CITY OF WEST DES MOINES
CITY COUNCIL MEETING COMMUNICATION

ITEM: **DATE: January 26, 2016**

Receive and File
Glen Oaks Drainage Study
LT Leon Associates, Inc.

FINANCIAL IMPACT:

All costs for these services were paid from budgeted account no. 8300.80.440.5.4500 with the ultimate funding intended to come from Stormwater Utility Fees.

BACKGROUND:

LT Leon Associates, Inc. was contracted to prepare a drainage study for the Glen Oaks area. The study is now complete and will be shared with Glen Oaks Country Club and the Glen Oaks Homeowners Association. Staff anticipates each group will request to meet with the City to discuss the results.

OUTSTANDING ISSUES:

None

RECOMMENDATION:

The City Council receive and file the Glen Oaks Drainage Study dated January 8, 2016.

Lead Staff Member: Duane C. Wittstock, P.E., L.S., City Engineer

STAFF REVIEWS

Department Director	Duane C. Wittstock, City Engineer DCW
Appropriations/Finance	Tim Stiles, Finance Director
Legal	Richard Scieszinki, City Attorney RJS
Agenda Acceptance	RTG

PUBLICATION(S) (if applicable)

Published In	
Dates(s) Published	

SUBCOMMITTEE REVIEW (if applicable)

Committee	Public Works		
Date Reviewed	January 18, 2016		
Recommendation	Yes	No	Split

LT LEON
ASSOCIATES · INC

Letter of Transmittal

Date Sent: January 11, 2016

Project: Glen Oaks Drainage Study

City PN #: 0430-025-2015
LT Leon Project #: 011.006

To: Brian Hemesath
City of West Des Moines

From: Luis Leon
LT Leon Associates
500 E Locust St., Suite 400
Des Moines, IA 50309

Subject: Final Report – 3 copies

Via: Hand Delivery

Comments:

Brian,
Included are three signed copies of the final Glen Oaks Drainage Study.

Thank you,

Luis T. Leon, P.E.
Principal

Glen Oaks Drainage Study

Glen Oaks
West Des Moines, Iowa

January 2016

City of West Des Moines Project Number: 0430-025-2015
LT Leon Project Number: 011.006

Prepared by:

LT LEON
ASSOCIATES · INC

500 East Locust Street, Suite 400
Des Moines, IA 50309
515-422-7016
www.ltleon.com

FINAL COPY

LICENSED PROFESSIONAL ENGINEER
LUIS T. LEON
18685
IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Signature 1/9/2016 Date

Luis T. Leon, P.E.
Iowa License Number 18685
My license renewal date is December 31, 2017.

Pages or sheets covered by this seal: ALL

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A. Introduction

1. Background

The purpose of this analysis was to evaluate the compliance of the Glen Oaks neighborhood development with the current City of West Des Moines stormwater management standards. This report does not contain design information and is not an approved stormwater management plan. Glen Oaks is located in West Des Moines between S. 60th Street, Mills Civic Parkway, Interstate 35, and Grand Avenue. Glen Oaks is a large gated residential community that began to be developed in the early 1990's. Prior to development the property was farmed for row crop. However, for the purposes of the stormwater calculations, the pre-development condition will be evaluated as the land use prior to the row crop, which is assumed to be prairie grass.

The site has been fully developed into multiple family living units, single family homes, and Glen Oaks Country Club. The impervious surfaces consist of roads, driveways, and roofs. There are a number of ponds on the property that provide some detention during rainfall events. Four main drainage basins collect and discharge stormwater from the site – NW, NE, East and South. The NW and NE areas drain to City storm sewer at Mills Civic Parkway. The East area drains to a large culvert at I-35. The South area drains to a large culvert at Grand Avenue. These areas all eventually drain to the Raccoon River.

B. Analysis

1. City Stormwater Standards

The current City stormwater management detention standards are described in the City's Design Standards Manual Chapter 2 Section 8.4. This section states that post-development peak runoff for rainfall events with an expected return frequency of two and five years shall not exceed the pre-developed peak runoff for those same storms. The section also states that peak runoff for a rainfall event with a 100-year return frequency in the post-developed scenario must not exceed the pre-development peak runoff for the five-year return frequency rainfall event.

2. Pre-Development Condition

The pre-development condition in this study is the assumed condition before the property was developed and before any farming activities. A historical USGS quadrangle topographic map (revised 1976) was used to delineate pre-development drainage basins for calculating runoff. There are three primary drainage basins (North, East, South) comprising the Glen Oaks development area for the pre-development scenario. Times of concentration were calculated for each drainage basin. Assumptions for the pre-development condition include a CN value of 74 and no impervious area. The soils within the site were determined to be primarily hydrologic soil group C based on web soil survey. See **Map 1 - Pre-Development Condition**.

Table 1 - Pre-Development Hydrology

	North	East	South	TOTAL
Area (ac)	36.8	62.5	359.4	458.7
Impervious %	0	0	0	0
T_c (min)	40	48	64	-
Cumulative CN	74	74	74	74

Win-TR-55 was used to calculate the peak runoff for the pre-development condition. SUDAS 2015 rainfall data and SCS Type II rainfall distribution (The NRCS Urban Hydrology for Small Watersheds method) were used for the design storms. The mean rainfall depths for each rainfall event are based on Region 5 of the SUDAS Climatic Sectional Codes of Iowa. The 2-year, 5-year and 100-year, 24-hour rainfall events were used for the analysis.

