City of Grand Island

Tuesday, March 06, 2012

Study Session Packet

City Council:

Larry Carney
Linna Dee Donaldson
Scott Dugan
Randy Gard
John Gericke
Peg Gilbert
Chuck Haase
Mitchell Nickerson
Bob Niemann
Kirk Ramsey

Mayor:

Jay Vavricek

City Administrator:

Mary Lou Brown

City Clerk:

RaNae Edwards

7:00:00 PM
Council Chambers - City Hall
100 East First Street

Call to Order

This is an open meeting of the Grand Island City Council. The City of Grand Island abides by the Open Meetings Act in conducting business. A copy of the Open Meetings Act is displayed in the back of this room as required by state law.

The City Council may vote to go into Closed Session on any agenda item as allowed by state law.

Invocation

Pledge of Allegiance

Roll Call

A - SUBMITTAL OF REQUESTS FOR FUTURE ITEMS

Individuals who have appropriate items for City Council consideration should complete the Request for Future Agenda Items form located at the Information Booth. If the issue can be handled administratively without Council action, notification will be provided. If the item is scheduled for a meeting or study session, notification of the date will be given.

B - RESERVE TIME TO SPEAK ON AGENDA ITEMS

This is an opportunity for individuals wishing to provide input on any of tonight's agenda items to reserve time to speak. Please come forward, state your name and address, and the Agenda topic on which you will be speaking.

MAYOR COMMUNICATION

This is an opportunity for the Mayor to comment on current events, activities, and issues of interest to the community.

City of Grand Island

Tuesday, March 06, 2012
Study Session

Item C1

Presentation of Audit Report - Pages 100- 101 - Budgetary Comparison Schedule - General Fund

Staff Contact: Jaye Monter

Council Agenda Memo

From: Jaye Monter, Finance Director

Meeting: March 6, 2012

Subject: Audit Report - Pages 100- 101 - Budgetary Comparison Schedule-General Fund

Item #'s: 1

Presenter(s): Terry Galloway

Background

The Fiscal Year 2011 City Single Audit and General Purpose Financial Statement Report was presented to council by Terry Galloway from Almquist, Maltzahn, Galloway & Luth in a study session on 2/21/12.

Discussion

During the presentation Mr. Galloway referenced the Budgetary Comparison Schedule for the General Fund on Page 100 and 101 of the Audit Report. The audit report showed the General Fund Total Appropriations were over budget by $2,633,647. After researching the 2011 Actual amounts in the Audit Report, we found amounts for depreciation expense and an ambulance bad debt expense account were included in the 2011 Actual amounts. These accounts are not considered outlays of cash and therefore should not be in the expenditure total per department to compare to the budgetary department total.

Conclusion

The total appropriations for 2011 Actuals are $34,571,217; therefore the General Fund was under budget by $1,216,938 for budget year 2011. This item is presented to the City Council in a Study Session to allow for any questions to be answered.

	2011 Budget	2011 Actuals	Report Over (Under) Budget	Actuals W/O Depr Exp and Ambulance Accruals	Actual Over (Under) Budget
City of Grand Island					
Budgetary Comparison Schedule-General Fund					
Audit Report-Page 100-101					
City Administrator's Office	313,182	251,487	(61,695)	251,487	(61,695)
Economic Development	350,000	315,554	(34,446)	315,554	(34,446)
Mayor's Office	24,580	15,981	(8,599)	15,981	(8,599)
Council	79,120	70,615	(8,505)	70,615	(8,506)
City Clerk	105,775	105,575	(200)	105,575	(200)
Finance	1,943,767	1,888,968	(54,799)	1,887,113	(56,654)
Legal	325,004	271,538	(53,466)	271,538	(53,466)
City Hall	328,949	506,475	177,526	277,996	(50,953)
One Stop Building	7,500	2,640	(4,860)	2,640	(4,860)
Human Resources	435,577	409,412	(26,165)	409,412	(26,165)
Total General Government	3,913,454	3,838,245	(75,209)	3,607,911	(305,543)
Public Safety:					
Building Inspection	825,856	794,657	(31,199)	787,682	(38,174)
Fire Services	6,878,715	7,444,239	565,524	6,091,337	(787,378)
Police	8,252,641	8,286,683	34,042	7,829,227	(423,414)
Law Enforcement Center	245,085	215,681	(29,404)	215,681	(29,404)
Emergency Management	296,862	310,250	13,388	301,347	4,485
Local Emergency Planning	15,560	5,062	(10,498)	5,062	(10,498)
Comunication	792,020	761,503	(30,517)	760,285	(31,735)
Total Public Safety	17,306,739	17,818,075	511,336	15,990,622	(1,316,117)

	2011 Budget	2011 Actuals	Report Over (Under) Budget	Actuals W/O Depr Exp and Ambulance Accruals	Actual Over (Under) Budget
Public Works					
Engineering	870,930	850,092	(20,838)	825,126	(45,804)
Streets and Transportation	5,463,895	5,191,616	(272,279)	5,009,194	(454,701)
Total Public Works	6,334,825	6,041,708	(293,117)	5,834,320	(500,505)
Environment and Leisure					
Planning	233,722	228,682	(5,040)	228,682	(5,040)
Library	1,865,468	1,970,718	105,250	1,720,394	(145,074)
Parks	1,447,787	1,620,246	172,459	1,390,803	(56,984)
Cemetery	454,101	466,534	12,433	439,096	(15,005)
Recreation	403,110	501,042	97,932	327,811	(75,299)
Aquatics	629,432	644,694	15,262	546,608	(82,824)
Public Information	203,157	235,555	32,398	200,611	(2,546)
Heartland Shooting Park	375,130	473,795	98,665	402,108	26,978
Total Environment and Leisure	5,611,907	6,141,266	529,359	5,256,112	(355,795)
Non-Departmental	2,621,230	4,582,508	1,961,278	3,882,252	1,261,022
Total Appropriations	35,788,155	38,421,802	2,633,647	34,571,217	(1,216,938)

City of Grand Island

Tuesday, March 06, 2012
Study Session

Item C2

Presentation of the Report for Inspection, Structural Analysis and Evaluation of the Eddy Street and Sycamore Street Underpasses

Staff Contact: John Collins, Public Works Director

Council Agenda Memo

From: Scott Griepenstroh, PW Project Manager

Meeting: March 6, 2012

Subject: Presentation of the Report for Inspection, Structural Analysis and Evaluation of the Eddy Street and Sycamore Street Underpasses

Item #'s: 2

Presenter(s): John Collins, Public Works Director

Background

Statements of Qualification were solicited from Consulting Engineering Firms for performing inspection, structural analysis and evaluation of the Eddy Street and Sycamore Street Underpasses.

Two (2) statements of qualification were received. On July 8, 2011, a committee comprised of Manager of Engineering Services Terry Brown, Project Manager Scott Griepenstroh, and Engineering Technician Paul Schwaderer evaluated the statements of qualification based on established criteria. Kirkham Michael & Associates, Inc. of Omaha, Nebraska was selected and an agreement was negotiated for the work to be performed at actual costs with a maximum amount of $42,932.20.

Discussion

An evaluation of the different structural components of the underpasses, including retaining walls, sidewalk tunnels, bridges carrying vehicular traffic, roadway pavement, and an investigation of the drainage systems adequacy, inspection routines and maintenance was performed by Kirkham Michael. A final report detailing the findings and recommendations for repairs has been prepared and will be presented at Tuesday's 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.

It is the intent of City Administration to bring this issue to a future council meeting for discussion and approval of individual treatments for each underpass.

Rehabilitation Alternatives Study

Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses

Grand Island, Nebraska

March 6, 2012

Introductions

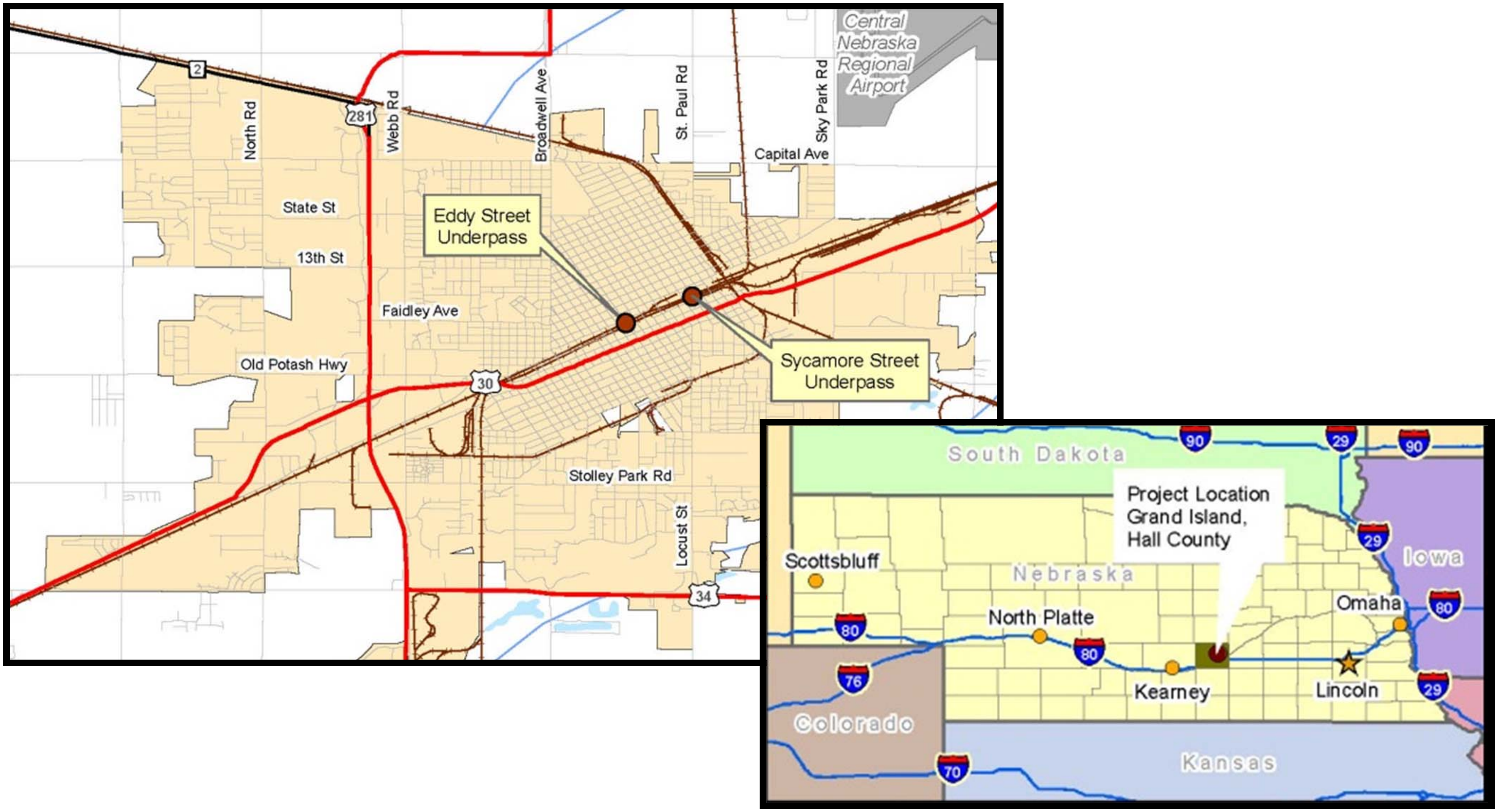
- Eric Johnson, Kirkham Michael

- Steven Kneip, P.E., Bridge Department Manager, Kirkham Michael

Agenda

- Background Information
- Existing Condition of Underpasses
- Proposed Repairs
- Questions / Answers

Project Location



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Project Goals

- Evaluate / Restore Structural Integrity
- Evaluate Drainage / Pavement
- Restore Aesthetic Components
- Deliverables
  - Rehabilitation Alternatives Study
  - Inspection Field Notes
  - Geotechnical Report

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Field Work

- Inspection of Retaining Walls/Pedestrian Walkways / Bridges
- Geotechnical Investigation
- Pavement and Drainage Inspection
- Interviews with City Staff
- General Conclusions
  - Good condition, structurally sound
  - But, in need of repairs to assure continued service

Eddy Street

- Underpass Description
  - Built in 1950
  - 980 Feet Long
  - 3 Union Pacific Railroad Structures
  - 2 Vehicular Structures
    - Mill Drive Bridge
    - N. Front Street Bridge

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Eddy Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Spalls and Popouts

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Eddy Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Horizontal and Vertical Cracks

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Eddy Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Joints

Eddy Street
Existing Conditions

- Retaining Walls/Pedestrian Walkways
  - Pedestrian Walkway / Tunnel

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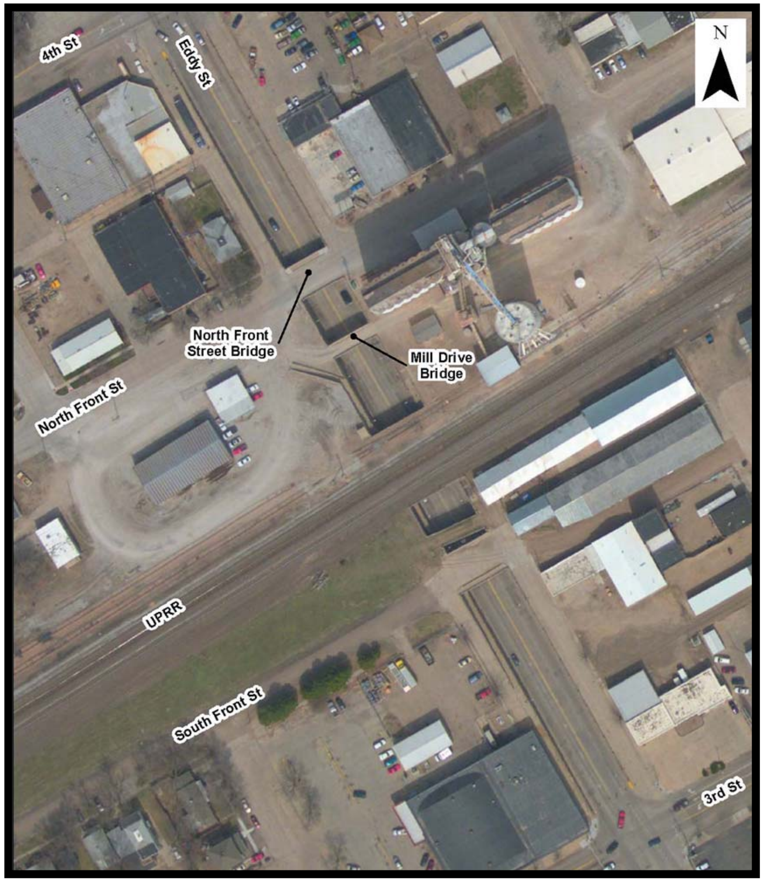
Eddy Street

Existing Conditions

- Bridges
  - Union Pacific Railroad (3 Structures)
  - Mill Drive
  - N. Front Street



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Eddy Street
Existing Conditions

- Mill Drive Bridge
  - 55-Foot Single-span Reinforced Concrete Bridge
  - Good Condition
    - Light spalls
    - Minor cracking
    - Handrail

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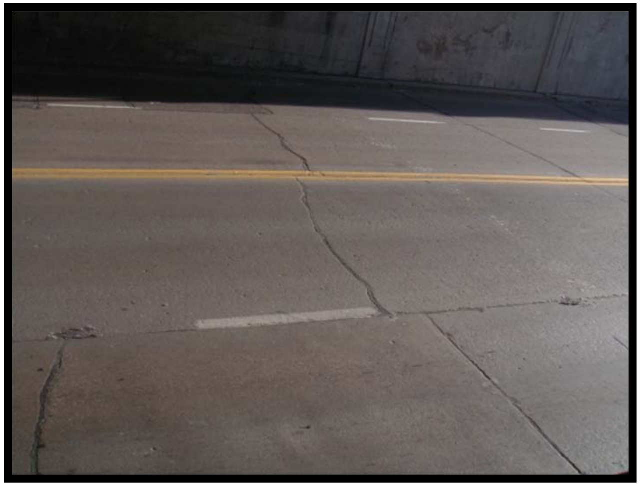
Eddy Street
Existing Conditions

- N. Front Street Bridge
  - 55-Foot Single-span Reinforced Concrete Bridge
  - Average Condition
    - Minor spalls
    - Cracks
    - Efflorescence
    - Map cracking under deck

Eddy Street

Existing Conditions

- Pavement
  - Underpass Pavement
    - Fair condition
    - Original pavement
    - Some structural failure of pavement
    - Curbs spalling
    - Transverse cracking
    - Weathering caused by deicing chemicals
    - 2010 full depth patching
  - Adjacent Pavement
    - Some surface distress
    - Anomalies detected by ground penetrating radar
    - Settlement of pavement slabs



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Eddy Street

Existing Conditions

- Drainage
  - Underpass Drainage System
    - Existing tile drains behind walls and under pavement
    - Failure of walkway drain

  - Storm Sewer System
    - Pumps
    - Downstream storm sewer trunk lines
      - 9,200 feet of 24-inch to 64-inch trunk
      - Discharges to channel on Capital Avenue
    - Road closures

Eddy Street

Proposed Repairs

- Retaining Walls / Pedestrian Walkways
  - Repair Spalls and Popouts
  - Seal All Cracks
  - Install New Lighting System
  - Repair Handrail
  - Replace Sidewalk Ramp in West Tunnel
  - Apply Concrete Coating

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Eddy Street
Proposed Repairs

- Mill Drive Bridge
  - Repair Spalls and Popouts
  - Seal Cracks
  - Replace Damaged Handrail

Eddy Street

Proposed Repairs

- N. Front Street Bridge

  Option 1

  – Repair Underside of Deck
  – Remove Asphalt Overlay
  – Repair Top of Bridge Deck
  – Install Waterproof Membrane
  – Install Asphalt Overlay

  Option 2

  – Install Global Zinc Metallizing

Eddy Street
Proposed Repairs

- Pavement
  - Underpass Pavement
    - Full depth pavement replacement of failing slabs
    - Partial depth replacement of spalling curb
  - Adjacent Pavement
    - Replace pavement slabs that have settled and do not drain

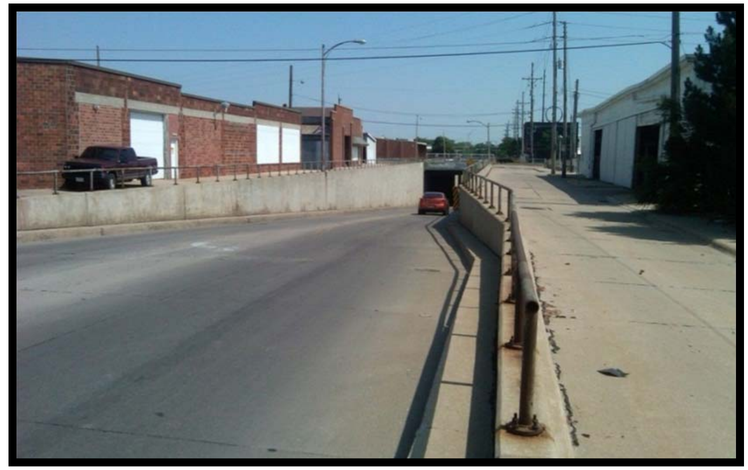
Eddy Street

Proposed Repairs

- Drainage
  - Repair Failed Walkway Drainage Pipe
  - Grout Connections of Drain Tiles to Inlets
  - Continue Program to Clean and Inspect Storm Sewers

Sycamore Street

- Underpass Description
  - Built in 1952
  - 960 Feet Long
  - 1 Union Pacific Railroad Structure
  - 2 Vehicular Bridges
    - Industry Overpass Bridge
    - S. Front Street Bridge



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Sycamore Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Spalls and Popouts

Sycamore Street

Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Horizontal and Vertical Cracks

Sycamore Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Joints

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Sycamore Street
Existing Conditions

- Retaining Walls / Pedestrian Walkways
  - Pedestrian Walkway Sidewalk

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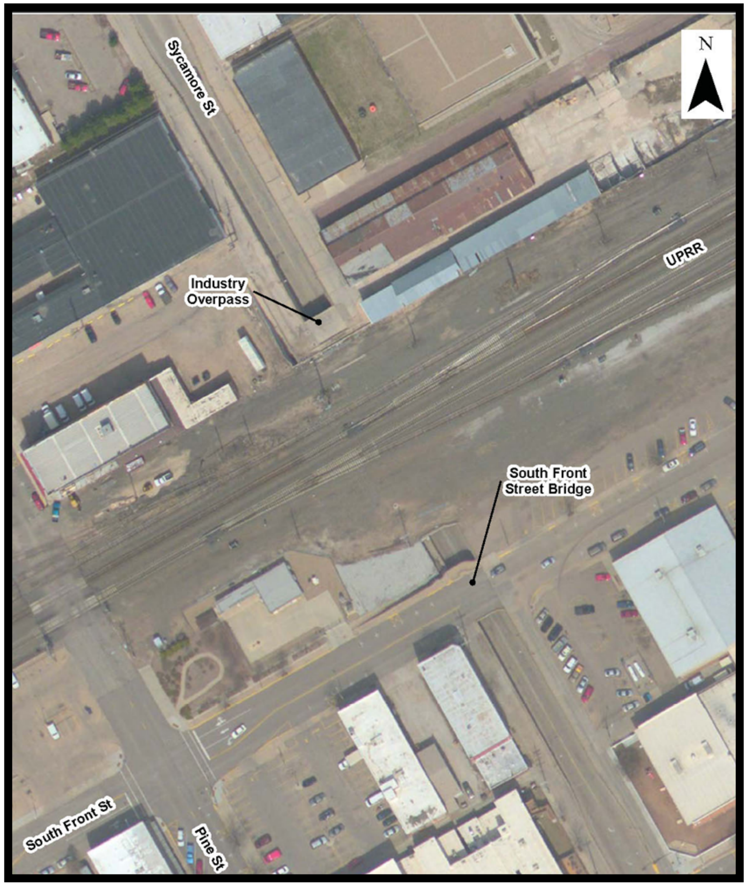
Sycamore Street

Existing Conditions

- Bridges
  - Union Pacific Railroad (1 Structure)
  - Industry Overpass
  - S. Front Street



Sycamore Street
Existing Conditions

- Industry Overpass Bridge
  - 30-Foot Single-span Reinforced Concrete Bridge
  - Poor Condition
    - Heavy spalls on deck
    - Broken curbs
    - Efflorescence

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Sycamore Street
Existing Conditions

- S. Front Street Bridge
  - 30-Foot Single-span Reinforced Concrete Bridge
  - Poor Condition
    - Collision damage
    - Map cracking
    - Efflorescense

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Sycamore Street

Existing Conditions

- Pavement
  - Underpass Pavement
    - Poor to failing condition
    - Original pavement
    - Structural failure of pavement
    - Pumping of subgrade
    - Transverse cracking
    - Weathering caused by deicing chemicals
    - Asphalt patching
  - Adjacent Pavement
    - Some surface distress
    - Anomalies detected by ground penetrating radar
    - Settlement of pavement slabs and walk

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Sycamore Street

Existing Conditions

- Drainage
  - Underpass Drainage System
    - Bridge drains, walkway drains, and tile drains under pedestrian walkway
  - Storm Sewer System
    - Sycamore Street inlets and storm sewer
    - Pumps
    - Downstream storm sewer trunk lines
      - 4,800 feet of 12-inch to 72-inch trunk
      - Discharges to channel on Swift Road
    - Road closures

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Sycamore Street

Proposed Repairs

- Retaining Walls / Pedestrian Walkways
  - Repair Spalls and Popouts
  - Seal Cracks
  - Replace Missing Handrail
  - Install New Lighting System
  - Replace Sidewalk Ramp at Southwest Approach to Tunnel
  - Apply Concrete Coating

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Sycamore Street

Proposed Repairs

- Industry Overpass Bridge
  - Repair Deck Spalls and Popouts
  - Repair Underside of Deck
  - Repair Curb
  - Place New Concrete Overlay

Sycamore Street
Proposed Repairs

- S. Front Street Bridge
  - Repair Damage to Northeast Corner
  - Repair Underside of Deck

Sycamore Street

Proposed Repairs

- Pavement
  - Underpass Pavement
    - Complete removal and replacement of pavement
  - Adjacent Pavement
    - Replace pavement slabs that have settled and do not drain
    - Replace sidewalk that has settled on the north side of the S. Front Street bridge.

