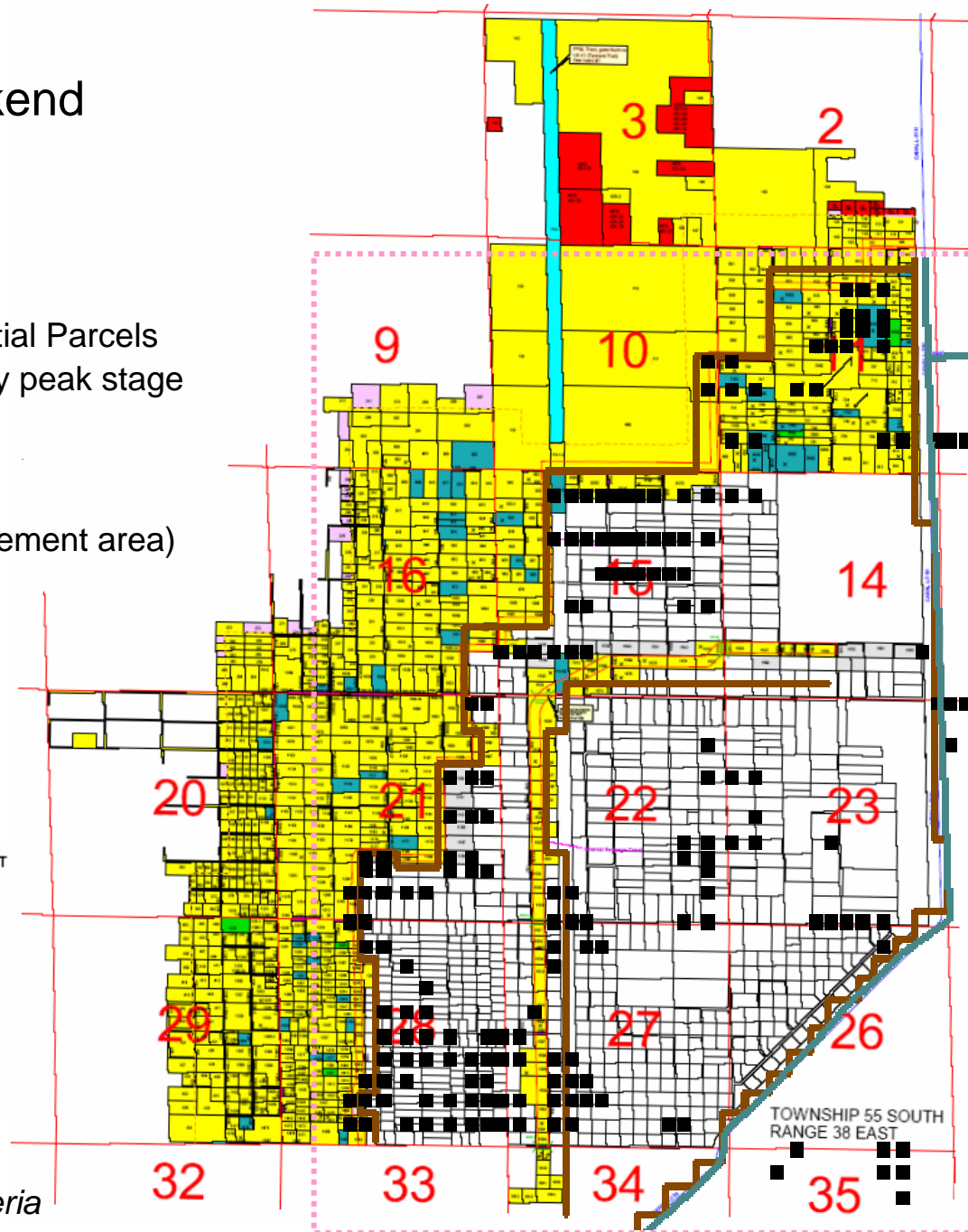
* based on original criteria

West Bookend

Number* of Residential Parcels potentially affected by peak stage in 1995:

