AGENDA

RILEY COUNTY PLANNING BOARD/
BOARD OF ZONING APPEALS

Monday, September 14, 2015 | **Commission Meeting Room**
7:30 p.m. | **Courthouse Plaza East**

(Procedure: Open joint meeting of the Riley County Planning Board/Board of Zoning Appeals.)

I. OPEN PUBLIC COMMENTS

II. CONSENT AGENDA

1. Consider the minutes of the August 10, 2015 meeting.

2. Consider the Report of Fees for the month of August 2015.

(Procedure: Adjourn the joint meeting of the Riley County Planning Board/Board of Zoning Appeals and due to no agenda items for the Board of Zoning Appeals, convene as the Riley County Planning Board.)

III. GENERAL AGENDA - RILEY COUNTY BOARD OF ZONING APPEALS

1. No agenda items.

IV. GENERAL AGENDA - RILEY COUNTY PLANNING BOARD

1. Public Hearing at the request of the Riley County Planning Board to amend Sections 2, 4, 5, 6, 7, 91 and 20, delete Section 13 – Accessory Building and Uses and replace with Section 13 – Accessory Buildings, Structures and Uses of the Riley County Zoning Regulations. **ACTION NEEDED: Recommend approval/denial to the Board of County Commissioners.**

2. Public Hearing to amend the Manhattan Urban Area Comprehensive Plan by adopting and incorporating the proposed Hartford Hill Master Plan as a part of the Manhattan Urban Area Comprehensive Plan.

3. Public Hearing at the request of the Board of Commissioners of Riley County, Kansas to amend Section 6 – Procedure of Plat Approval of the Riley County Subdivision Regulations. **ACTION NEEDED: Recommend approval/denial to the Board of County Commissioners.**

4. Update on Big Blue Floodplain Management Plan.

(Procedure: Adjourn the Riley County Planning Board meeting.)

MINUTES

RILEY COUNTY PLANNING BOARD/
BOARD OF ZONING APPEALS

Monday, August 10, 2015	**Courthouse Plaza East**
7:30 pm	**Commission Meeting Room**
	115 North 4th Street

Members Present:	Lorn Clement, Chairman Julie Henton John Wienck
Members Absent:	Diane Hoobler Dr. Tom Taul, Vice-Chair
Staff Present:	Bob Isaac – Planner and Lisa Daily - Administrative Assistant
Others Present:	Stan Moore

OPEN PUBLIC COMMENTS

None.

CONSENT AGENDA

The minutes of the July 13, 2015 meeting were presented and approved. The Report of Fees for the month of July ($2,384.00) were presented and approved.

John Wienck moved to adjourn the joint meeting of the Riley County Planning Board/Board of Zoning Appeals and, due to the lack of agenda items for the Board of Zoning Appeals, moved to reconvene as the Riley County Planning Board.

Julie Henton seconded. Carried 3-0

RILEY COUNTY PLANNING BOARD

Moore – Residential Use Designator – Extraneous Farmstead & Plat

Lorn Clement opened the public hearing at the request of Stanley E. Moore, petitioner and owner, to receive a Residential Use Designator - Extraneous Farmstead and plat a tract of land into one (1) lot in Zeandale Township, Section 16, Township 10 South, Range 9 East, in Riley County, Kansas.

Bob Isaac presented the request. Mr. Isaac described the background, location and physical characteristics of the proposed tract.

Staff recommended approval of the request to receive a Residential Use Designator – Extraneous Farmstead as it was determined that each request meets the minimum requirements of the Riley County Zoning Regulations. Staff also recommended that the Board approve the concurrent plat of Moore Acres, as it was determined to meet all requirements of the Riley County Subdivision Regulations, Zoning Regulations and the Sanitary Code.

There were no other proponents or opponents in attendance of the meeting.

John Wienck moved to close the public hearing. Julie Henton seconded. Carried 3-0.

John Wienck moved to approve the Residential Use Designator – Extraneous Farmstead for reasons listed in the staff report.

Julie Henton seconded. Motion carried 3-0.

Julie Henton moved to recommend approval of the concurrent plat of Moore Acres for reasons listed in the staff report.

John Wienck seconded. Motion carried 3-0.

Mr. Isaac announced that the Board of County Commissioners will hear the request to plat the property on August 24, 2015, at 9:15 am, in the County Commission Chambers.

Big Blue Floodplain Management Plan update

Bob Isaac stated the draft plan is still being reviewed at this time.

Julie Henton moved to adjourned. John Wienck seconded. Carried 3-0.

The meeting was adjourned at 7:41 P.M.

RILEY COUNTY
PLANNING & DEVELOPMENT

REPORT OF FEES

August 2015

DATE	NAME	AMOUNT
08-03-2015	L&L Trenching, Repair Permit	$ 75.00
08-03-2015	Shosa, Environmental Site Evaluation	100.00
07-28-2015	Westervelt, Building Permit #15-0049	225.00
08-05-2015	Tegtmeier, Alternative Wastewater System	300.00
08-06-2015	Dishman, Repair Permit	75.00
08-06-2015	Springer, Building Permit #15-0053	225.00
08-06-2015	Erickson, Radon kit	5.00
08-06-2015	SMH Consultants, Boundary Line Adjustment	100.00
08-10-2015	Steiner, Well Permit and Percolation Test	225.00
08-11-2015	Petty, Sign Permit	50.00
08-11-2015	Alexander, Water Screening Report	12.00
08-11-2015	Heger, Water Screening Report	8.00
08-12-2015	Alexander, Water Screening Report	10.00
08-13-2015	Zimmer, Repair Permit	75.00
08-13-2015	Dul, Radon Kit	5.00
08-14-2015	Alexander, Water Screening Report	8.00
08-17-2015	Deines, Water Screening Report	16.00
08-17-2015	Hargrave, Well Permit	75.00
08-17-2015	Hageman, Water Screening Report	10.00
08-17-2015	Wehyer, Water Screening Report	20.00
08-18-2015	Carpenter, Building Permit #15-0055	225.00
08-19-2015	Clark, Replat w/utility review	270.00
08-20-2015	Thompson, Building Permit #15-0056, Lagoon Permit & Well Permit	525.00
08-24-2015	Fief, Lagoon Permit	300.00
08-25-2015	Hammel, Water Screening Report	10.00
08-25-2015	Gordon, Water Screening Report	8.00
08-26-2015	Chizek, Building Permit #15-0058	150.00
08-28-2015	McGill, Environmental Site Evaluation	100.00
08-28-2015	Smith, Environmental Site Evaluation	100.00
08-28-2015	Yocum, Building Permit #15-0060	150.00
08-28-2015	L&L Trenching, Repair Permit	75.00
08-28-2015	Closson, Building Permit #15-0061	150.00
08-31-2015	BAM, Repair Permit	150.00
08-31-2015	Davis, Water Screening Report	10.00
08-31-2015	Hammel, Water Screening Report	8.00
08-31-2015	Schwab-Eaton, Plat, Rezone & Utility	320.00

08-31-2015	Schwab-Eaton, Replat & Utility	270.00
08-31-2015	Grogg, Building Permit #15-0062 + copy	150.25
08-31-2015	D&T Investments, Plat & Rezone	550.00
08-31-2015	Hall, Environmental Site Evaluation	100.00
08-31-2015	Jueneman, Water Screening Report	22.00
08-31-2015	Lentz, Building Permit #15-0063	150.00
08-31-2015	Wernette, Building Permit #15-0064	150.00
	TOTAL	**$5,562.25**

DEPOSITS MADE:

07-28-2015	$ 225.00
08-05-2015	300.00
08-14-2015	973.00
08-21-2015	1141.00
08-28-2015	1043.00
08-31-2015	1458.25
09-01-2015	422.00
TOTAL	**$5,562.25**

Permit #	App Date	Ownr	Type of Bldg	Use of Bldg	Const Cost	Amnt Paid	Property Address	City & Zp
15-0042	07/06/2015	Ronnie Richter	Miscellaneous	Grain bin	$50,000.00	$0.00	20021 May Day Rd	Green (67447)
15-0043	07/07/2015	Norman Lally	Storage (residential)	Vehicle storage & workshop	$40,000.00	$150.00	9419 Condray Rd	Manhattan (66503)
15-0044	07/20/2015	Gavin Garman	Addition (residential)	2 Bedrooms	$93,000.00	$300.00	2565 W 60th Ave	Manhattan (66503)
15-0045	07/20/2015	Robert & Joanne Parks	Storage (residential)	Storage	$5,800.00	$150.00	1201 Pleasant Valley Rd	Manhattan (66502)
15-0046	07/21/2015	Steven Butler	House (site built)	Residential dwelling	$50,000.00	$150.00	6922 Deer Run	Manhattan (66503)
15-0047	07/27/2015	Alan & Lacey Yordy	Storage (residential)	Equipment & vehicle storage	$30,000.00	$150.00	7169 Crooked Creek Rd	Riley (66531)
15-0048	07/28/2015	Roy Larson	Storage (ag related)	Machinery storage	$4,500.00	$0.00	10551 Alembic Rd	Leonardville (66449)
15-0049	07/28/2015	Riley United Methodist Church Inc	Miscellaneous	Concrete slab	$300,000.00	$225.00	3193 Keats Ave	Manhattan (66503)
15-0050	07/29/2015	James Rudolph	Storage (ag related)	Farm equipmennt	$28,740.00	$0.00	8897 Crooked Creek Rd	Riley (66531)
15-0051	08/04/2015	Bart Anstaett	Storage (ag related)	Ag equipment storage and livestock	$70,000.00	$0.00	7887 Marie Ln	Manhattan (66503)
15-0052	08/05/2015	LAWE LLC	Miscellaneous	Rural resort, retreat or event center - winery	$1,200,000.00	$0.00	1745 Wildcat Creek Rd	Manhattan (66503)
15-0053	08/06/2015	Anne Springer	House (residential design)	Residential dwelling	$50,000.00	$150.00	5920 Zeandale Rd	Manhattan (66502)
15-0054	08/10/2015	Steven & Renee Salzman	Storage (ag related)	Hay & Ag equipment storage	$30,000.00	$0.00	12751 Tuttle Creek Blvd	Randolph (66554)
15-0055	08/17/2015	Tuttle Creek Shooting Park LLC	Storage (commercial)	Storage rental	$50,000.00	$225.00	6364 Tuttle Creek Blvd	Manhattan (66503)