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Sycamore Street

Proposed Repairs

- Drainage
  - Abandon grate inlets on the walkway ramps
  - Continue program to clean and inspect storm sewers

Repair Schedule

- 2012
  - Eddy Street
    - Pavement repairs – full depth
  - Sycamore Street
    - Pavement replacement
    - Retaining wall / walkway repairs
    - S. Front Street Bridge repairs

Repair Schedule

- 2013
  - Eddy Street
    - Retaining wall / walkway repairs
    - Mill Drive Bridge repairs
    - N. Front Street Bridge repairs
  - Sycamore Street
    - Industry Overpass Bridge repairs

Repair Schedule

- 2013 - 2017
  - Eddy Street
    - Miscellaneous adjacent pavement repairs
    - Walkway drain repair
  - Sycamore Street
    - S. Front Street pavement repairs
    - Miscellaneous adjacent pavement repairs
    - Walkway repairs / abandon inlets

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Repair Schedule

- 2013 - 2017
  - Eddy Street
    - Miscellaneous adjacent pavement repairs
    - Walkway drain repair
  - Sycamore Street
    - S. Front Street pavement repairs
    - Miscellaneous adjacent pavement repairs
    - Walkway repairs / abandon inlets
- 2022
  - Eddy Street Pavement Replacement

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Summary

- Eddy Street and Sycamore Street Underpasses
  – Structurally sound – but,
  – Repairs needed
    - Provide safe passage for traveling public
    - Prevent further deterioration
    - Extend life of underpasses
    - Restore the aesthetic appeal

Questions ?

February 23, 2012

Rehabilitation Alternatives Study

Eddy Street and Sycamore Street Union Pacific Railroad Underpasses

Grand Island, Nebraska

Submitted to:

City of Grand Island

Prepared by:

Kirkham Michael

TABLE OF CONTENTS

FIGURES

TABLE

EXECUTIVE SUMMARY

Background

The City of Grand Island (City) seeks to extend the life and address pedestrian safety issues of the Eddy Street and Sycamore Street Underpasses. In July of 2011, the City contracted with Kirkham, Michael & Associates, Inc. (Kirkham Michael) to develop a rehabilitation and maintenance program for the Underpasses.

Field Inspections

The field inspection was conducted during the week of August 24, 2011, and the complete field notes and the associated photos are included in a separate document which is available from the City Public Works Department. The field inspection of the Underpasses included the following components: retaining walls; pedestrian walkways; vehicular bridges; roadway curbs; and miscellaneous components such as railings.

The field inspection identified extensive concrete spalling and popouts, areas of broken concrete with exposed rebar, horizontal, vertical, and map cracking, and some collision damage. In addition to the concrete issues noted, there was damage to the handrails in numerous areas and the lighting system in both viaducts was inoperable.

Material Testing and Sampling

Terracon Consultants, Inc. (Terracon) performed material sampling and testing on August 24, 2011. The testing and sampling was done to determine subsurface soil conditions, groundwater conditions, condition of backfill behind the retaining walls, and locate any voids under the pavement and behind the retaining walls. The testing and sampling did not reveal any substantial voids or adverse subsurface conditions. The full report is a separate document and is available from the City Public Works Department.

Pavement Evaluation

The pavement evaluation noted that the condition of the Eddy Street pavement as fair and the condition of Sycamore Street pavement as poor to starting to fail. Transverse cracking was the most common type of pavement distress. The City's annual street maintenance program has done a good job sealing cracks and preventing severe pavement failure from developing. The primary cause of pavement distress was found to be weathering and damage by deicing chemicals. It was found that there was distress caused by structural failure of pavement. Given the condition of the Eddy Street pavement, it is recommended that full depth repairs of failing pavement near the low point of the underpass be completed in 2012. When it becomes necessary to completely remove and replace the Eddy Street pavement, a subgrade drainage system should be constructed.

Given the extent of distress on Sycamore Street, it is recommended that the pavement be completely removed and replaced.

Drainage Evaluation

The drainage evaluation noted that the drainage system is effective at preventing damage to infrastructure. The performance of the system to prevent ponding was hampered by run-on to the Underpasses, and was constrained by the capacity of the downstream storm sewer trunk lines.

Conclusion

The observed deterioration to the retaining walls and pedestrian walkways appear to be cosmetic only. There is little or no settlement or lateral movement of the retaining wall which indicates that the structural integrity of both underpasses is satisfactory. The four (4) vehicular bridges will need further investigation and a load rating will need to be completed. By observation, the bridges appear to be in adequate condition to carry the anticipated load at this time. However, continued maintenance and rehabilitation of the underpasses will need to be performed to extend the life of both facilities.

American with Disabilities Act (ADA)

The pedestrian walkway on both the Eddy Street and Sycamore Street Underpasses do not meet ADA requirements. The recommended repairs contained herein do not address ADA requirements, which was beyond the scope of this report. Additional evaluation of the pedestrian walkway will need to be completed in order to accommodate ADA requirements.

Recommended Repairs

The following repairs are recommended to extend the life of the Underpasses and to provide safe passage for vehicles and pedestrians:

Retaining Walls and Pedestrian Walkways (both Eddy Street and Sycamore Street)

- Repair spalls, popouts, and concrete breakouts
- Seal all horizontal and vertical cracks
- Seal expansion joints at two locations
- Repair/replace handrails

- Install vandal resistant lighting system in pedestrian walkways
- Apply concrete coating to vertical faces of the retaining walls and bridge abutments
- Repair/replace pedestrian walkways

Bridges (detailed recommended repairs per bridge located later in the report)

- Repair spalled areas on top of and underside of decks
- Repair curbs
- Repair collision damage
- Install waterproof membrane
- Install asphalt overlay
- Apply concrete coating to vertical faces of the retaining walls and bridge abutments

Pavement

- Continue annual street maintenance program including repair of potholes and routing and sealing cracks
- For the Eddy Street underpass, continue the full depth pavement repairs that were started in 2011 in order to replace failing pavement as needed
- For the Sycamore Street underpass, completely remove and replace pavement and install subgrade under-drain system
- Abandon Sycamore Street ramp drainage grates
- Remove and replace settled pavement

Drainage System

The City's storm sewer maintenance program will be successful in increasing the capacity of the downstream system by removing built up sediment from storm sewer trunks. Once the deposition of sediment in the storm system has stabilized, a detailed study to determine whether it would be beneficial to increase the capacity of the pumps is recommended. This study will need to evaluate the efficiency of the existing storm sewer system and the impacts caused by local street drainage.

Proposed Rehabilitation / Maintenance Program

The recommended repairs and maintenance issues to the Eddy Street and Sycamore Street Underpasses are listed in Table 4.1 below. The repairs and maintenance issues are prioritized in order of need and are recommended to be completed over the next six years.

Table 4.1 – Rehabilitation / Maintenance Schedule

Year	Repair / Maintenance Description	Facility
2012	Repair Retaining Walls / Walkways [1]	Sycamore Street
2012	Full Depth Pavement Repairs	Eddy Street
2012	Complete Removal and Replacement of Pavement	Sycamore Street
2012	S. Front Street Bridge Repairs	Sycamore Street
2013	Industry Overpass Repairs	Sycamore Street
2013	Repair Retaining Walls / Walkways [1]	Eddy Street
2013	Mill Drive Bridge Repairs	Eddy Street
2013	N. Front Street Bridge Repairs (Option No. 1)	Eddy Street
2013-2017	Miscellaneous Patching to Adjacent Pavement	Eddy Street
2013-2017	Damaged Walkway Drain Repair	Eddy Street
2013-2017	S. Front Street Pavement Repairs	Sycamore Street
2013-2017	Miscellaneous Patching to Adjacent Pavement	Sycamore Street
2013-2017	Repair Walkway and Abandon Grate Inlets	Sycamore Street
2022	Complete Removal and Replacement of Pavement	Eddy Street

(1) See Pages 12 and 32 for complete repair information

1.0 INTRODUCTION

1.1 Project Description

The UPRR runs through the center of Grand Island in a northeast to southwest direction. There are two overpasses, located at U.S. Highway 281 and U.S. Highway 30, and two underpasses, located at Eddy Street and Sycamore Street, that move vehicular and pedestrian traffic across the UPRR corridor. All other crossings along the UPRR corridor are at-grade crossings controlled by gates and flashers. The Eddy Street and Sycamore Street Underpasses provide unobstructed movement of traffic north and south of the UPRR corridor, which is vital to businesses and emergency vehicles. The project location is shown in *Figure 1, Page 3*.

These 1950's era underpasses at Eddy Street and Sycamore Street are exhibiting some major defects and deterioration in the form of concrete spalls and popouts, horizontal, vertical and map cracking, and collision damages.

This study will address the rehabilitation of the Eddy Street and Sycamore Street Underpasses, which includes the following components:

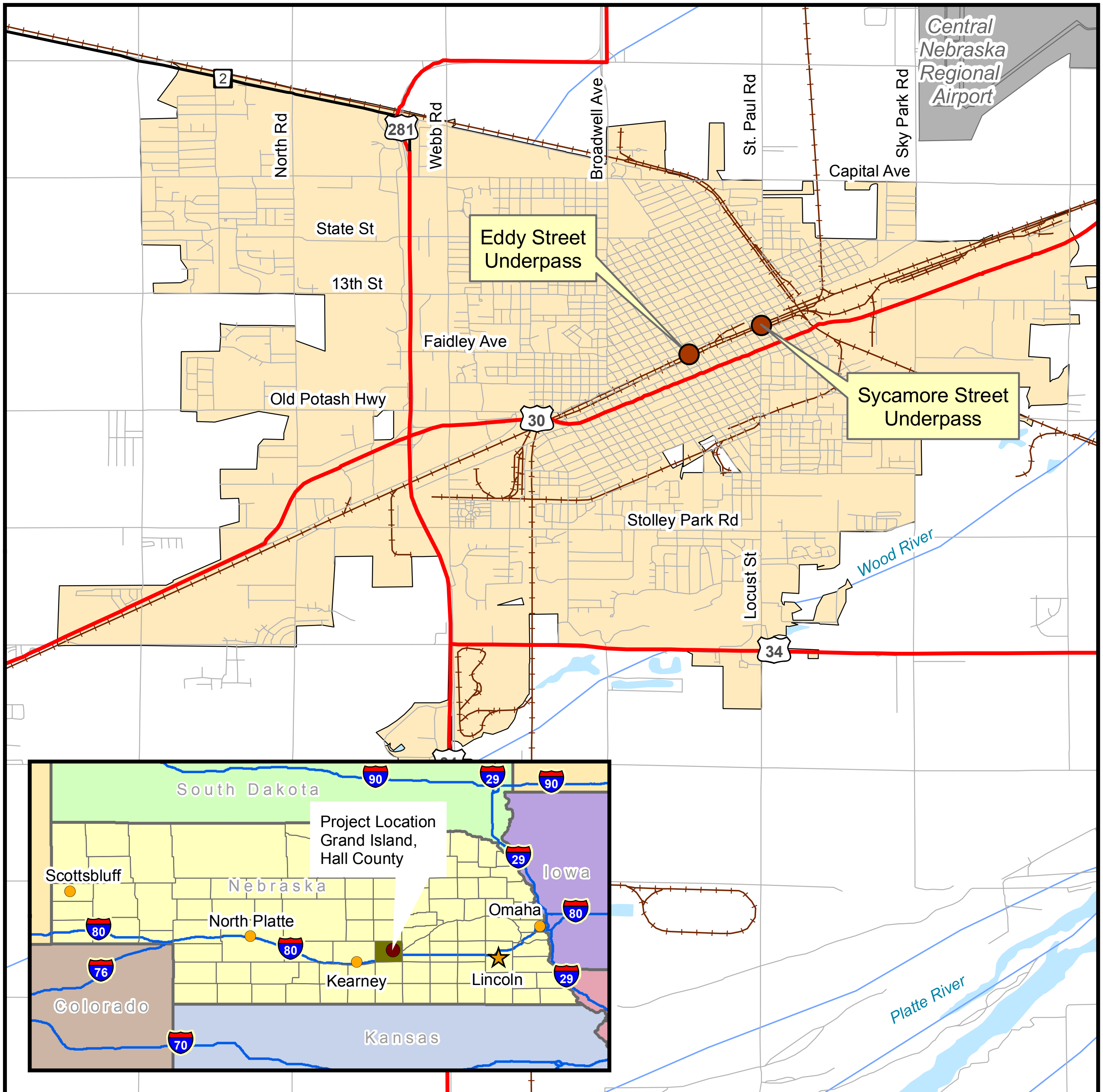
- Retaining Walls
- Pedestrian Walkways
- Vehicular Bridges
- Pavement (on Eddy Street and Sycamore Street, as well as the side streets, on top of and adjacent to the retaining walls)
- Drainage System

1.1.1 Structural Description of Eddy Street Underpass
(Figure 2, Page 4)

- Built in 1950
- 980 feet long, end of retaining wall to end of retaining wall
- Accommodates four lanes of traffic – four 12-foot lanes, two two-foot shoulders
- Three UPRR structures
- Two vehicular crossings (Mill Drive and N. Front Street)
- Plans and agreement with UPRR on file in the Public Works Department

Photo 1.1: Eddy Street Underpass at south end of underpass, looking north.

Photo 1.2: Eddy Street Underpass at Mill Drive Bridge, looking north.



N

1 inch equals 1.25 miles

Legend

- Interstate Highway
- US Highway
- State Highway
- Local Roads and Streets
- County Boundary
- Grand Island City Limits
- Airport
- Rivers and Creeks

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FIGURE 1
PROJECT LOCATION MAP

Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses
Grand Island, Nebraska

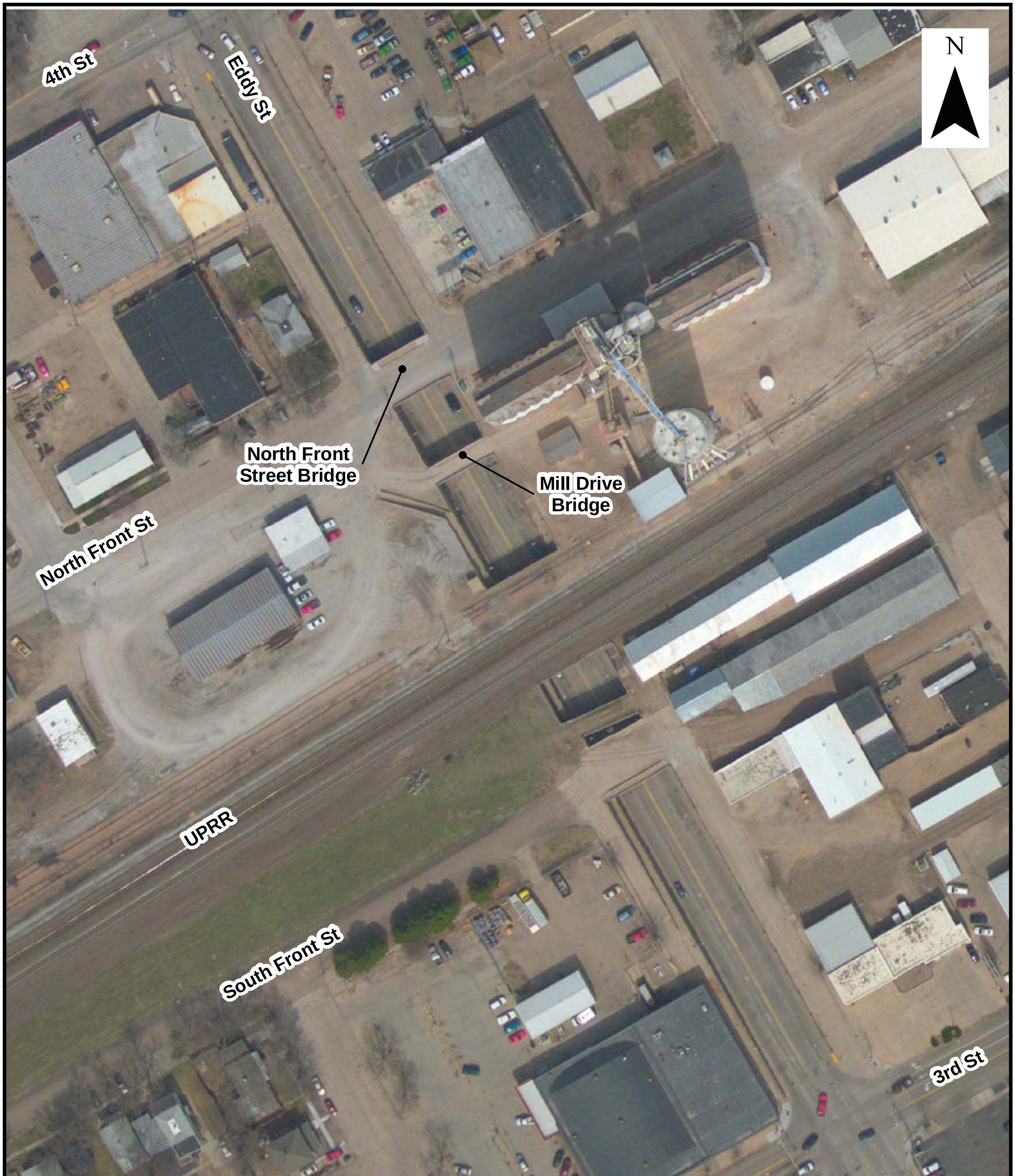

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FIGURE 2
EDDY STREET UNDERPASS SITE MAP

Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses
Grand Island, Nebraska

1.1.2 Structural Description of Sycamore Street Underpass

(Figure 3, Page 6)

- Built in 1952
- 960 feet long, end of retaining wall to retaining wall
- Accommodates two lanes of traffic – two 12-foot lanes, two 1.5-foot shoulders
- One UPRR structure
- Two vehicular crossings (Industrial Overpass and S. Front Street)
- Plans and agreement with UPRR on file in the Public Works Department

Photo 1.3 - Sycamore Street Underpass at S. Front Street Bridge, looking south.

Photo 1.4 - Sycamore Street Underpass at north end of Underpass, looking south.

CITY OF GRAND ISLAND

KIRKHAM MICHAEL

FIGURE 3
SYCAMORE STREET UNDERPASS SITE MAP

Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses
Grand Island, Nebraska

1.2 Project Goals

The City desires to extend the life of the Eddy Street and Sycamore Street UPRR Underpasses. In response to continued deterioration of the underpasses, both structurally and aesthetically, and the motoring public voicing concerns regarding the safety and appearance of the underpasses, the City has contracted with Kirkham, Michael to provide a detailed inspection and recommend low cost maintenance and rehabilitation projects to extend the service life of the underpasses.

The purpose of this report is to provide a long-range plan that the City can use as a guide to rehabilitate the Eddy Street and Sycamore Street Underpasses. Specifically, several objectives were identified for this study and are as follows:

- Perform a detailed inspection of the Eddy Street and Sycamore Street Underpasses, including the retaining walls, pedestrian walkways, vehicular bridges, pavement, and drainage
- Identify specific areas of concern in each of the underpass components
- Develop repair/rehabilitation alternatives
- Develop a repair/rehabilitation schedule within budget restrictions

It is vital while meeting the above objectives that we focus on the following issues:

- Public safety through structural integrity
- Availability of funding and project budget
- Phasing of construction to minimize disruption to motoring public

Ultimately, it is the goal of the recommended actions to restore the structural integrity and the aesthetic components of the Eddy Street and Sycamore Street UPRR Underpasses, and thus foster public pride and confidence in these two important transportation links.

2.0 EDDY STREET UNDERPASS

The Eddy Street Underpass was inspected by Kirkham Michael during the week of August 24, 2011. The complete inspection report entitled, *"Eddy Street and Sycamore Street Underpasses, Inspection Notes and Photos, August 2011"(Reference 1),* including notes and photos, is a supporting document that is available from the City Public Works Department.

A pavement and drainage evaluation was also conducted by Kirkham Michael November 15, 2011. Detailed results of these evaluations are included in subsequent sections later in this report.

In addition to the structural inspections and pavement and drainage evaluations, Terracon performed material sampling and testing on August 24, 2011. The detailed results of the report entitled*, "Geotechnical and Geophysical Survey Report, December 2011" (Reference 2)*, is a supporting document that is also available from the City Public Works Department.

2.1 Retaining Walls / Pedestrian Walkways

The existing retaining walls are reinforced cast-in-place concrete cantilever walls with concrete footings and provide a foundation for the vehicular and railroad bridge structures. The walkways were constructed integral with the retaining walls. The Eddy Street Underpass plans are available for review at the City offices.

Existing Conditions:

The retaining walls and pedestrian walkways, on both the left and right sides of Eddy Street, are in fairly good structural condition. There is no apparent settlement of the retaining walls, no differential lateral deflection of the retaining wall segments, and no structural failures. However, the retaining walls and pedestrian walkways do exhibit numerous minor faults including concrete popouts and spalling, horizontal and vertical cracking, exposed rebar, and expansion joint sealant failure. A full, detailed inspection of the retaining walls and pedestrian walkways is included in the *"Eddy Street and Sycamore Street Underpasses, Inspection Notes and Photos, August 2011" (Reference 1).*

1. ***Spalls and Popouts.*** There are almost 200 areas of concrete spalling (i.e. the concrete is debonded from the rebar). Of these 200 spalled areas, the concrete has "popped out" in 140 of them, exposing the reinforcing steel. The spalled areas vary in size from 2" x 2" to 4' x 8'. Many of the spalled areas occur in the curb, which is not structurally part of the retaining walls, but was inspected at the same time as the retaining walls. The anticipated repairs to the spalled curbs are the same as the anticipated repair to the retaining walls, so the repair of the curbs was included with the repair of the retaining walls.

There are several reasons for the occurrence of spalls and popouts:

- Inadequate concrete cover over the rebar
- Presence of cracks which allow access to water making the concrete susceptible to freeze/thaw cycles
- Embedded concrete forming hardware (snap ties/hairpins); this hardware was probably grouted over, but the grout may have failed.

Because of the substantial thickness of the retaining walls (2 to 3 feet), the spalls and popouts are not compromising the integrity of the retaining walls at this time. However, if not addressed, any exposed rebar in the spalls and popouts will continue to rust and will cause further deteriorization of the concrete.

Photo 2.1: Typical spalls.

Photo 2.2: Typical popouts.