Table 2 - Pre-Development Peak Flow Results

	North	East	South
2-year (cfs)	24	36	170
5-year (cfs)	38	57	271
100-year (cfs)	112	168	811

3. Post-Development Condition

The post-development condition for this study is also the existing (current) condition. Any potential future development within the Glen Oaks development area would necessitate further analysis to ensure the compliance with City stormwater requirements. LIDAR data was used to delineate post-development drainage basins. There are four drainage basins (NW, NE, East, and South) for the post-development condition. The post-development drainage basins contain storm sewer systems and have a culvert or storm sewer as the final outlet. The drainage basins were sub-divided into drainage areas generally at low points in streets, ponds, and culverts. Times of concentration were calculated for each sub-divided drainage area. Impervious areas were calculated and the pervious area CN value was assumed to be 74. The soils were determined to be primarily hydrologic soil group C based on web soil survey. See **Map 2 - Post-Development Condition.**

Table 3 - Post-Development Hydrology

	North (NW+NE)	East	South	TOTAL
Area (ac)	46.3	53.8	358.7	458.8
Impervious %	36	18	36	34
T_c (min)	-	-	-	-
Cumulative CN	83	78	83	82

An XPSWMM 1D was used to calculated peak runoff for the post-development condition. SUDAS 2015 rainfall data and SCS Type II rainfall distribution were used for the design storms. The mean rainfall depths for each rainfall event are based on Region 5 of the SUDAS Climatic Sectional Codes of Iowa. The model used the 2-year, 5-year and 100-year, 24-hour rainfall events as the design storms.

GIS data available through the West Des Moines Digital Maps website was used to create the existing storm sewer network in XPSWMM. Physical characteristics include structure type, rim/grate elevations, flowline elevations, pipe diameters, and pipe material. Any missing or questionable data was verified with field survey, the City, engineering drawings provided by the City, or Google Earth. In certain cases where data was missing, flowline elevations were interpolated based on existing upstream and downstream flowline elevations. Topographic survey was completed for strategic areas within the Glen Oaks area to add detail to LIDAR contour data and West Des Moines GIS utility information.

Intakes were modeled as having no inlet capacity restrictions, thereby allowing all runoff from the associated catchment to be captured into the storm sewer system, unless the storm sewer was surcharging onto the surface. An overflow route was modeled to route overland flows downstream for storm sewer systems that surcharge during the 100-year rainfall event. The model includes storage in depression areas to show detention.

Preliminary design of the S. 60th Street reconstruction project (by others) has been incorporated into the post-development model. The City provided stormwater reports and as-built drawings for development upstream of S. 60th Street. This information was reviewed and incorporated into the model to account for detention. The soils in this upstream offsite area were hydrologic soil group B, based on web soil survey, and a CN value of 61 was assumed. The following design flows at the existing 84-inch S. 60th Street culvert were used for this study:

- 2-year = 176 cfs
- 5-year = 229 cfs
- 100-year = 445 cfs

Most of the land for the upstream offsite area is currently developed. A model was prepared for the scenario that assumes all upstream offsite area land is developed according to the City of West Des Moines Comprehensive Land Use Map and is constructed with required detention. The model revealed that future development with required detention has minimal impact on the offsite peak flows. Therefore the potential of future offsite development does not impact the recommendations or improvements within this report.

4. Modeling Results

The following Modeling Results tables show the peak flow results for the pre-development and post-development conditions for each basin. For the post-development condition, flows are reported as 'Outflow', 'Onsite Runoff', 'Offsite Pass Thru', and 'Glen Oaks Site Release'. See below for definitions of these flows.

- Outflow – This is the peak flow that leaves each basin from the outlet culvert or storm sewer. This outflow includes all drainage area that drains to the outflow pipe, including both onsite and offsite areas.
- Onsite Runoff – This is Glen Oaks development area within each respective basin that drains directly offsite and does not drain to the outflow pipe. These areas would likely not be able to be captured and managed for stormwater detention in the future.
- Offsite Pass Thru – This is offsite area that drains into the Glen Oaks development area. These areas would typically be allowed to pass thru the site or detention facilities unrestricted. The NW and NE Basins are similar in that each basin has no off-site drainage area that passes

thru the basin. The East Basin has a minor amount of offsite area that passes thru. The South Basin has a significant amount of off-site area that passes thru the basin via the main creek and tributaries.

- Glen Oaks Site Release – This is the total peak flow from the Glen Oaks development area that leaves each basin, including onsite runoff and excluding offsite pass thru runoff.
    - Glen Oaks Site Release = Outflow + Onsite Runoff – Offsite Pass Thru

Table 4 - North Basin Post-Development Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	Site Release TOTAL	Site Release Requirement
NW						
2-year (cfs)	17	1	-	18		
5-year (cfs)	18	1	-	19		
100-year (cfs)	47	3	-	50		
NE					**NW+NE**	**North**
2-year (cfs)	44	1	13	32	50	24
5-year (cfs)	57	2	18	41	60	38
100-year (cfs)	111	5	36	80	130	38

Table 5 - East Basin Post-Development Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	Site Release Requirement
2-year (cfs)	75	4	1	78	36
5-year (cfs)	106	6	2	110	57
100-year (cfs)	254	16	7	263	57

Table 6 - South Basin Post-Development Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	Site Release Requirement
2-year (cfs)	467	26	331	162	170
5-year (cfs)	638	40	467	211	271
100-year (cfs)	1104	108	1126	86	271

Conclusions

The North (NW + NE) and East Basins fail to satisfy the standards, stated in **B. Analysis 1. City Stormwater Standards**, for all three rainfall events. The South Basin satisfies the standards for all three rainfall events. Based on the modeling results and the methodology used to determine peak flow rates leaving the Glen Oaks development, it is concluded that the site is not in compliance with current City of West Des Moines stormwater management standards.