Permit #	App Date	Ownr	Type of Bldg	Use of Bldg	Const Cost	Amnt Paid	Property Address	City & Zp
15-0056	08/18/2015	Kimberly Boice	House (site built)	Residential home	$250,000.00	$150.00	1464 McDowell Creek Rd	Manhattan (66502)
15-0057	08/25/2015	Stan & Sandy Johnson	Addition (residential)	Garage, extending kitchen & bedroom	$100,000.00	$0.00	16460 Green Randolph Rd	Green (67447)
15-0058	08/26/2015	David J. Chizek	Storage (residential)	Workshop & Storage	$30,000.00	$150.00	7108 Redbud Dr	Manhattan (66503)
15-0059	08/27/2015	Riley United Methodist Church Inc	Church	Addn - Community Center	$300,000.00	$0.00	3193 Keats Ave	Manhattan (66503)
15-0060	08/28/2015	David Yocum	Garage (detached)	Boat, jet-ski, vehicle storage	$22,000.00	$150.00	3219 Driftwood Dr	Manhattan (66503)
15-0061	08/28/2015	Mike & Michaela Closson	Garage (detached)	Residential storage	$30,000.00	$150.00	11302 Lakeview Dr	Manhattan (66503)
15-0062	08/31/2015	Bruce Grogg	Garage (detached)	Shop - work shop	$15,000.00	$150.00	5007 Vista Acres Dr	Manhattan (66503)
15-0063	08/31/2015	Brian E. & Angela J. Lentz	Garage (detached)	Vehicle & Equipment Storage	$8,500.00	$150.00	7112 Mound Ridge Rd	Manhattan, KS 66503
15-0064	08/31/2015	Monica M. Wernette	Storage (residential)	Equipment and material storage	$85,000.00	$150.00	5120 Vista Acres Dr	Manhattan (66503)

PLANNING & DEVELOPMENT

STAFF REPORT

Regulation Amendment

PETITION: #15-12

APPLICANT: Riley County Planning Board

REQUEST: Amend Sections 2, 4, 5, 6, 7, 9A, 13 and 20 of the Riley County Zoning Regulations

PUBLIC NOTICE EXCERPT:

RILEY COUNTY ZONING REGULATIONS

SECTION 2 – DEFINITIONS

Replace the definition of Accessory Building or Use with the following:

ACCESSORY BUILDING: A building detached from a principal building located on the same lot as the principal building which is used in a manner that supports or serves the uses allowed within the principal building.

ACCESSORY STRUCTURE: A structure, other than a building, detached from a principal building located on the same lot as the principal building which is used in a manner that supports or serves the uses allowed within the principal building.

ACCESSORY USE: A use of land or of a building or portion thereof which supports and serves the principal use occurring on the same lot as the principal use.

TEMPORARY *BUILDING OR* STRUCTURE: Means a *building or* structure permitted in a district for a period not to exceed 180 days and shall be removed upon the expiration of the permit period. Temporary buildings or structures may include ~~recreational vehicles,~~ *communication towers,* ~~temporary~~ construction offices~~,~~ or temporary business facilities used until permanent facilities can be constructed, but at no time shall ~~it include manufactured homes~~ *such buildings be* used as residences.

SECTION 4 – SF ZONES REGULATIONS

ZONE SF-1 SINGLE FAMILY RESIDENTIAL DISTRICT

1. PERMITTED USES:
   b. Accessory buildings, structures and uses *(subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES).*

4. USE LIMITATIONS:

   ~~b. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONE SF-2 SINGLE FAMILY RESIDENTIAL DISTRICT

4. USE LIMITATIONS:

~~b. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONE SF-3 SINGLE FAMILY RESIDENTIAL DISTRICT

4. USE LIMITATIONS:

~~b. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONE SF-5 SINGLE FAMILY RESIDENTIAL DISTRICT

3. USE LIMITATIONS:

~~c. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONE SF-1, SF-2, SF-3, SF-4 and SF-5 DENSITY REQUIREMENTS:

9. Minimum Side Yard on both sides of lot:

~~Accessory Buildings = 3 feet except that:~~

~~(1) Accessory buildings shall be at least 10 feet away from a principal building on own or adjoining lot; and~~
~~(2) for any structure in which livestock is kept (Zones SF-4 and SF-5 only), the minimum side yard shall be 30 feet.~~

10. Minimum Rear Yard:

~~Accessory Buildings = 5 feet except that:~~

~~(1) when abutting an alley, the minimum rear yard shall be 10 feet; and~~
~~(2) for any structure in which livestock is kept (Zones SF-4 and SF-5 only), the minimum rear yard shall be 30 feet.~~

12. Accessory Buildings, Structures and Uses:
Accessory buildings, Structures and uses shall be subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES.

SECTION 5 – B ZONES REGULATIONS

ZONE B-1 TWO FAMILY RESIDENTIAL DISTRICT

4. USE LIMITATIONS:

~~b. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONE B-2 MULTIPLE FAMILY RESIDENTIAL DISTRICT

4. USE LIMITATIONS:

~~b. Manufactured or mobile homes may not be used for accessory buildings.~~

ZONES B-1 and B-2 DENSITY REQUIREMENTS:

7. Minimum Side Yard on both sides of lot:

Zone B-1and B-2 = 8 feet for dwellings
~~= 15 feet for all other uses~~

9. Accessory Buildings, Structures and Uses:

Accessory buildings, Structures and uses shall be subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES.

SECTION 6 – C ZONES REGULATIONS

ZONE C-1 NEIGHBORHOOD BUSINESS DISTRICT

1. PERMITTED USES:

   r. Accessory buildings, *structures* and uses (~~see Use Limitations~~ *subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES*)

3. USE LIMITATIONS:

   d. ~~Mobile homes may not be used as accessory buildings.~~ Manufactured homes *on a permanent foundation* may be used for offices only.

ZONE C-2 SHOPPING CENTER DISTRICT

1. PERMITTED USES:

   ~~i. Accessory buildings and uses (see Use Limitations)~~

3. USE LIMITATIONS:

   d. ~~Mobile homes may not be used as accessory buildings.~~ Manufactured homes *on a permanent foundation* may be used for offices only.

ZONE C-3 GENERAL BUSINESS DISTRICT

1. PERMITTED USES:

   ~~k. Accessory buildings and uses (see Use Limitations)~~

3. USE LIMITATIONS:

   d. ~~Mobile homes may not be used as accessory buildings.~~ Manufactured homes *on a permanent foundation* may be used for offices only.

ZONE C-4 HIGHWAY BUSINESS DISTRICT

1. PERMITTED USES:

   r. Accessory buildings, *structures* and uses (~~see Use Limitations~~ *subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES*)

3. USE LIMITATIONS:

   g. ~~Mobile homes may not be used as accessory buildings.~~ Manufactured homes *on a permanent foundation* may be used for offices only.

SECTION 7 – D ZONES REGULATIONS

ZONE D-1 INDUSTRIAL PARK DISTRICT

1. PERMITTED USES:

   i-4. Accessory *buildings*, *structures* and ~~temporary~~ uses (~~see Use Limitations~~ *subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES*)

ZONE D-2 LIGHT INDUSTRIAL DISTRICT

1. PERMITTED USES:

   e-6. Accessory *buildings*, *structures* and ~~temporary~~ uses (~~see Use Limitations~~ *subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES*)

ZONE D-3 HEAVY INDUSTRIAL DISTRICT

1. PERMITTED USES:

   v-4. Accessory *buildings*, *structures* and ~~temporary~~ uses (~~see Use Limitations~~ *subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES*)

ZONE D-4 BUSINESS PARK DISTRICT

1. PERMITTED USES:

   13. Accessory *buildings*, *structures* and ~~temporary~~ uses ~~as permitted by Section 13~~ *(subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES)*

SECTION 9A – N ZONES REGULATIONS

1. PERMITTED USES:

   e. *Accessory Buildings, Structures and Uses:*

   Accessory buildings, Structures and uses shall be subject to the provisions of SECTION 13 – ACCESSORY BUILDINGS, STRUCTURES AND USES.

SECTION 13 – ACCESSORY BUILDINGS, *STRUCTURES* AND USES

~~1. Accessory buildings, as defined and regulated herein, shall be permitted in any zoning district. No detached accessory building shall occupy a required front yard or be located within 10 feet of any dwelling existing or under construction on the building site, except that for a detached garage the minimum distance may be 5 feet. No single accessory building in a residential district shall occupy more than 30%, nor shall all such buildings collectively occupy more than 40% of the required yard spaces in the rear half of the lot. No accessory building shall be located closer than 5 feet to any lot line and, in the case of a reversed corner lot, no accessory building shall project closer to the street side yard than the front yard abutting. On an external lot, an accessory building shall not project closer than 15 feet to the street side of the lot line except that if the building is a required parking garage which has access to a side street, such setback shall be a minimum of 20 feet.~~

~~2. An accessory use as defined and regulated herein is permitted in any district where the principal use to which it is accessory is permitted.~~

1. PURPOSE

The purpose of these regulations is to establish the relationship between principal and accessory buildings, structures and uses and the criteria for regulating such accessory buildings, structures and uses. Further, the purpose of these regulations is to:

a. Maintain neighborhood integrity and preserve the existing character of the neighborhood by encouraging compatible land uses; and

b. *Provide residents the opportunity to use their property to enhance or fulfill personal objectives as long as the use of the property is not incompatible with the land use or character of the neighborhood.*

3. STANDARDS

a. *Accessory buildings, structures or uses must be located on the same lot as the principal building, structure or use. No accessory building, structure or use shall be constructed or established prior to the construction or establishment of the principal building, structure or use.*

b. *Mobile or manufactured homes, truck trailers/bodies, railroad cars, RV's or buses shall not be used as accessory buildings. Portable storage containers or shipping containers may be used as accessory structures but shall require a permit and must meet all setback requiremets.*

c. *No accessory building shall be used as sleeping or housekeeping quarters unless expressly permitted in the zoning district in which the property is located.*

d. *Prior to the issuance of a permit for an accessory building, the Environmental Health Specialist shall determine that the building will not create a violation of the Sanitary Code nor impede the construction of a new sanitary system if a new system is required at the time of permit approval.*

e. *Except for commercial and industrial zoning districts, accessory buildings shall not be rented or used for any business, profession, trade or occupation, other than as an accessory to an approved home occupation or small scale business occurring on the same lot.*

f. *Except for commercial and industrial zoning districts, accessory buildings shall not be rented for storage.*

4. DENSITY REQUIREMENTS

a. *Accessory buildings, regardless of size shall be set back a minimum of five (5) feet from the side or rear lot lines.*

b. *No detached accessory building shall be closer than ten (10) feet from the principal structure.*

c. *Except for commercial and industrial zoning districts, accessory buildings shall not exceed a sidewall height of sixteen (16) feet.*

d. *Except for commercial and industrial zoning districts, a maximum of two (2) detached accessory structures shall be permitted.*

e. *Whether one or multiple accessory structures, the total cumulative floor area shall not exceed the maximum size allowed per lot size/zoning district calculations (see Table 1) or the maximum square footage of the footprint of the principal structure; whichever is greater.*

Table 1. Maximum Floor Area for Accessory Buildings		
Lot Size (acres)	**Zoning District**	
	AG, SF-1, SF-2 & SF-3, C, D and N Zones	SF-4 and SF-5 Zones
Less than .50	1000 sf.	NA
.50 - .99	1000 sf. plus 50 sf. per additional .1 acre of lot area above .5 acres (1200 sf max)	NA
1 – 1.99	1250 sf. plus 50 sf. per additional .1 acre of lot area above 1 acre (1700 sf max)	NA
2 – 4.99	1750 sf. plus 50 sf. per additional .1 acre of lot area above 2 acres (3200 sf max)	1750 sf. plus 50 sf. per additional .1 acre of lot area above 2 acres (3200 sf max)
5 – 19.99	3250 sf. plus 100 sf. per additional 1 acre of lot area above 5 acres (4750 sf max)	3250 sf. plus 100 sf. per additional 1 acre of lot area above 5 acres (4750 sf max)
20 or more	5000 sf.	5000 sf.