2. ***Horizontal and Vertical Cracks.*** There are about 75 horizontal and vertical cracks evident in the retaining walls and pedestrian walkways, ranging in length from several inches to several feet.

   These cracks are caused by several factors:

   - Concrete shrinkage
   - Alkali aggregate reactivity (network of cracks, spalling)[1]
   - Corrosion of embedded reinforcing steel

   The cracks observed in the retaining walls have not "opened up". They remain as hairline cracks or minor cracks which indicate that there is no structural issue related to the cracks and they do not compromise the integrity of the retaining walls. However, if not addressed, the cracks will remain susceptible to freeze/thaw cycles and spalling and popouts may occur along the crack line.

3. ***Joints.*** A typical wall expansion joint consists of a Gates Rubber waterstop located at the center of the wall and a strip of 1-inch bituminous material on each side of the water stop. It appears that the 1-inch bituminous material on the roadway side of the retaining walls at each of the joints has fallen out, but there is little or no evidence of any of the backfill material migrating through the waterstop. At this time, no repairs are needed on the joints, but it is recommended that the City monitor the joints for any future material migration.

4. ***Sidewalk in Pedestrian Tunnel.*** A section of sidewalk in the pedestrian tunnel on the west side of Eddy Street has settled at the face of the retaining wall and water is ponding up against the wall. This is a result of settlement of the backfill material under the sidewalk up against the retaining wall where full compaction is difficult. The sidewalk in this area will need to be removed, the backfill restored and adequately compacted, and the concrete sidewalk replaced.

   An additional section of the sidewalk in the pedestrian tunnel on the west side of Eddy Street needs to be removed and replaced to correct a broken drainage pipe. A discussion of the problem is presented in the Eddy Street drainage section of the report.

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[1] Not prevalent in Portland Cement produced prior to the Clean Air Act of 1963.

Photo 2.3: Typical vertical crack.

Photo 2.4: Typical horizontal crack.

Conclusion:

The deterioration of the retaining walls and pedestrian walkways appears to be cosmetic only. There is little or no settlement or lateral movement of the retaining walls which indicates that the structural integrity of the underpass is satisfactory. However, continued maintenance and rehabilitation of the retaining walls and pedestrian walkways will need to be performed to extend the useable life of the Eddy Street Underpass.

Proposed Repairs:

The following repairs to the retaining walls and pedestrian walkways should be completed to assure that the Eddy Street Underpass will continue to provide safe passage for vehicles and pedestrians for the next 20 years:

- Repair all spalled areas and popouts
- Seal all horizontal and vertical cracks with caulk
- Install new vandal resistant lighting system in pedestrian walkway under the bridge
- Repair handrail
- Remove and replace concrete sidewalk ramp in west pedestrian tunnel

Repairing spalled areas, popouts, and sealing all horizontal and vertical cracks will prevent the exposed reinforcing steel from further corrosion and reduce the chance of future concrete failures. At this time, no repairs to the expansion joints are needed, but it is recommended that the city monitor the joints for any backfill material migration.

Americans with Disabilities Act (ADA):

The ADA requires that the maximum slope allowable on pedestrian walkways is 8.33% (12:1). Level landings are required at every 30 inches of rise for ramps greater than 5.0% grade. The Eddy Street Underpass pedestrian walkway ramps are at a 10% grade and do not have level landings. Therefore, the pedestrian walkways do not comply with ADA requirements. The recommended repairs contained herein do not address ADA requirements, which was beyond the scope of this report. Additional evaluation of the pedestrian walkway will need to be completed in order to accommodate ADA requirements.

2.2 Bridges

2.2.1 Mill Drive Bridge

The Mill Drive Bridge is a single-span, 55-foot reinforced concrete slab bridge with a three-foot roadway width. The bridge is supported on concrete wall abutments.

According to the agreement with UPRR for the underpass, the City of Grand Island has the responsibility for the maintenance and inspection of the Mill Drive Bridge. Kirkham Michael performed the first inspection of the Mill Drive Bridge during the week of August 24, 2011, and reported the findings to the Nebraska Department of Roads (NDOR) Bridge Division. The bridge inspection information was uploaded into NDOR’s PONTIS Bridge Data system. The bridge is required to be inspected every two years.

Photo 2.5: Mill Drive Bridge, looking north.

Existing Conditions:

The Mill Drive Bridge is in good condition, exhibiting light spalling and two 3-foot horizontal cracks along the side of the slab. There is also random map cracking and minor spalls on the top of the slab. A 10-foot section of handrail is missing.

Photo 2.6: Mill Drive Bridge, random map cracking and minor spalls.

Conclusion:

The Mill Drive Bridge will need further investigation and a load rating will need to be completed. By observation, the bridge appears to be in adequate condition to carry the anticipated loads at this time. Continued maintenance and rehabilitation of the Mill Drive Bridge will need to be performed to extend the life of the bridge.

Proposed Repairs:

The following repairs to the Mill Drive Bridge are recommended to inhibit further deterioration of the bridge and to continue to provide safe passage for vehicles and pedestrians:

- Repair areas of spalling/popouts
- Seal cracks
- Replace damaged handrail

2.2.2 N. Front Street Bridge

The N. Front Street Bridge is a single-span, 55-foot reinforced concrete slab bridge with 32-foot roadway width. The bridge is supported on concrete wall abutments.

According to the agreement with UPRR for the Underpass, the City of Grand Island is responsible for the maintenance and inspection of the N. Front Street Bridge. Kirkham Michael performed the first inspection of the N. Front Street Bridge during the week of August 24, 2011, and reported the findings to the NDOR, Bridge Division. The bridge inspection information was uploaded into NDOR's PONTIS bridge data system. The bridge is required to be inspected every two years.

Existing Conditions:

The N. Front Street Bridge is in average condition and is exhibiting some minor popouts, spalling, several vertical and horizontal cracks on the sides of the slab and severe map cracking on the underside and along the edge of the slab. Secondary efflorescence is evident at one corner of the bridge. Road salts have been absorbed through cracks in the concrete deck and have begun to dissolve the cement, forming stalactites on the bottom of the bridge deck.

As previously stated, the map cracking on the underside of the deck is severe. Repairs need to be implemented soon. If not, chunks of concrete may start to break loose and drop on the roadway below.

Conclusion:

The N. Front Street Bridge will need further investigation and a load rating will need to be completed. By observation, the bridge appears to be in adequate condition to carry the anticipated loads at this time. Continued maintenance and rehabilitation of the N. Front Street Bridge will need to be performed to extend the life of the bridge.

Photo 2.7: N. Front Street Bridge, bottom of the bridge deck.

Proposed Repairs:

The N. Front Street Bridge can be repaired with either of two options:

Option 1:

- Repair underside of deck (Class II Repair[2]). This is accomplished by removing delaminated concrete, cleaning the rebar, forming up the underside of the bridge deck and pumping in a cementitious construction grout.
- Remove existing asphalt overlay
- Repair bridge deck slab (Class I and II Repair)[3]
- Install waterproof membrane
- Install new 2-inch asphalt overlay

It is anticipated that the underside of the bridge deck will require additional repairs at 5 years and again at 10 years due to advancing rebar corrosion and a potential for more spalling.

Option 2:

- Same repair procedure as Option 1 above.
- Install global zinc metalizing[4]

[2] Class II Repairs – Removal of concrete from bottom of Class I repair to mid depth of concrete.
[3] Class 1 Repairs – Removal of concrete from surface to nearest mat of rebar.

The zinc metalizing will provide galvanized protection of the rebar, stopping further corrosion. This repair option will last about 15 to 20 years.

2.2.3 UPRR Bridges

UPRR inspects each railroad structure twice annually. Inspection reports are reported on the "Engineer Structure Management Program". Based on an interview of UPRR officials by City Engineering staff on May 2, 2011, most inspection items are rated in good condition or only need minor maintenance. There are no immediate concerns with the railroad structures and no repairs are needed.

2.3 Pavement Evaluation

The Eddy Street Underpass pavement was evaluated from 3rd Street to 4th Street. Both the Eddy Street pavement and the pavement located adjacent to the perimeter of the underpass structure were evaluated. Information about the pavement was obtained from field visits, a geotechnical investigation, City staff interviews, and review of construction drawings.

The Pavement Evaluation section begins with a discussion of the history of the pavement, provides a classification system for determining the condition of the pavement, identifies and evaluates areas of concern, and finally recommends a program for reconstruction and maintenance.

2.3.1 Pavement History

The Pavement History subsection provides information regarding the type, age, and repair history of the pavement.

The Eddy Street pavement is comprised of Portland Cement Concrete (PCC), also referred to as rigid pavement. The depth of the pavement varies from 8 inches to 11 inches, and is reinforced with rebar and welded wire. The pavement subgrade is comprised of clean fine to coarse sand. Although groundwater was observed in the subsoil, the subgrade material is well draining and there was no indication of pavement damage caused by poorly draining subgrade or by high groundwater table.

The Eddy Street pavement was constructed at the time that the underpass was built. The strength, wear resistance, and resilience to Alkali-Silica Reaction damage of the original paving material is excellent. However, the overall condition of the pavement is fair.

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[4] Zinc Metalizing – Application of a thin layer of metallic zinc and an electrical connection to the bridge deck rebar, providing galvanic corrosion protection.

However, there is considerable transverse cracking, the concrete curbing is spalling, and the pavement located at the bottom of the overpass is starting to fail.

The City's annual street maintenance program undertakes pavement repair work and sealing of pavement joints. Maintaining the seal of joints prevents infiltration of moisture, preventing saturation of subgrade and eliminating damage caused by expansion of frozen water. As a result of the annual street maintenance program, the Eddy Street Underpass joints are resealed every two years.

Pavement was repaired on Eddy Street in the summer of 2011, replacing failing concrete panels with PCC pavement. Failing panels were identified as those that were badly cracked. The pavement failure was not accompanied by faulting or by structural failure of the pavement slab, indicating that there were no drainage problems nor deficiencies of the subgrade. Some voids were discovered under the failing pavement slabs. The soil borings conducted for the geotechnical report were taken under pavement that was replaced. The soil boring report supports that the pavement failure was not caused by poorly performing subgrade.

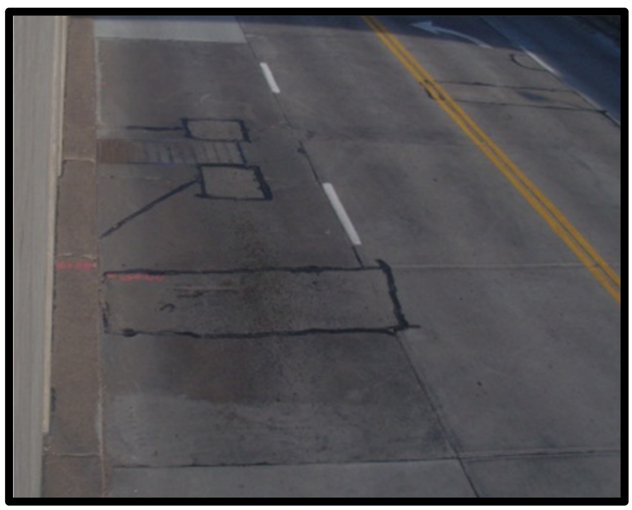

Photo 2.8: Typical Eddy Street pavement failure.

The paved areas adjacent to the underpass are comprised of PCC, and are maintained biennially through the City's program to route and seal cracks and joints. The Pavement sections and repair history of the adjacent pavement is unknown.

2.3.2 Systematic Evaluation of Pavement Condition

The NDOR *Pavement Maintenance Manua*l *(Reference 7)* identifies six distinct types of pavement distress, listed below:

1. Joint Distress
2. Faulting
3. Transverse Cracks
4. Pattern Cracking
5. Surface Distress
6. Slab Cracking

Chapter 3 of the Pavement Maintenance Manual has detailed descriptions and illustrations of each type of distress. The following sections discuss each type of distress that was observed during the field inspection of the Eddy Street pavement.

1. ***Joint Distress.*** With the exception of the failing pavement located at the bottom of the underpass, joint distress was not typically observed. Breaking or chipping at the joints was not observable because the joints were sealed. Where joint distress was observed it was characterized as low. Joint distress characterized as low, has a few hairline cracks emanating from the joint, with the possibility of discoloration emanating from the joint. The City's current maintenance program is adequately controlling joint distress problems by maintaining the seal of joints and cracks. No additional action is recommended to specifically correct joint distress.

At the bottom of the underpass, joint distress is severe, resulting in spalling and pavement failure. The maintenance history of this pavement includes filling potholes on an annual basis and full depth pavement repair. Given the severity of the distress, and the increasing cost of maintenance, corrective action is recommended.

2. ***Faulting.*** Faulting was not observed. Joint deformation was observed between the original pavement and pavement patches. The joint deformation results in a slight vertical elevation difference between pavement slabs, similar to faulting. The joint deformation is difficult to avoid for patch repairs. As is the case for faulting, the joint deformation was not caused by pavement failure or subgrade failure. Because the root cause of the deformation is unrelated to these issues, the joint deformation and the resulting bumpy ride could be corrected by surface grinding.

3. ***Transverse Cracks.*** Transverse cracking was observed through all original panels that have not been replaced. The transverse cracking most likely developed shortly after the pavement was placed, and would have been prevented if transverse joints had been constructed at a 15-foot to 18-foot spacing. The severity of the transverse cracking would be characterized as high, with cracks greater than ¼-inch wide and spanning the entire width of the panel. Given the cause of the cracking, costly repairs are not warranted. The City's current maintenance program involving routing and sealing the cracks is adequate to prevent degradation of the pavement structure and subgrade. At this point, continued maintenance and monitoring is recommended.

Photo 2.9: Typical Eddy Street Underpass transverse cracks.

4. ***Pattern Cracking.*** Pattern cracking was observed at the surface of the pavement. The cracking is characterized as low. The pattern cracking is likely caused by deicing chemicals and weathering. No additional maintenance treatments are recommended.

5. ***Surface Distress.*** Surface distress was not common with the exception that evidence of surface distress was observed in the low points of the road near drainage inlets and was found on the concrete curbing. In the vicinity of drainage inlets surface distress is evidenced by pothole repairs. Potholes are caused by freeze-thaw stresses, causing the pavement to spall and pop out. At these locations, the recommended maintenance activity is to repair potholes with hot-mix or cold-mix asphalt. As the severity and frequency of repairs increases, a partial or full depth patch with PCC should be used.

   The concrete curbing was observed to be cracking and spalling, resulting in exposed reinforcing steel. Corrosion of the exposed reinforcing steel increases the rate of deterioration of the curb. The rusted steel expands and causes internal stresses that break apart the concrete curb. Recommendations for maintenance are to clean the reinforcing steel and repair the spalling. Because this repair is similar to repairs made to the retaining wall, the recommended repairs are included with the repairs to the retaining walls.

Photo 2.10: Typical Eddy Street Underpass curb spalling along west curb line.

6. ***Slab Cracking.*** Slab cracking was low. No maintenance treatments are recommended.

2.3.3 Areas of Concern

This section identifies areas of concern which were not noted in the previous section. *The Geotechnical and Geophysical Survey Report (Reference 2)* noted areas where the pavement located adjacent to the perimeter of the Underpass structure has settled. At these locations, surface drainage collects and ponds. The ponding eventually degrades the seal of cracks and joints, allowing water to infiltrate behind the underpasses retaining walls. Introducing water behind the retaining walls is not desirable, and should be eliminated. Areas of poorly draining pavement should be completely removed, and replaced with pavement that drains properly.

2.3.4 Recommendations

The age of the pavement indicates that the paving materials were high quality, having exceptional resistance to wear and weathering, resulting in a low level of pattern cracking. The City's annual street maintenance program has been effective in mitigating joint distress, faulting, surface distress, and slab cracking. The most prevalent distress was transverse cracking, and this problem developed shortly after the pavement was placed.

The pavement located at the bottom of the underpass is starting to rapidly deteriorate and fail. Repairs conducted in 2011 addressed many of the worse failures. Similar repairs should be conducted in 2012, and continuing in the future as needed.

The spalling of the Eddy Street curbing is a result of the rusting and subsequent expansion of reinforcing steel. This is largely a cosmetic issue as the curb spalling does not result in structural degradation of the pavement, retaining walls, or bridge structures. The recommended action is to perform a partial depth replacement of the cracking and spalling curbing as required. This repair will not stop future cracking and spalling from occurring.

Pavement located adjacent to the perimeter of the underpass structure that has settled should be removed and replaced with properly draining pavement. At the time that the pavement is being repaired, the subgrade should be over-excavated and re-compacted as structural fill in order to prevent future settlement.

2.4 Eddy Street Drainage

The Eddy Street Underpass drainage system was evaluated from 3rd Street to 4th Street. Information about the drainage system was obtained from field visits, the City's Geographical Information System, records, City staff interviews, and review of construction drawings.

The drainage system evaluation section includes a description of the drainage system, an evaluation of the drainage system performance, and recommendations for maintenance and improvements.

2.4.1 Description of Drainage System

A properly functioning drainage system is a critical component to the roadway system, preventing damage to infrastructure and ensuring public safety. The underpass pavement, retaining walls, and structures are vulnerable to damage caused by infiltration of water. Typical damage is caused by expansion of frozen water, saturation of subgrade, and loss of soil and backfill material through soil migration processes. Poorly drained streets are a hazard to public safety. As pavement is wetted, traction and control of vehicles is reduced, and the risk of hydroplaning increases. As flooding inundates the street, vehicles must be prevented from using the underpass as it is no longer safe for public use.

The critical components of the drainage system are the underpass drainage system, and the storm sewer system. Each component will be discussed in the following subsections.

Underpass Drainage System:

The Underpass drainage system is comprised of drains on the bridge decks, drains on the walkway, and drainage tiles.

The bridge deck drains and the walkway drains were constructed at the time that the structure was constructed. The drains are connected via a system of pipes located behind the retaining walls to the drainage tile system, and discharges to the wet-well of the lift station.

An inspection performed by the City in the summer of 2011 found that one of the walkway drains on the west side of Eddy Street was not functioning. The drainage pipe was broken and as a result, the drain discharged to the chamber below the walkway. When constructed the chambers below the walkway were filled with sand. As a result of the broken drain pipe, the level of the sand had dropped several feet below the bottom of the walkway slab.

Photo 2.11: Eddy Street Underpass, loss of backfill material below walkway.

Drain tiles were constructed at the base of the retaining wall at the time that the underpass was constructed. If water was allowed to pond behind the retaining walls, the resultant hydrostatic loads could cause the walls to displace. The drain tiles prevent water from ponding, reducing the load that the walls are required to retain. There is no visible displacement in the retaining walls, and therefore, it is unlikely that significant hydrostatic loads are developing. There is evidence of soil migration and observation of water weeping through retaining wall joints. This however is not indicative of a malfunctioning drain tile system.

The drain tiles are comprised of 6-inch clay tile pipe that follow the profile of the roadway. The drain tiles connect to the deck drainage system, and eventually discharge to the wet-well of the lift station. The record drawings show that drain tiles were also built under the Eddy Street pavement, and under the walkway. The record drawings do not clearly show how the drain tiles connect to the drainage system. The storm sewer inspection revealed drain tiles discharge to the inlets numbered F6-609 and F7-602. A considerable amount of sediment was discovered in the tile pipe, suggesting that the drains are becoming clogged, compromising the function of the tile drain system. The tile system serves as the outlet for the deck drains of the structures. Therefore, the origin of the sediment could be a combination of soil migration and sand and gravel applied to the deck.

Photo 2.12: Eddy Street Underpass clay drain tiles outlet to Inlet F6-609.

Inspection of the storm sewer inlets found drain tiles comprised of corrugated high density polyethylene pipe, HPDE, discharging to inlets numbered F6-609 and F7-601. It is not known when the HDPE drain tiles were constructed, or where the drain tiles are located beneath the pavement.

Photo 2.13: Eddy Street Underpass HDPE drain tiles outlet to Inlet F6-609.

The inspection discovered voids at the point where the HDPE drain tiles discharge to the inlets. Absent the recommended pavement repairs, the voids and connections to the inlets should be filled with non-shrink grout.

Storm Sewer System:

The storm sewer system is comprised of inlets along the Eddy Street underpass, storm sewer pipe and appurtenances, a lift station, and downstream storm sewer trunk line.

Run-off collects in Eddy Street, and is captured by one of six (6) combination curb and grate inlets. The inlets discharge to the lift station wet-well located on the west side of Eddy Street near the low point of the roadway. The contributing drainage area to the Eddy Street storm sewer system was not delineated as part of this study. The size of the drainage area is directly linked to the volume of run-off, and the flow rate that the storm sewer system must intercept and convey. These topics are further discussed in the drainage system performance section.

The lift station is a wet-well/dry-well configuration with two pumps. Pumps and controls are housed in the dry-well. Water collects in the wet-well, until pumps are triggered to start, drawing water out of the wet-well and discharging to the downstream storm sewer trunk line. Typically, the pumps alternate operation from one pumping cycle to the next pumping cycle. At the high water control point, both pumps operate in unison. City staff reported that when both pumps are running in unison, flow is emitted from a downstream manhole. The pumps are routinely inspected and maintained as needed twice a week.

The pumps discharge to the downstream storm sewer trunk line, where flow is routed northerly along Eddy Street and Broadwell Avenue. The route is comprised of 9,200 feet of 24-inch to 64-inch diameter storm sewer trunk. The route discharges to the drainage channel located on the south side of Capital Avenue, east of Broadwell Avenue *(Figure 4).*

Record drawings of the downstream storm sewer trunk line were not available. Based on record drawings that are available for nearby storm sewer, and the topography of Grand Island, it is assumed that the storm sewer trunk line is between 0.1% and 0.3% slope. Based on the size of the drainage area, and the flat pipe slopes, the velocity of flow through the pipe is not great enough to keep the storm sewer pipes clear of sediment. Typically a velocity of 2 feet per second is required to transport particles, and a velocity of 3 to 5 feet per second is required suspend particles that have settled. To achieve a velocity of 3 feet per second, a 36-inch line flowing under an open channel flow regime and with no backwater would need to have a minimum slope of 0.11%.