C. Deficiencies

Based on the modeling results for 100-year rainfall event, **Map 4 – Deficiencies** was developed to show the potential inundation and overtopping areas within the site. These areas include street low points, storage areas, detention ponds and culvert crossings. The following City stormwater

management standards were used to evaluate the performance of roadway low points, culverts and detention ponds within the site.

- Storm Sewers should convey 5-year storm within pipe. 100-year storm should overflow without damaging private property. Storm/surface water flowage easements should be provided to Jurisdiction. (WDM Design Standards Manual chapter 2, section 3.9, #1)
- Culverts should convey 10-year storm with headwater depth less than diameter of culvert, 50-year storm with headwater depth less than one foot over top of culvert, and 100-year headwater depth with headwater depth less than one foot below roadway elevation. (WDM Design Standards Manual chapter 2, section 3.9, #2)
- Detention basins should have capacity to retain 100-year storm. Top of basin should be minimum of one foot above the 100-year storage elevation. (WDM Design Standards Manual chapter 2, section 3.9, #4)

Multiple stormwater management concerns have been identified based on modeling results. These deficiencies include:

- Storm Sewer Capacity at Low Point – The following road low points may see potential road overtopping due to storm sewer capacity during the 100-year rainfall event:
  - D-E1 – Glen Oaks Drive Low Point just south east of the Clubhouse entrance
  - D-S2 – Tulip Tree Lane open-sided intake
  - D-S4 – Burr Oaks Drive Low Point near Red Bud Way intersection
  - D-S5 – Burr Oaks Drive Low Point near Beechwood Terrace intersection

- Road Culvert Capacity – The following culverts fail to provide one foot of freeboard below the road elevation for the 100-year rainfall event:
  - D-N1 – NW Basin storm intake south of Mills Civic Parkway
  - D-N2 – NE Basin culvert southwest of entrance road and Glen Oaks Drive intersection
  - D-S1 – Plum Thicket Lane at wet pond/creek (Twin 6.5-foot diameter culverts)
  - D-S3 – Burr Oaks Drive at creek (Twin 6-foot diameter culverts)

- Detention Basin Outlet/Storage Capacity – The following detention pond fails to provide one foot of freeboard during the 100-year rainfall event.
  - D-N3 – NE Basin wet pond

1. Northwest Basin

- **D-N1** – Road Culvert Capacity – 100-year flow elevation overtops R.O.W. onto Mills Civic Parkway.

2. Northeast Basin

- **D-N2** – Road Culvert Capacity – 100-year flow elevation overflows onto Glen Oaks Drive. 100-year flow elevation impacts two structures.
- **D-N3** – Detention Basin Outlet/Storage Capacity – 100-year water surface elevation is less than one foot below the overtopping elevation. One structure sits below the 100-year water surface elevation and overtopping elevation.

3. East Basin

- **D-E1** – Storm Sewer Capacity at Low Point – 100-year flow elevation overtops Glen Oaks Drive into the golf course driving range. Drainage collects in the street and overtops the curb at a depth of approximately 8 inches. Field observation revealed gully erosion is present at the existing storm sewer outlet.

4. South Basin

- **D-S1** – Road Culvert Capacity – 100-year flow elevation is within one foot of overtopping Plum Thicket Lane. The existing raised median prevents overtopping and roadway on the west side of the median is submerged.
- **DS2** – Storm Sewer Capacity at Open-Sided Intake – 5-year flow elevation overtops open-sided intake and runoff flows into Tulip Tree Lane roadway.
- **D-S3** – Road Culvert Capacity – 100-year flow elevation overtops Burr Oaks Drive.
- **D-S4** – Storm Sewer Capacity at Low Point – 100-year flow elevation overtops at the low point on Burr Oaks Drive and runoff flows through the side yard between two houses onto the golf course. Drainage collects in the street and overtops the right-of-way. The approximate depth of water at the low point is 3 feet.
- **D-S5** – Storm Sewer Capacity at Low Point – 100-year flow elevation overtops Burr Oaks Drive near the intersection with Beechwood Terrace and runoff flows through the side yard between two houses and onto the golf course. Drainage collects in the street and overtops the right-of-way. The approximate depth of water at the low point is 2 feet.

D. Proposed Improvements

A number of projects have been identified as potential solutions to bring Glen Oaks into compliance with current City stormwater management standards and to eliminate potential deficiencies. Projects have been identified for all four basins (NW, NE, East, and South). Each improvement was modeled in XPSWMM to evaluate its impact. See **Map 5 - Future Improvements.**

1. Northwest Basin

- **I-N1** – Remove orifice or increase orifice size and detention capacity. The existing outlet pipe is a 24-inch RCP with an orifice plate. One option to prevent overtopping is to remove the orifice plate. An alternative improvement is to perform minor earthwork to provide more storage and increase the orifice diameter.
    - **Impact** – Both improvements provide one foot of freeboard at the detention pond and eliminate overtopping onto Mills Civic Parkway. Each improvement, in combination with the NE improvements, allows the North Basin to achieve compliance with City requirements.

2. Northeast Basin

- **I-N2** – Excavate a new low point at north side of the drainage swale located west of the townhomes. The low point will be lower than the existing low point. Construct a storm sewer from the new low point to the existing storm sewer in Glen Oaks Drive.