* When calculating the cumulative area of all accessory buildings or total building height, fractions up to 0.5 may be disregarded and fractions of 0.5 or more shall be rounded to the next whole number.

SECTION 20 – BOARD OF ZONING APPEALS

4. Variances may be granted only:

   k. To increase the maximum floor area of an accessory structure or combination of accessory structures (square feet) by not more than 20%.

BACKGROUND:
Recently, the Planning & Development Department has encountered several inquiries regarding accessory buildings; questioning the size restriction within the zoning regulations. Currently, the definition of "accessory building or use" found in Section 2-Definitions of the Riley County Zoning Regulations states:

> "A subordinate building or portion of the principal building, or a use customarily incident to and located on the lot occupied by the principal building or use of the property."

Staff currently interprets "subordinate" as meaning smaller in area (building footprint) than the principal building (usually a house). This definition currently does not apply to buildings used to house stock animals (horses, cows, etc.) in the "SF-4" and "SF-5" Single Family Residential districts. Moreover, any accessory building determined to be used for agricultural purposes is exempt from the zoning regulations. Thus, the size of any accessory buildings used for purposes other than those mentioned, in most cases, is dependent upon the size of the house on the property. It is proposed that this rationale is flawed, especially considering that such structures are primarily used to store items not necessarily related to the size of a home (e.g. vehicles, RVs, ATVs, boats, canoes, jet skis and lawn maintenance equipment). Maintaining larger tracts, 10-20+ acres, in many cases, requires the use of large equipment, precipitating the need for larger accessory structures to store such equipment. Therefore, the current method of determining the size of an accessory structure is arbitrary and does not provide a logical nexus between the size of the building and its function.

The proposed method for determining the size and number of accessory structures, as shown herein, is based on the size of the tract for which it is to be located and the zoning designation of the property. Furthermore, it is proposed that an option be added to the variance criteria within the regulations which will allow citizens to request an increase the maximum floor area of an accessory structure or combination of accessory structures (square feet) by not more than 20%.

Staff prepared a draft of the amendments and presented it to both the Riley County Planning Board (July 13, 2015) and Manhattan Urban Area Planning Board (July 20, 2015) for discussion. Both Boards were in favor of moving forward with the amendments and instructed staff to prepare the draft for public hearing.

STAFF RECOMMENDATIONS: Staff recommends that the Planning Board forward a recommendation of <u>approval</u> to adopt the proposed amendment(s) as published and as shown in the staff report.

POSSIBLE MOTION(S)

ACTION NEEDED:

A. Move to forward a recommendation of <u>approval</u> to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Zoning Regulations as published.

Or

B. Move to forward a recommendation of <u>approval</u> to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Zoning Regulations with the following changes:

Or

C. Move to forward a recommendation of <u>denial</u> to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Zoning Regulations as published.

Prepared by: Bob Isaac, Planner
September 3, 2015

RILEY COUNTY

MEMO

- [ ] PLEASE COMMENT
- [ ] PLEASE REPLY
- [ ] URGENT
- [x] FOR REVIEW

DATE 9/8/15

TO:
Riley County Planning Board

Phone:
Fax:
E-mail:

FROM:
Monty R. Wedel
Planning & Development
110 Courthouse Plaza
Manhattan, Kansas 66502

Phone: (785) 537-6332 Ext.6401
Fax: (785) 537-6331
E-mail: mwedel@rileycountyks.gov

SUBJECT: Amendment to the Manhattan Urban Area Comprehensive Plan (MUACP) to incoporate the Hartford Hill Master Plan

MESSAGE: Attached is a copy of the proposed Hartford Hill Master Plan along with a staff report from the City of Manhattan explaining the project. Although the staff report is written for the Manhattan Urban Area Planning Board, the facts are the same for the Riley County Planning Board and Riley County staff concurs with the report and the recommendations therein. One correction to the staff report is that the Riley County Planning Board will conduct their public hearing on September 14, not the Riley County Commission. The Riley County Board of Commissioners will consider the matter on September 21, 2015.

If you approve amending the MUACP to incorporate the Hartford Hill Master Plan, the Chairman should be authorized to sign a resolution to that effect. This resolution will be supplied at the meeting.

INTER-OFFICE MEMORANDUM

DATE: **September 1, 2015**

TO: **Manhattan Urban Area Planning Board**

FROM: **Lance Evans, AICP, Senior Planner;**
Eric Cattell, AICP, Assistant Director for Planning

RE: **Public Hearing to Amend the Manhattan Urban Area Comprehensive Plan by Adopting and Incorporating the Hartford Hill Master Plan by reference, and amending Chapter 3 and Appendix B to include a cross reference to the Hartford Hill Master Plan.**

BACKGROUND

This is a public hearing to consider amending the Manhattan Urban Area Comprehensive Plan, by adopting and incorporating the Hartford Hill Master Plan dated September 2015, by reference and adding a cross reference to the Master Plan in Chapter 3 and Appendix B of the Manhattan Urban Area Comprehensive Plan. Hartford Hill is a 320 acre site located northwest of Grand Mere and Colbert Hills.

To approve an amendment of the Manhattan Urban Area Comprehensive Plan, the Manhattan Urban Area Planning Board must hold a public hearing to receive and consider any comments on the proposed amendment, after which it may approve the amendment by resolution *(see attached Resolution No.* 091015-A*).* State Statute requires that amendments to the Comprehensive Plan be approved by a majority of the full membership of the Planning Board, which would require at least four (4) members. No amendment is effective unless it is also approved by the City Commission by ordinance. Additionally, the eastern half of Hartford Hill is located in the Manhattan Urban Area Planning Board's jurisdiction and the western half is located in the Riley County Planning Board's jurisdiction. Therefore both Planning Board and both Governing Bodies will need to adopt and incorporate the Master Plan before it effective.

The required 20-day legal notice for the public hearing to consider the amendment was published in *The Manhattan Mercury* on Monday, July 27, 2015. On August 24, 2015, the Planning Board tabled the public hearing to September 10, 2015, to allow additional time for the applicant to make final revisions to the Master Plan.

The recently updated Manhattan Urban Area Comprehensive Plan identified the Hartford Hill site as a future growth area that is being master planned. The proposed Hartford Hill Master Plan provides further details and guidance on land uses and development of the 320 acre site. The land uses as proposed consist of approximately 212 acres of Low/Medium Density Residential (0-11 dwelling units/acre) "Development Areas A, B, C and D"; an approximate 38 acre Office/ Research Park "Development Area E"; a 23 acre potential school site for USD 378 Riley County School District; approximately 48 acres for an open space/bike park; and a future Neighborhood Park located near the easternmost detention area in the south central portion of the site. (See Development Diagram – Figure 2)

DISCUSSION

The Manhattan Urban Area Comprehensive Plan provides high level guidance on growth, development, future land uses, and general guiding principles, goals, and policies. The Hartford Hill Master Plan provides more focused delineation of the land use designations for development of the site and addresses development phasing; access and traffic improvements; storm drainage and utility services; parks, open space and trails; pedestrian and bicycle facilities; future land uses; and strategies for disclosure and mitigation of Fort Riley Noise impact. The Master Plan designates four low/medium density residential development areas, one Office/ Research Park, a School site and an Open Space/ Bike Park. Each development area will be consistent with the respective Manhattan Urban Area Comprehensive Plan's Guiding Principles, Goals, and Policies.

It is proposed that the Hartford Hill Master Plan be adopted as a more detailed master plan or neighborhood level plan for the proposed area as shown on the Development Diagram. In this capacity, the proposed Hartford Hill Master Plan provides a more detailed guide for implementing and directing future development of this area in the northwest corner of the community.

The proposed site abuts Kansas State University's open range land to the north and west. The neighborhoods to the east and southeast consist of existing and future phases of Grand Mere, characterized by a mixture of single-family, townhome and multiple-family developments along Grand Mere Parkway.

The proposed Hartford Hill Master Plan is made up of individual neighborhoods (i.e. development areas), that are defined by natural terrain such as ridgelines, steep slopes and natural drainage areas. A potential school site and office research park are located in the western and northwestern portions Hartford Hill. It should be noted that USD 378 has not determined if it will build a school at this site. It is a site that the developer has identified as a potential location. The Master Plan provides more detailed guidance for the development and expansion of the community in this area, while recognizing the need to be flexible enough to respond to changing market demands.

City Administration worked closely with the applicant/developer and his consultant in reviewing this proposal, to ensure that the land use designations in the proposed Master Plan are consistent with the Manhattan Urban Area Comprehensive Plan.

Fort Riley – Land Use Planning Zone

Hartford Hill lies entirely within Fort Riley's Land Use Planning Zone (LUPZ) noise contour, also identified as the Critical Area (see Figure 18), resulting from noise generated by Fort Riley's training operations. The LUPZ is used for planning purposes to account for days of higher than average training operations, where large caliper weapon noise is averaged over the course of a year and ranges from 57 to 62 decibels CDNL (C-weighted day-night sound level). After consultation between Fort Riley and City

Administration, the applicant modified the original proposal to significantly reduce the number of acres for low/medium density residential development in the western portion of the site and converted it into additional land for the Open Space/Bike Park, and Office/Research Park. In addition, an area of Medium/ High density residential near the center of the site was converted to Low/Medium density residential, now shown as Development Area D.

The Master Plan identifies additional strategies and precautions that the developer is implementing to minimize the potential for noise complaints which include:

Noise Disclosure. Noise disclosure will be provided to prospective and future buyers, through the note on plats, disclosure statements filed on the deed of each lot that is platted, and by working with builders and realtors to provide noise disclosure through marketing and MLS documents.

