City of Grand Island

Tuesday, September 18, 2007
Study Session

Item -1

Groundwater Removal Study and Computer Model Presentation

Staff Contact: Gary R. Mader;Steve Riehle

Council Agenda Memo

From: Gary R. Mader, Utilities Director

Meeting: September 18, 2007

Subject: Groundwater Removal Study and Computer Model Presentation

Item #'s: Special Item #1

Presenter(s): Gary R. Mader, Utilities Director

Background

The Aquifer underlying the City of Grand Island is relatively shallow and very porous, and responds rapidly to surface precipitation. Prior to 2006, the region experienced an extended drought, but beginning in 2006, normal and above normal precipitation returned to the area. And with the recent return of heavy precipitation, groundwater levels have risen several feet, resulting in water intrusion into many basements in the City.

The issue of high water tables and water intrusion into basements has a long history in Grand Island and the City has undertaken a number of studies to create systems to address the problem. The more affected areas are in the south in the Park-View, Lamar, Phoenix, and Circle Drive areas, in the west, some portions of Capital Heights, and on the east and southeast, the Pleasant View and Seedling Mile areas.

In 1993, a period of wet weather, the Public Works Department designed a dewatering system to address issues in the Capital Heights area. The design included 17 wells at 500 gallons per minute, with an estimated project construction cost of $1,100,000 (1993 dollars). Most of the cost was associated with the construction of the discharge piping and the need to remove and replace streets, driveways, sidewalks, etc., in order to accomplish the pipe installation. The computed cost to the participating home owners was $1,128 per half acre lot, plus continuing operating costs. Subsurface Drainage District #1 was created by the Council. It was protested out by a margin of 3 to 1.

Prior to the 1993 district, the issue was also discussed in 1987, during another wet period. At that time, the City designed two districts, but neither was actually created because of protest from property owners who would have been included in the district.

In 1994, the City undertook a comprehensive study of historic groundwater levels and found that except for the older part of town that was built on the "high" ground, nearly all areas of the town perimeter are susceptible to basement flooding. And those areas are wet again this year after seven years of drought. That study resulted in City Building Codes being amended to include a requirement for the installation of collector systems and sump pumps under all new homes built.

In 2002, the City entered into a joint project with the Central Platte Natural Resources District (CPNRD) to again address the issue of high groundwater. This was a comprehensive approach addressing the more problematic areas in the west, south and east. Olsson Associates was commissioned to prepare detailed hydrologic models and, using those models, design a comprehensive dewatering system to address the problem. The system consisted of 25 to 30 wells with discharge piping to remove the high groundwater to area drainage. There was some discussion of limitations on the drainage due to concerns with downstream flooding being aggravated by the added water from the City. The estimated construction cost for that project was $13,063,000 with annual operating costs estimated at $341,000. The approach at the time was to create a municipal enterprise fund similar to the water and sewer utilities. The year 2002 was a very dry year and one of the first in the extended drought from which we have only recently recovered. The creation of Subsurface Drainage Districts did not result from the 2002 project.

Discussion

In the evaluation of options to address the problems associated with high ground water levels, a good deal of the hydrologic, computer modeling and engineering work was done for the 2002 study. In July, City Council authorized Olsson and Associates to update the 2002 model for presentation at a Study Session. That presentation is scheduled for the September 18 meeting.

Conclusion

This item is presented to the City Council in a Study Session to allow for any questions to be answered and to create a greater understanding of the issue at hand.

Grand Island Dewatering System Study:

An Innovative Approach to Alleviating Groundwater Infiltration

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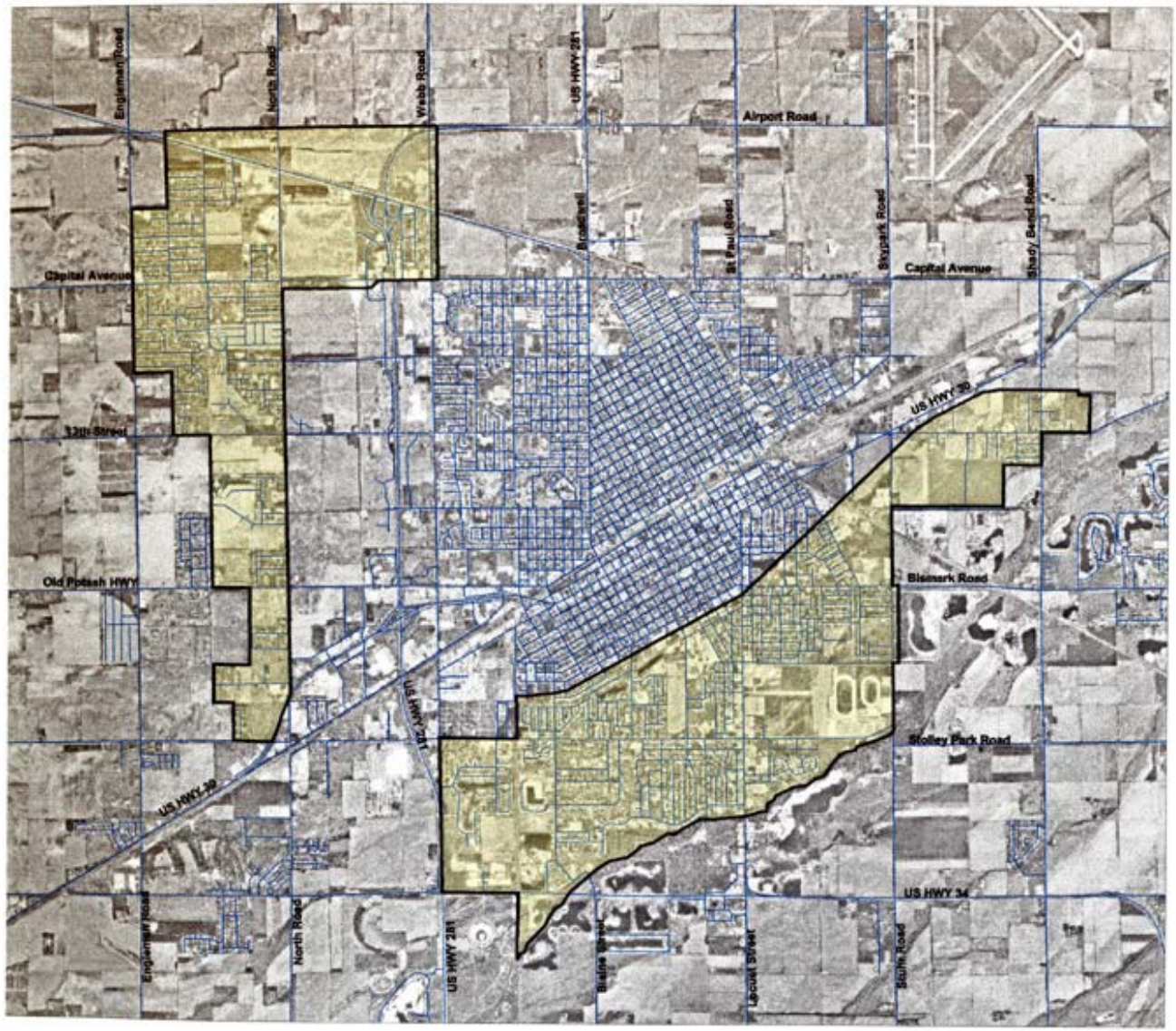
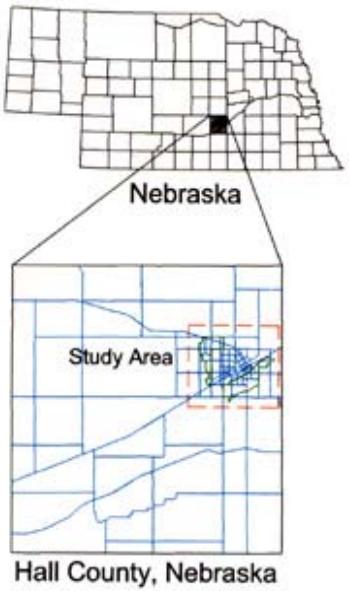
OLSSON ASSOCIATES
ENGINEERS • PLANNERS • SCIENTISTS • SURVEYORS