- **Impact** – Provides at least one foot of freeboard for the townhomes adjacent to this ditch.

- **I-N3** – Replace the existing storm sewer pipes from wet pond to NE dry detention pond with larger storm sewer pipes. Modify wet pond overflow path to be lower than adjacent townhomes. Replace outlet structure at wet pond.
  - **Impact** – Increased pipe capacity reduces 100-year elevation in wet pond to provide one foot freeboard for adjacent townhomes.
- **I-N4** – Expand existing storage area located at the northeast corner of the site. Reduce the outlet size to increase attenuation of peak flows.
  - **Impact** – The proposed dry detention pond meets the requirements to provide minimum one foot of freeboard at the 100-year elevation. Extra storage and smaller outlet pipe allows site release from North Basin to achieve compliance with City requirements.

3. East Basin

- **I-E1** – Construct a dry pond and outlet pipe.
  - **Impact** – The proposed improvement reduces the total 100-year peak flow for the East Basin enough to comply with the City site release requirements and provide one foot of freeboard.
- **I-E2** – Construct a storm sewer pipe that drains the low point intake at Glen Oaks Drive to the proposed dry pond.
  - **Impact** – The proposed pipe provides capacity to eliminate overtopping from Glen Oaks Drive. Routing the drainage to the proposed dry pond allows the East Basin to comply with City site release requirements.

4. South Basin

- **I-S1** – Install a supplemental RCP culvert.
  - **Impact** – The proposed improvement provides additional capacity for the road culvert with one foot of freeboard below the road.
- **I-S2** – Replace existing storm sewer pipes with larger storm sewer pipes to increase capacity.
  - **Impact** – The proposed improvement eliminates overtopping onto Tulip Tree Lane and provides additional capacity for the storm sewer system during minor rainfall events.
- **I-S3** – Install a supplemental RCP culvert.
  - **Impact** – The proposed improvement eliminates overtopping onto Burr Oaks Drive and provides additional capacity for the road culvert with minimum one foot of freeboard below the road.
- **I-S4** – Replace the existing storm sewer pipes with larger storm sewer pipes to increase capacity. Another option is to acquire appropriate easements that would include an overland flow route between private homes.
  - **Impact** – The proposed improvement eliminates overtopping from Burr Oaks Drive.
- **I-S5** – Replace the existing storm sewer pipes with larger storm sewer pipes to increase capacity. Another option is to acquire appropriate easements that would include an overland flow route between private homes.
  - **Impact** – The proposed improvement provides increased storm sewer capacity and eliminates overtopping from Burr Oaks Drive.

Table 7 - North Basin Improvements Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	TOTAL	Requirement
NW						
2-year (cfs)	17	1	-	18		
5-year (cfs)	23	1	-	24		
100-year (cfs)	38	3	-	41		
NE						
2-year (cfs)	12	1	13	0	18	24
5-year (cfs)	14	2	17	-1	23	38
100-year (cfs)	20	5	36	-11	30	38

Table 8 - East Basin Improvements Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	Requirement
2-year (cfs)	26	4	1	29	36
5-year (cfs)	30	6	2	34	57
100-year (cfs)	39	16	7	48	57

Table 9 - South Basin Improvements Model Results

	Outflow	Onsite Runoff	Offsite Pass Thru	Glen Oaks Site Release	Requirement
2-year (cfs)	470	26	331	165	170
5-year (cfs)	644	40	467	217	271
100-year (cfs)	1207	108	1126	189	271

E. References

Comprehensive Plan - City of West Des Moines, September 20, 2010

The City of West Des Moines Comprehensive Land Use Map, Revised July 1, 2013

Des Moines Metropolitan Design Standards Manual, July 1993

Iowa Statewide Urban Design and Specifications (SUDAS), 2015

Web Soil Survey, USDA Natural Resources Conservation Service (NRCS)

Iowa Department of Transportation (DOT) Culvert guidelines, April 2000

Applebee's Storm Water Management Plan – Civil Design Advantage, LLC., February 13, 2006

Galleria at Jordan Creek Plat 3 Storm Water Management Plan – Civil Design Advantage, LLC., Revised December 2, 2004

Galleria at Jordan Creek Plat 5 Storm Water Management Plan – Civil Design Advantage, LLC., Revised April 7, 2005

Galleria at Jordan Creek Plat 6 Storm Water Management Plan – Civil Design Advantage, LLC., Revised April 14, 2006

Galleria at Jordan Creek Plat 8 Revised Storm Water Management Plan – Civil Design Advantage, LLC., June 7, 2006

Galleria at Jordan Creek Plat 9 Revised Storm Water Management Plan – Civil Design Advantage, LLC., February 22, 2008

Galleria at Jordan Creek Plat 13 Storm Water Management Plan – Civil Design Advantage, LLC., Revised June 23, 2011