Building Siting and Orientation. In order to reduce interior noise impacts and minimize the potential for noise complaints, the developer will establish best management practices for builders including:

- Lot by lot analysis of the placement and orientation of structures;
- Minimize placement on ridge tops and western facing slopes;
- Orient structures so that longer exterior walls are not perpendicular to percussion waves that may be coming from the impact area on the Fort;
- Orientation of structures so that corners face the impact area; and
- Incorporation of noise attenuation construction techniques.

With these additions to the Master Plan, the impact on future homeowners and Fort Riley's training operations should be minimized within acceptable levels.

Parks and Open Space

The Hartford Hill Master Plan proposes approximately 48 acres of parks and open space that would include open space buffers preserving the most significant natural features including drainage-ways, and trails for bikes and pedestrians connecting development areas. The Master Plan proposals were discussed at the Parks and Recreation Advisory Board (PRAB) meeting on July 16, 2015.

The PRAB raised concerns about the ownership, development and maintenance of the park land; the vision for the Bike Park and Neighborhood Park; and how the parks would fit into the overall park service areas. The applicant subsequently modified the Master Plan to address the PRAB's concerns. The applicant is willing to work with the City to donate the park land; however the City would have to own and maintain the parks and any amenities. The bike park would consist of earthen trails as detailed in the Master Plan. Future connections northeast to Washington Memorial Park and along Marlatt Avenue to the existing and future phases of the trail network will also be the responsibility of the City and County.

The Parks and Recreation Department has review the revised Master Plan and is satisfied that future park needs can be met.

Access & Traffic

Initial access to Hartford Hill will be from Grand Mere Parkway which abuts the southeast corner of the site, approximately 1,200 feet north of Colbert Hills Drive. A second future access will be provided at the northeast corner of the development, prior to any development beyond Development Area A, which will eventually connect to Marlatt Avenue via the extension of Grand Mere Parkway. The Master Plan also shows conceptually how the future internal ring-road system will serve and link the different development areas within Hartford Hill, and connect to future phases of Grand Mere to the south.

The round-a-bout at Grand Mere Parkway and Kimball Avenue will need to be upgraded prior to development beyond Development Areas A and B. In addition, prior to development in Development Area B, the connection to Marlatt Avenue needs to be made and it is likely that improvements to Marlatt Avenue may also be necessary. *(See pages 12 and 13 under Traffic Impacts in the Master Plan.)*

The Public Works Department reviewed the Hartford Hill Master Plan and is satisfied that the future traffic needs of the Master Plan can be adequately accommodated for Development Areas A and B. *(See memo from Rob Ott, Director of Public Works, dated September 2, 1025).*

Drainage

The Hartford Hill drainage system will consist of typical street inlets and include three detention basins along the southern edge of the site located in the three major natural drainage areas, as indicated in Figure 8. These basins will be constructed with each new phase of development. The Public Works Department is satisfied with the preliminary drainage information submitted by the consultant for the Hartford Hill Master Plan *(see memo dated September 2, 2015).*

Utility Services

Development Area A is within the Urban Service Area (USA) and as development proceeds incrementally to the west the USA will continue to be evaluated and updated. The Master Plan identifies additional pump stations that will be used to connect to the existing systems. The Public Works Department is satisfied with the preliminary analysis provided in the Master Plan regarding sanitary sewer and water service *(see memo dated September 2, 2015).*

Fire

The internal ring-road network will initially be established with one access road from Grand Mere Parkway at the southeast corner of Hartford Hill. The second access at the northeast corner will be required to service the area, prior to the development beyond Development Area A.

Proposed Comprehensive Plan Amendment

The proposed amendment is to adopt and incorporate the Hartford Hill Master Plan, dated September 2015, as a part of the Manhattan Urban Area Comprehensive Plan. Similar to other citations of separately bound documents that are a part of the Comprehensive Plan, the Hartford Hill Master Plan will be adopted under separate cover and will be incorporated by reference. The citations for the Hartford Hill Master Plan are proposed to be added to the end of Chapter 3: A Coordinated and Efficient Pattern of Growth and Appendix B Related Plans and Policy Documents *(See attached citations that will be made on pages 59 and 162of the Manhattan Urban Area Comprehensive Plan).*

ALTERNATIVES

The Manhattan Urban Area Planning Board has the following alternatives concerning the issue under consideration. The Planning Board may:

1. Approve Resolution No. 091015-A amending the Manhattan Urban Area Comprehensive Plan, by adopting and incorporating the Hartford Hill Master Plan, dated September 2015, by reference as presented and adding the necessary citations to Chapter 3 and Appendix B, as proposed;

2. Modify the proposed Hartford Hill Master Plan, i.e. the written text and/or map(s), to meet the needs of the community as perceived by the Planning Board, and approve a modified Resolution; or,

3. Table the proposed amendment and provide further direction to City Administration and the Applicant.

   *(**NOTE:** amendments to the Comprehensive Plan must be approved by a majority of the full membership of the Planning Board, which would require at least four (4) members.)*

The Hartford Hill Master Plan, together with the Planning Board's Resolution and written summary of the public hearing will be forwarded to the City Commission for its consideration at a meeting on October 6, 2015, and the Riley County Commission, on September 14, 2015.

RECOMMENDATION

City Administration recommends that the Manhattan Urban Area Planning Board approve and adopt Resolution No. 091015-A, amending the Manhattan Urban Area Comprehensive Plan, by adopting and incorporating by reference the Hartford Hill Master Plan, dated September 2015, and incorporating the necessary citations in Chapter 3 and Appendix B, as proposed.

POSSIBLE MOTION

The Manhattan Urban Area Planning Board approves and adopts Resolution No. 091015-A, amending the Manhattan Urban Area Comprehensive Plan, by adopting and incorporating by reference the Hartford Hill Master Plan, dated September 2015; and, forwards a recommendation of approval to the City Commission and Riley County Commission.

LE/EC
15137}MUAPB}HartfordHillPlanAdoption

Enclosures:

1. Memorandum from Rob Ott, Director of Public Works, dated September 2, 2015
2. Resolution No. 091015-A
3. Hartford Hill Development Diagram – Figure 2
4. Reference citation and modification to Chapter 3 and Appendix B of the Manhattan Urban Area Comprehensive Plan
5. Hartford Hill Master Plan: under separate cover - link provided to download from City Web site (Note: very large PDF document)

INTER-OFFICE MEMORANDUM

City of Manhattan Kansas
Public Works

DATE: September 2, 2015

TO: Eric Cattell, AICP, Assistant Director for Planning

FROM: Robert K. Ott, P.E., Director of Public Works
Brian Johnson, P.E., City Engineer
Randy DeWitt, P.E., Director of Utilities
Peter Clark, P.E., PTOE. Civil Design/Traffic Engineer
Shane Swope, P.E., Stormwater Engineer

RE: Hartford Hill Master Plan

The Utilities and Engineering Divisions of Public Works have completed the review the proposed Hartford Hill Master Plan document. We appreciate the opportunity through multiple meetings and dialogue between the Public Works Department and the developer and his consulted to examine and review the technical content of the master plan.

Water and Wastewater ~ (Randy DeWitt)

I have reviewed the revised Master Plan document, including Technical Supplement No. 1 for Water Supply (TS1) and No. 2 for Sanitary Sewer (TS2) and find that the data and information presented in the water supply and sanitary sewer analysis' are sufficient for the purposes of master planning the proposed Hartford Hill Development.

For TS1, the existing water supply system should allow for the Hartford Hill Development to meet minimum requirements for domestic water supply pressures. The adequacy of water storage capacities for the purposes of fire protection and domestic supply volumes will need to be analyzed further depending on the nature of future multi-family residential and non-residential development within the Hartford Hill Development. It is intended that future water supply issues for the overall northwest region of Manhattan will be studied by the City within the upcoming 2016-2017 Water and Wastewater Facilities Master Plan Update.

For TS2, there is the potential for future development within the Hartford Hill Development, as well as within Grand Mere, to cause the downstream sanitary sewer system to be under capacity during peak and wet weather flow events. As Hartford Hill, and other areas within this sanitary sewer basin develop in the future, design and analysis considerations must be made for the downstream sanitary sewer to ensure that potential capacity constraints are avoided, either by increasing the downstream sewer capacity or by using controlled lift station releases that lower the peak flows within the constrained sewer.

Traffic ~ (Brian Johnson and Peter Clark)

A traffic impact analysis for the proposed development was submitted by SMH Consultants, of Manhattan, KS and was prepared by a licensed engineer in the state of Kansas, following the criteria in the 2015 MATS. All of the comments previously submitted on this traffic analysis have been addressed in the final report and there are no further comments or recommendations beyond the final published master plan.

Stormwater ~ (Brian Johnson and Shane Swope)

A stormwater management analysis for the proposed development was submitted by SMH Consultants, of Manhattan, KS and was prepared by a licensed engineer in the state of Kansas. All of the comments previously submitted on this stormwater management analysis have been addressed in the final report and there are no further comments beyond the final published master plan.

PWC/15064

HARTFORD HILL

MASTER PLAN

A Fieldhouse Development
Master Planned Community

September 2015

SMH CONSULTANTS

FIELDHOUSE DEVELOPMENT, INC.

HARTFORD HILL
MASTER PLAN

TABLE OF CONTENTS

VII. Technical Supplements
A. Technical Supplement Number 1 – Water
B. Technical Supplement Number 2 – Sanitary Sewer
C. Technical Supplement Number 3 – Storm Water
D. Technical Supplement Number 4 – Traffic
E. Technical Supplement Number 5 – USD 378

INTRODUCTION

The purpose of this master plan submittal is to continue the planning process that began over a year ago to incorporate a tract of land into the Manhattan Urban Area Comprehensive Plan.

The intent of eventually developing this 320 acre development called Hartford Hill is to provide some of the land that the City of Manhattan needs to continue to grow and prosper. Historically, the major growth of Manhattan has been primarily to the northwest, with simultaneous expansions to the southwest and northeast. Recent years have seen the amount of land for continued development diminish along the western boundary of the City. Reasons for that include building to the edge of capabilities of the city's utility systems; building to the edge of the Ft. Riley Noise Zones; building up against large expanses of land owned by Kansas State University.

In order to continue to expand and meet the housing demands of one of the fastest growing communities in Kansas, more land has to be made available. The City of Manhattan and Counties of Riley and Pottawatomie have updated the Manhattan Urban Area Comprehensive Plan (MUACP). All three of those entities adopted the new plan in the spring of 2015. The MUACP indicates current population of the City of Manhattan is just over 56,000. Using the tools at their disposal, and the inside knowledge they have of what is happening in and around Manhattan, the professionals that developed the MUACP project the population of the city to increase to these approximate numbers:

61,000 in 2019
65,000 in 2024
69,000 in 2029
72,000 in 2034

The owners of Hartford Hill are Zac and Amber Burton, through one of their business enterprises, Fieldhouse Development, Inc. Throughout the MUACP updating efforts, the Burtons have worked with City Administration to expand the current Growth Area. Efforts have also been put forth to expand the current Urban Service Area to include Hartford Hill. Since the Manhattan Urban Area Planning Board reviews the Urban Service Area annually, City Administration indicate it is likely that boundary will move incrementally as development progresses. Hartford Hill will provide a portion of the land needed to meet the growing demand of housing in Manhattan.