CPNRD





Roads and Streets

Study Area

SCALE: 1"=4,000'

N

0 2,000 4,000 8,000

SCALE IN FEET

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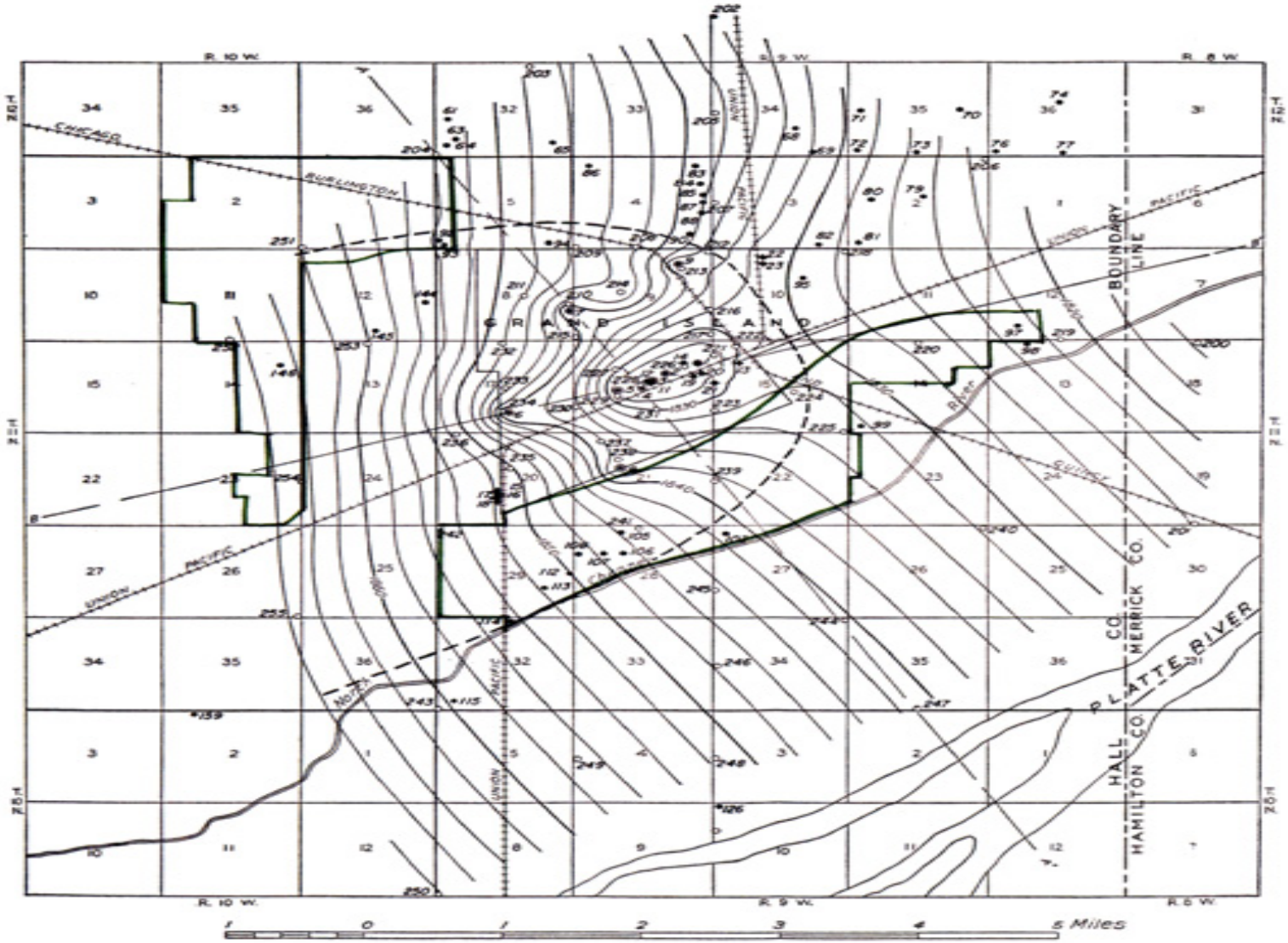

Figure 3

MAP SHOWING CONTOURS ON THE WATER TABLE IN THE VICINITY OF GRAND ISLAND ON JANUARY 1, 1938.

Key Issues

- Wet Basements
- Sanitary Sewer Infiltration and Residential Pumping to Sanitary Sewer
- Property Values
- Future Growth in Grand Island
- Discharge Location Options

Groundwater Dewatering Options

- Deep/High Capacity Wells
- Shallow/Low Capacity Wells
- Horizontal Wells
- French Drain

Modeling Objectives

- Simulate existing water table conditions
- Evaluate aquifer response to pumping
- Examine affects of pumping on contamination
- Examine affects of pumping and water disposal on existing surface water bodies
- Assess potential subsidence due to dewatering