87 total
76 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS



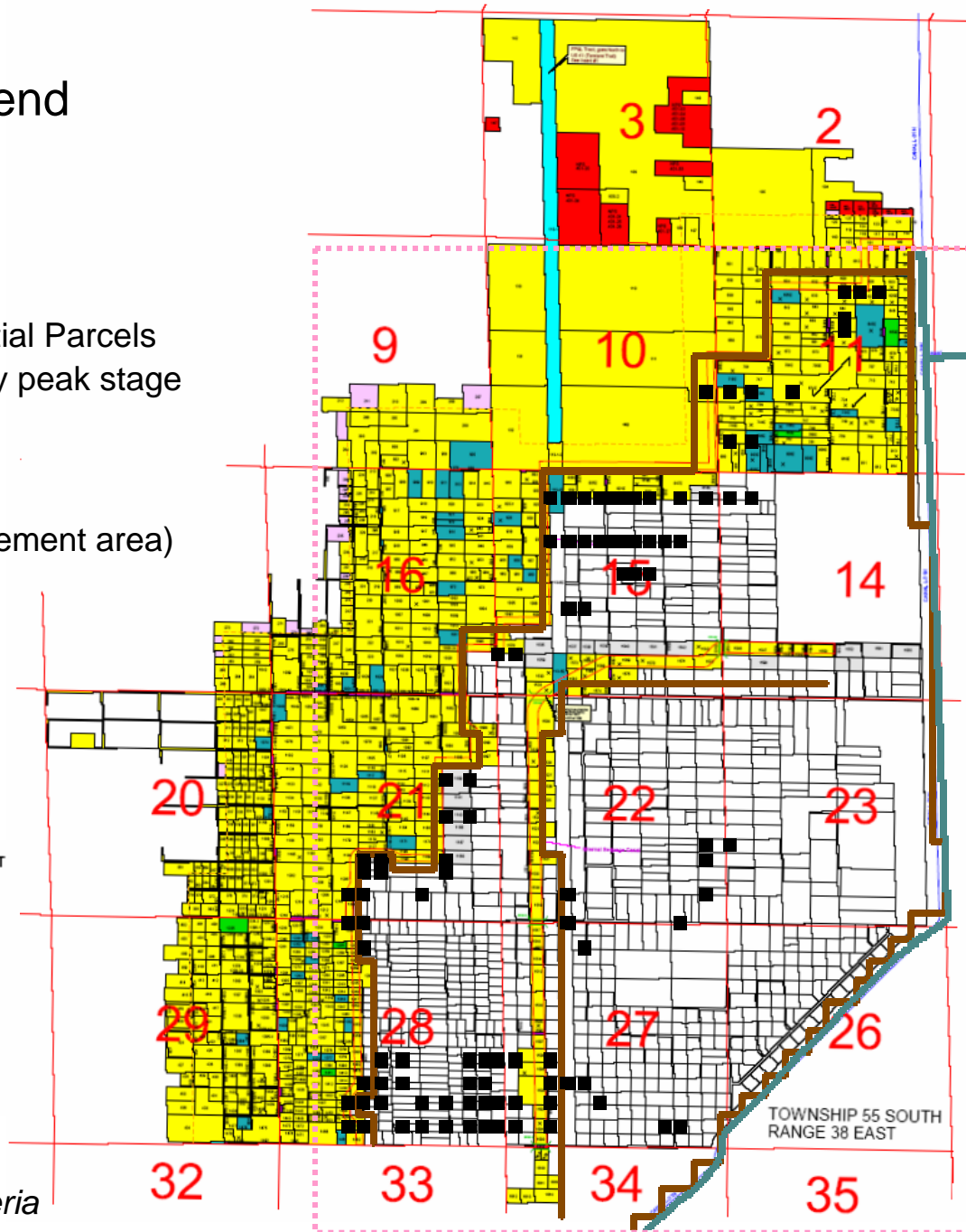
* based on original criteria

East Bookend

Number* of Residential Parcels potentially affected by peak stage in 1995:

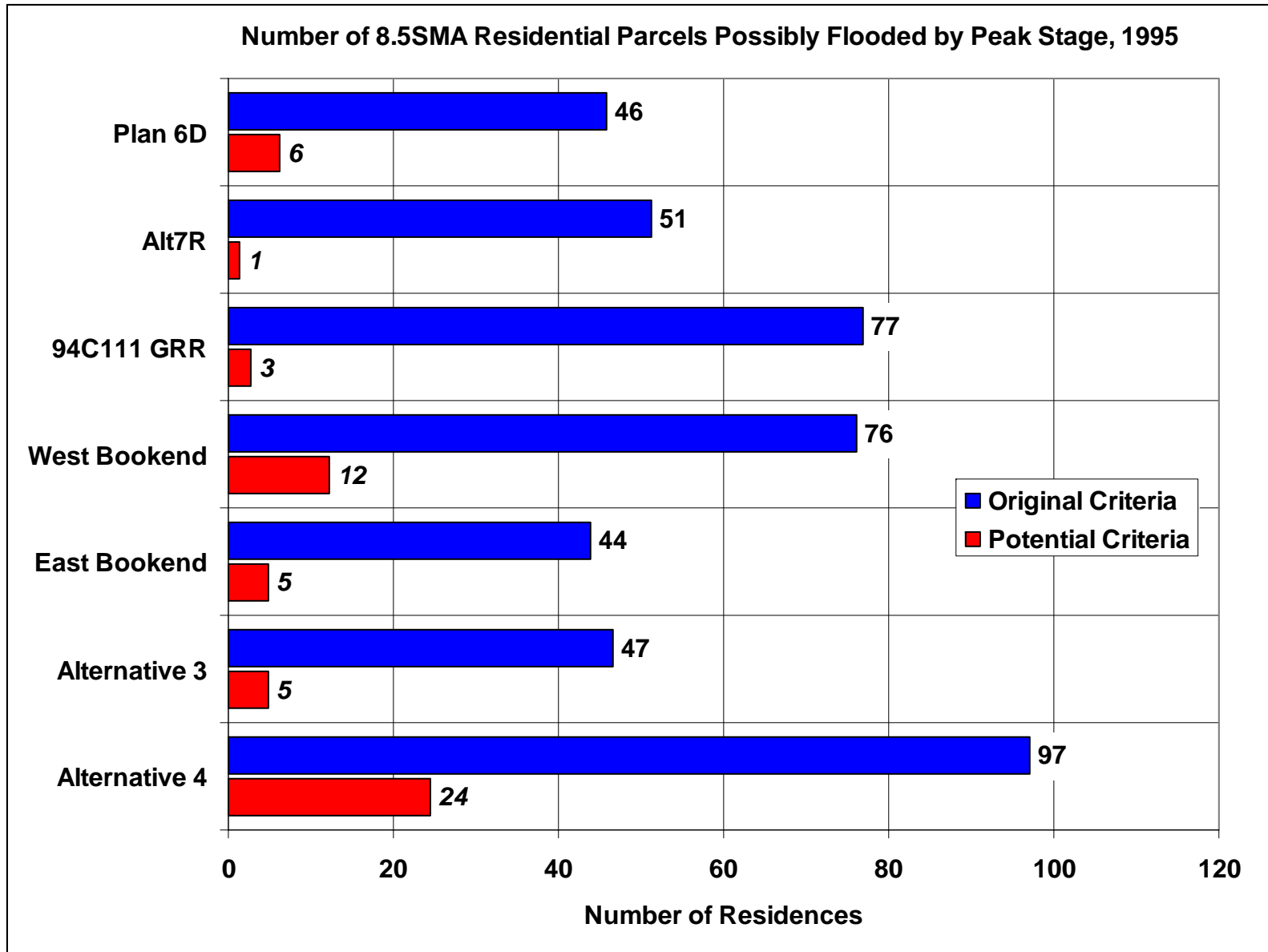
51 total
43 (not including easement area)

- TRACTS CLOSED/RIGHT TO CONSTRUCT
- NO OFFER SENT (NPS TRACTS)
- OFFER SENT (NPS TRACTS)
- RIGHT OF ENTRY/IN CLOSING
- TO BE CONDEMNED
- NPS ACQUIRED
- RESIDENTIAL PARCELS
- NOT NEEDED FOR PROJECT
- TRANSFER TO NPS