As described in more detail later in this plan, the vision of the owners of Hartford Hill is to provide a quality, well planned, residential neighborhood that continues the success of other neighborhoods with similar terrain and character in northwest Manhattan. The various land uses, and their approximate acreages, throughout Hartford Hill are shown on Figure 2. As with any good master plan of any size, flexibility has to be recognized as a component. Market influences and demands will drive the ultimate, smaller development designs, but because of the physical constraints imposed upon the land, the densities of any final designs will be naturally much lower than what would otherwise be possible on flatter terrain. Likewise, the timing of the various phases will be largely driven by market demand. In a perfect developer world, with the anticipated strength of the foreseeable Manhattan economy, the entire development could be built out in 5 to 10 years. If there are any unforeseen circumstances that substantially slow Manhattan's growth, it might take 15 to 20 years to build out the entire 320 acres.

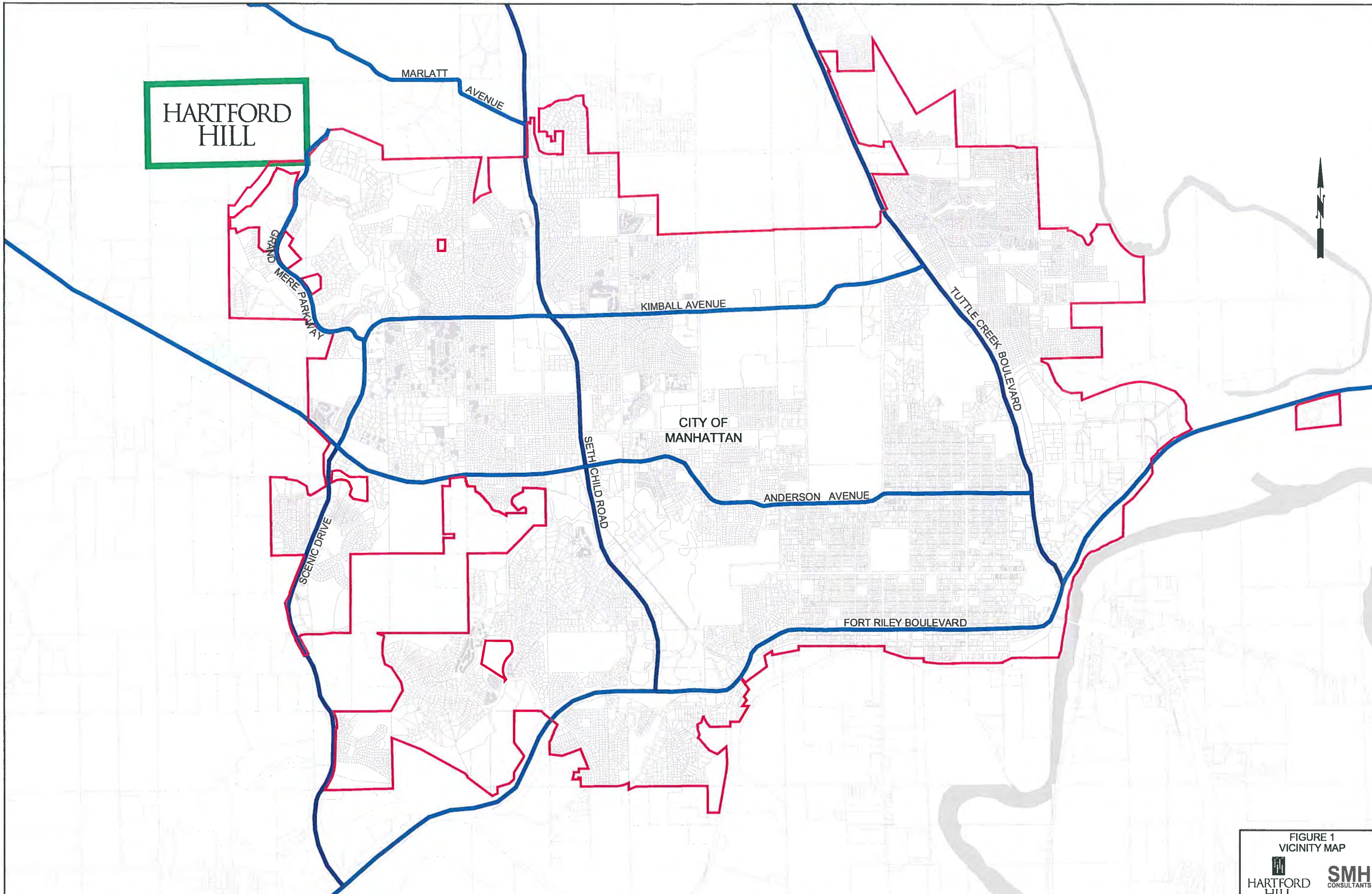
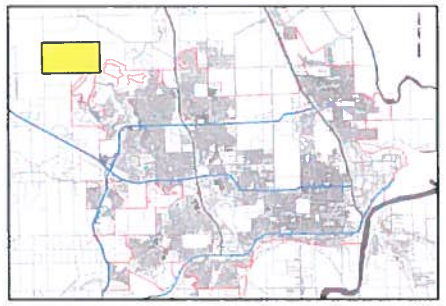


FIGURE 1
VICINITY MAP

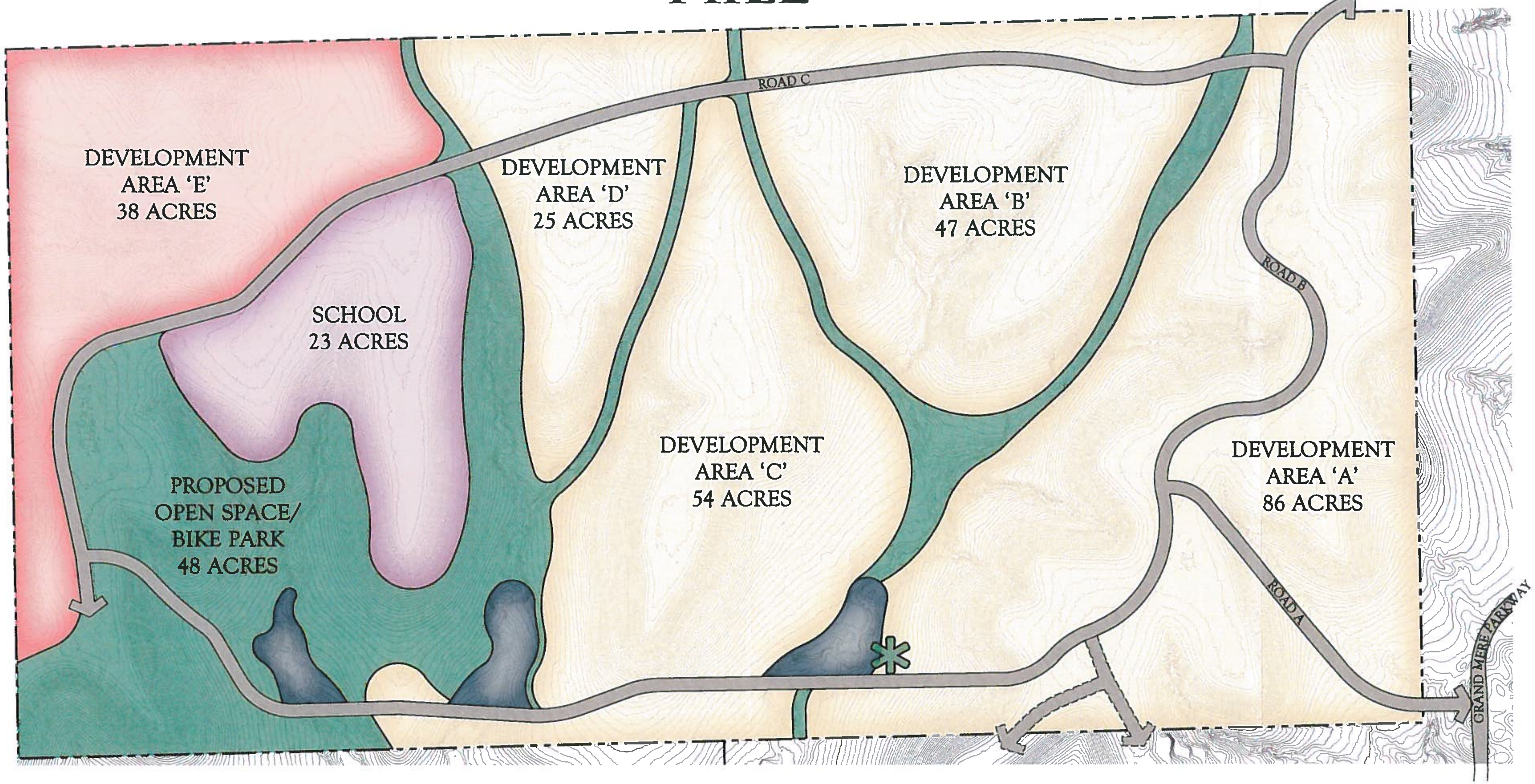
HARTFORD HILL

SMH CONSULTANTS



VICINITY MAP

HARTFORD HILL



LEGEND

- Low / Medium Density Residential 0 - 11 DU/AC
- Open Space
- Office / Research Park
- Public / Semi-Public
- Stormwater Management
- Proposed Neighborhood Park

DEVELOPMENT DIAGRAM

September 2015

NORTH 0' 100' 200' 400' 600'

SMH CONSULTANTS

THE SITE

The Hartford Hill Development is located in the far northwest portion of Manhattan, Kansas, as shown on Figure 1. A conceptual Development Diagram is shown on Figure 2.

It is rectangular in shape, 1.0 by 0.5 miles, consisting of 320 acres of native range land that has been used for grazing cattle. The property lies north and west of, and adjacent to Grand Mere Development and the Colbert Hills Golf Course.

Approximately 31 acres of the southeast corner of the development drains southeast through Grand Mere and Colbert Hills, reaching Little Kitten Creek after a 0.75 mile journey, and then eventually to Wildcat Creek in another 1.5 miles. A small portion of the northwest corner of the development, about 49 acres, drains to the northwest into an unnamed tributary that after 3.2 miles joins Wildcat Creek. Runoff from the remaining 240 acres of the development traverses southwest through private rangeland, and then cropland via well-defined drainage ways and ravines, eventually reaching Wildcat Creek about 3.1 miles upstream of the bridge at Scenic Drive.