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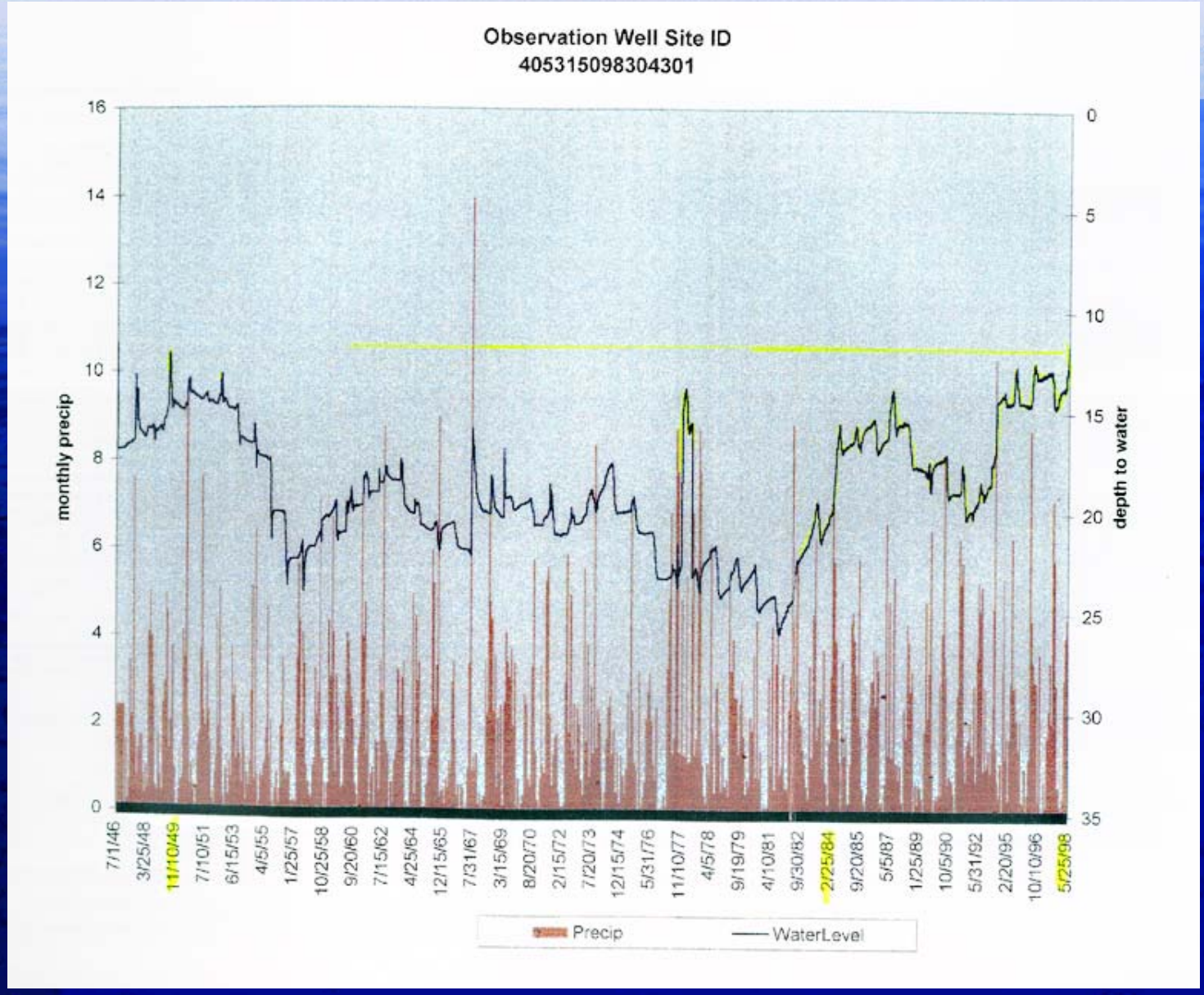
Modeling Aspects

- Utilized GMS – MODFLOW, MODPATH, AND MT3DMS
- Utilized GMS's capabilities for data evaluation and exhibits
- Large data base for model
- Modeled worse-case scenarios including high and low water tables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3/25/48
11/10/49
7/10/51
6/15/53
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9/20/60
7/15/62
4/25/64
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7/31/67
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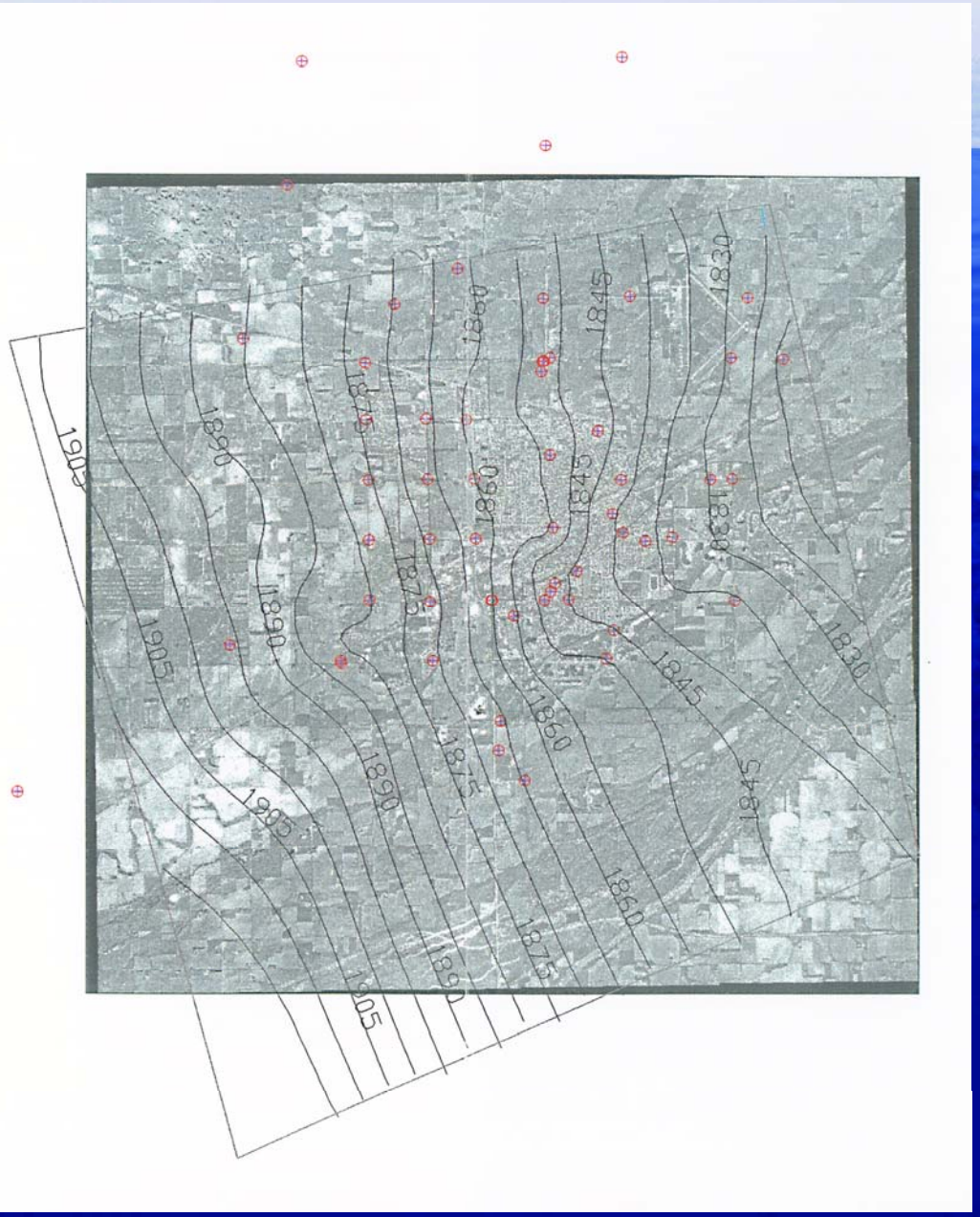
Precip
WaterLevel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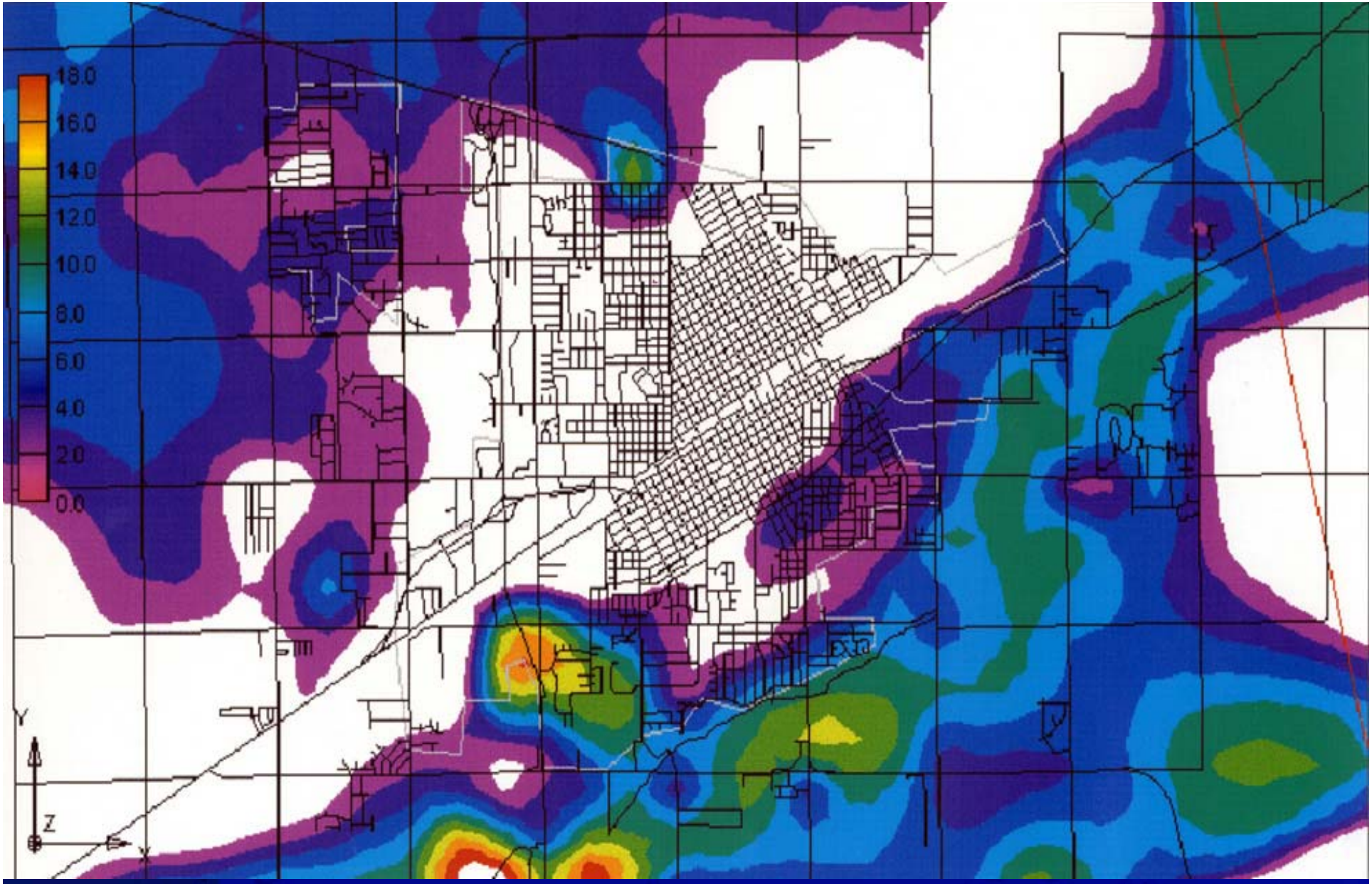