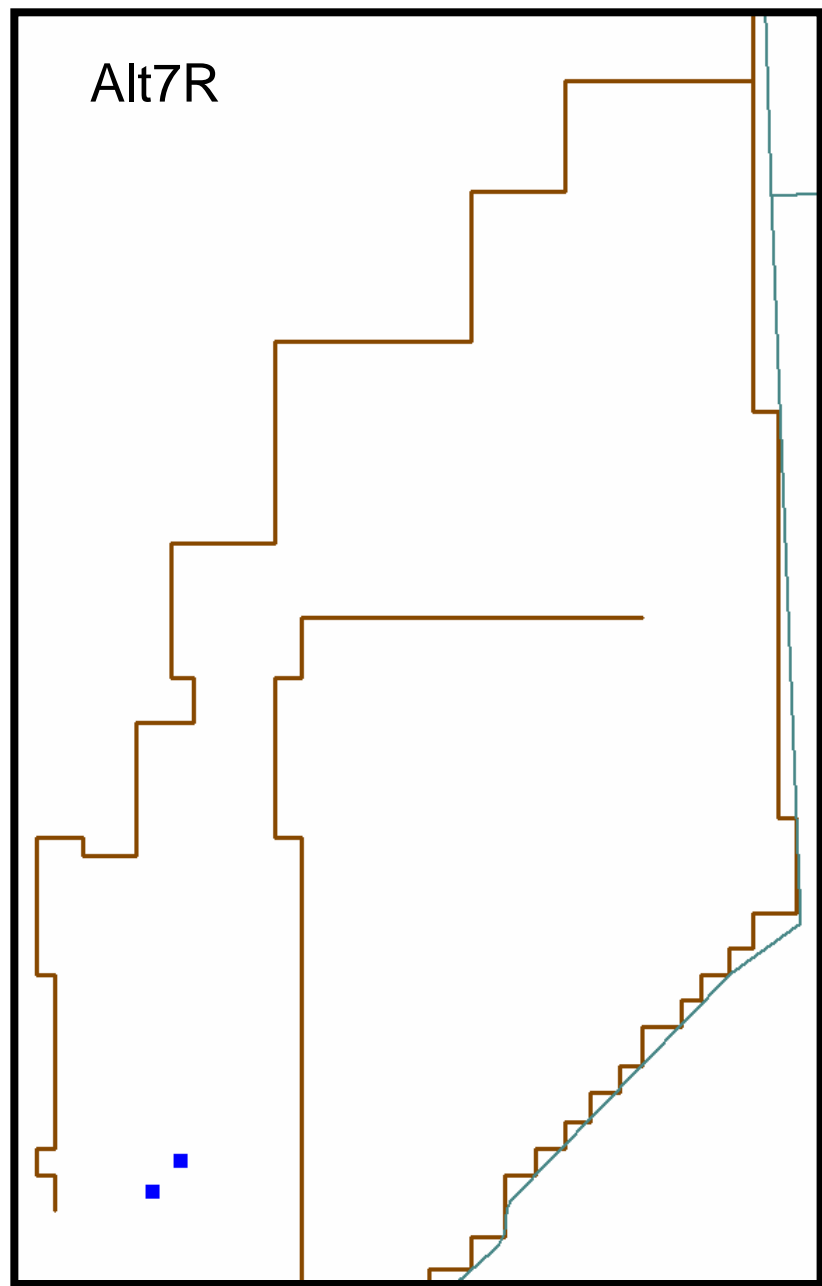
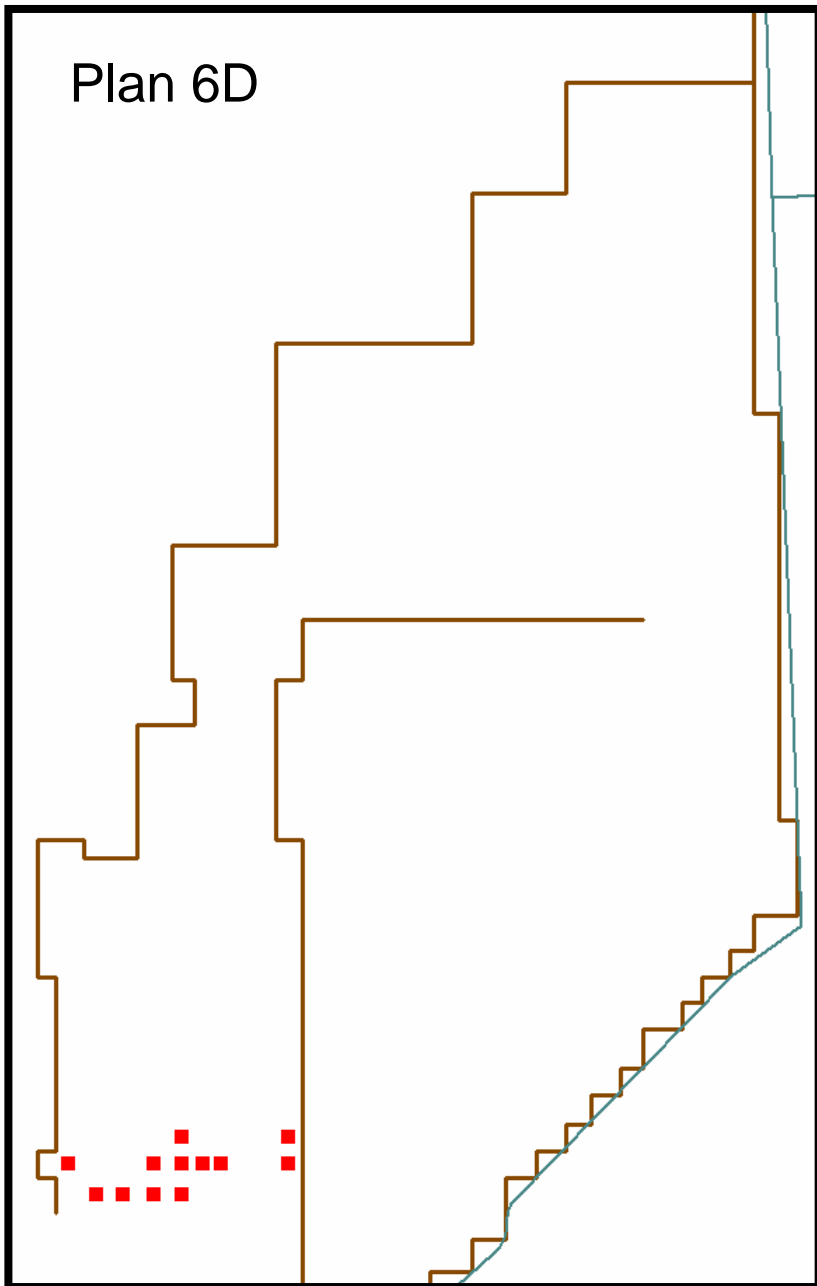