NEIGHBORING LANDS

The names of owners of land adjacent to Hartford Hill can be seen on Figure 3.

Those land parcels consist of a mix of private and public ownerships.

The land owned by Fieldhouse Development is now known as Baltustrol as recently platted through the City of Manhattan.

The land east of Hartford Hill owned by Grand Mere is master planned to be developed as an "elder care" residential area. In the event a project meeting that definition does not materialize in the foreseeable future, it is likely that area will be converted to single family residential.

The land south of Hartford Hill owned by Grand Mere is master planned to be developed as single family residential homes. It is unlikely that will change since the terrain is very difficult in that area, and not conducive to more intense development.

There is no indication as to what the owners of the Troyer land might have in mind as a long term plan for their land.

It is impossible to ascertain what Kansas State University might want to do with its land in the future. There are on-going, and continuing, studies related to KSU land nearer the main campus, but nothing related to the land in question.

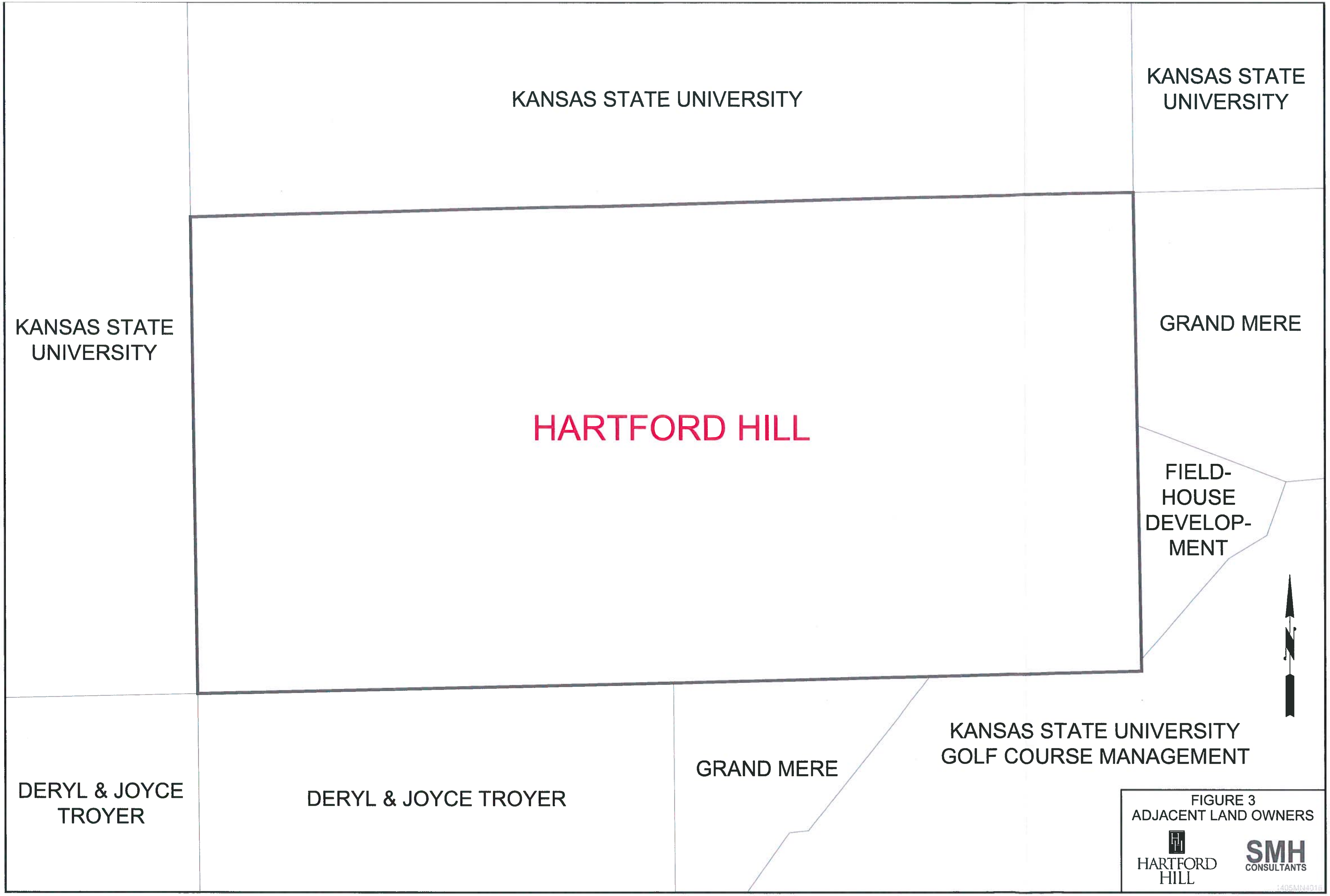


FIGURE 3
ADJACENT LAND OWNERS

SITE ANALYSIS

Existing Conditions, Land Use, and Topography

The site on which Hartford Hill sits is 100% pasture. It has always been vacant of buildings, and used to graze cattle.

The land is extremely rough in places, with elevations ranging from a low of about 1205 to a high of approximately 1350. Slopes range from almost flat to in excess of 50 %, with some exposed rock ledges showing on topographic maps at 200%. The areas that have been grazed are separated by deep ravines that contain the only trees on the site. Several varieties of native trees and brush exist along the steep slopes and bottoms of the gullies, but trees in general are few and far between. Elevations and slopes can be seen on Figures 4 and 5 respectively.

Ridgelines along the higher elevations are relatively flat, and provide commanding views in all directions.

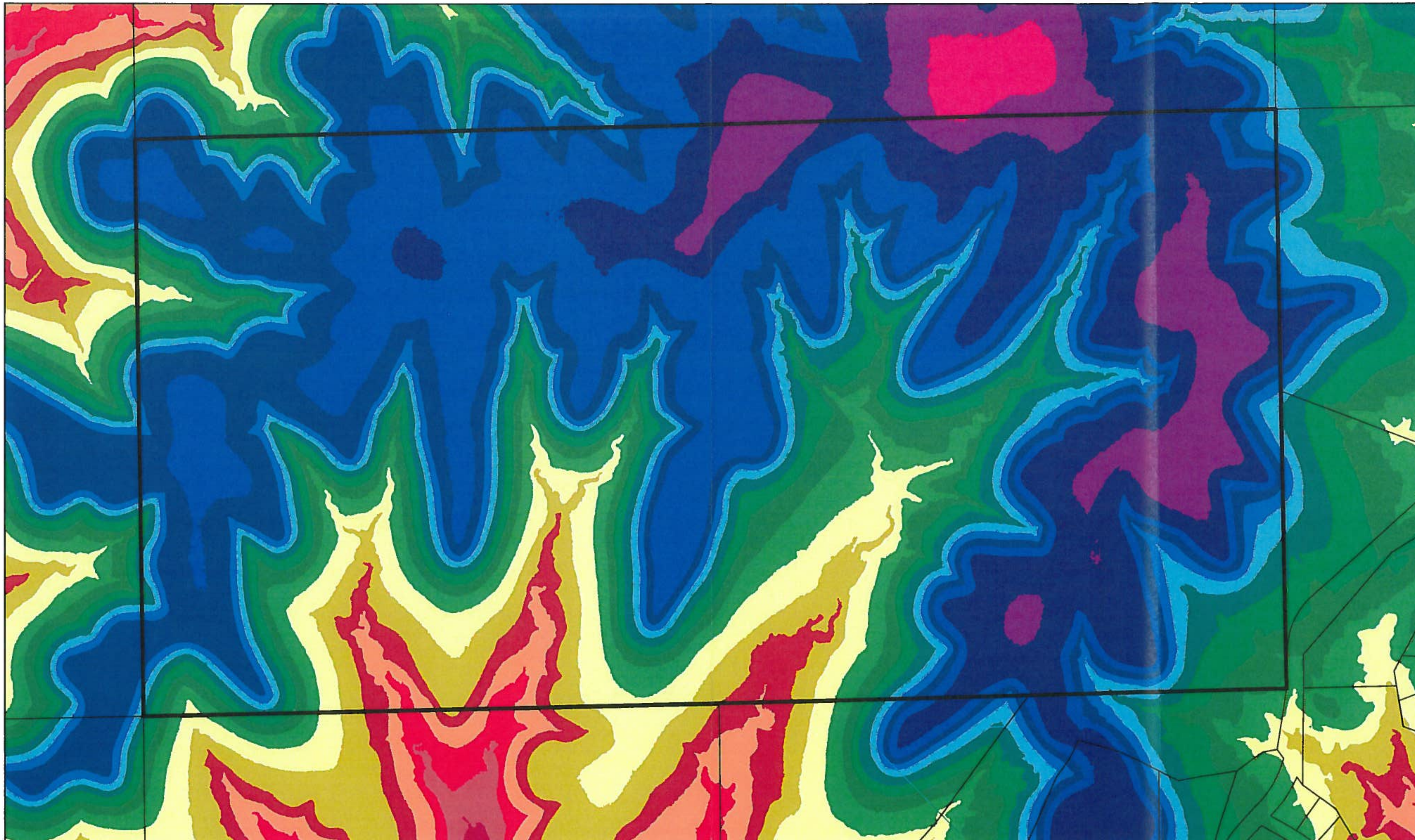
Soils within the site are shown on Figure 6. They generally include thin topsoil of just a few inches, underlain by layers of limestone and shale.

Access

The roadway network near Hartford Hill can be seen on Figure 1. Vehicular access to the site will be obtained at a minimum of two (2) locations. The first to occur will be near the southeast corner of the development, and will connect to Grand Mere Parkway. Grand Mere Parkway is functionally classified as a major collector street, and serves many modes of traffic south to where it intersects Kimball Avenue. Grand Mere Parkway carries motor vehicles, bicycles on separately marked lanes in both directions, and pedestrians on sidewalks along both sides of the street. Kimball is classified a minor arterial in the City's street network. In addition to being one of the primary east-west movers of vehicular traffic in the community, it also carries pedestrians on sidewalks, for the most part on both sides of the streets. From Grand Mere Parkway south, sidewalks do not exist yet because some land on both sides of the roadway is still undeveloped. The intent is for those sidewalks and for better bicycle facilities to be added as the City continues to grow in that direction.

The second access will be near the northeast corner of Hartford Hill. It is at that point that the subject land parcel enjoys the benefits of an easement dedicated by Kansas State University. That easement allows travel to and from Marlatt Avenue. Marlatt is functionally classified as a local road, currently under the jurisdiction of Riley County. Marlatt is a rural section, gravel roadway.

It is possible that other access points into Hartford Hill could be realized in the future. Possible connection points have been shown on Figure 2.