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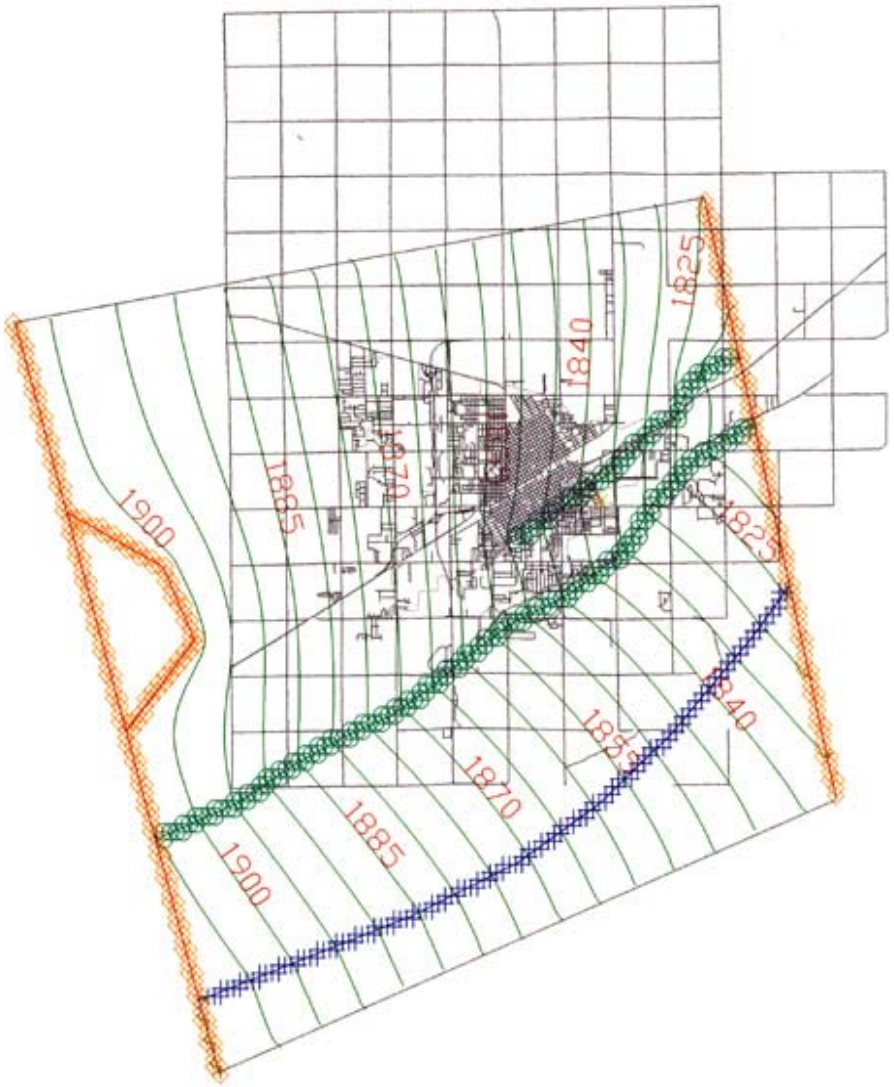

WATER TABLE CONTOUR

CI = 5 FEET

N

SCALE: 1"=12000'