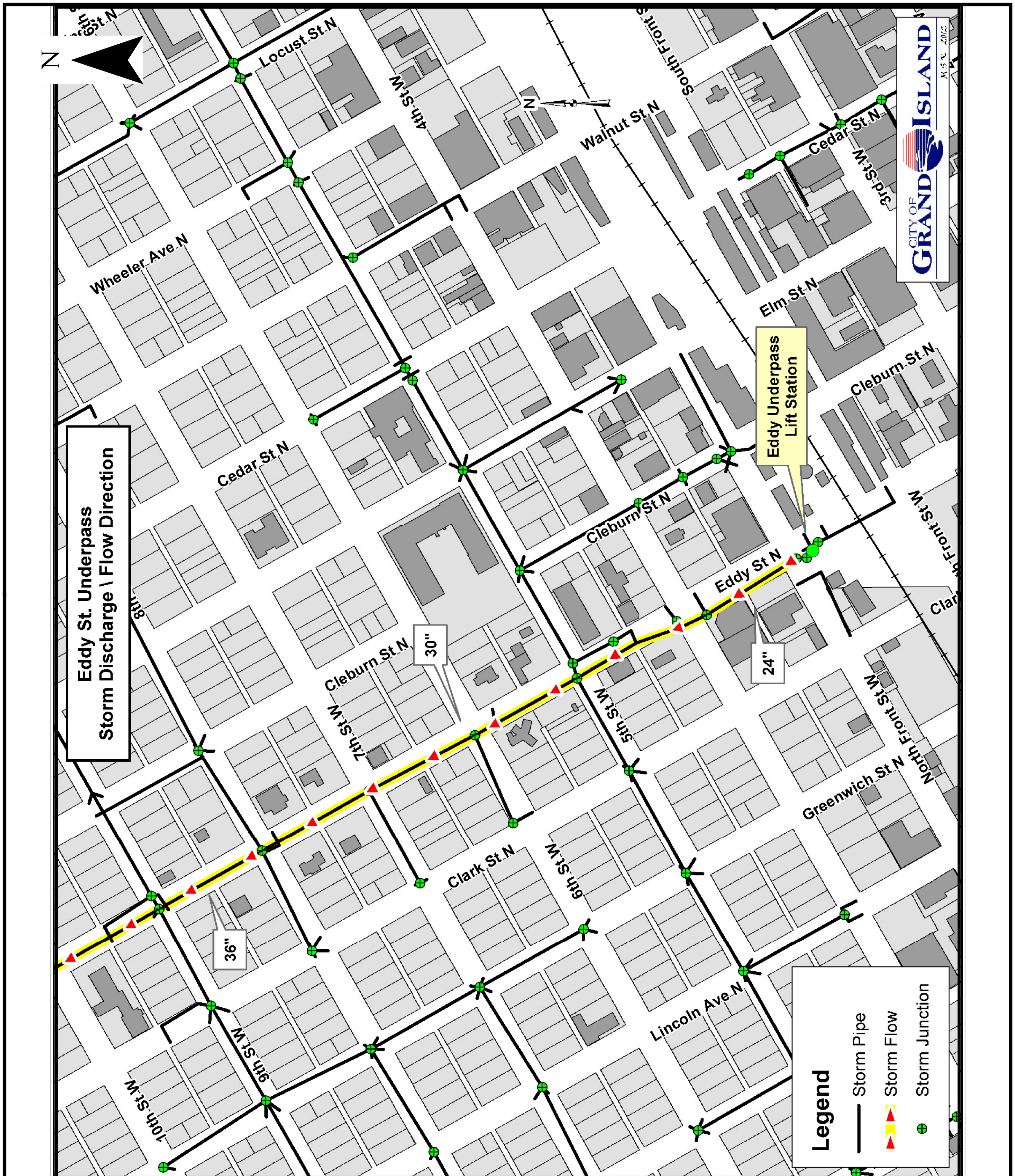

FIGURE 4
EDDY STREET UNDERPASS STORM DISCHARGE / FLOW DIRECTION

CITY OF GRAND ISLAND

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Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses
Grand Island, Nebraska

2.4.2 Drainage System Performance

The performance of a drainage system is related to how effectively the system prevents water damage to infrastructure, and how effectively the system keeps streets clear of water.

The failed walkway drain pipe that was discovered during a City inspection in 2011 resulted in the only damage directly attributed to a poorly performing component of the drainage system. There is no other evidence that the drainage system is failing to prevent water damage. Examples of damage that would be caused by a failing drainage system are bowed or displaced retaining walls, faulting of pavement joints, and pump failure.

The other performance indicator is how effectively the storm sewer system keeps streets clear of water. City staff reported that Eddy Street is typically closed three to four times a year due to flooding. When the street is unsafe to traverse, gates located at 3rd Street and 4th Street are used to prevent vehicles from using the underpass. Additionally, it is reported that once a rain event stops, it typically takes up to two (2) hours for the pumps to draw down the impounded water and for the street to reopen.

There are two ways to improve the performance of the storm sewer system: the first is by controlling the volume and rate of runoff to the system; and the second is by improving the capacity of the system.

The direct contributing area to the Eddy Street Underpass is a relatively small area. The northern and southern boundaries of the drainage area are bounded by 3rd Street and 4th Street. The eastern and western boundaries are bounded by the retaining walls. Flooding therefore is not a result of runoff from the direct contributing area, but instead is caused by run-on from adjacent areas.

As the intensity of a rainfall event increases, the runoff rate exceeds the capacity of the storm sewer to remove drainage. Runoff bypasses the system and seeks out low points where the runoff is stored. As a result of the extremely flat street grades in Grand Island, drainage areas combine as water ponds in the streets. This process of combining drainage areas routes drainage to a low area such as the underpass. To prevent the combination of drainage areas, the grade of Eddy Street north of 3rd Street, and south of 4th Street, would need to be raised to an elevation sufficient to prevent run-on from adjacent areas.

The capacity of the system has three potential constraints; the inlet and storm sewer capacity, the lift station capacity, and the capacity of the downstream storm sewer. The storm sewer is not a constraint. The inlets and storm sewer have adequate capacity to deliver runoff to the lift station. When both lift station pumps are running concurrently, the capacity of the downstream storm sewer is exceeded, and discharge is emitted from the downstream manhole. Increasing the capacity of the lift station would yield marginal benefits in the absence of increasing the capacity of the downstream storm sewer. The capacity of the downstream storm sewer to convey flow is the biggest constraint to the performance of the system.

In 2011, the City started a program to systematically clean and inspect storm sewers. City staff reported that such a program has not been implemented in the past. The storm sewers lines that have been cleaned and inspected to date have been found to be half to three quarters full of sediment and debris. The capacity of the storm sewer to convey flow is dramatically decreased under such circumstances. Continued implementation of this program will effectively increase the capacity of the downstream storm sewer system.

2.4.3 Drainage System Recommendations

The failed walkway drainage pipe should be repaired, and the void under the sidewalk should be filled.

The program to clean and inspect storm sewers should be continued. Once the issue with sediment filled pipes is under control, a detailed study to determine whether it would be beneficial to increase the capacity of the pumps is recommended. Such a study should include data acquisition to properly size the pumps.

3.0 SYCAMORE STREET UNDERPASS

The Sycamore Street Underpass was inspected by Kirkham Michael during the week of August 24, 2011. The complete inspection report entitled, *"Eddy Street and Sycamore Street Underpasses, Inspection Notes and Photos, August 2011" (Reference 1),* including notes and photos, is a supporting document that is available from the City Public Works Department.

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The existing retaining walls are reinforced cast-in-place concrete cantilever walls with concrete footings and provide a foundation for the vehicular and railroad bridge structures. The walkways were constructed integral with the retaining walls. The Sycamore Street Underpass plans are available for review at the City offices.

Existing Conditions:

The retaining walls and pedestrian walkways, on both the left and right sides of Sycamore Street, are in average structural condition. There is no apparent settlement of the retaining walls or failures. However, the retaining walls and pedestrian walkways do exhibit numerous minor faults including concrete popouts and spalling, horizontal and vertical cracking, exposed rebar, and expansion joint sealant failure. A full detailed inspection of the retaining walls and pedestrian walkways is included in the Eddy Street and Sycamore Street Underpasses Inspection Report.

1. ***Spalls and Popouts.*** There are about 160 areas of concrete spalling (ie, the concrete is debonded from the rebar). Of these 160 spalled areas, the concrete has "popped out" in 110 of them, exposing the reinforcing steel. The spalled areas vary in size from 2" x 2" to 4' x 8'. Many of the spalled areas occur in the curb, which is not structurally part of the retaining walls, but was inspected at the same time as the retaining walls. The anticipated repairs to the spalled curbs are the same as the anticipated repair to the retaining walls, so the repair of the curbs was included with the repair of the retaining walls.

There are several reasons for the occurrence of spalls and popouts:

- Inadequate concrete cover over the rebar
- Presence of cracks which allow access to water making the concrete susceptible to freeze/thaw cycles
- Embedded concrete forming hardware (snap ties/hairpins); this hardware was probably grouted over, but the grout may have failed, exposing the hardware.

Because of the substantial thickness of the retaining walls (2 to 3 feet), the spalls and popouts are not compromising the integrity of the retaining walls at this time. However, if not addressed, any exposed rebar in the spalls and popouts will continue to rust and will cause further deterioration of the concrete.

Photo 3.1: Typical spall.

Photo 3.2: Typical popout.

2. ***Horizontal and Vertical Cracks.*** There are about 75 horizontal and vertical cracks evident in the retaining walls and pedestrian walkways, ranging in length from several inches to several feet.

These cracks are caused by several factors:

- Concrete shrinkage
- Alkali aggregate reactivity (network of cracks, spalling)[5]
- Corrosion of embedded reinforcing steel

The cracks observed in the retaining walls have not "opened up". They remain as hairline cracks or minor cracks which indicate that there is no structural issue related to the cracks and they do not compromise the integrity of the retaining walls. However, if not addressed, the cracks will remain susceptible to freeze/thaw cycles and spalling and popouts may occur along the crack line.

3. ***Joints***. A typical wall expansion joint consists of a full height, ½-inch bituminous felt strip between sections of the retaining wall and a copper expansion strip on the fill face of the wall, embedded in a 3-ply waterproofing membrane, to within 8 feet ± of the top of the wall. There is a migration of backfill material through the joint located at 190 feet north of the south end of the west retaining wall. See Photo 3.3. There is also migration of backfill material in the area under the sidewalk approach to the

[5] Not prevalent in Portland Cement produced prior to the Clean Air Act of 1963.

northwest corner of the S. Front Street Bridge, resulting in settlement of the sidewalk. See Photo 3.11.

Photo 3.3 – Backfill migration.

4. ***Pedestrian Sidewalk Ramp.*** The section of pedestrian sidewalk ramp at the southwest approach to the pedestrian tunnel is exhibiting severe deterioration, settlement, and cracking. It appears that this is due to settlement of the backfill material under the sidewalk. The sidewalk ramp in this area will need to be removed, the backfill restored and adequately compacted, and the concrete sidewalk replaced.

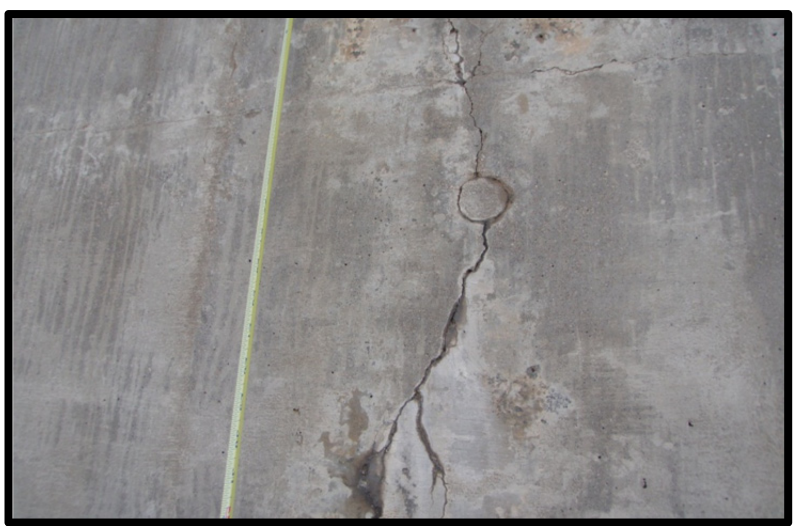

Photo 3.4: Vertical cracks.

Photo 3.5: Horizontal crack.

Conclusion:

The deterioration of the retaining walls and pedestrian walkways appears to be cosmetic only. There is little or no settlement or lateral movement of the retaining walls which indicates that the structural integrity of the retaining walls and pedestrian tunnels is satisfactory. However, continued maintenance and rehabilitation of the retaining walls and pedestrian walkways will need to be performed to extend the useable life of the Sycamore Street Underpass.

Proposed Repairs:

The following repairs to the retaining walls and pedestrian walkways should be completed to assure that the Sycamore Street Underpass will continue to provide safe passage for vehicles and pedestrians for the next 20 years:

- Repair all spalled areas and popouts
- Seal all horizontal and vertical cracks with caulk
- Replace 50-foot handrail
- Install new vandal resistant lighting system in pedestrian walkway under the bridges
- Replace pedestrian sidewalk ramp at southwest approach to the pedestrian tunnel

Repairing spalled areas, popouts, and sealing all horizontal and vertical cracks will prevent the exposed reinforcing steel from further corrosion and reduce the chance of future concrete failures. At this time, it is recommended that City forces seal the expansion joints at the two locations noted earlier. All other joints should be monitored for any backfill migration.

It is also recommended that further investigation and repairs to the joints be made when the pavement adjacent to the backside of the retaining walls are made.

Americans with Disabilities Act (ADA):

The ADA requires that the maximum slope allowable on pedestrian walkways is 8.33% (12:1). Level landings are required at every 30 inches of rise for ramps greater than 5.0% grade. The Sycamore Street Underpass pedestrian walkway ramps are at a 10% grade and do not have level landings. Therefore, the pedestrian walkways do not comply with ADA requirements. The recommended repairs contained herein do not address ADA requirements, which was beyond the scope of this report. Additional evaluation of the pedestrian walkway will need to be completed in order to accommodate ADA requirements.

3.2 Bridges

3.2.1 Industry Overpass

The Industry Overpass Bridge is a 30-foot, single-span reinforced concrete structure, cast integrally with the support walls at the abutments.

According to the agreement with UPRR for the underpass, the City of Grand Island has the responsibility for the maintenance and inspection of the Industry Overpass Bridge. Kirkham Michael performed the first inspection of the Industry Overpass Bridge during the week of August 24, 2011, and reported the findings to the NDOR Bridge Division. The bridge inspection information was uploaded into NDOR's PONTIS bridge data system. The bridge is required to be inspected every two years.

Existing Conditions:

The Industry Overpass Bridge is in poor condition. The deck surface is 90% spalled, with 70% heavy spalls. There are popouts and spalling on the bridge curb and the curb is broken off at one corner. The underside of the deck slab is exhibiting severe spalling and efflorescence on 90% of the surface.

Photo 3.6: Industry Overpass Bridge, popouts and spalling.

Conclusion:

The Industry Overpass will need further investigation and a load rating will need to be completed. By observation, the bridge appears to be in adequate condition to carry the anticipated loads at this time. Continued maintenance and rehabilitation of the Industry Overpass will need to be performed to extend the life of the bridge.

Proposed Repairs:

The following repairs to the bridge deck should be completed to assure that the Industry Overpass Bridge will continue to provide safe passage for vehicles and pedestrians for the next 20 years:

- Repair deck spalls and popouts (Class I and Class II Repair), apply concrete overlay
- Repair underside of deck spalls (Class I Repair) accomplished by removing delaminated concrete, cleaning rebar, and hand applying construction grout
- Repair curb
- Place new concrete overlay

3.2.2 S. Front Street Bridge

The S. Front Street Bridge is a 30-foot, single-span reinforced concrete structure, cast integrally with the support walls at the abutments.

According to the agreement with UPRR for the underpass, the City of Grand Island has the responsibility for the maintenance and inspection of the S. Front Street Bridge. Kirkham Michael performed the first inspection of the S. Front Street Bridge during the week of

August 24, 2011, and reported the findings to the NDOR Bridge Division. The bridge inspection information was uploaded into NDOR's PONTIS bridge data system. The bridge is required to be inspected every two years.

Existing Conditions:

The S. Front Street Bridge is in poor condition. The northeast corner of the bridge has sustained collision damage to the concrete curb and the edge of the deck. There is severe map cracking with efflorescence on 80% of the underside of the deck on the east side and some map cracking along the south edge of the slab extending to the underside of the deck.

Conclusion:

The S. Front Street Bridge will need further investigation and a load rating will need to be completed. By observation, the bridge appears to be in adequate condition to carry the anticipated loads at this time. Continued maintenance and rehabilitation of the S. Front Street Bridge will need to be performed to extend the life of the bridge.

Photo 3.7: S. Front Street Bridge, severe cracking.

Photo 3.8: S. Front Street Bridge, severe cracking.

Proposed Repairs:

The following repairs to the bridge deck should be completed to assure that the S. Front Street Bridge will continue to provide safe passage for vehicles and pedestrians for the next 20 years:

- Repair collision damage to the northeast corner
- Repair underside of deck map cracking (Class I Repair). This is accomplished by removing delaminated concrete, cleaning rebar, and hand applying construction grout.

3.2.3 UPRR Bridges

UPRR inspects each railroad structure twice annually. Inspection reports are reported on the "Engineer Structure Management Program". Based on an interview of UPRR officials by City Engineering staff on May 2, 2011, most inspection items are rated in good condition or only need minor maintenance. There are no immediate concerns with the railroad structures and no repairs are needed.

3.3 Pavement Evaluation

The Sycamore Street Underpass pavement was evaluated from 3rd Street to 4th Street. Both the Sycamore Street pavement, and the pavement located adjacent to the perimeter of the underpass structure were evaluated. Information about the pavement was obtained from field visits, a geotechnical investigation, City staff interviews, and review of construction drawings.

The pavement evaluation section begins with a discussion of the history of the pavement, provides a classification system for determining the condition of the pavement, identifies and evaluates areas of concern, and finally recommends a program for reconstruction and maintenance. Opinions of Probable Costs are summarized in Section 4.

3.3.1 Pavement History

The pavement history subsection provides information regarding the type, age, and repair history of the pavement.

The Sycamore Street pavement is comprised of PCC, also referred to as rigid pavement. The depth of the pavement varies from 8 inches to 11 inches. The pavement subgrade is comprised of clean fine to coarse sand. The geotechnical investigation did not observe groundwater in the subsoil beneath the pavement. City staff indicated that ground water is often observed coming through the pavement. The subgrade material is well draining; however, there is evidence of pavement damage caused by poorly draining subgrade or by high groundwater table.

The Sycamore Street pavement was constructed at the time that the underpass was built. The strength, wear resistance, and resilience to Alkali-Silica Reaction damage of the original paving material is excellent, in spite of the age of the pavement. However, the ovarall condition of the pavement is poor to starting to fail. There is considerable transverse cracking and the asphalt patch repairs indicate that the pavement has had some surface distress problems.

Photo 3.9: Sycamore Street Underpass, looking north.

The City's annual street maintenance program undertakes pavement repair work and sealing of pavement joints. Maintaining the seal of joints prevents infiltration of moisture, preventing saturation of subgrade and eliminating damage caused by expansion of frozen water. As a result of the annual street maintenance program the Sycamore Street Underpass joints are resealed every two years.

Pavement was repaired on Sycamore Street in 2008 with overlay full depth asphalt patch. It is assumed that failing panels had signs of surface distress, joint distress, and even the possibility of pattern cracking. The pavement failure was indicative of a structural failure of the pavement slab, possibly caused by drainage problems.

The paved areas adjacent to the underpass are comprised of PCC, and are maintained biennially through the City's program to route and seal cracks and joints. The pavement sections and repair history of the adjacent pavement is unknown.

3.3.2 Systematic Evaluation of Pavement Condition

The *NDOR Pavement Maintenance Manual (Reference 7)* identifies six distinct types of pavement distress, listed below:

1. Joint Distress
2. Faulting
3. Transverse Cracks
4. Pattern Cracking
5. Surface Distress
6. Slab Cracking

Chapter 3 of the Pavement Maintenance Manual has detailed descriptions and illustrations of each type of distress. The following sections discuss each type of distress that was observed during the field inspection of the Sycamore Street pavement.

1. ***Joint Distress.*** With the exception of the failing pavement located at the bottom of the underpass, joint distress was not typically observed. Breaking or chipping at the joints was not observable because the joints were sealed. Where joint distress was observed it was characterized as low. Joint distress characterized as low, has a few hairline cracks emanating from the joint, with the possibility of discoloration emanating from the joint. The City's current maintenance program is adequately controlling joint distress problems by maintaining the seal of joints and cracks. No additional action is recommended to specifically correct joint distress.

At the bottom of the Underpass, joint distress is severe, resulting in spalling and pavement failure. The maintenance history of this pavement includes filling potholes on an annual basis and full depth pavement repair. City staff reported that water is often observed coming through the pavement. The pumping action results in undermining of the pavement subgrade, leading to foundation failure. The only remediation option available is to completely remove pavement so that the pavement subgrade can be reconstructed. Other attempts, such as partial depth pavement replacement, to repair the pavement will rapidly fail.

2. ***Faulting.*** Faulting was not observed. Joint deformation was observed between the original pavement and pavement patches. The joint deformation results in a slight vertical elevation difference between pavement slabs, similar to faulting. The joint deformation is difficult to avoid for patch repairs. As is the case for faulting, the joint deformation was not caused by pavement failure or subgrade failure. Because the root cause of the deformation is unrelated to these issues, the joint deformation and the resulting bumpy ride could be corrected by surface grinding.

3. ***Transverse Cracks.*** Transverse cracking was observed through all original panels. The transverse cracking most likely developed shortly after the pavement was placed, and would have been prevented if transverse joints had been constructed at a 15-foot to 18-foot spacing. The severity of the transverse cracking would be characterized as high, with cracks greater than ¼-inch wide and spanning the entire width of the panel. Given the cause of the cracking, costly repairs are not warranted. The City's current maintenance program involving routing and sealing the cracks is adequate to prevent degradation of the pavement structure and subgrade.

4. ***Pattern Cracking.*** Pattern cracking was observed at the surface of the pavement. The cracking is characterized as moderate. The pattern cracking is likely caused by deicing chemicals and weathering. It is assumed that the asphalt patch repair work was done in part to repair severe pattern cracking and surface distress.

5. ***Surface Distress.*** Surface distress was not commonly observed with the exception that evidence of surface distress was observed in the low points of the road near drainage inlets. In the vicinity of drainage inlets surface distress is evidenced by pot-hole repairs. Potholes are caused by freeze-thaw stresses, causing the pavement to spall and pop-out. At these locations, the recommended maintenance activity is to repair potholes with hot-mix or cold-mix asphalt. As the severity and frequency of repairs increases, a partial or full depth patch with PCC should be used.

   It was assumed that the asphalt patch repair work was done in part to repair surface distress. The asphalt overlay is aging, however there are no signs that structural failure is occurring in the underlying pavement.

6. ***Slab Cracking.*** Slab cracking was low. No additional maintenance treatments are recommended.

3.3.3 Areas of Concern

This section identifies areas of concern which were not noted in the previous section.

The "Geotechnical and Geophysical Survey Report, December 2011" (Reference 2), noted areas where the pavement located adjacent to the perimeter of the Underpass structure has settled. At these locations, surface drainage collects and ponds. The ponding eventually degrades the seal of cracks and joints, allowing water to infiltrate behind the underpasses retaining walls. Introducing water behind the retaining walls is not desirable, and should be eliminated. Areas of poorly draining pavement should be completely removed, and replaced with pavement that drains properly.

Photo 3.10: Sycamore Street Underpass, example of poorly draining pavement located adjacent to west retaining wall approximately 190 feet north of south end of the underpass. Ponded water infiltrates the pavement joints, resulting in soil migration through retaining wall joints.

The sidewalk on the north side of the S. Front Street Overpass has settled four to six inches. This is a significant amount of settlement, and more effort is warranted to determine the root cause. In addition, the settlement has created drainage issues and has made the sidewalk non-compliant to Americans with Disabilities Act (ADA) standards. The sidewalk should be removed, underlying issues repaired, and the sidewalk should be replaced at the proper lines and grades.

Photo 3.11: Sycamore Street Underpass, north curb line of S. Front Street.