Elevations Table			
Number	Min. Elev.	Max. Elev.	Color
1	1170.00	1180.00	
2	1180.00	1190.00	
3	1190.00	1200.00	
4	1200.00	1210.00	
5	1210.00	1220.00	

Elevations Table			
Number	Min. Elev.	Max. Elev.	Color
6	1220.00	1230.00	
7	1230.00	1240.00	
8	1240.00	1250.00	
9	1250.00	1260.00	
10	1260.00	1270.00	

Elevations Table			
Number	Min. Elev.	Max. Elev.	Color
11	1270.00	1280.00	
12	1280.00	1290.00	
13	1290.00	1300.00	
14	1300.00	1310.00	
15	1310.00	1320.00	

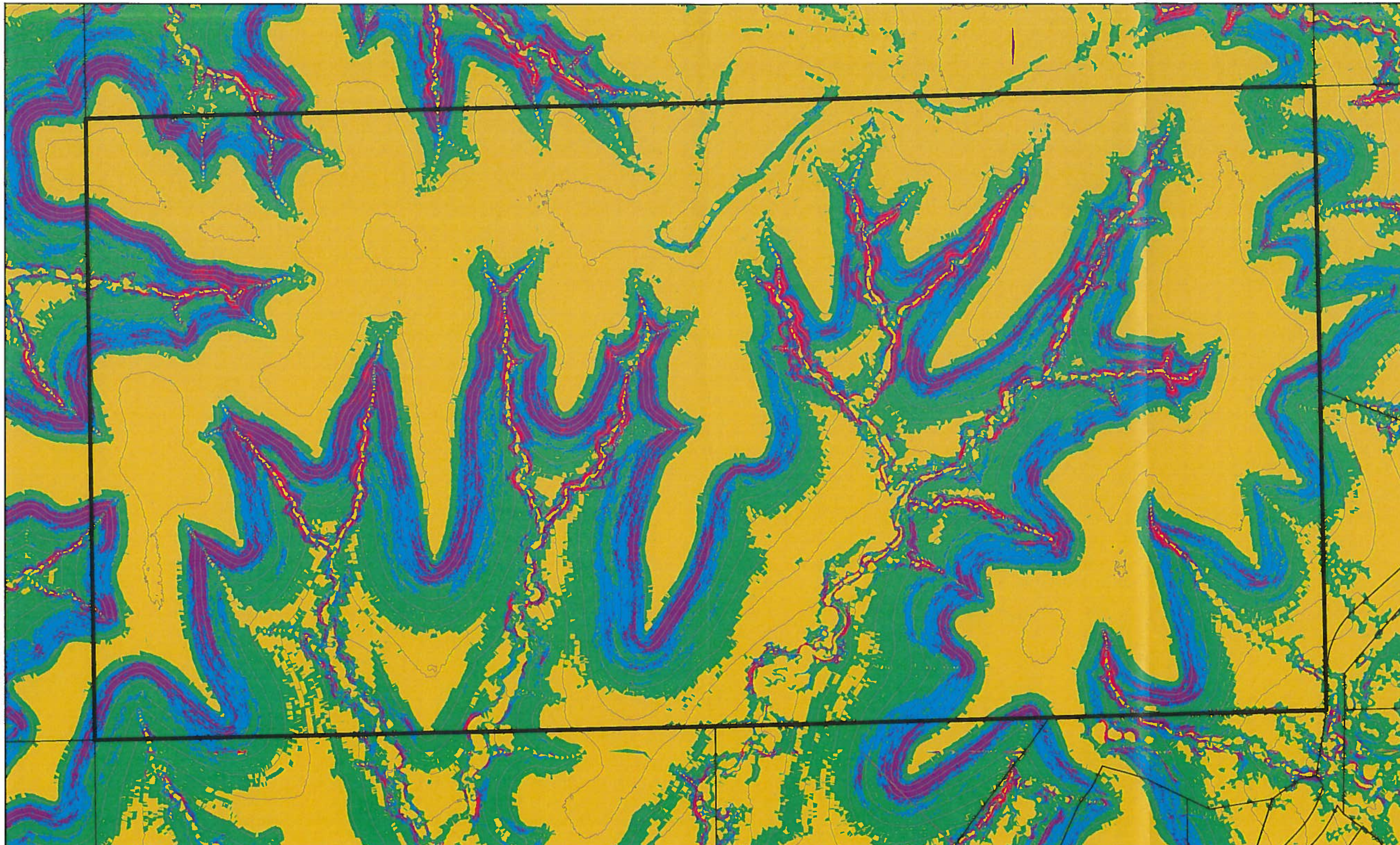
Elevations Table			
Number	Min. Elev.	Max. Elev.	Color
16	1320.00	1330.00	
17	1330.00	1340.00	
18	1340.00	1350.00	
19	1350.00	1360.00	

N

FIGURE 4
ELEVATION MAP

HARTFORD HILL

SMH CONSULTANTS



Slopes Table			
Number	Min. Slope	Max. Slope	Color
1	0.00%	10.00%	
2	10.00%	25.00%	

Slopes Table			
Number	Min. Slope	Max. Slope	Color
3	25.00%	33.00%	
4	33.00%	50.00%	

Slopes Table			
Number	Min. Slope	Max. Slope	Color
5	50.00%	200.00%	

N

FIGURE 5
SLOPE MAP

HARTFORD HILL

SMH CONSULTANTS

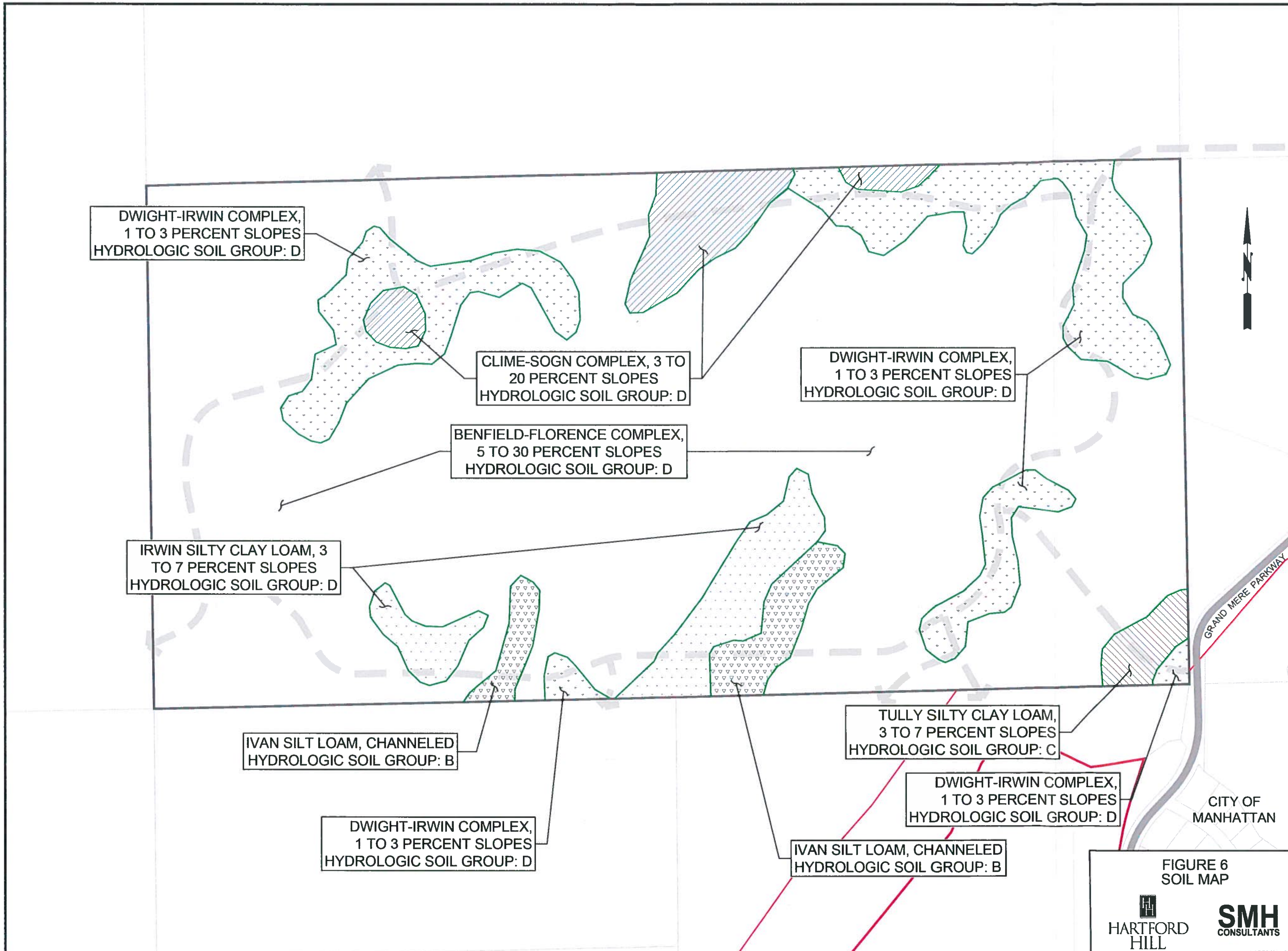


FIGURE 6
SOIL MAP

Availability of Utilities

A map of water and sanitary sewers facilities is shown on Figure 7.

Water

Water, provided by the City of Manhattan, is available in the form of a 16-inch transmission main at the east line of Hartford Hill. Water transmission runs between the Hudson Avenue Storage facility and the Northwest Storage facility. Technical Supplement No. 1, provided at the end of this master plan report explains the details regarding the water system in this portion of Manhattan. Generally, when the northwest storage tower is slightly less (4 feet) from full, the static pressure at the highest point in Hartford Hill will be in excess of 53 psi. With a combination of 16-inch and 12-inch water mains in Hartford Hill, the residual pressure (pressure under fire flow) would still remain in excess of 45 psi.

Water mains will generally follow the alignment of roadways. Therefore it is anticipated the first connection to service Hartford Hill will be near the intersection of Grand Mere Parkway and Road A. A second connection will occur near where Road B crosses the existing 16 inch water main, thus creating a looped system into Hartford Hill.

City Administration has pointed out that there are some challenges regarding the water system. On days of peak demand, it is difficult to keep the northwest storage tower full. There are at least two ways to address that issue. First, the old pump stations and transmission mains far east of the developing areas of Manhattan could be upgraded to accommodate the inevitable growth. Second, additional storage could be provided somewhere strategically located to be of best service to the entire community. The owners of Hartford Hill are willing to work with City officials to identify an appropriate site if it is determined such a site should be in Hartford Hill.

Sanitary Sewer

Sanitary sewer service by the City of Manhattan will be provided by a combination of gravity flow sewers and a series of pump stations.