0 6000 12000 24000

SCALE IN FEET

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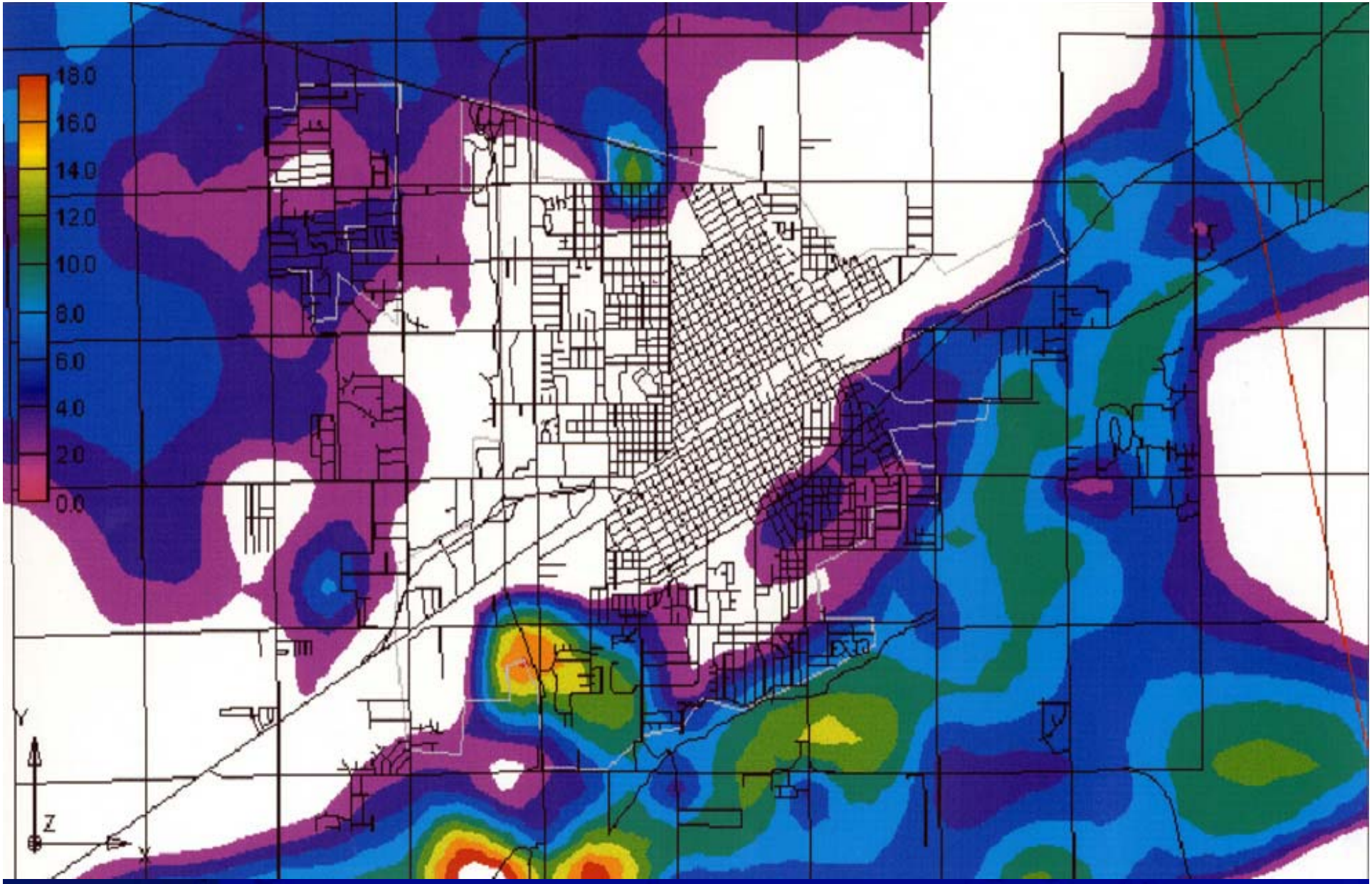