Grate inlets were constructed on the walkway ramps leading to the Underpass walkway. The inlets are full of sediment, causing runoff to bypass the inlet. City staff reported that the bypass from the grate inlets does not cause issues downstream. In the vicinity of the southernmost grate inlet, drainage infiltrating joints has created a void underneath sidewalk. The void has the potential to develop into a public safety hazard in the future. At the time that the walk is repaired in the vicinity of this grate inlet, the inlet should be removed. The other grate inlets could also be removed or abandoned at that time.

Photo 3.12: Sycamore Street Underpass walkway grate inlet, with voids under walkway.

3.3.4 Recommendations

The age of the pavement indicates that the paving materials were high quality, having good resistance to wear and weathering, resulting in a low level of pattern cracking. The City's annual street maintenance program has been effective in mitigating joint distress, faulting, surface distress, and slab cracking. The most prevalent distress was transverse cracking, and this problem developed shortly after the pavement was placed.

The pavement is starting to rapidly deteriorate and fail. The pavement failure is caused by degradation of the pavement foundation and structural failure of the pavement. Given that the underpass structures are expected to last for an additional 20 to 30 years, a full depth repair of the pavement is warranted. The pavement replacement should be accompanied by the construction of a subgrade under-drain system, preventing perched ground water from decreasing the expected lifespan of the pavement.

Pavement located adjacent to the perimeter of the Underpass structure that has settled should be removed and replaced with properly draining pavement. At the time that the pavement is being repaired, the subgrade should be over-excavated and re- compacted as structural fill in order to prevent future settlement. In the case of the severe settlement noted on the north side of the S. Front Street Overpass, the underlying reason for the settlement should also be repaired.

The grate inlets found on the walkway ramps are in disrepair and are not functioning. In the case of the southernmost grate, the disrepair has contributed to the development of a void under the sidewalk immediately downstream from the inlet. When the walkways are repaired, the grate inlet should be removed, and the pipe plugged and filled with flowable fill. The City should evaluate whether the other grate inlets should receive the same treatment.

3.4 Sycamore Street Drainage

The Sycamore Street Underpass drainage system was evaluated from 3rd Street to 4th Street. Information about the drainage system was obtained from field visits, the City's Geographical Information System, records, City staff interviews, and review of construction drawings.

The drainage system evaluation section includes a description of the drainage system, an evaluation of the drainage system performance, and recommendations for maintenance and improvements.

3.4.1 Description of Drainage System

A properly functioning drainage system is a critical component to the roadway system, preventing damage to infrastructure and ensuring public safety. The Underpass pavement, retaining walls, and structures are vulnerable to damage caused by infiltration of water. Typical damage is caused by expansion of frozen water, saturation of subgrade, and loss of soil and backfill material through soil migration processes. Poorly drained streets are a hazard to public safety. As pavement is wetted, traction and control of vehicles is reduced, and the risk of hydroplaning increases. As flooding inundates the street, vehicles must be prevented from using the underpass as it is no longer safe for public use.

The critical components of the drainage system are the underpass drainage system, and the storm sewer system. Each component will be discussed in the following subsections.

Underpass Drainage System:

The Underpass drainage system is comprised of drains on the bridge decks, drains on the walkway, and drainage tiles under the pedestrian walkway.

The bridge deck drains and the walkway drains were constructed at the time that the structure was constructed. The drains are connected via a system of pipes located under the pedestrian walkway, and discharges to the wet-well of the lift station. The drain network is shown in the record drawings of the Sycamore Street Underpass.

Storm Sewer System:

The storm sewer system is comprised of inlets along the Sycamore Street Underpass, storm sewer pipe and appurtenances, a lift station, and downstream storm sewer trunk line.

Run-off collects in Sycamore Street, and is captured by one of six (6) combination curb and grate inlets. The inlets discharge to the lift station wet-well located on the west side of Sycamore Street near the low point of the roadway. The contributing drainage area to the Sycamore Street storm sewer system was not delineated as part of this study. The size of the drainage area is directly linked to the volume of run-off, and the flow rate that the storm sewer system must intercept and convey. These topics are further discussed in the drainage system performance section.

The lift station is a wet-well/dry-well configuration with two pumps. Pumps and controls are housed in the dry-well. Water collects in the wet-well, until pumps are triggered to start, drawing water out of the wet-well and discharging to the downstream storm sewer trunk line. Typically, the pumps alternate operation from one pumping cycle to the next pumping cycle. At the high water control point, both pumps operate in unison. The pumps are routinely inspected and maintained as needed twice a week.

The pumps discharge to the downstream storm sewer trunk line, where flow is routed northerly along Sycamore Street, then easterly along 5th Street, then southerly along Vine Street, continuing to the point of discharge south of U.S. Highway 30. The route is comprised of 4,800 feet of 12-inch to 72-inch diameter storm sewer trunk. The storm sewer trunk discharges to a drainage channel located along the north side of Swift Road *(Figure 5).*

Record drawings of the downstream storm sewer trunk line were not available for the discharge route. Based on record drawings that are available for nearby storm sewer, and the topography of Grand Island, it is assumed that the storm sewer trunk line is between 0.1 % and 0.3% slope. Based on the size of the drainage area, and the flat pipe slopes, the velocity of flow through the pipe is not great enough to keep the storm sewer pipes clear of sediment. Typically a velocity of 2 feet per second is required to transport particles, and a velocity of 3 to 5 feet per second is required suspend particles that have settled. To achieve a velocity of 3 feet per second, a 36-inch line flowing under an open channel flow regime and with no backwater would need to have a minimum slope of 0.11%.

3.4.2 Drainage System Performance

The performance of a drainage system is related to how effectively the system prevents water damage to infrastructure, and how effectively the system keeps streets clear of water.

There is no evidence that the drainage system is failing to prevent water damage. Damage caused by water that has been noted elsewhere in the report was not caused by a malfunctioning drainage system. Rather, the damage is caused by other factors such as failing waterproofing and deficiencies in the drainage system. Regarding deficiencies, the construction drawings show no drainage tiles beneath the pavement, nor at the base of the retention walls. In the example of the pavement, if there had been a functioning under-drain system, the pavement failure caused by pumping would have been abated.

The other performance indicator is how effectively the storm sewer system keeps streets clear of water. City staff reported that Sycamore Street is typically closed three to four times a year due to flooding. When the street is unsafe to traverse, gates located at 3rd Street and 4th Street are used to prevent vehicles from using the Underpass. Additionally, it is reported that once a rain event stops, it typically takes up to two (2) hours for the pumps to draw down the impounded water and for the street to reopen.

There are two ways to improve the performance of the storm sewer system: the first is by controlling the volume and rate of runoff to the system; and the second is by improving the capacity of the system.

The direct contributing area to the Sycamore Street Underpass is a relatively small area. The northern and southern boundaries of the drainage area are bounded by 3rd Street and 4th Street. The eastern and western boundaries are bounded by the retaining walls. Flooding therefore is not a result of runoff from the direct contributing area, but instead is caused by run-on from adjacent areas.

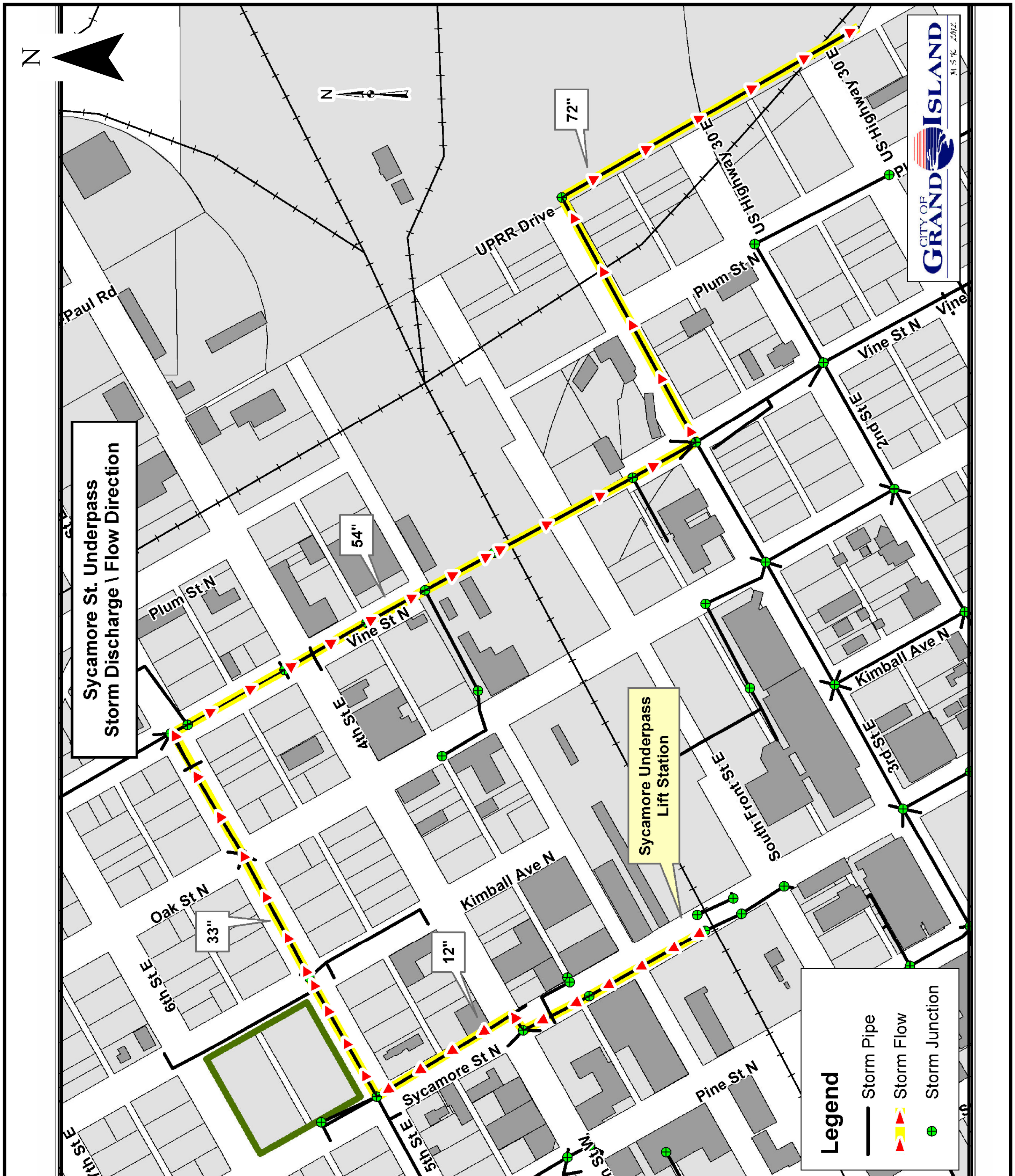

FIGURE 5
SYCAMORE STREET UNDERPASS STORM DISCHARGE / FLOW DIRECTION

Eddy Street and Sycamore Street
Union Pacific Railroad Underpasses
Grand Island, Nebraska

CITY OF GRAND ISLAND

KIRKHAM MICHAEL

As the intensity of a rainfall event increases, the runoff rate exceeds the capacity of the storm sewer to remove drainage. Runoff bypasses the system and seeks out low points where the runoff is stored. As a result of the extremely flat street grades in Grand Island, drainage areas combine as water ponds in the streets. This process of combining drainage areas would tend to route drainage to a low area such as the underpass. To prevent the combination of drainage areas, the grade of Sycamore Street north of 3rd Street, and south of 4th Street, would need to be raised to an elevation sufficient to prevent run-on from adjacent areas.

The capacity of the system has three potential constraints, the inlet and storm sewer capacity, the lift station capacity, and the capacity of the downstream storm sewer. The storm sewer is not a constraint. The inlets and storm sewer have adequate capacity to deliver runoff to the lift station. Increasing the capacity of the lift station would yield marginal benefits in the absence of increasing the capacity of the downstream storm sewer. The capacity of the downstream storm sewer to convey flow is the biggest constraint to the performance of the system.

In 2011, the City started a program to systematically clean and inspect storm sewers. City staff reported that such a program has not been implemented in the past. The storm sewers lines that have been cleaned and inspected to date have been found to be half to three-quarters full of sediment and debris. The capacity of the storm sewer to convey flow is dramatically decreased under such circumstances. Continued implementation of this program will effectively increase the capacity of the downstream storm sewer system.

3.4.3 Drainage System Recommendations

The program to clean and inspect storm sewers should be continued. Once the issue with sediment filled pipes is under control, a detailed study to determine whether it would be beneficial to increase the capacity of the pumps is recommended. Such a study should include data acquisition to properly size the pumps.

4.0 RECOMMENDED REHABILITATION / MAINTENANCE PROGRAM

The recommended repairs and maintenance issues for the Eddy Street and Sycamore Street Underpasses are listed in Table 4.1 below. The repairs and maintenance issues are prioritized in order of need and are recommended to be completed over the next six years.

Table 4.1 – Rehabilitation / Maintenance Schedule

Year	Repair / Maintenance Description	Facility
2012	Repair Retaining Walls / Walkways [(1)]	Sycamore Street
2012	Full Depth Pavement Repairs	Eddy Street
2012	Complete Removal and Replacement of Pavement	Sycamore Street
2012	S. Front Street Bridge Repairs	Sycamore Street
2013	Industry Overpass Repairs	Sycamore Street
2013	Repair Retaining Walls / Walkways [(1)]	Eddy Street
2013	Mill Drive Bridge Repairs	Eddy Street
2013	N. Front Street Bridge Repairs (Option No. 1)	Eddy Street
2013-2017	Miscellaneous Patching to Adjacent Pavement	Eddy Street
2013-2017	Damaged Walkway Drain Repair	Eddy Street
2013-2017	S. Front Street Pavement Repairs	Sycamore Street
2013-2017	Miscellaneous Patching to Adjacent Pavement	Sycamore Street
2013-2017	Repair Walkway and Abandon Grate Inlets	Sycamore Street
2022	Complete Removal and Replacement of Pavement	Eddy Street

[(1)] See Pages 12 and 32 for complete repair information

Due to the deteriorated condition and the potential for the condition to worsen in the near future, the Sycamore Street Underpass should be addressed immediately. Recommended repairs to retaining walls, walkways, the S. Front Street Bridge structure, repairs to Eddy Street pavement, and rebuild pavement on Sycamore Street should be completed in 2012.

The next critical facility is the Eddy Street Underpass and repairs to the retaining walls, walkways, and the Mill Drive and N. Front Street Bridges should be completed in 2013. Option No. 1 for the N. Front Street Bridge repair is recommended based on the initial cost and that the future costs for additional repairs referred in Option 1 do not exceed the initial cost of Option 2.

The remaining repair items indicated to be completed in 2013-2017, are minor items and could be completed at any time.

This proposed schedule for repairs and maintenance of the Eddy Street and Sycamore Street Underpasses was developed based on the current condition of the facilities and may be revised as necessary depending on funding availability.

5.0 REFERENCES

1. Eddy Street and Sycamore Street Underpasses
Inspection Notes and Photos
Kirkham Michael, August 2011

2. Geotechnical and Geophysical Survey Report Sycamore and Eddy Street Underpasses
UPRR and Adjacent Streets Grand Island, Nebraska.
Terracon Consultants, Inc. , December 6, 2011.

3. Construction Drawings for Eddy Street Underpass.

4. Construction Drawings for Sycamore Street Underpass.

5. NDOR Standard Specifications for Road and Bridge Construction.

6. NDOR Average Unit Price Summary, July 2010-June 2011.

7. Pavement Maintenance Manual, Nebraska Department of Roads,
http://www.nebraskatransportation.org/docs/pavement.pdf.

Geotechnical and Geophysical Survey Report

Sycamore and Eddy Street Underpasses

UPRR and Adjacent Streets

Grand Island, Nebraska

February 28, 2012

Terracon Project No. 05115091

Prepared for:

Kirkham Michael Consulting Engineers

Omaha, Nebraska

Prepared by:

Terracon Consultants, Inc.

Omaha, Nebraska

PROFESSIONAL CIVIL ENGINEER
EDWARD D. PROST, JR.
E-7760
2-28-12
STATE OF NEBRASKA

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Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

February 28, 2012

Terracon

Kirkham Michael Consulting Engineers
12700 West Dodge Road
Omaha, Nebraska 68154-8030

Attn: Mr. Steve Kneip

Re: Geotechnical and Geophysical Survey Report
Sycamore and Eddy Street Underpasses
UPRR and Adjacent Streets
Grand Island, Nebraska
Terracon Project No. 05115091

Dear Mr. Kneip:

Terracon Consultants, Inc. (Terracon) has completed a subsurface exploration and geophysical study for the referenced project. The accompanying report presents the findings of the subsurface exploration and geophysical study for the referenced project.

We appreciate the opportunity to provide the geotechnical consulting services for this project. Please contact us if you have any questions regarding the contents of the attached report, or if we may be of further service.

Sincerely,

Terracon Consultants, Inc.

Gopala K. Allam, E.I.
Staff Geotechnical Engineer

Edward D. Prost Jr., P.E.
Principal Engineer

GKA/EDP:gka/leb

Distribution: Addressee (2 bound and 1 via e-mail)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A geotechnical and geophysical survey report has been completed for the proposed Sycamore and Eddy Street Underpasses project in Grand Island, Nebraska. The field exploration included eight borings to obtain subsurface information. Laboratory tests were performed on the samples recovered from the borings. Typed boring logs are included in Appendix A. Ground penetrating radar data was collected along portions of the wall face, the pavement along Sycamore and Eddy Streets and on the paved areas retained by the walls.

This report presents the findings of the field exploration and laboratory testing, and our geotechnical recommendations for the project. Following is a summary of significant geotechnical issues and recommendations:

- Backfill behind the retaining walls generally consisted of very loose to medium dense fine to coarse sands (fill overlying natural soils).
- Anomalous areas were observed with the Ground Penetrating Radar survey, however, the borings completed at a selected number of these locations did not indicate the presence of voids directly below the pavement or within the boring profile.
- Settlement of the pavements has occurred in several of the areas retained by the walls.
- Migration of soil appears to have occurred through some of the open joints in the wall face along Sycamore Street. Further observation during and after rain or high groundwater events is recommended. We recommend sealing of the vertical joints between the retaining wall panels where soil migration has occurred and other locations where the joint seal is not intact to prevent further migration of the retained soils through the wall.
- We recommend sealing of the joints between the retaining wall and the pavement above the wall and sealing all joints and cracks in these pavements. Re-grading of the pavement grades may be required in settlement has resulted in poorly drained areas.
- Borings completed through the pavement on Eddy and Sycamore Streets did not indicate the presence of voids or loose soils. However, high groundwater was present in some of the borings along Eddy Street.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
SYCAMORE AND EDDY STREET UNDERPASSES
UPRR AND ADJACENT STREETS
GRAND ISLAND, NEBRASKA

Terracon Project No. 05115091
February 28, 2012

1.0 INTRODUCTION

This report presents the results of our subsurface exploration and geophysical study for the proposed Sycamore and Eddy Street Underpasses project in Grand Island, Nebraska. The field exploration included eight borings completed to depths of about 2 to 20 feet to obtain subsurface information. The individual boring logs are included in Appendix A of this report. The approximate boring locations are shown on the Boring Location Plan, also included in Appendix A.

Our work was completed in general accordance with proposal-agreement no. P05110524 dated August 24, 2011.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- ground penetration radar results
- condition of backfill
- presence of voids

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Project layout	See Exhibits A-2 and A-3, Appendix A, Boring Location Plan.

Item	Description
Structure Performance	The following information regarding structural performance is based on conversations with Mr. Steve Kneip and photos provided to Terracon. We understand that some settlement has occurred above the retaining walls in the area of Sycamore Street and South Front Street. Visibly, the walls appear to be in good condition throughout this underpass. The South Front Street bridge has some efflorescence occurring near the northeast corner of the deck.
Structure Performance (Cont.)	The walls of the Eddy Street underpass also appear visibly to be in good condition, however, open vertical joints are present along the wall, and it is not certain whether backfill materials have been allowed to exit through these joints. No significant settlement of the retained soils was noted at the Eddy Street underpass. The roadways at each underpass appear to be functioning well overall, however, portions of the pavement have been removed and replaced in the past and shallow groundwater is present at Eddy Street.
Existing Data	We have no information available regarding previous explorations, however, we were provided with project plans for the two underpass structures, dated 1948 and 1951, and recent photographs of the project area.
Purpose of Exploration	Perform geophysical survey and soil exploration to explore for potential voids or loose soils that may affect the performance of the retaining walls, retained structures or pavements, and the underpass roadway to help determine the cause of the deformation and pavement distress, and develop recommendations for corrective action.

2.2 Site Location and Description

Item	Description
Location	The project site is located along the Sycamore and Eddy Street underpasses beneath the Union Pacific Railroad (UPRR), from about 3rd Street to 4th Street in Grand Island, Nebraska. See Exhibit A-1, Appendix A, Site Location Plan.

Item	Description
Existing structures / improvements	The Eddy Street underpass is a four lane thoroughfare, approximately 1000 feet in length, travelling beneath several UPRR bridges and bridges for Mill Drive and North Front Street. The Sycamore Street underpass is a two lane thoroughfare, approximately 1000 feet in length, travelling beneath a wide UPRR bridge and bridges for an Industry Drive and South Front Street. The streets are paved with Portland cement concrete. Retaining walls are located on each side of the underpasses, with maximum heights of about 18 to 19 feet. The east and west retaining walls at the Eddy Street underpass are separate cantilever walls. The Sycamore Street underpass is constructed with an integral mat and retaining walls with the pavement supported on fill above the mat.
Existing topography	The site is located within a relatively flat alluvial valley. The underpass appears to have been constructed below the adjacent grade primarily through cut and extends approximately 18 to 19 feet below adjacent grade.
Previous Topography and Site Development	The project site is a developed inner city area with rail lines, streets, parking and drive areas and adjacent buildings. Previous development of the site and grading is unknown.

3.0 SUBSURFACE CONDITIONS

3.1 Mapped Soil Units

Surface soils at the project site were mapped as part of the effort to develop the Hall County NRCS-USDA Soil Survey. According to this document, the soil series mapped at the site are the O'Neill and Pivot series. The O'Neill series consists of very deep, well drained soils formed in loamy material 20 to 40 inches deep over gravelly sand. Permeability is moderately rapid in the solum and very rapid in the underlying material. The Pivot series consists of somewhat excessively drained soils. They are moderately deep over gravelly coarse sand. Permeability is rapid in the solum and very rapid in the underlying material.

The soil profile may have been considerably altered by grading associated with urban development.

More information is presented in the Soil Survey of Hall County, Nebraska.

3.2 Typical Profile

Based on the results of the borings, we anticipate the subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Surface:	N/A	Asphaltic cement concrete over Portland cement concrete or Portland cement concrete	N/A
Stratum 1	2 to 20 feet	Fine to Coarse Sand (fill or native)	Very Loose to Medium Dense

No measurable void was observed below the pavement surface at the boring locations. The conditions encountered at each boring location are indicated on the individual boring logs in Appendix A. Additional information is presented on the boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual.

Variations could occur between boring locations or across the site. Construction associated with previous grading and other items may have created additional variations.

3.3 Groundwater

The boreholes were observed while and after completion of drilling for the presence and level of groundwater. The water levels observed are noted on the boring logs in Appendix A and are summarized below.