* based on original criteria

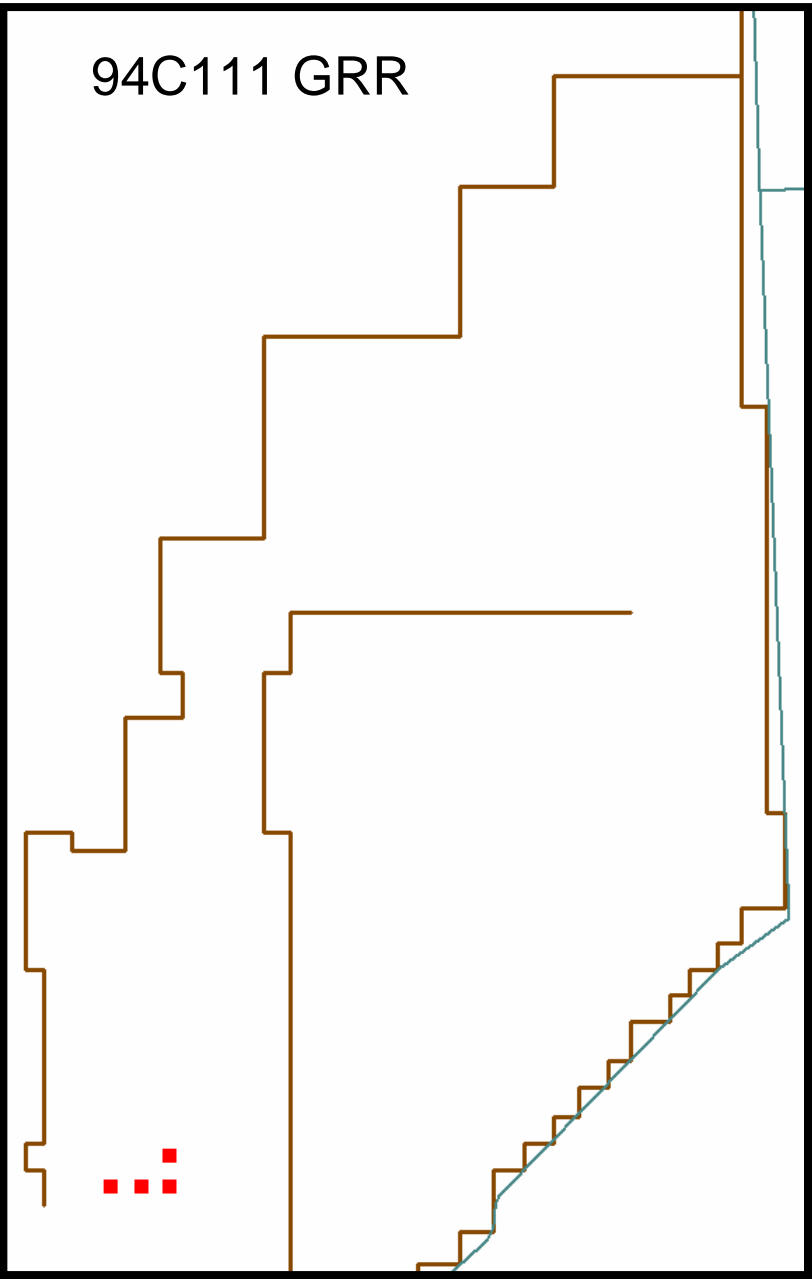
8.5 SMA “Residential Properties”