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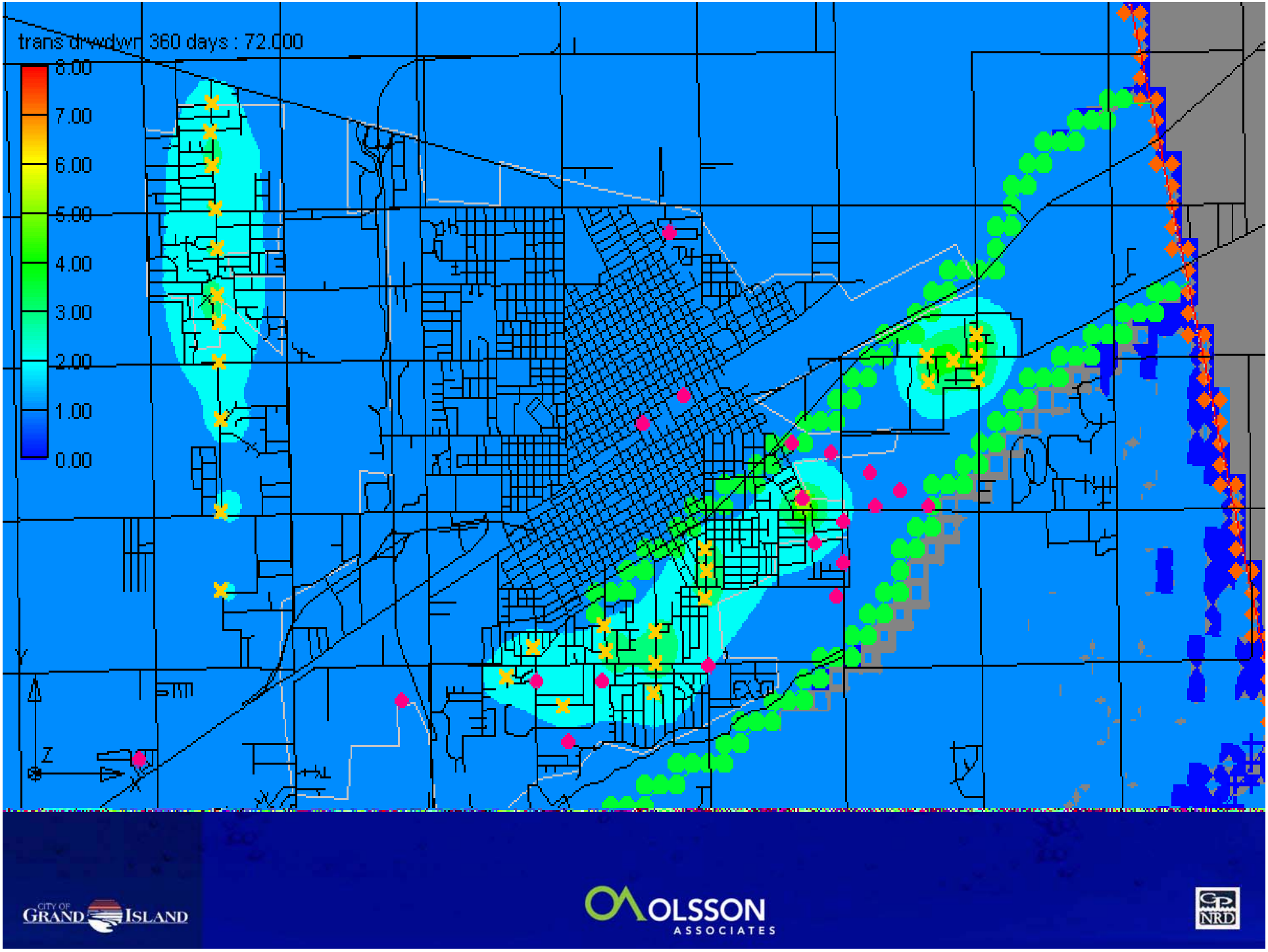
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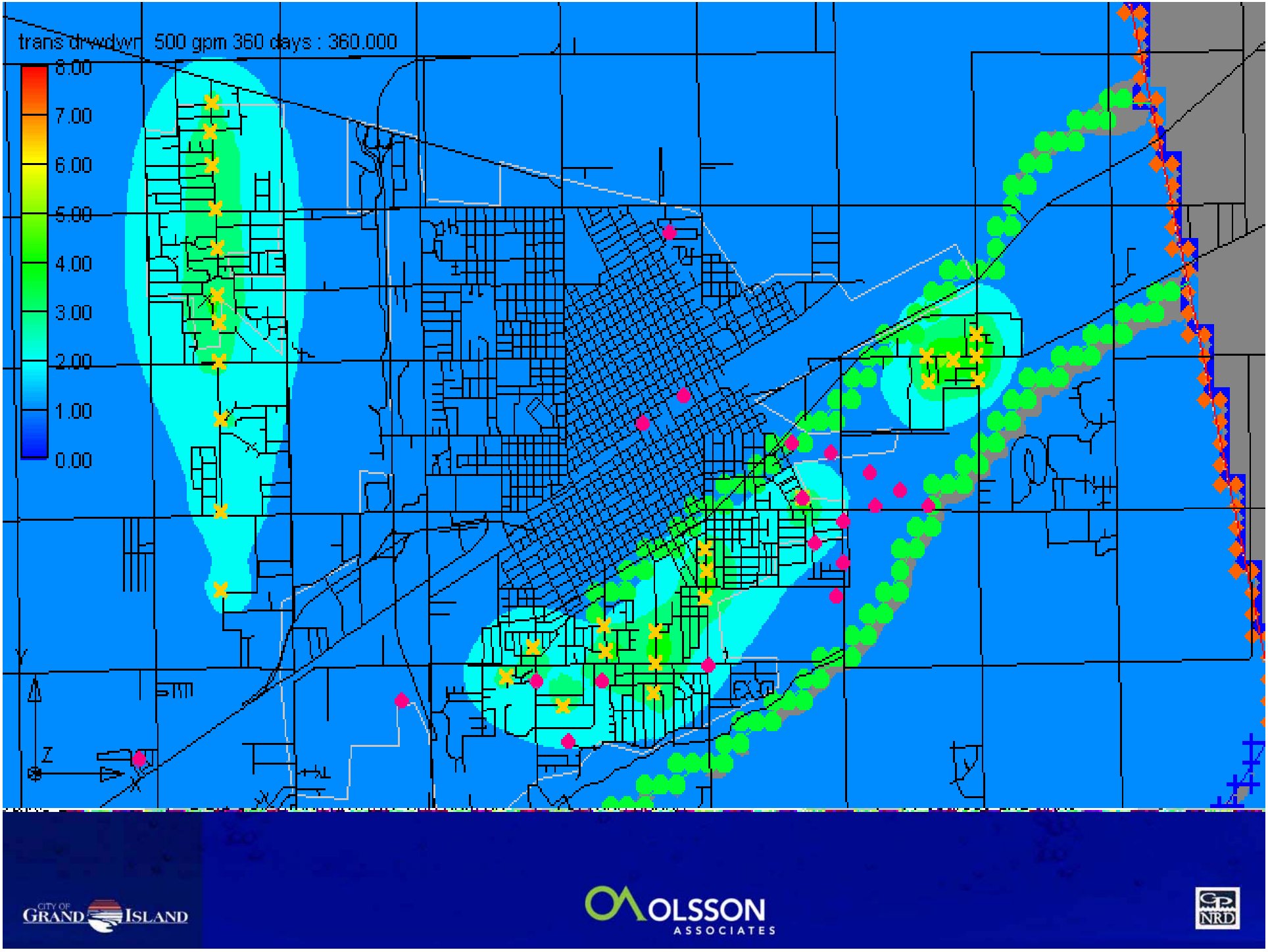
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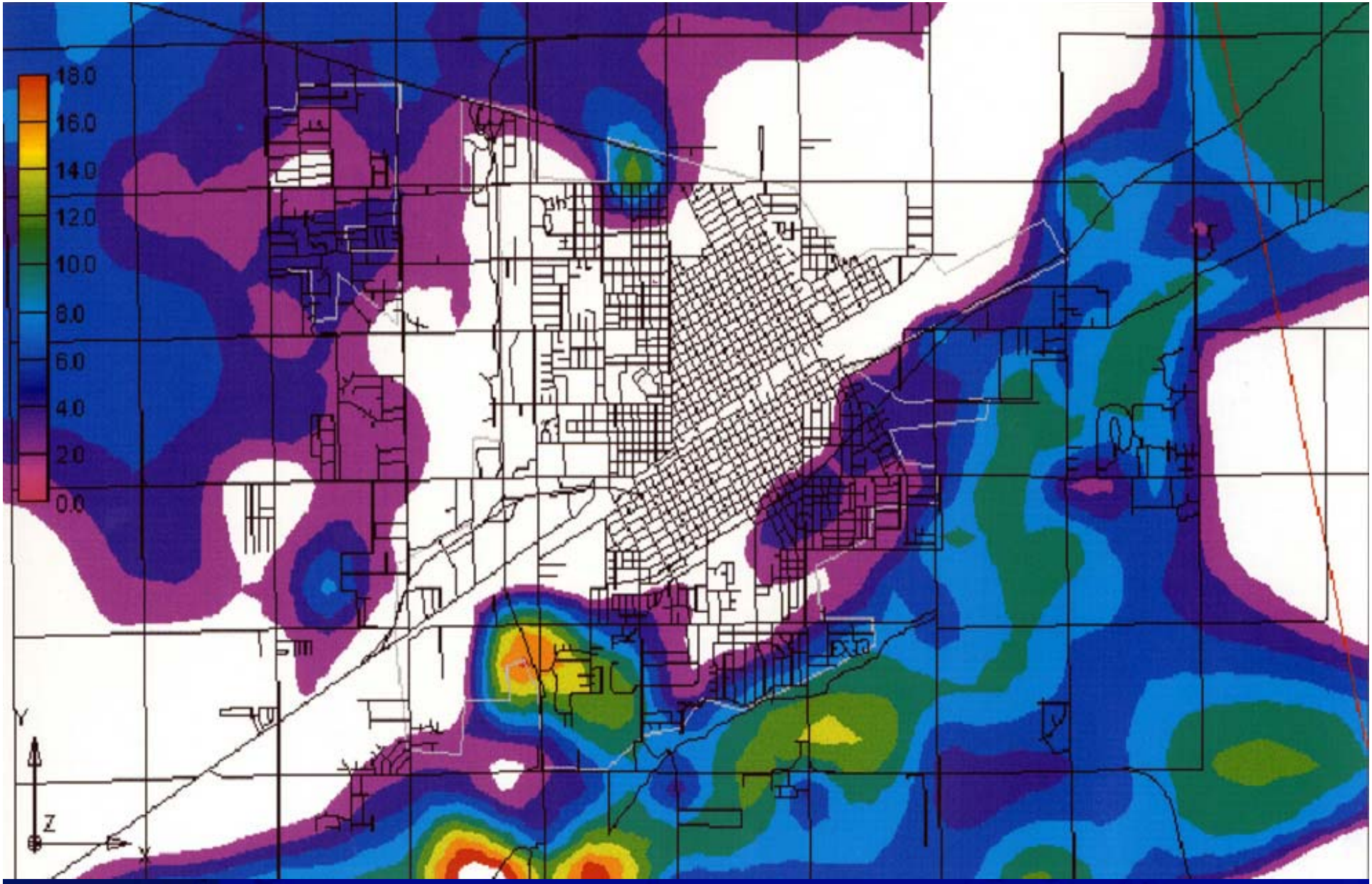