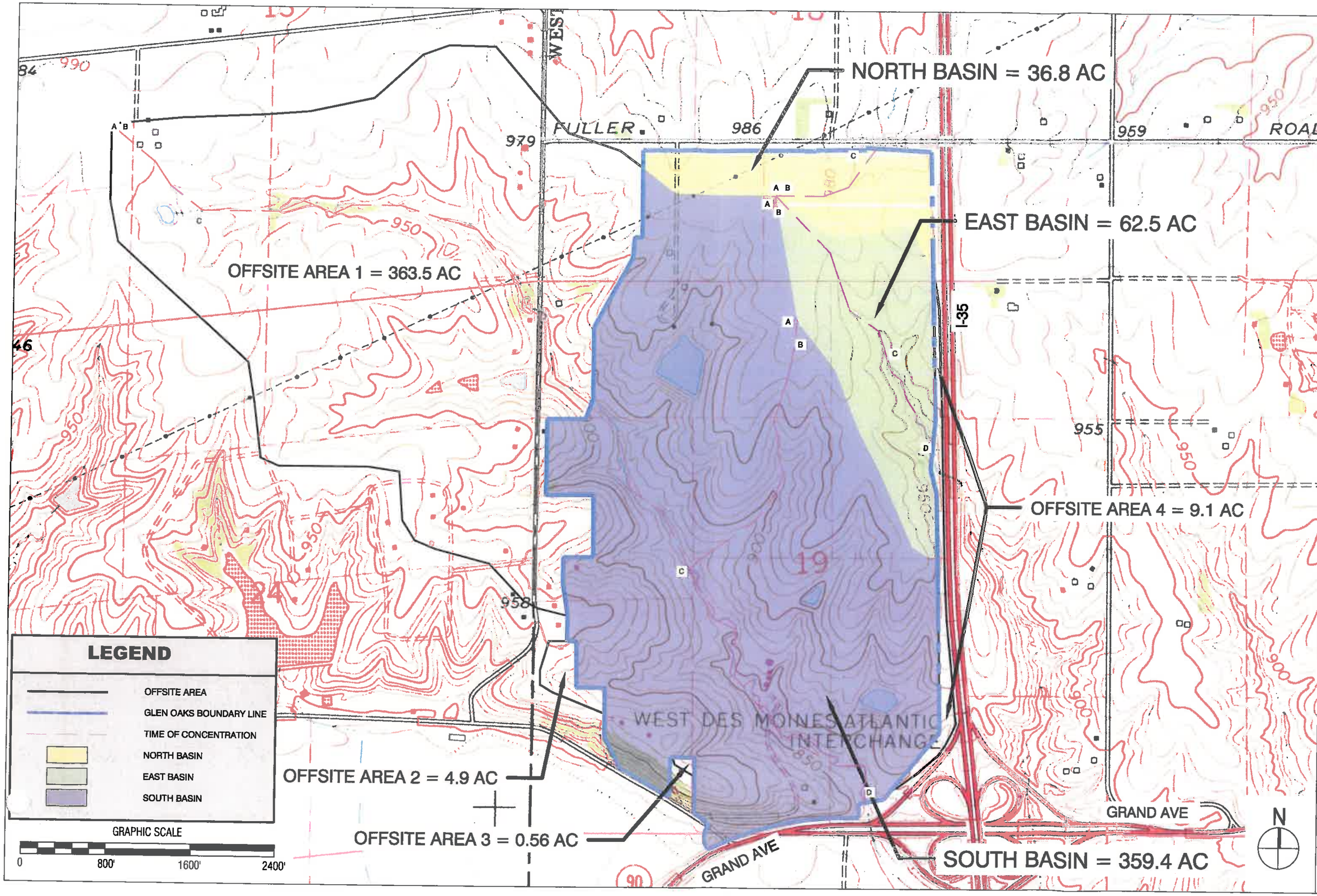
Preliminary Design Report for South 60th Street Culvert Replacement – City of West Des Moines, February 3, 2012

Stormwater Management Plan for Homewood Suites/Hampton Inn – Snyder & Associates, Inc., January 23, 2014

Stormwater Management Plan for Summit at Glen Oaks – Civil Engineering Consultants, Inc., October 8, 2007

Watermark Residential Strom Water Management Plan – Civil Design Advantage, LLC., Revised March 28, 2013

Water Resources Management Study: Glen Oaks Country Club – Snyder & Associates, Inc., June 7, 1999