Boring Number	Depth to water while drilling, ft.	Depth to water after drilling, ft.
B-1, B-2, B-3, B-4, B-5	N/E	---
B-6	1	½ (1/4 Hr AB)
B-7	4	3 (1/4 Hr AB)
B-8	3	2 (1/4 Hr AB)

A relatively long period of time is necessary for a groundwater level to develop and stabilize in a borehole. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

Fluctuations of the water levels will occur due to seasonal variations in the amount of rainfall and runoff, and other factors not evident at the time the borings were performed. Subsurface water levels during construction or at other times in the life of the structure will be higher or lower than the levels indicated in the boring logs. Perched water conditions can also develop over compacted clay fill and overlying dense clay layers. The possibility of groundwater level fluctuations and development of perched water conditions should be considered when developing the design and construction plans for the project.

3.4 Geophysical Study

On October 3 - 5, 2011, Terracon Consultants, Inc. (Terracon) conducted geophysical exploration services at selected Union Pacific Underpasses in Grand Island, Nebraska. The purpose of the Ground Penetrating Radar (GPR) exploration was to gather information to aid in identifying the presence and locations, if applicable, of existing anomalies consistent with voids directly behind the concrete slabs and walls.

In general, field collection follows the procedures referenced in ASTM D 6432, and more information on both the general method and collection procedures can be found in the standard. Ground Penetrating Radar (GPR) utilizes radio waves to detect changes in the subsurface of the area being scanned. Changes in the signal generally indicate material property changes such as but not limited to electromagnetic conductivity and dielectric constant, which in some cases can be qualitatively linked to other material properties such as density. These changes can be effective in identifying the presence and location of items such as subsurface voids, buried concrete, tanks, underground utilities, and embedded reinforcing steel in concrete and masonry structures, among other things.

Terracon used a GPR system consisting of hand-cart-mounted 1600 MHz antenna and a cart-mounted 400 MHz antenna made by Geophysical Survey Systems Inc. (GSSI) to perform an upper profile geophysical survey.

GPR scanning of the sidewalks were performed with the 400 MHz antenna. 2 traverses were done at approximately 3 foot on center for each sidewalk. The traverses were done along the sidewalk adjacent to the city-owned portion of the retaining wall, as well as the walkway below bridges.

Scanning of the roadway was also performed with the 400 MHz antenna. Traverses were done at approximately 6 foot on center. Traverses covered the edge or the roadway along the wall, the center of each lane, as well as the centerline between each lane. The GPR scan of the roadway was done along the length of road adjacent to the city-owned portion of the retaining wall.

The scanning along the side of the wall was performed with the 1600 MHz antenna. 3 traverses were done at approximately 5 foot on center. The traverses spanned approximately 200 feet down the wall, as well as along the length of the walkway below the bridges. The scanned area of wall was located within about the bottom 10 feet above the sidewalk or pavement and the scanning progressed down the wall until the GPR unit could no longer penetrate the wall's entire slab thickness.

Anomalies were marked in the field for coring personnel. The approximate locations of the anomalies recorded during the GPR testing are illustrated on Attachments A-4 and A-5, in Appendix A. The anomalies observed in the wall scans were based on scans between about 5 to 10 feet above the bottom of the wall. The anomalies below the pavement surfaces were based on the conditions within about the top five feet below the pavement.

After the GPR survey had finished, concrete coring operations were undertaken at areas of suspected anomalies below the pavements. The coring crew used a Hilti coring machine with a diamond bit coring barrel to verify the anomalies and subsequently, the soils were explored with a soil boring at that location.

Although anomalies were noted with the GPR, no apparent voids were found when followed up with coring operations. It is likely that the anomalies indicated a large change of subgrade material, density, or moisture directly underneath the slabs. In this case, the low density of the very loose sands seemed to be showing the anomalies.

It should be noted that, as with any geophysical testing method, the process relies on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator such as but not limited to, soil/concrete types, soil/concrete moisture, and/or reinforcing steel spacing. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical scientist evaluating the results. Utilizing conventional observation, sampling and testing ("truthing") of select areas was performed to confirm the results from the GPR scans in limited areas only. As with all geophysical methods, the GPR results provide a level of confidence but should not be considered precise or absolute, and should not be used for construction purposes. We cannot be responsible for the misinterpretation of unverified GPR results by others.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Visual observation of the retaining walls indicated the presence of open vertical joints between the wall panels. We understand that the design included joint seals which appear to be present in the recesses of the joints. However, migration of soil appears to have occurred through some of the open joints in the wall face along Sycamore Street based on our observations of sand wash near some joint locations and visible soil in the recesses of some joints. It is not clear whether similar conditions may be present at some locations along Eddy Street since the street could not be closed for inspection the day our engineer visited the site. Further observation during and after rain or high groundwater events is recommended. We recommend sealing of the vertical joints between the retaining wall panels where soil migration has occurred and other locations where the joint seal is not intact to prevent further migration of the retained soils through the wall. Our scope did not include testing or verifying the effectiveness of any joint seals.

In addition, indications of settlement of the pavements overlying the retained soils were observed in the form of depressed areas and the presence of exposed sealant above (in some cases several inches above) the present pavement surface. With the likelihood of migration of the retained soils through some of the vertical joints in the retaining walls, there is a possibility that voids may have or will form below supported pavements and other structures; however, our exploration did not indicate the presence of such voids. We theorize that due to the granular nature of the backfill, only limited soil arching is likely to occur, and thus large void formation has not occurred. This does not rule out the possible presence of voids in closer proximity to the joint locations near the base of the wall or the possible formation of larger voids with time. However, this would be unlikely unless soil migration is allowed to occur through the wall. Therefore, we recommend that the open joints be sealed to prevent further migration of the retained soils.

It appears that the anomalies observed below the pavements are generally indicative of loose soils and not actual voids. Without the presence of voids near the bottom of the pavement, the risk of large pavement movement or catastrophic failure is unlikely, however, the loose subgrade soils will likely result in additional future settlement and poor pavement support, particularly in these areas of the noted anomalies. We do not see an immediate need for removal of pavements and recompaction of these soils, unless it is planned to repave or redevelop any of these areas or the pavement is in disrepair, however, it is recommended that the pavement joints and cracks be sealed to limit infiltration of surface water. Where settlement has resulted in poor drainage, consideration should be given to repairing by re-grading and reconstructing these pavements or by overlaying to promote drainage away from the walls.

Borings completed through the pavement on Eddy and Sycamore Streets did not indicate the presence of voids or loose soils. However, high groundwater was present in some of the borings along Eddy Street. This is consistent with the design of the two walls, where the bottom of the Eddy Street section is open to underlying groundwater, but the Sycamore Street section is protected by an underlying concrete mat structure. The presence of groundwater below the Eddy Street pavement will reduce the subgrade support, especially during occurrences of seasonal high groundwater which could potentially produce pavement uplift or migration of soils through joints if it is elevated above the pavement surface. Maintaining the groundwater level below the pavement surface could be accomplished with wells or other similar dewatering measures.

5.0 GENERAL COMMENTS

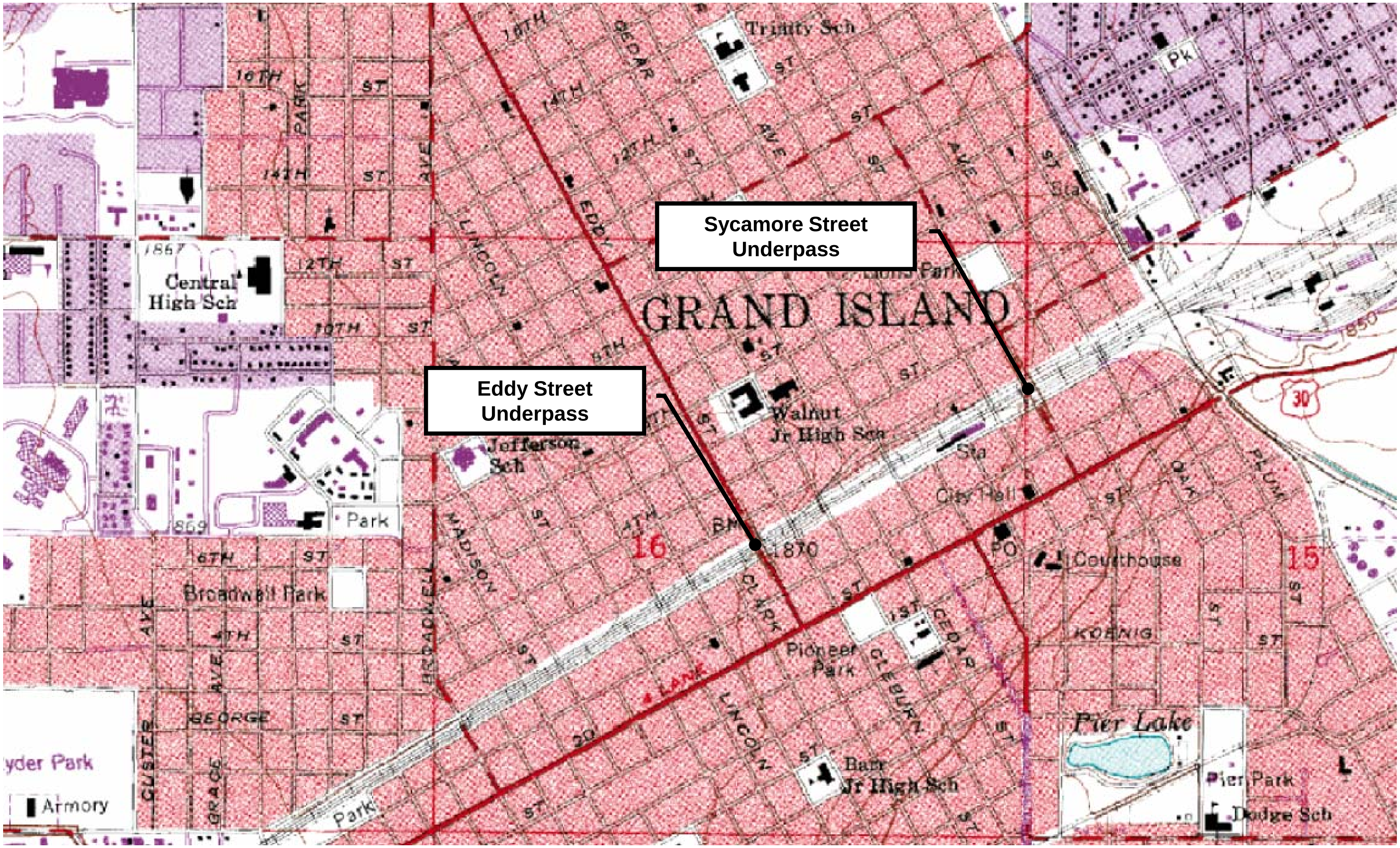
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



Source: United States Geological Survey, 7.5-minute series map “Grand Island, Nebraska”,1963, Revised 1993.

N

Project Manager: GKA	Project No. 05115091	Terracon Consulting Engineers & Scientists	SITE LOCATION PLAN
Drawn by: GKA	Scale: Not to scale	15080 A Circle Omaha, Nebraska 68144	SYCAMORE & EDDY STREET UNDERPASSES
Checked by: EDP	File Name: 05115091 VMAP	PH. (402) 330-2202 FAX. (402) 330-7606	UPRR AND ADJACENT STREETS GRAND ISLAND, NEBRASKA
Approved by: EDP	Date: 11/16/2011		Ex. No. A-1

- Boring location (approx.)

N

Source: City of Grand Island GIS Website

THIS DIAGRAM IS FOR GENERAL LOCATION PURPOSES ONLY

Project Manager: GKA	Project No. 05115091	Terracon Consulting Engineers & Scientists	BORING LOCATION PLAN
Drawn by: GKA	Scale: Not to Scale	15080 A Circle, Omaha, Nebraska 68144	SYCAMORE & EDDY STREET UNDERPASSES
Checked by: EDP	File Name: 05115091BLAN	PH. (402) 330-2202 FAX. (402) 330-7606	UPRR AND ADJACENT STREETS
Approved by: EDP	Date: 11/16/2011		GRAND ISLAND, NEBRASKA

FIG No. A-2

N

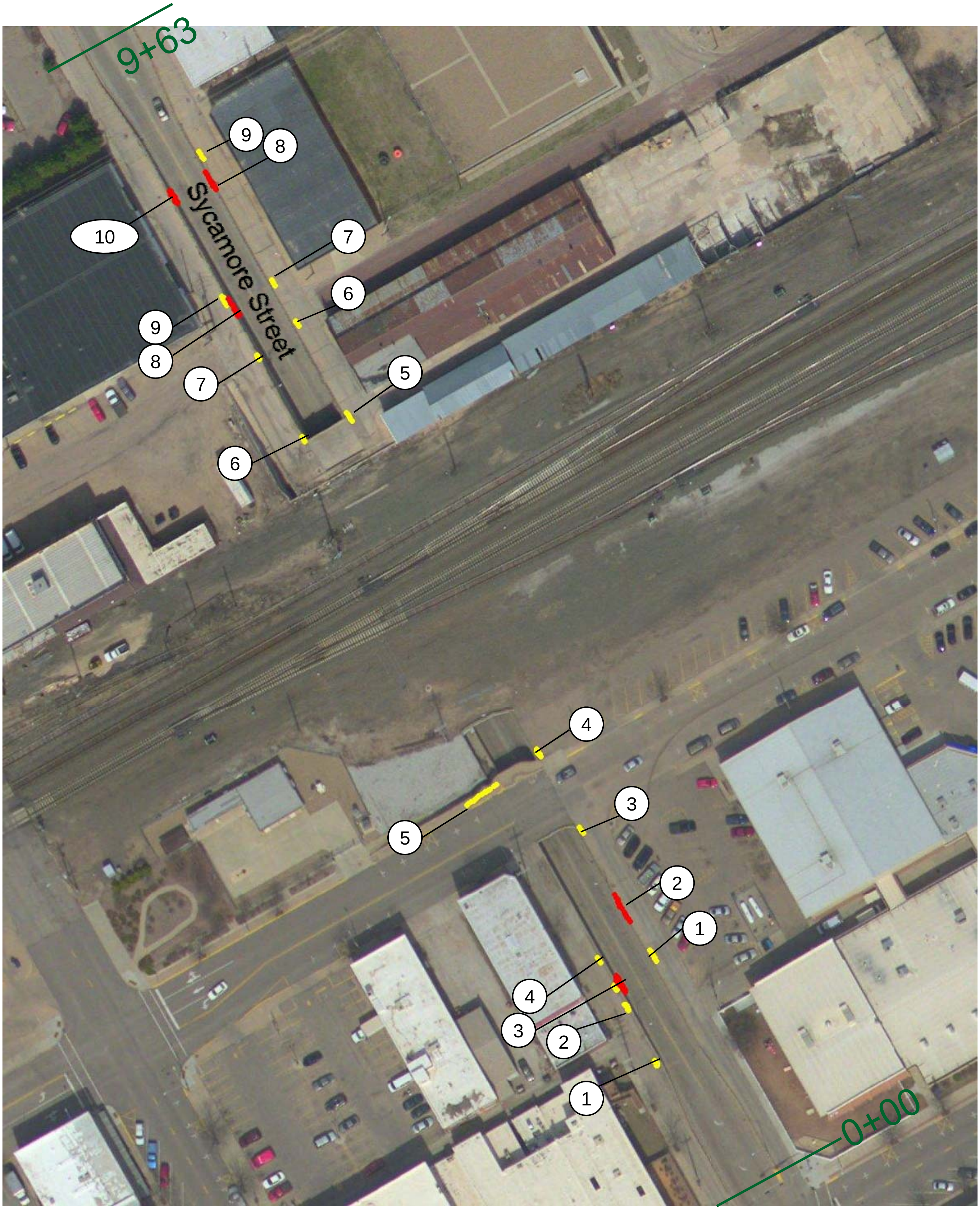
- Boring location (approx.)

Source: City of Grand Island GIS Website

THIS DIAGRAM IS FOR GENERAL LOCATION PURPOSES ONLY

Project Manager: GKA	Project No. 05115091	Terracon Consulting Engineers & Scientists	BORING LOCATION PLAN
Drawn by: GKA	Scale: Not to Scale		SYCAMORE & EDDY STREET UNDERPASSES
Checked by: EDP	File Name: 05115091BLAN	15080 A Circle Omaha, Nebraska 68144	UPRR AND ADJACENT STREETS
Approved by: EDP	Date: 11/16/2011	PH. (402) 330-2202 FAX. (402) 330-7606	GRAND ISLAND, NEBRASKA

FIG No. A-3



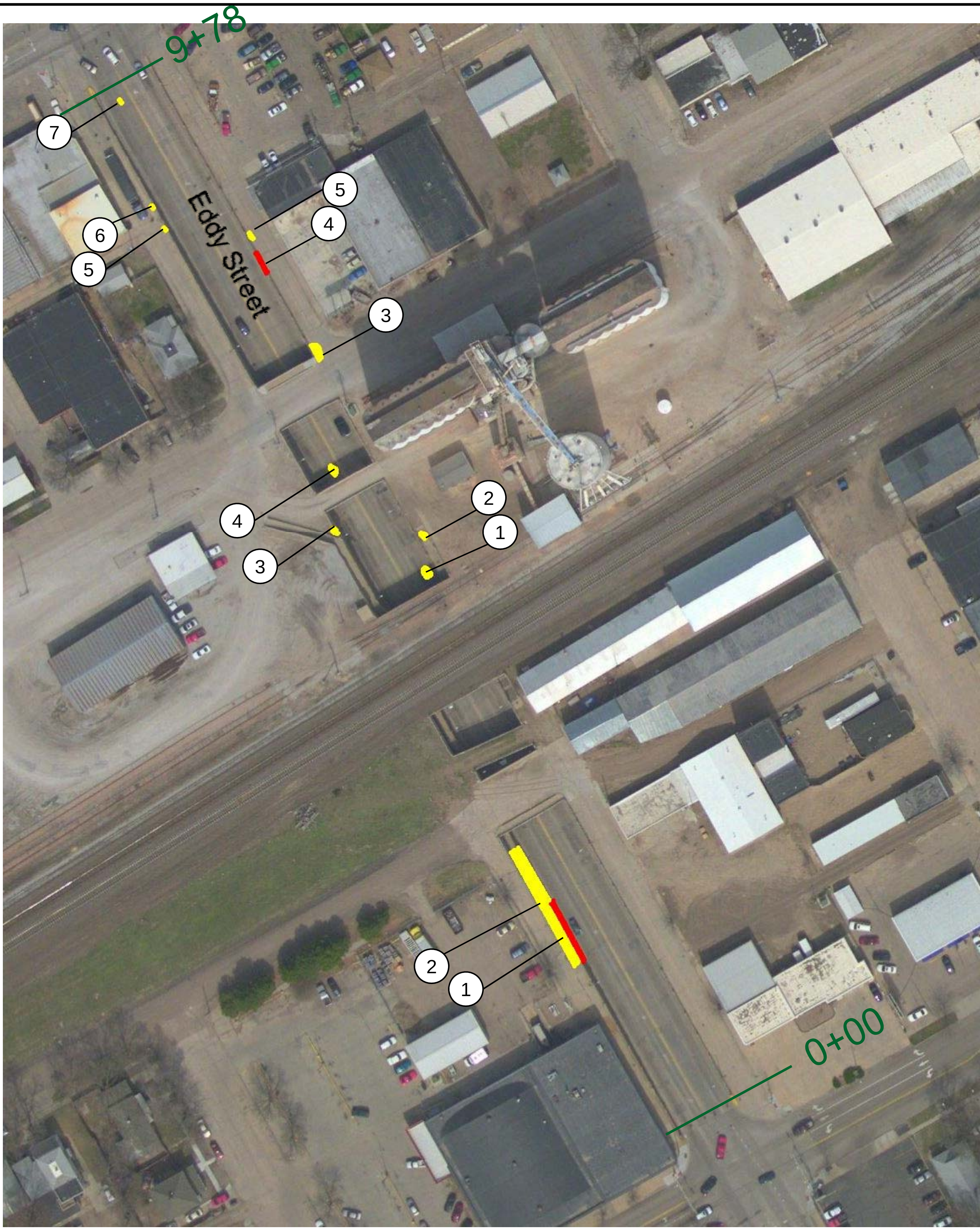
Source: City of Grand Island GIS Website

N

- GPR pavement location anomaly (approx.) See Sheet A-6 for approximate Stationing
- GPR wall location anomaly (approx.) See Sheet A-6 for approximate Stationing
- x - Anomaly Stationing Reference, See Sheet A-6

THIS DIAGRAM IS FOR GENERAL LOCATION PURPOSES ONLY

Project Manager: GKA	Project No. 05115091	Terracon Consulting Engineers & Scientists 15080 A Circle, Omaha, Nebraska 68144 PH. (402) 330-2202 FAX. (402) 330-7606	GPR ANOMALIES LOCATION PLAN
Drawn by: GKA	Scale: Not to Scale		SYCAMORE STREET UNDERPASS UPRR AND ADJACENT STREETS GRAND ISLAND, NEBRASKA
Checked by: EDP	File Name: 05115091BLAN		FIG No. A-4
Approved by: EDP	Date: 12/1/2011		



Source: City of Grand Island GIS Website

N

- GPR pavement location anomaly (approx.) See Sheet A-6 for approximate Stationing
- GPR wall location anomaly (approx.) See Sheet A-6 for approximate Stationing

x - Anomaly Stationing Reference, See Sheet A-6

THIS DIAGRAM IS FOR GENERAL LOCATION PURPOSES ONLY

Project Manager: GKA	Project No. 05115091	Terracon Consulting Engineers & Scientists	GPR ANOMALIES LOCATION PLAN	FIG No.
Drawn by: GKA	Scale: Not to Scale	15080 A Circle, Omaha, Nebraska 68144	EDDY STREET UNDERPASS	A-5
Checked by: EDP	File Name: 05115091BLAN	PH. (402) 330-2202, FAX. (402) 330-7606	UPRR AND ADJACENT STREETS	
Approved by: EDP	Date: 12/1/2011		GRAND ISLAND, NEBRASKA	

GPR Anomalies – Approximate Project Stationing

Sycamore Street				Eddy Street			
Left Side		Right Side		Left Side		Right Side	
Number	Station	Number	Station	Number	Station	Number	Station
1	1+24	1	2+03	1	1+85	1	5+01
2	1+74	2	2+48	2	2+12	2	5+30
3	1+94	3	3+19	3	5+71	3	7+04
4	2+20	4	3+92	4	6+13	4	7+89
5	3+86	5	7+10	5	8+51	5	8+14
6	7+09	6	7+95	6	8+73	-	-
7	7+86	7	8+35	7	9+59	-	-
8	8+31	8	9+33	-	-	-	-
9	8+41	9	9+52	-	-	-	-
10	9+36	-	-	-	-	-	-

LOG OF BORING NO. B-1

CLIENT **Kirkham Michael & Associates**

SITE **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT **Sycamore and Eddy Street Underpasses**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	5.5 inches of Portland cement concrete at surface				PA					
	(FILL) FINE TO COARSE SAND, trace concrete rubble, trace gravel Dark gray			1	SS	18	2	6		
					PA					
				2	SS	18	2	9		
		5			PA					
				3	SS	18	2	9		
					PA					
				4	SS	18	2	11		
		10			PA					
	Trace clay, trace asphalt rubble at about 13.5 feet			5	SS	18	2	16		
15	**FINE TO COARSE SAND**, trace gravel Dark gray, very loose	15			PA					
			SP	6	SS	16	3	2		
20	**BOTTOM OF BORING**	20								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	N/E	WD
WL		
WL		