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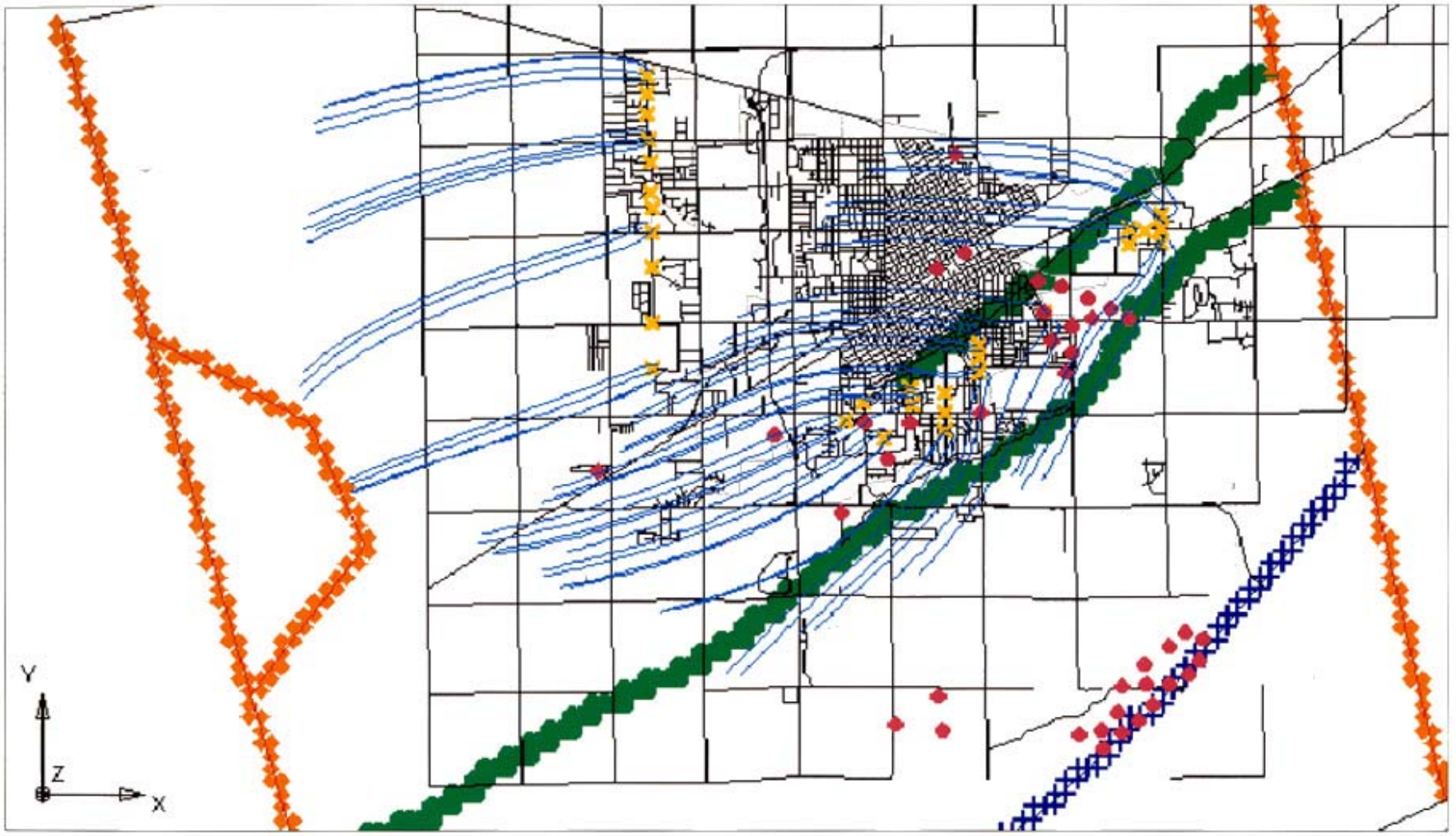