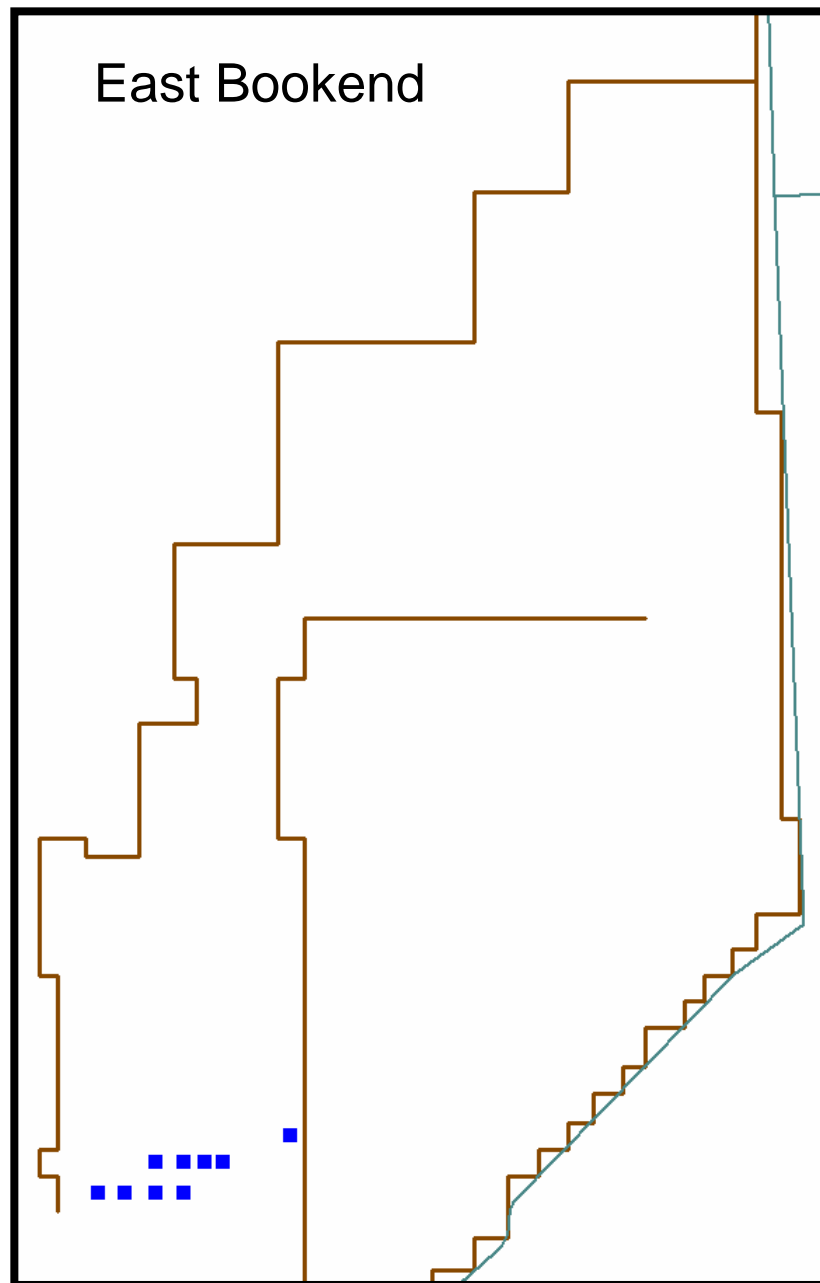
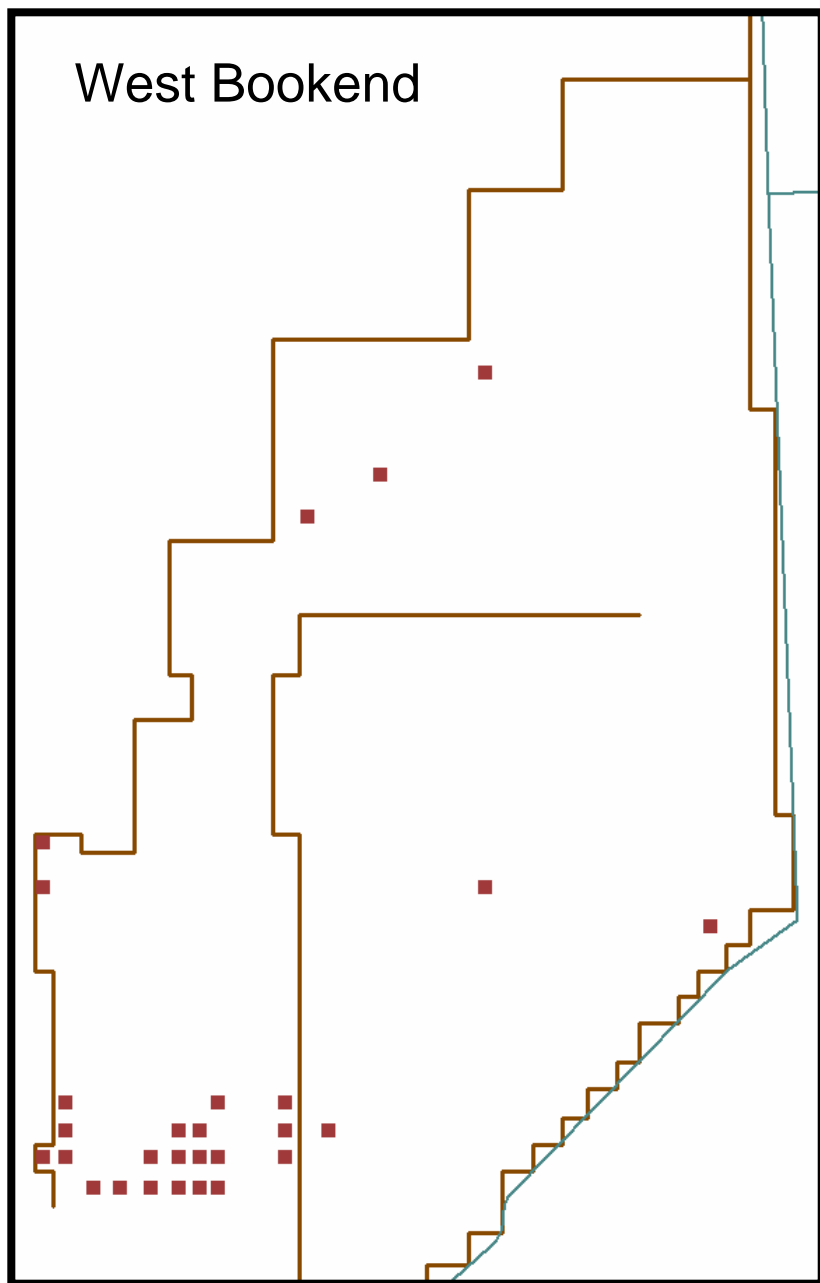
These numbers do not include parcels in the flowage easement area.