NO.	REVISION	BY	DATE

DESIGNED: LTL
DRAFTED: ZD
CHECKED: LTL
SCALE: 1:800

PROJECT NO.: 011.006
FILE NUMBER: 011.006
SHEET NO.: MAP 1
DATE: JANUARY 2016

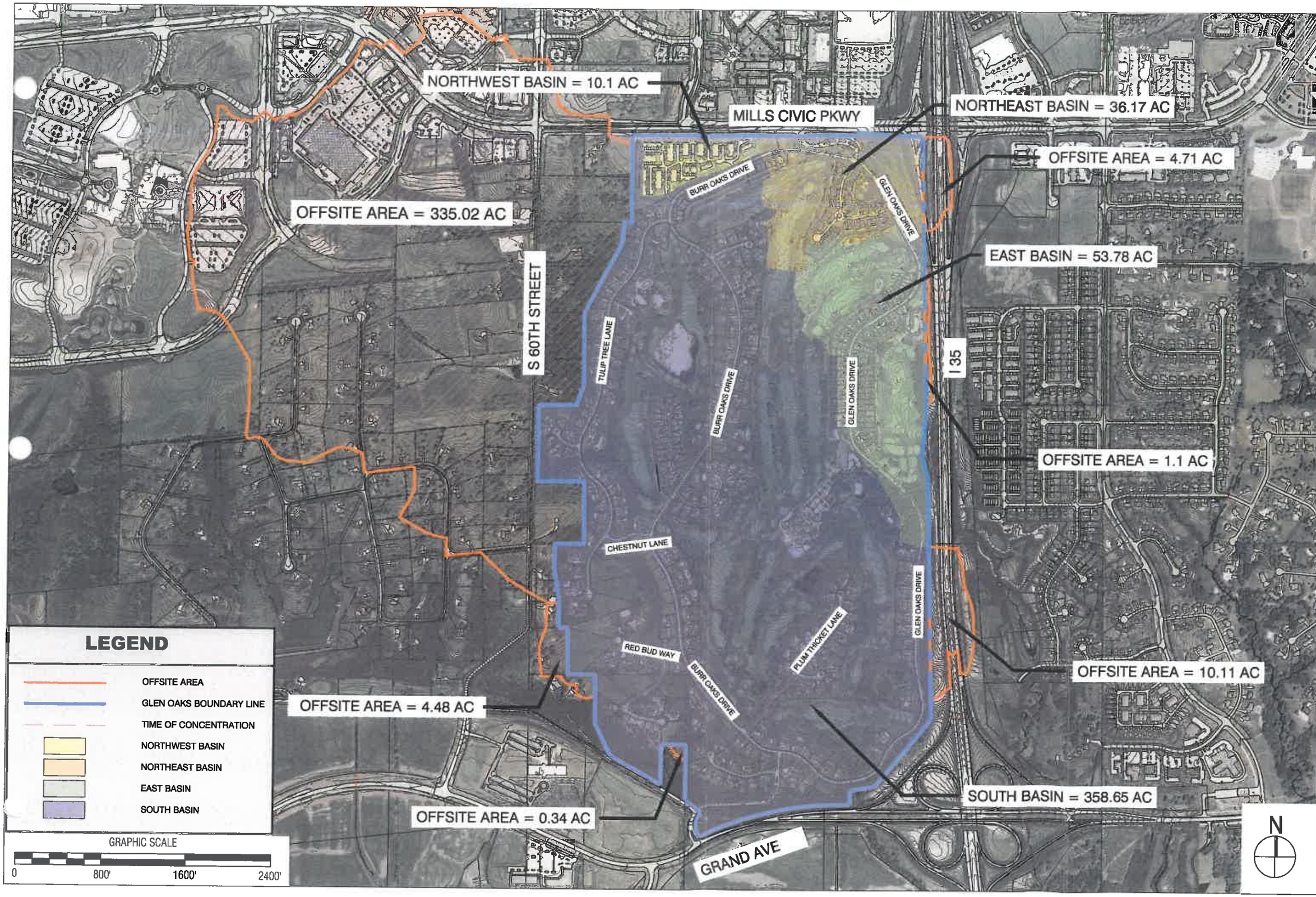
GLEN OAKS DRAINAGE STUDY
WEST DES MOINES, IOWA
MAP 1
PRE-DEVELOPMENT CONDITION

LT LEON ASSOCIATES INC
office 515-422-7018
www.ltleon.com
5010 EAST LOCUST STREET SUITE 400
DES MOINES IOWA 50320

PROJECT NO. 011.006

PRE-DEVELOPMENT

SHEET NO.
MAP 1



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DESIGNED: LTL
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PROJECT NO.: 011.006
FILE NUMBER: 011.006
SHEET NO.: MAP 2
DATE: JANUARY 2016