PUMPING WELL

PARTICLE PATHWAYS

EXISTING CITY WELL

0 3000 6000 12000

SCALE IN FEET

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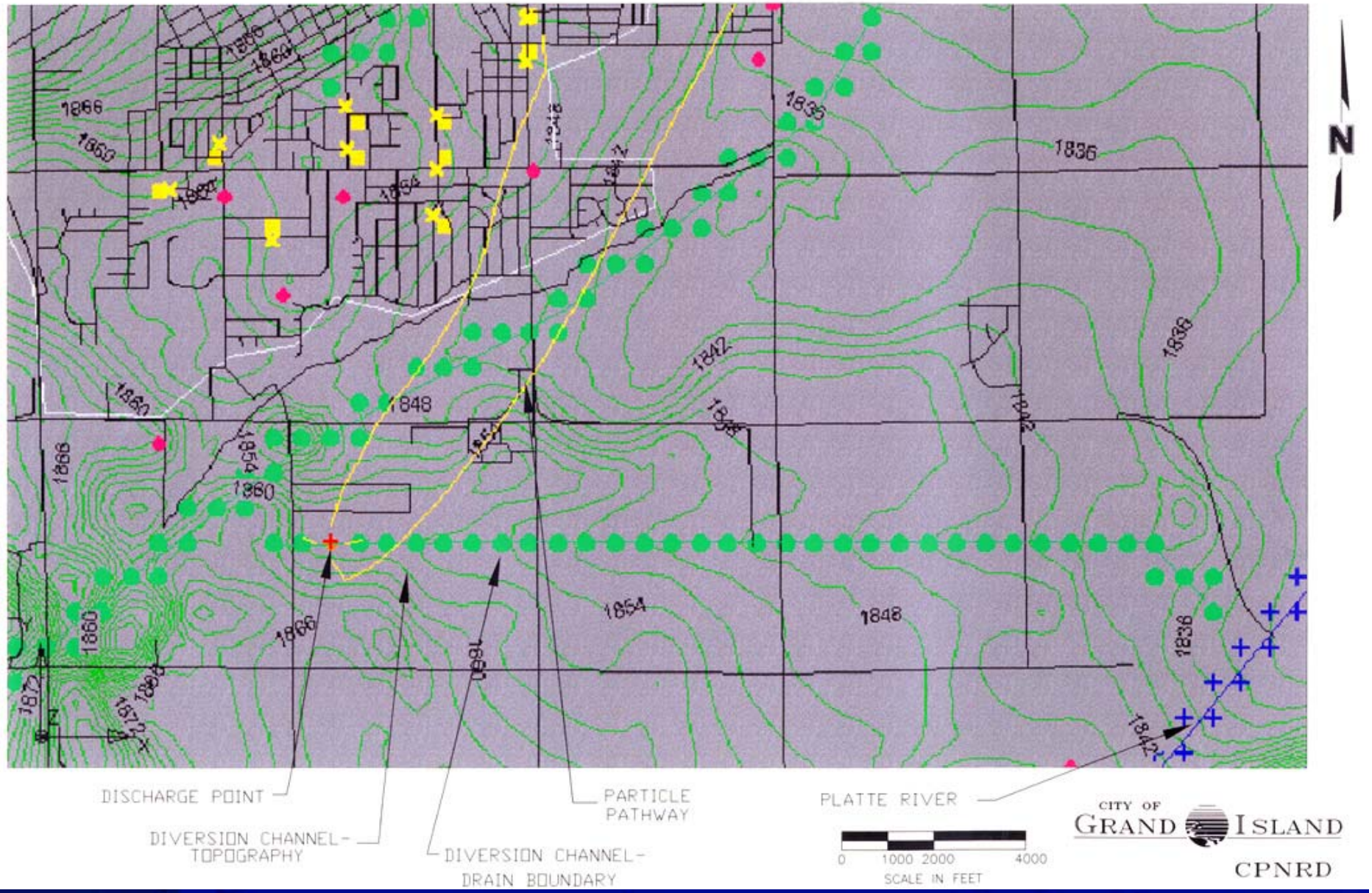
Conveyance/Disposal Options

- Discharge of the water into the Wood River Diversion Channel just south of Stuhr Museum
- Discharge of the water into the Platte River where it crosses Shady Bend Road
- Discharge of the water into the Platte River south of the Stuhr Museum, and using the water for downstream industrial or other uses.



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Modeling Summary

- Combination of low- and high-capacity wells meets project objectives
- System would consist of eleven 500 gpm wells in NW and seventeen 300 gpm wells and one 1100 gpm in SE
- Maximum capacity is 11,700 gpm or 16,85 mgd
- Subsidence should not be an issue
- Discharge would need to be piped to the Platte River
- Surface water impacts are unlikely

Opinion of Probable Costs

Preliminary Opinion of Probable Costs in 2000			
Item	**Alternative #1**	**Alternative #2**	**Alternative #3**
Transmission Line	$6,428,000	$8,935,000	$8,928,000
Utility conflicts	125,000	175,000	125,000
Dewatering Wells	1,013,000	1,013,000	1,013,000
Control System	510,000	510,000	510,000
Construction Cost Subtotal	$8,076,000	$10,633,000	$10,576,000
Contingency	808,000	1,063,000	1,058,000
Overhead, Legal, Fiscal, Engr.	969,000	1,276,000	1,269,000
ROW Acquisition	90,000	90,000	90,000
TOTAL Project Costs	**$9,943,000**	**$13,062,000**	**$12,993,000**
Annual Costs (20 years, 5%, A/P)	$797,826	$1,048,095	$1,042,558

Opinion of Probable Costs

Preliminary Opinion of Probable Costs in 2007*			
Item	**Alternative #1**	**Alternative #2**	**Alternative #3**
Transmission Line	$11,506,000	$15,994,000	$15,981,000
Utility conflicts	224,000	313,000	224,000
Dewatering Wells	1,813,000	1,813,000	1,813,000
Control System	913,000	913,000	913,000
Construction Cost Subtotal	$14,456,000	$19,033,000	$18,931,000
Contingency	1,446,000	1,903,000	1,893,000
Overhead, Legal, Fiscal, Engr.	1,735,000	2,284,000	2,272,000
ROW Acquisition	165,000	165,000	165,000
TOTAL Project Costs	**$17,802,000**	**$23,385,000**	**$23,261,000**
Annual Costs (20 years, 5%, A/P)	$1,428,432	$1,876,412	$1,866,463

* Construction Cost Index of 1.79 was used based on FHWA

Construction Cost Index of 1.71 was calculated by the Bureau of Labor Statistics for the same period

Opinion of Probable Costs

Operations and Maintenance (O&M) Costs in 2000			
Item	**Alternative #1**	**Alternative #2**	**Alternative #3**
Labor	$36,000	$36,000	$36,000
Power	230,000	230,000	230,000
Miscellaneous Repairs and Supplies	75,000	75,000	75,000
Total O&M (Per Year)	$341,000	$341,000	$341,000
TOTAL Annual Costs	**$1,138,826**	**$1,389,095**	**$1,383,558**

Opinion of Probable Costs

Operations and Maintenance (O&M) Costs in 2007*			
Item	**Alternative #1**	**Alternative #2**	**Alternative #3**
Labor	$49,320	$49,320	$49,320
Power	$315,100	$315,100	$315,100
Miscellaneous Repairs and Supplies	$102,750	$102,750	$102,750
Total O&M (Per Year)	$467,170	$467,170	$467,170
TOTAL Annual Costs	**$1,895,602**	**$2,343,582**	**$2,333,633**

* Cost Index of 1.37 was calculated by the Bureau of Labor Statistics for labor costs

Findings

- The opinion of costs for the construction of the capital improvements is $23,385,000. Annual costs to amortize the capital improvements is $1,876,412 (20yrs., i = 5%).
- Operation and maintenance costs are estimated to be $467,170/ year.
- Total cost of the project on a per resident basis is estimated at $44.00/month.
- Several potential methods of payment to retire the capital costs and annual operation exist.

Financing Options

Nebraska Natural Resources Commission

-Development Fund — Grants/Loans

Nebraska Cooperative Agreement/Water Action Plan

- District Creation

  -Drainage District – Assessment of project benefits to the designated area

- Off-Set Water on the Platte River

  -Market Water to Platte River Users

  -- Potential sources include: Downstream Communities and Industry

  -Market Water to Environmental Agencies

  -- Potential sources include: Fish and Wildlife Service, Nebraska Game and Parks, State of Nebraska Department of Water Resources/New Depletion Plan

Financing Options

- Utility User Fees

  Wastewater Department

  Water Department

- General Fund

  General Fund — Municipal Bonds

Thanks for Listening

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