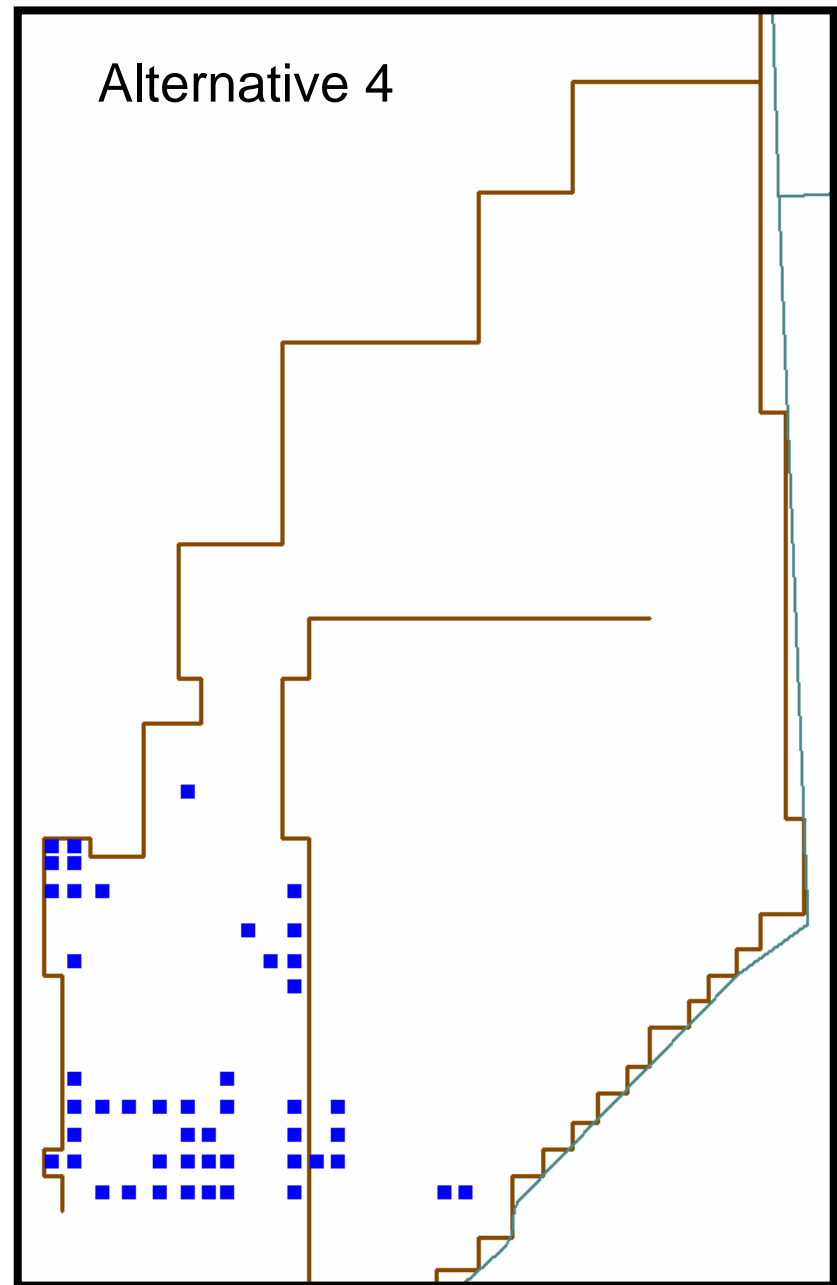
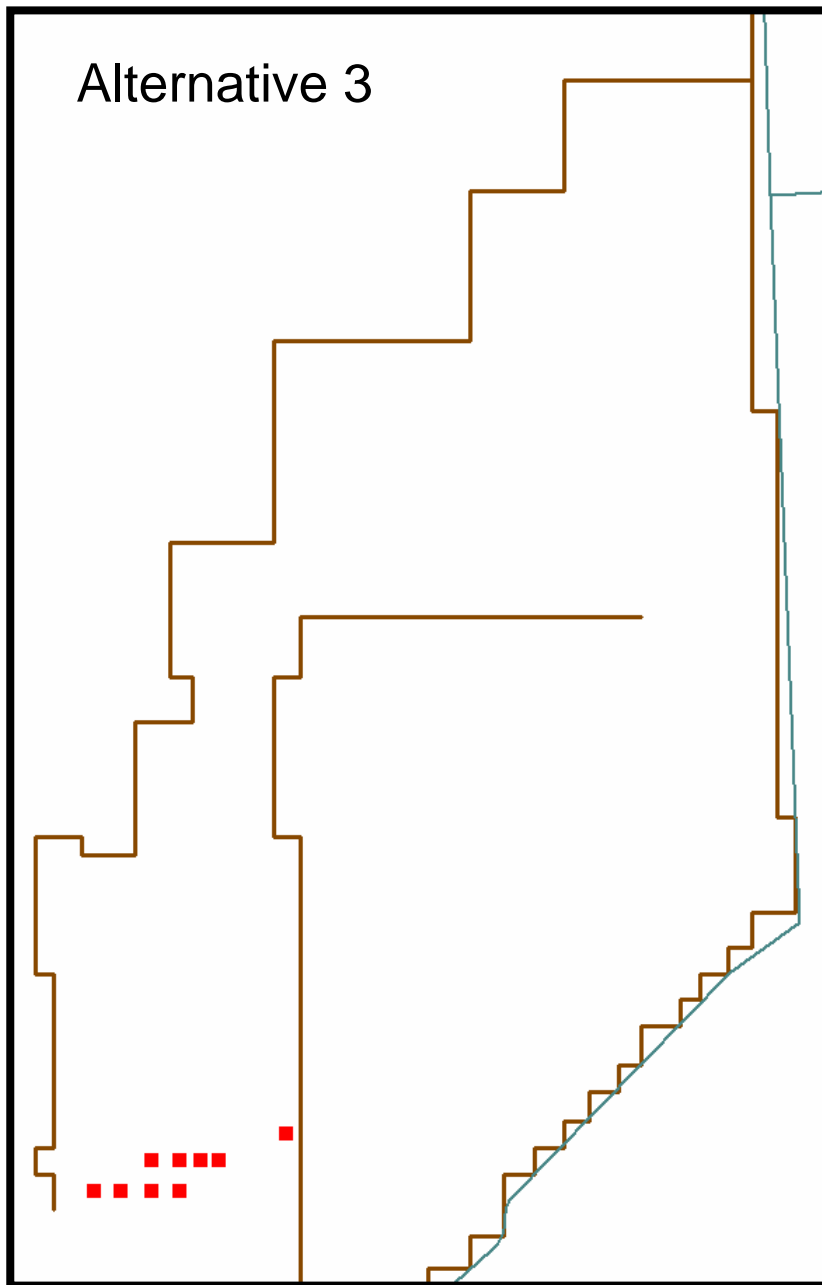
MODBRANCH cells shown represent cells with at least 0.1 residential parcels probably flooded.



MODBRANCH cells shown represent cells with at least 0.1 residential parcels potentially impacted



MODBRANCH cells shown represent cells with at least 0.1 residential parcels potentially impacted



MODBRANCH cells shown represent cells with at least 0.1 residential parcels potentially impacted