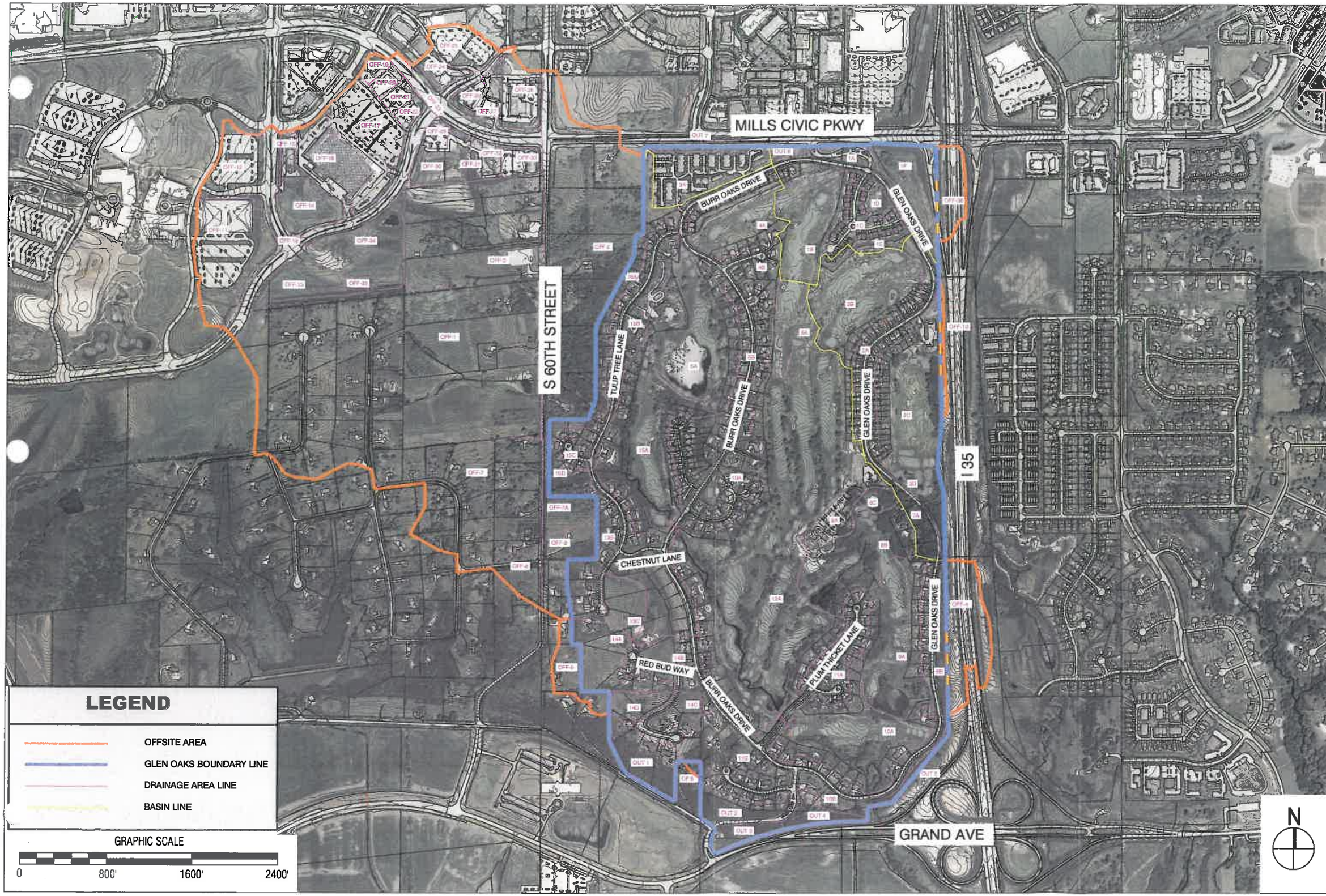
GLEN OAKS DRAINAGE STUDY
WEST DES MOINES, IOWA
MAP 2
POST-DEVELOPMENT CONDITION

LT LEON ASSOCIATES INC
500 EAST LOUCUST STREET SUITE 400
DES MOINES IOWA 50309
office 515-472-7000
www.ltleon.com

PROJECT NO. 011.006

POST DEVELOPMENT

SHEET NO.
MAP 2



GLEN OAKS DRAINAGE STUDY
WEST DES MOINES, IOWA
MAP 3
POST-DEVELOPMENT CONDITION - SUB AREAS

NO.	REVISION	BY	DATE

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DRAFTED: ZD
CHECKED: LTL
SCALE: 1:800

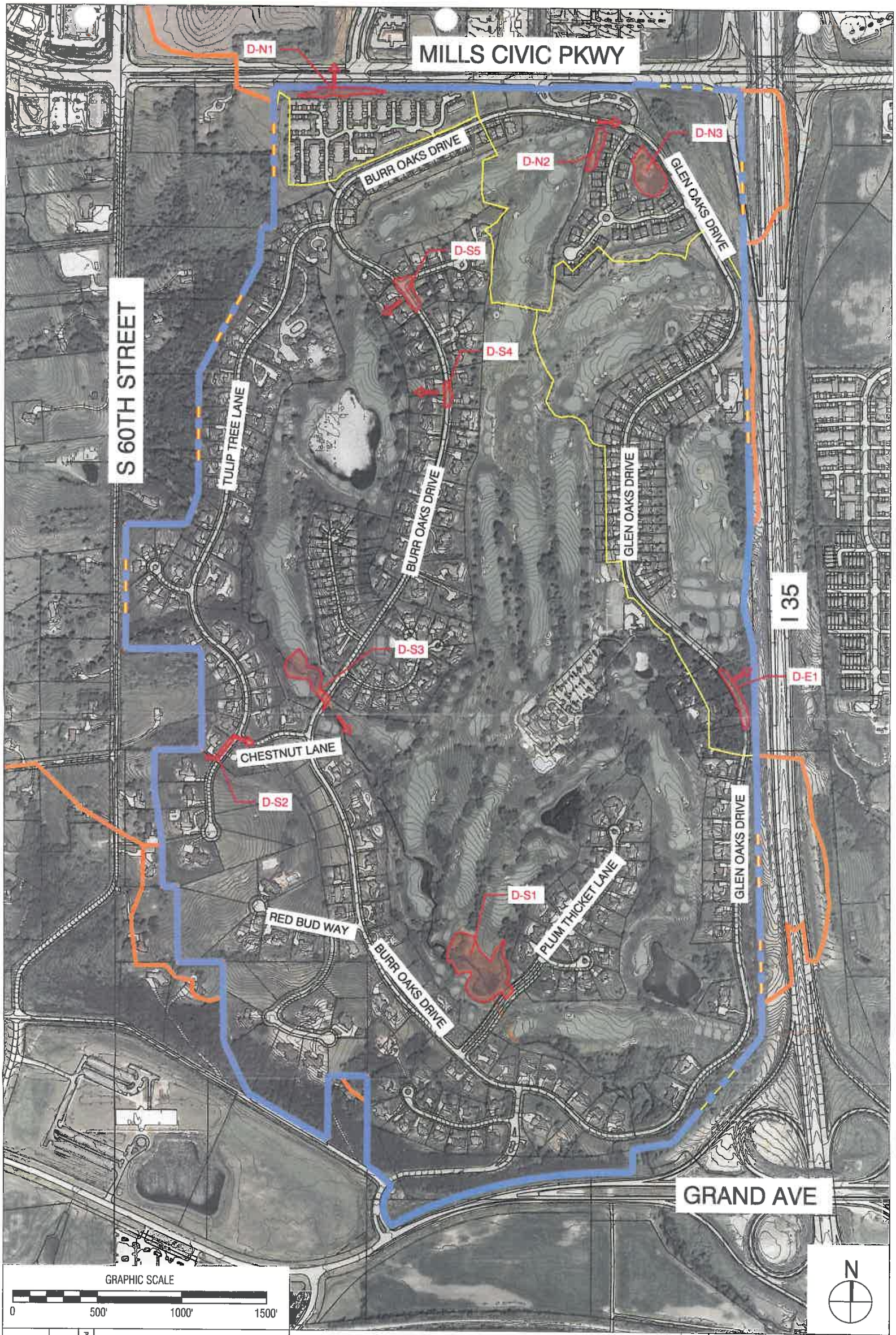
PROJECT NO.: 011.006
FILE NUMBER: 011.006
SHEET NO.: MAP 3
DATE: JANUARY 2016

LT LEON ASSOCIATES INC
500 EAST LOCUST STREET SUITE 400
DES MOINES IOWA 50309
office 515-472-7095
www.ltleon.com