Terracon

BORING STARTED	10-3-11
BORING COMPLETED	10-3-11
RIG 96	FOREMAN JM
APPROVED GKA	JOB # 05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

LOG OF BORING NO. B-2

CLIENT
Kirkham Michael & Associates

SITE **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT
Sycamore and Eddy Street Underpasses

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	5 inches of Portland cement concrete at surface **(FILL) FINE TO COARSE SAND**, trace concrete rubble, trace gravel Dark gray				PA					
				1	SS	18	2	5		
					PA					
				2	SS	18	2	7		
		5			PA					
				3	SS	18	3	4		
					PA					
				4	SS	18	3	5		
		10			PA					
	13.5									
	FINE TO COARSE SAND, trace gravel Dark gray, loose		SP	5	SS	17	5	7		
		15			PA					
	Very loose at about 18.5 feet		SP	6	SS	18	3	12		
	20	20								
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	∇ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED			10-3-11
BORING COMPLETED			10-3-11
RIG	96	FOREMAN	JM
APPROVED	GKA	JOB #	05115091

LOG OF BORING NO. B-3

CLIENT
Kirkham Michael & Associates

SITE **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT
Sycamore and Eddy Street Underpasses

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	6 inches of Portland cement concrete at surface				PA					
	(FILL) FINE TO COARSE SAND, trace concrete rubble, trace gravel Dark gray			1	SS	18	9	6		
3.5					PA					
	FINE TO COARSE SAND, trace gravel, trace clay Dark gray, loose			2	SS	12	6	11		
5	**BOTTOM OF BORING**	5								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	10-3-11		
BORING COMPLETED	10-3-11		
RIG	96	FOREMAN	JM
APPROVED	GKA	JOB #	05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

LOG OF BORING NO. B-4

CLIENT **Kirkham Michael & Associates**

SITE **UPRR and Adjacent Streets, Grand Island, NE**

PROJECT **Sycamore and Eddy Street Underpasses**

Graphic log depth	Description	Depth, ft.	USCS Symbol	Samples: Number	Samples: Type	Samples: Recovery, in.	Samples: SPT - N ** Blows / ft.	Tests: Water Content, %	Tests: Dry Unit Wt pcf	Tests: Unconfined Strength, psf
	1.5 inches of asphaltic cement concrete over 8 inches of Portland cement concrete at surface				PA					
	(FILL) FINE TO COARSE SAND, trace concrete rubble, trace gravel Dark gray			1	SS	17	7	3		
					PA					
				2	SS	18	4	3		
		5			PA					
				3	SS	16	4	3		
					PA					
				4	SS	16	2	3		
		10			PA					
13.5	**FINE TO COARSE SAND**, trace gravel Dark gray, very loose		SP	5	SS	15	1	4		
		15			PA					
	Loose at about 18.5 feet		SP	6	SS	16	5	4		
20	**BOTTOM OF BORING**	20								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	N/E	WD
WL		
WL		

Terracon

BORING STARTED	10-4-11
BORING COMPLETED	10-4-11
RIG 96	FOREMAN JM
APPROVED GKA	JOB # 05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

LOG OF BORING NO. B-5

CLIENT: **Kirkham Michael & Associates**

SITE: **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT: **Sycamore and Eddy Street Underpasses**

Depth, ft.	Description
0 – 13.5	8 inches of Portland cement concrete at surface **<u>(FILL) FINE TO COARSE SAND</u>**, trace concrete rubble, trace gravel Dark gray
13.5 – 20	**<u>FINE TO COARSE SAND</u>**, trace gravel Dark gray, very loose
20	**BOTTOM OF BORING**

USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
		PA					
	1	SS	14	12	4		
		PA					
	2	SS	14	14	3		
		PA					
	3	SS	12	9	4		
		PA					
	4	SS	6	3	6		
		PA					
SP	5	SS	18	2	6		
		PA					
SP	6	SS	18	4	5		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	∇ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED	10-4-11
BORING COMPLETED	10-4-11
RIG	96
FOREMAN	JM
APPROVED	GKA
JOB #	05115091

LOG OF BORING NO. B-6

CLIENT Kirkham Michael & Associates

SITE UPRR and Adjacent Streets
Grand Island, NE

PROJECT Sycamore and Eddy Street Underpasses

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	3 inches of asphaltic cement concrete over 8 inches of Portland cement concrete at surface				PA					
2.5	**(FILL) FINE TO COARSE SAND**, trace concrete rubble, trace gravel Dark gray Sampler refusal at about 2.5 feet			1	SS		50/0"	15		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	1 WD	0.5 ¼ hr AB
WL		
WL		

Terracon

BORING STARTED	10-4-11
BORING COMPLETED	10-4-11
RIG 96	FOREMAN JM
APPROVED GKA	JOB # 05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

LOG OF BORING NO. B-7

CLIENT
Kirkham Michael & Associates

SITE **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT
Sycamore and Eddy Street Underpasses

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	3 inches of asphaltic cement concrete over 9 inches of Portland cement concrete at surface				PA					
	(FILL) FINE TO COARSE SAND, trace concrete rubble, trace gravel Dark gray			1	SS	12	8	13		
3.5					PA					
	FINE TO COARSE SAND, trace gravel Dark gray, loose		SP	2	SS	18	4	15		
5	**BOTTOM OF BORING**	5								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 4 WD	▼ 3	¼ hr AB
WL	▽	▽	
WL			

Terracon

BORING STARTED	10-4-11
BORING COMPLETED	10-4-11
RIG 96	FOREMAN JM
APPROVED GKA	JOB # 05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

LOG OF BORING NO. B-8

CLIENT
Kirkham Michael & Associates

SITE **UPRR and Adjacent Streets**
Grand Island, NE

PROJECT
Sycamore and Eddy Street Underpasses

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	6 inches of Portland cement concrete at surface				PA					
	(FILL) FINE TO COARSE SAND, trace concrete rubble, trace gravel Dark gray			1	SS	12	10	16		
3.5					PA					
	FINE TO COARSE SAND, trace gravel Dark gray, loose		SP	2	SS	18	8	17		
5	**BOTTOM OF BORING**	5								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	∇ 3 WD	▼ 2 ¼ hr AB
WL	▼	▼
WL		

Terracon

BORING STARTED	10-4-11
BORING COMPLETED	10-4-11
RIG 96	FOREMAN JM
APPROVED GKA	JOB # 05115091

BOREHOLE 05115091 LOGS.GPJ TERRACON.GDT 11/17/11

Field Exploration Description

The drill crew staked the boring locations relative to existing physical features at the site. Distances were measured with a mechanical wheel or nylon tape and right angles for these measurements were estimated. The approximate boring locations are shown on the Boring Location Plan included in Appendix A. The ground surface elevations were not recorded. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were advanced with a truck-mounted drilling rig utilizing continuous flight solid-stemmed augers to advance the boreholes. Representative samples were obtained using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground with an automated 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the standard penetration resistance value. These values are indicated on the boring logs at the depths of occurrence. The samples were sealed and transported to the laboratory for testing and classification.

The drill crew prepared a field log for each boring. Each log included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B

LABORATORY TESTING

Laboratory Testing

The soil samples were tested in the laboratory to measure their natural water contents. Results of the laboratory tests are provided on the boring logs included in Appendix A.

The samples were classified in the laboratory based on visual observation and texture. Additional laboratory testing could be performed to more accurately classify the samples. The soil descriptions presented on the boring logs for native soils are in accordance with our enclosed General Notes and Unified Soil Classification System (USCS). The estimated group symbol for the USCS is also shown on the boring logs, and a brief description of the Unified System is included in Appendix C.

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 3" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the “Standard Penetration” or “N-value”.

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0-1	Very Soft
500 – 1,000	2-4	Soft
1,001 – 2,000	4-8	Medium Stiff
2,001 – 4,000	8-15	Stiff
4,001 – 8,000	15-30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

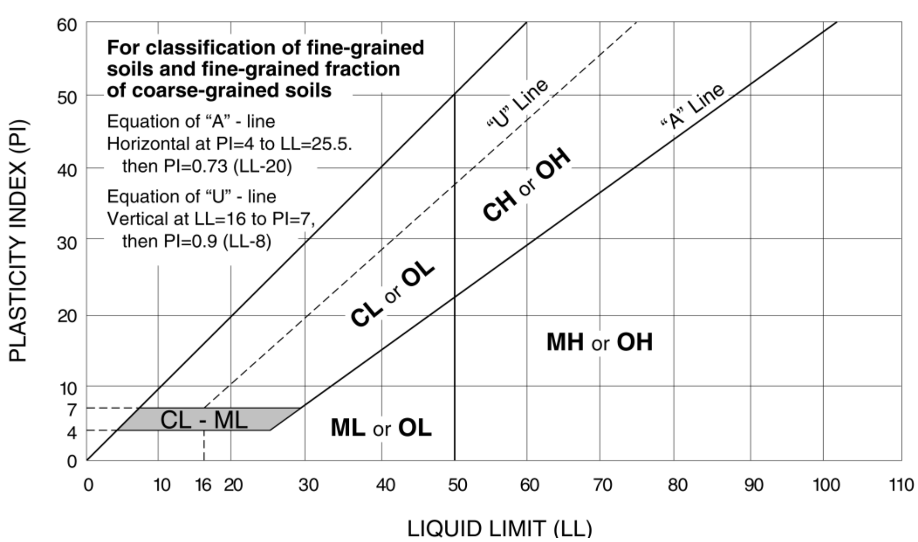
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] $PI \geq 4$ and plots on or above "A" line.
[O] $PI < 4$ or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



References:

Soil Survey of Hall County, Nebraska; United States Department of Agriculture;
URL: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

United States Geological Survey, 7.5-minute series map "Grand Island, Nebraska", 1963, Revised 1993.

City of Grand Island GIS Mapping Website, via http://gisweb.grand-island.com/mapsifter7/default.aspx

City of Grand Island

Tuesday, March 06, 2012
Study Session

Item C3

Presentation on Uranium Removal Project Cost/Revenue Analysis

Staff Contact: Tim Luchsinger

<u>Council Agenda Memo</u>

From: Timothy Luchsinger, Utilities Director

Meeting: March 6, 2012

Subject: Uranium Removal Project Cost/Revenue Analysis

Item #'s: 3

Presenter(s): Tim Luchsinger, Utilities Director

<u>Background</u>

The City's municipal water system is supplied primarily from its Platte River Well Field. This well field is comprised of 21 wells and a pumping station. Testing for State regulatory requirements indicated composite uranium levels to be approaching the Maximum Containment Level (MCL) established by the EPA. Uranium is not an acute concern but rather is a chronic concern over a lifetime of exposure, and sampling and testing of the Grand Island water system thus far show full compliance with the EPA regulation. Testing of individual wells for uranium has indicated most wells exceed this MCL. To allow use of these wells during high water system demand periods, additional piping was installed in the past year for blending with lower uranium concentration wells. Recent testing of uranium concentrations in the wells indicated a trend towards increasing levels, reducing the effectiveness of well blending to reduce overall levels, therefore, based on Department recommendations, the Utilities Department was authorized by Council on February 22, 2011, to proceed with the procurement and installation of the large-scale pilot uranium removal system. Based on the multiple phase structure of the uranium engineering services RFP, HDR, the City's consultant on this project, was requested to provide a proposal for preparing specifications to issue for bids for an adsorptive media pilot plant. On June 28, 2011, Council awarded the contract for the Uranium Removal System – Equipment Procurement to Water Remediation Technology.

On August 23, 2011, Council approved the proposal of HDR Engineering, Inc., of Lincoln, Nebraska, for Uranium Removal Water Plant – Task Order No. 2. This task order authorized the detailed engineering services which included preparation of specifications for bidding of a new building and foundations, underground piping, well modifications, and installation of the uranium removal equipment. As part of these engineering services, HDR developed the specifications for the pump modifications of well field wells and installation of the uranium removal system equipment. Contracts have been awarded for the construction of the uranium removal equipment building and for the installation of the equipment. The system is planned to be operational in May of this year. Methods to fund the capital cost and annual operating costs are now required to be finalized to support completion of the uranium removal system project.

Discussion

Possible funding methods for the capital cost and annual operating costs have been previously discussed with Council. Now that the project is approaching completion and costs are becoming more defined, proposed funding options will be presented at this Study Session to allow staff to prepare an ordinance for revising the Water Rate Schedule and its consideration by Council at a future 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.

It is the intent of City Administration to bring this issue to a future council meeting for the revision of the Water Rate Schedule.

CITY OF Grand Island NEBRASKA

UTILITIES

Uranium Removal Project
Cost / Revenue Analysis

Council Study Session

March 6, 2012

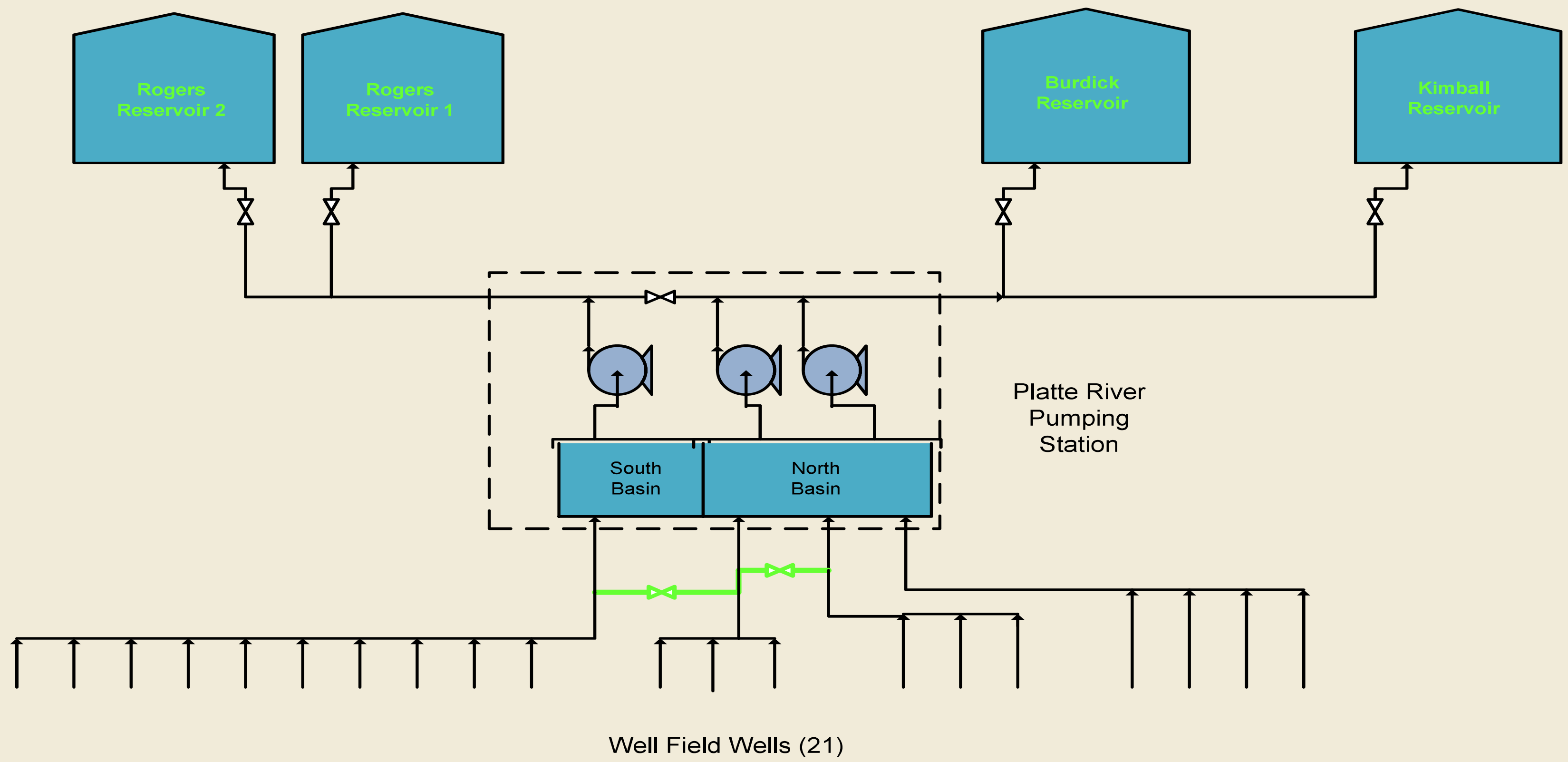
2000 Uranium Rule

- Established by EPA and the Safe Water Drinking Water Act
- Maximum Contaminant Level (MCL)- 30 ug/L (ppb)
- Based on rolling average of 4 quarterly samples
- Samples must be taken at each Point of Entry (POE) to the water distribution system

CITY OF Grand Island NEBRASKA

UTILITIES

Water Supply System



CITY OF
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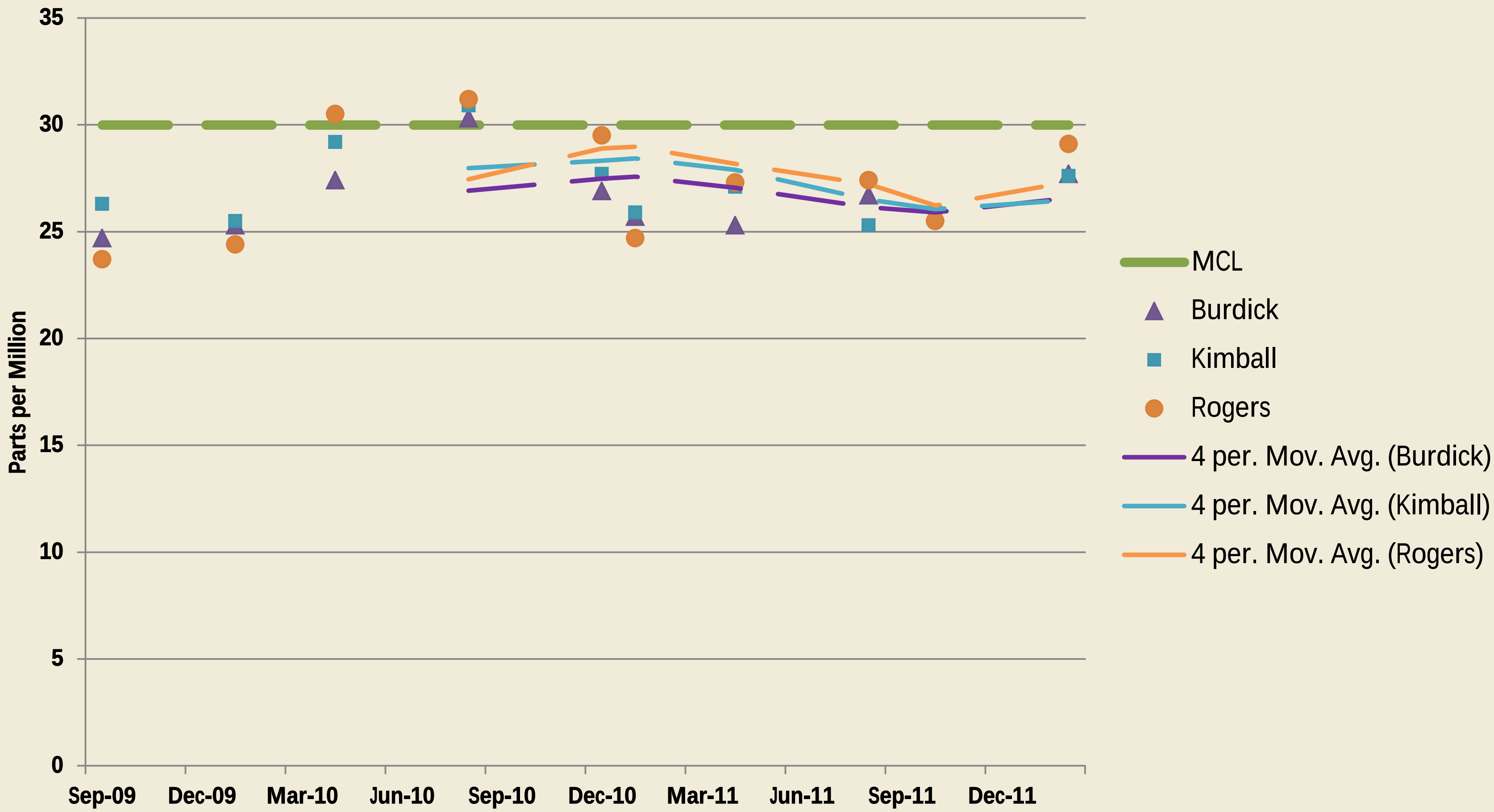
UTILITIES

Point of Entry Uranium Sampling Results



Implementation Plan

- Adsorptive media system recommended
  - Phased construction – Treat three wells, blend treated water to lower overall uranium concentrations
  - Residual management/disposal and radioactive licensing responsibility of manufacturer

Uranium Removal Project

- Utilities Department directed by Council to proceed with the procurement and installation of a large-scale uranium removal system at the Platte River Well Field – February 22, 2011

Project Status

- Phase 1 – Equipment Procurement
  - Phase 1 Engineering Authorization, Prepare System Specifications – August 23, 2010
  - Awarded Uranium Removal System Contract – July 26, 2011

Project Status

- Phase 2 – Detailed Engineering/Construction Specifications
  - Phase 2 Engineering Authorization, Prepare Construction Specifications – August 23, 2011
  - Awarded Treatment Building – October 11, 2011
  - Awarded System Installation Contract – February 28, 2012
  - Construction Complete - May 2012

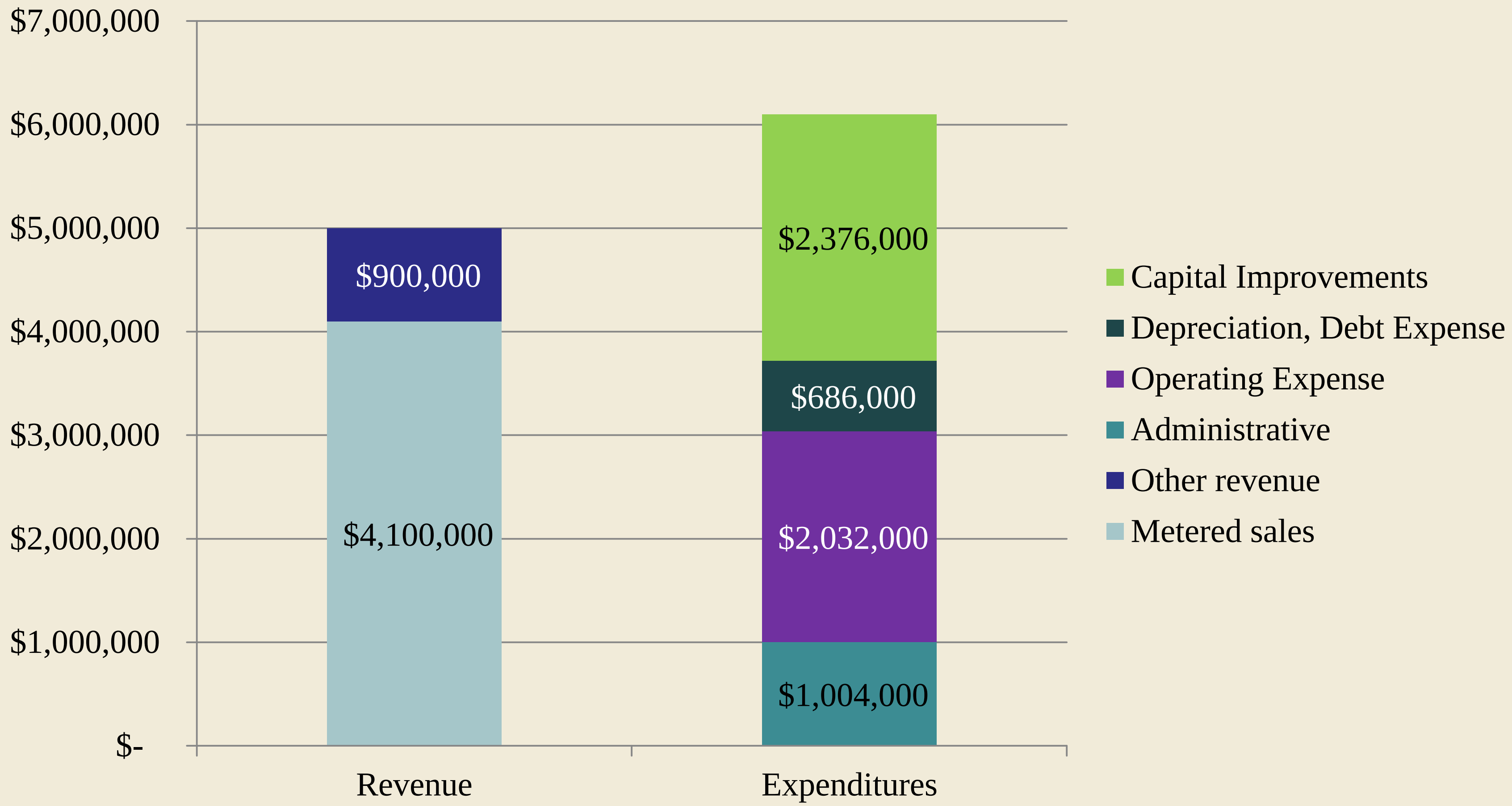
Project Parameters

- Capital Cost = $3,000,000
- Annual Operating Costs = $800,000 to treat up to 1.5 billion gallons per year
- Annual Water Demand = 3.75 billion gallons
- Annual Water Sales = $4,100,000

CITY OF Grand Island NEBRASKA

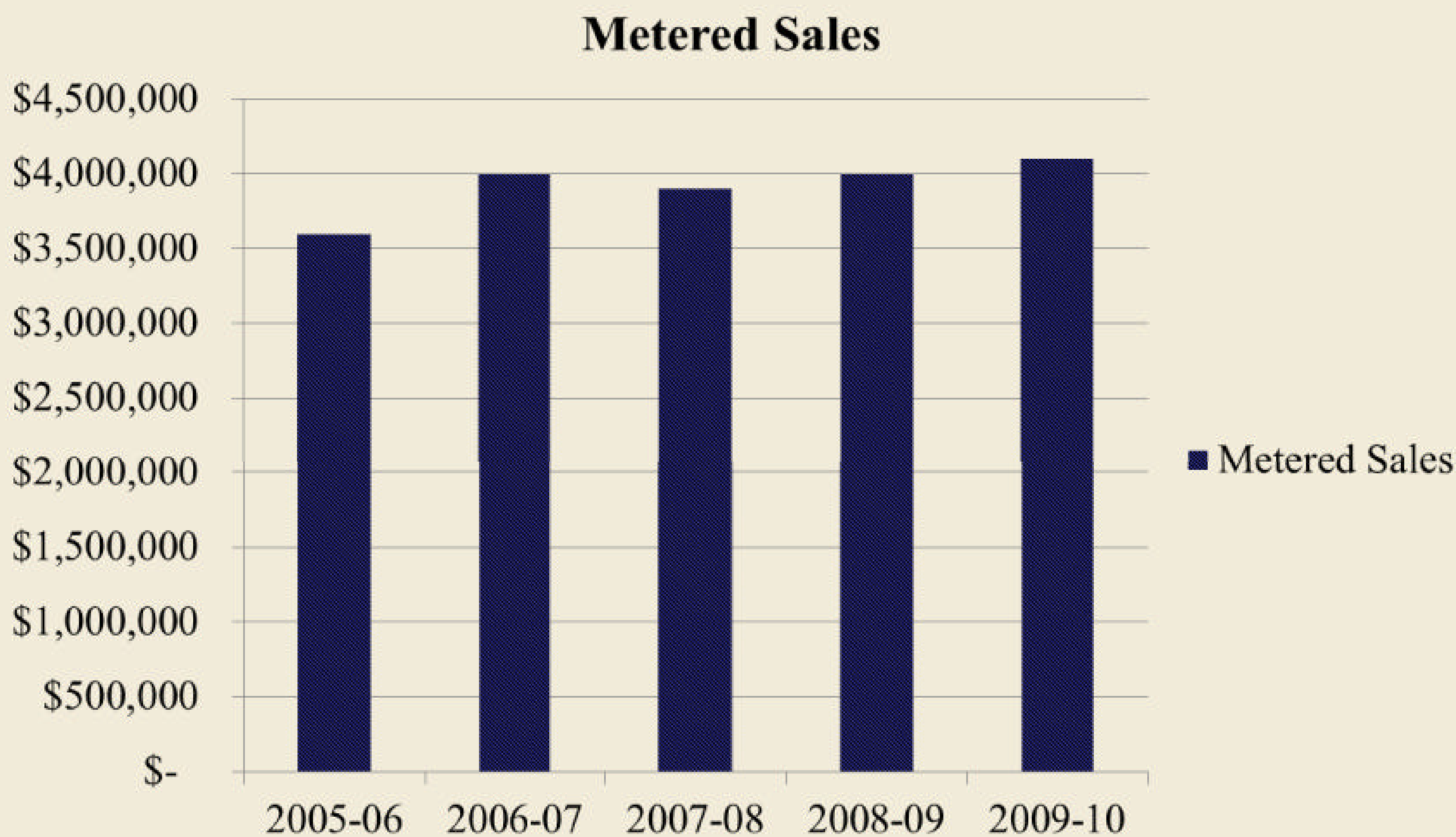
UTILITIES

Water Fund - 2010-11



CITY OF Grand Island NEBRASKA

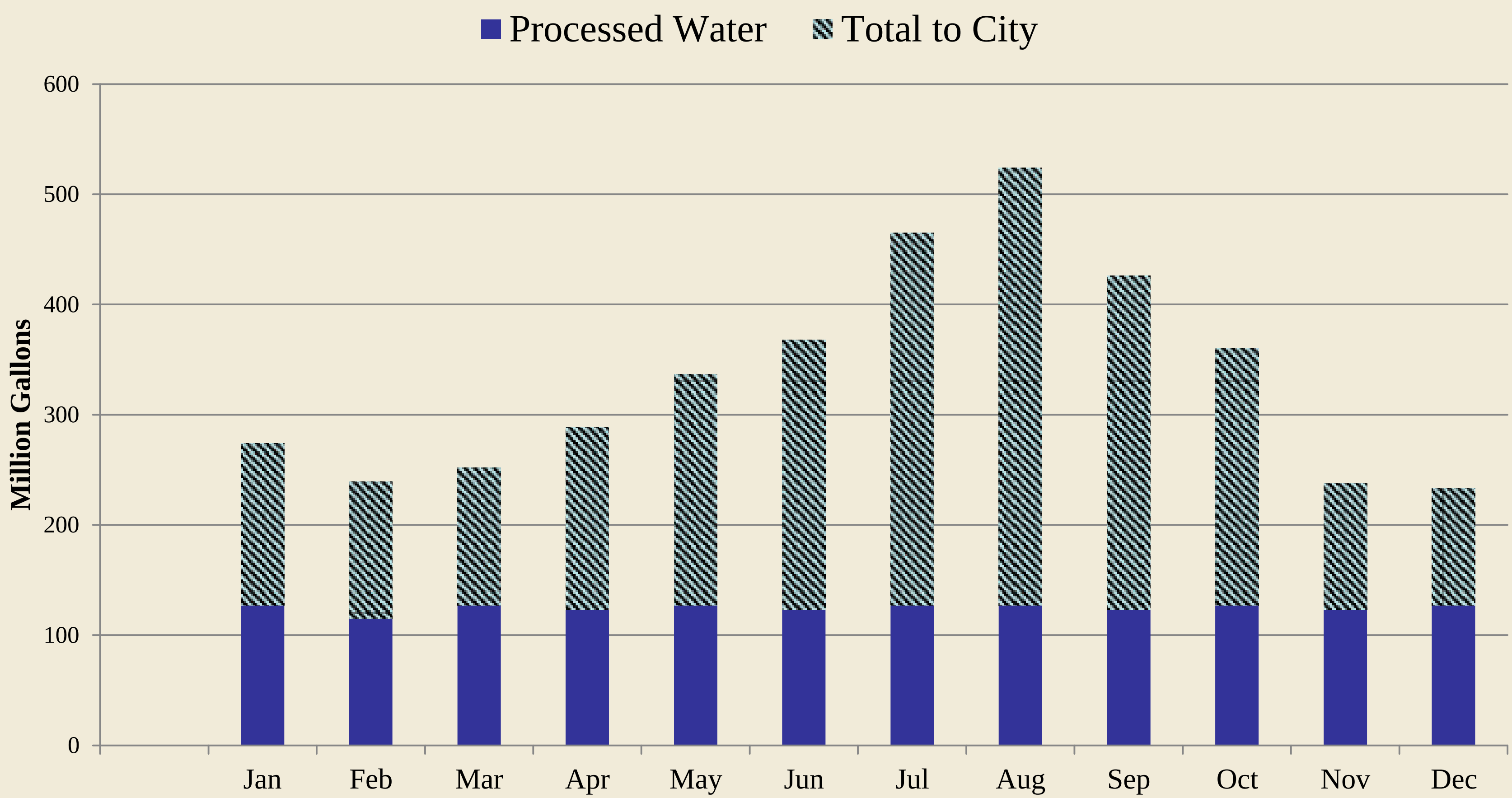
UTILITIES



CITY OF Grand Island NEBRASKA

UTILITIES

Removal System Operation



Capital Funding

- Evaluation of Capital Funding Options
  - Short-term debt
  - Cash reserves
  - **Long-term bonding**
    - **Refinance existing 1999 bond**
    - **Lower interest rate**
    - **Extend term**
    - **Maintain existing debt service level**

Revenue

- Evaluation of revenue streams to cover the additional annual operating cost
  - Volumetric/Flat Rate (per gallon)
  - Flat Percentage
  - Cost per Service

Current Rate Structure

Cubic Feet Per Month	Rate Per 100 Cubic Feet
First 500	$1.496
Next 500	$0.700
Next 500	$0.692
Next 2,500	$0.767
Next 6,000	$0.713
Next 90,000	$0.654
Next 100,000	$0.574
Over 200,000	$0.535
Monthly Minimum (500 cubic feet)	$7.480
(1 cubic foot = 7 ½ gallons)	

CITY OF Grand Island NEBRASKA

UTILITIES

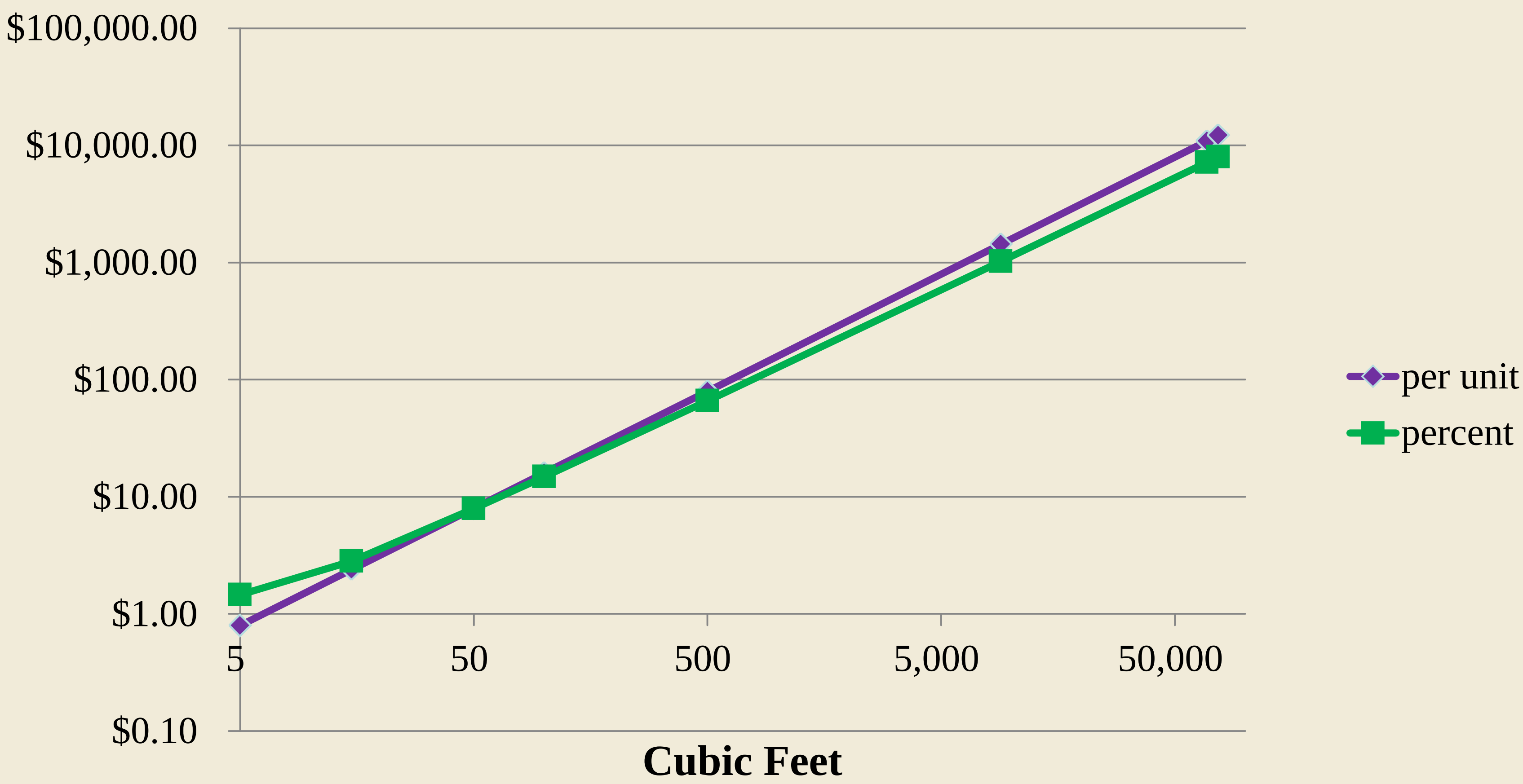
Flat Rate Increase ($0.16 / 100cf)

Cubic Feet	Current Amount	Increase	Increased Amount	% Increase	Typical Customer
500	$7.83	$0.80	$8.63	10%	small household
1,500	$14.79	$2.39	$17.18	16%	average household
5,000	$41.10	$7.98	$49.08	19%	small business
13,000	$96.37	$20.75	$117.12	22%	small manufacturing
35,000	$240.25	$55.85	$296.10	23%	motels, large manufacturing
900,000	$5,257.34	$1,436.26	$6,693.60	27%	food processing
3,000,000	$15,684.00	$4,787.53	$20,471.53	31%	meat processing

Percentage Rate Increase (20%)

Cubic Feet	Current Amount	Increase	Increased Amount	Typical Customer
500	$7.83	$1.46	$9.29	small household
1,500	$14.79	$2.82	$17.61	average household
5,000	$41.10	$7.95	$49.05	small business
13,000	$96.37	$18.74	$115.11	small manufacturing
35,000	$240.25	$46.81	$287.06	motels, large manufacturing
900,000	$5,257.34	$1,025.75	$6,283.09	food processing
3,000,000	$15,684.00	$3,060.22	$18,744.22	meat processing

UTILITIES



$100,000.00
$10,000.00
$1,000.00
$100.00
$10.00
$1.00
$0.10
5
50
500
5,000
50,000
Cubic Feet
per unit
percent

CITY OF **Grand Island** NEBRASKA

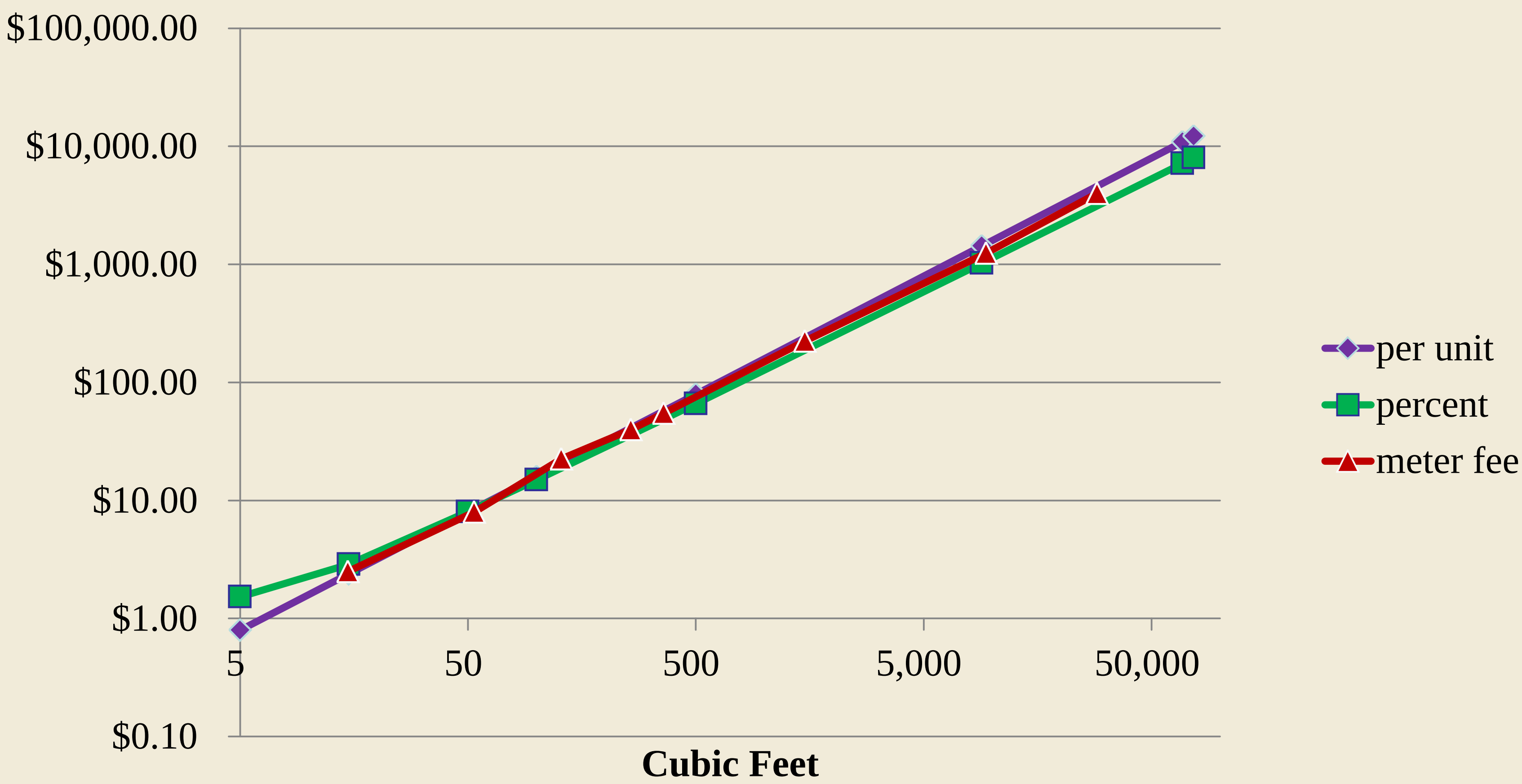
UTILITIES

Meter Fee

Meter Size	Consumption	No. of meters	Avg. consump. (100 cf)	Proposed Monthly Fee	Typical Customer
<= 1"	**212,928**	**14,332**	**15**	**$2.50**	household
1 1/2"	16,860	317	53	$8.00	small business
2"	29,693	231	129	$22.50	small manufacturing
3"	14,930	58	260	$40.00	
4"	12,473	35	362	$55.00	motels
6"	19,584	13	1,506	$225.00	large manufacturing
8"	56,282	6	9,380	$1,250.00	food processing
10"	57,708	2	28,854	$4,000.00	meat processing
TOTALS	420,455	14,993			

CITY OF Grand Island NEBRASKA

UTILITIES



CITY OF Grand Island NEBRASKA

UTILITIES

Monthly Increase Comparison

Cubic Feet	Increasing rates per gallon	Increasing rates by percentage	Establishing Meter Fee	Typical Customer
500	$0.80	$1.46	$2.50	small household
1,500	**$2.39**	**$2.82**	**$2.50**	**average household**
5,000	$7.98	$7.95	$8.00	small business
13,000	$20.75	$18.74	$22.50	small manufacturing
35,000	$55.85	$46.81	$55.00	motels, large manufacturing
900,000	$1,436.26	$1,025.75	$1,250.00	food processing
3,000,000	$4,787.53	$3,060.22	$4,000.00	meat processing

CITY OF Grand Island NEBRASKA

UTILITIES

Water Rate Comparison

	Residential 1" Meter		Commercial 2" Meter	Industrial 6" Meter
	5 ccf	50 ccf	100 ccf	1500 ccf
Omaha Area				
Winter	$31.37	$76.31	$172.25	$1684.78
Summer	$31.37	$76.31	$202.02	$2131.33
Lincoln	$10.14	$94.10	$159.40	$2944.02
North Platte	$22.67	$67.03	$128.60	$1416.89
Norfolk	$14.50	$69.97	$152.39	$1643.83
Fremont	$16.17	$53.26	$128.00	$1416.40
Hastings	$16.35	$62.25	$110.07	$1366.74
Columbus	$11.65	$63.85	$134.00	$1705.00
Kearney	$13.25	$69.50	$125.00	$1774.91
Grand Island	**$7.83**	**$41.10**	**$76.75**	**$992.35**
$0.16 per ccf	**$8.63**	**$49.08**	**$92.71**	**$1231.73**
20% flat rate	**$9.29**	**$49.05**	**$91.66**	**$1185.91**
Meter fee	**$10.33**	**$43.60**	**$99.25**	**$1217.35**

Methodology Comparison

	Per Cubic Foot/Gallon	Flat Percentage	Meter Fee
Revenue Change	Dependent on water usage	Dependent on water usage	Dependent on number and type of customers
Revenue stream	Variable by season and weather	Variable by season and weather	Constant by month
Customer impact	Higher impact on large users	Higher impact on small users	Neutral on customer usage

Proposed Timeline Implementation

- Consideration by Council for Rate Schedule Revision – March 13, 2012
- Fifteen day publication
- Revised Rate Schedule effective April 1, 2012
- Refinance 1999 Revenue Bonds – April, 2012
- Revised Rate Receipts begin May, 2012
- Receive Bond Receipts – May, 2012

CITY OF Grand Island NEBRASKA

UTILITIES

Budget Plan!

- Utilities Customers
- Flat monthly payments
- Budget amount determined in December, beginning January
- Balance reviewed in September, payment adjusted accordingly

Questions/Discussion