PROJECT NO. 011.006

POST- SUB AREAS

SHEET NO.
MAP 3



MAP 4

DEFICIENCIES

PROJECT NO. 011.006

LT LEON ASSOCIATES INC
500 EAST LOCUST STREET SUITE 400
DES MOINES IOWA 50309
office 515-422-7016
www.ltleon.com

GLEN OAKS DRAINAGE STUDY
WEST DES MOINES, IOWA
MAP 4
DEFICIENCIES

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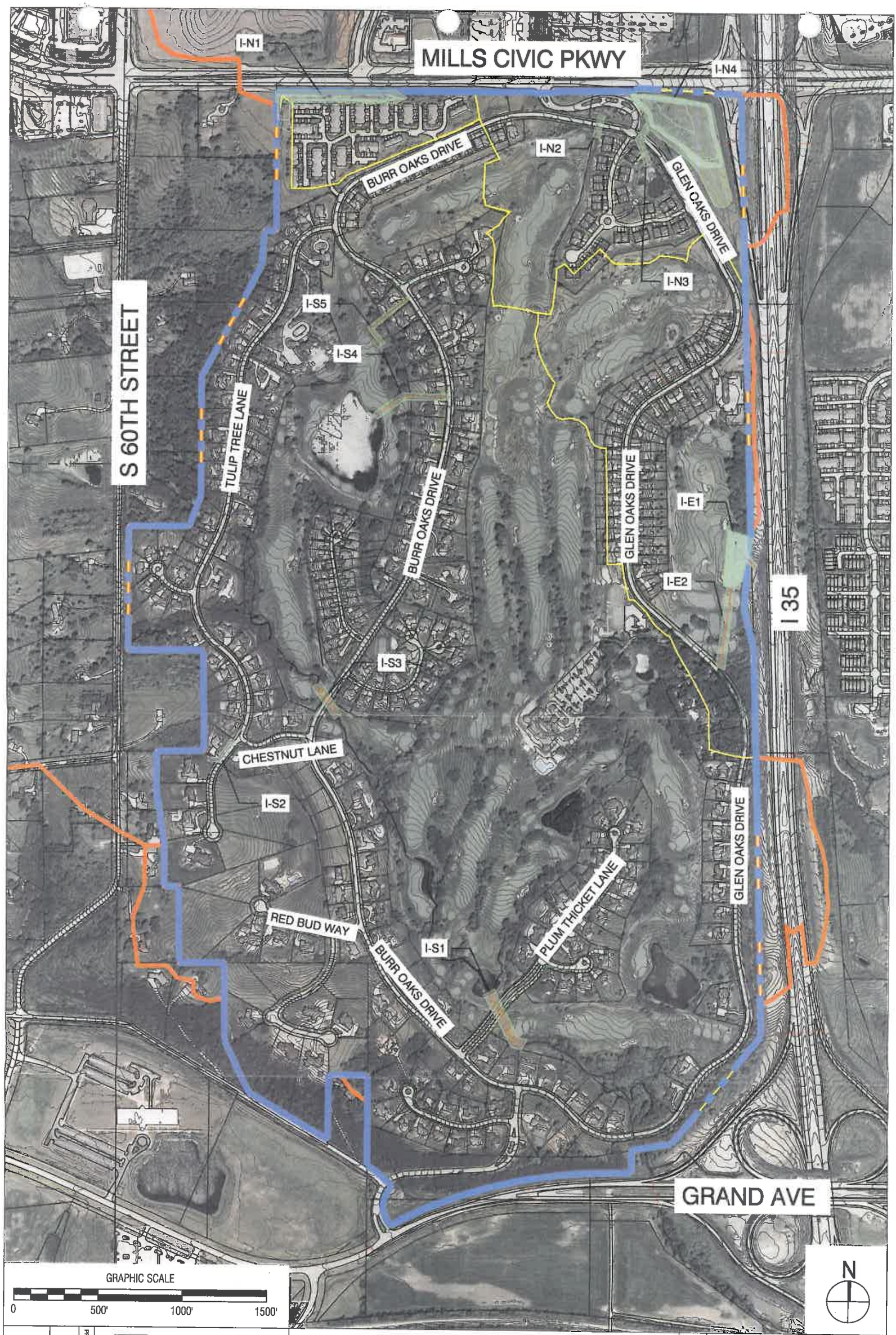
SCALE: 1:500	DATE: JANUARY 2016



SHEET NO. MAP 5

IMPROVEMENTS

PROJECT NO. 011.006

LT LEON ASSOCIATES INC
500 EAST LOCUST STREET SUITE 400
DES MOINES IOWA 50309
office 515-422-7018
www.ltleon.com

GLEN OAKS DRAINAGE STUDY
WEST DES MOINES, IOWA
MAP 5
FUTURE IMPROVEMENTS

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