The first phases of development, starting at the southeast corner of Hartford Hill, will flow by gravity to the southeast, connecting to existing sewers that run through the Grand Mere Development and the Colbert Hills Golf Course. Once the Hartford Hill development process reaches the first ridgeline west, wastewater will have to be collected in a wet well and pumped back over the hill to the previously mentioned gravity system. This general service technique will continue across the ridgelines to the west, resulting in three (3) pump stations. Eventually, if the City decides to develop westward along Anderson Avenue, gravity flow sewers could potentially be made available, and the pump stations could potentially be eliminated from service.

In Technical Supplement No. 2 details of efforts to examine the existing sewer system downstream of Hartford Hill are provided. City Administration worked with the Hartford Hill team to obtain some existing wastewater flows at strategic manholes. With the relatively low

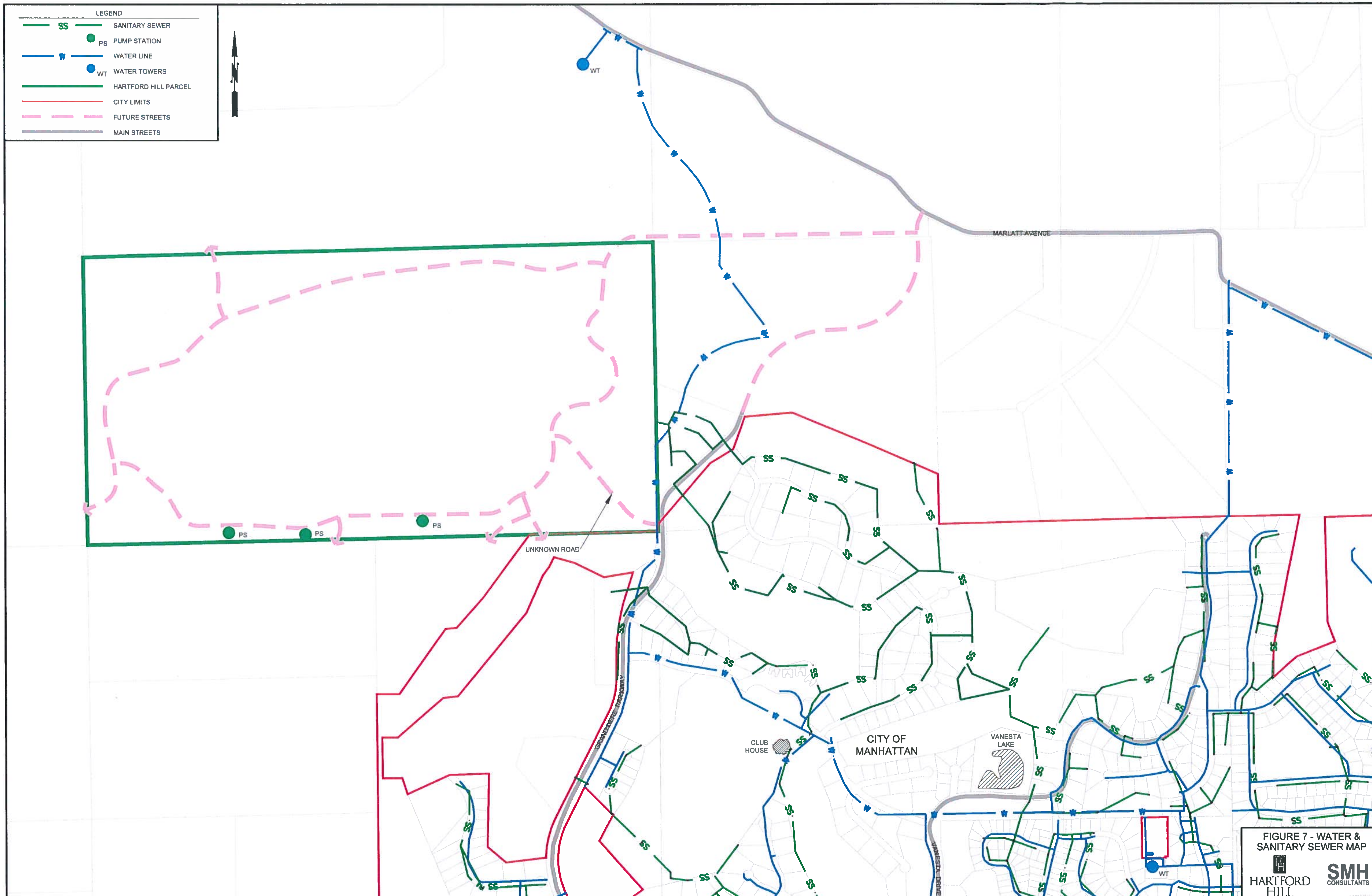


FIGURE 7 - WATER & SANITARY SEWER MAP

densities which this land will develop at, the gravity system in place downstream is anticipated to accommodate this new development. In the event flows reach a point downstream that tax the system, technology of today is available to allow off-peak pumping of wastewater. A simple communication system could be implemented. A permanently mounted flow measuring device, or if necessary devices, could be installed in a strategically located manhole that is determined to be the control location in the sewer system. This device would be equipped with a transmitter that, when the flow in the sewer is at a level that more wastewater can be passed safely, a signal is given to the pump stations within Hartford Hill that they can release their flow. The pump stations will have to include slightly larger than normal wet wells in order to temporarily store the wastewater. This means the unused capacity of the existing sewer system would be used in an efficient and safe manner during off-peak periods. More details about this possibility are included in Supplement No. 2.

Electric service will be provided by Westar Energy.

Natural gas will be provided by Kansas Gas Service.

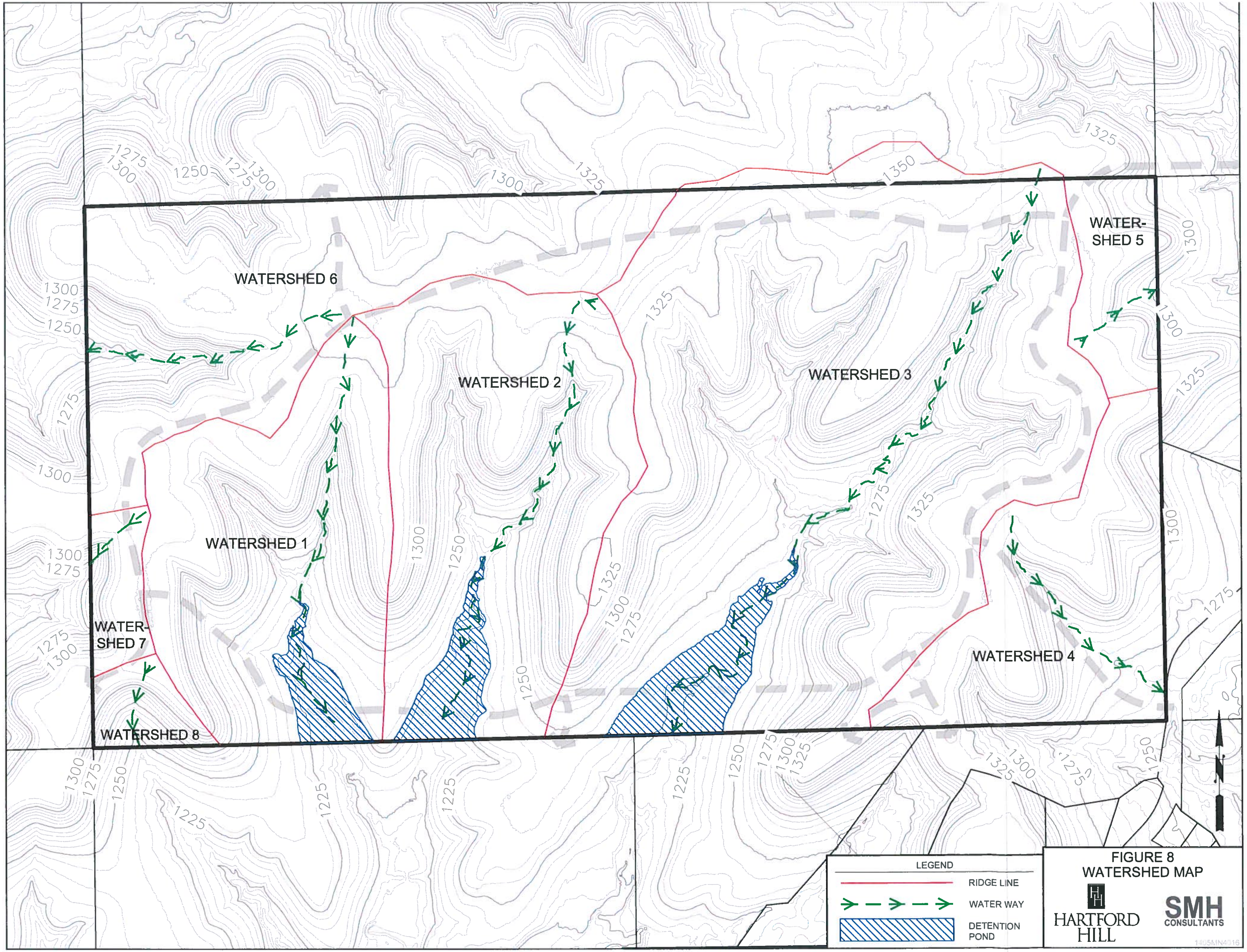
Communications will be provided by AT&T and Cox Cable, and as this industry evolves there will probably be more competitors in the future.

Stormwater Management

It is clearly recognized by the owners of Hartford Hill that Wildcat Creek is a very important focal point that must be given serious and significant attention. Because of the lay of the land within Hartford Hill, there are multiple opportunities to construct storm water management facilities, probably in the form of detention basins. City public works officials have expressed a preference that detention, rather than retention, basins be utilized. Therefore, Figure 8 shows a concept of where three (3) detention basins could be constructed as part of the roadway system.

Technical Supplement No. 3 provides details of a proposed storm water management plan. Actual engineering design will have to be part of the various phases of development. However, the intent is to plan and design the storm water facilities in a holistic manner so as to control runoff from the entire 320 acres as efficiently as possible. Separate detention ponds will not be part of every phase of development, but rather the control provided by larger, strategically placed ponds, will provide runoff management for the entire development.

Preliminary engineering analysis indicates that storm water management provided by Hartford Hill will make the flooding situation on Wildcat Creek better than it is in current conditions. In simple terms normal criteria for stormwater runoff requires that post-construction rates of runoff for 2-year, 10-year, and 100-year peak discharges be at or below pre-development levels. The owners of Hartford Hill intend for the rates of runoff values to be well below pre-development levels. The proposed approach towards storm water management in Hartford Hill generally conforms to the goals, objectives and strategies identified in the Wildcat Creek Floodplain Management Plan.


WATERSHED 6
WATERSHED 2
WATERSHED 3
WATER-
SHED 5
WATERSHED 1
WATER-
SHED 7
WATERSHED 4
WATERSHED 8
LEGEND
RIDGE LINE
WATER WAY
DETENTION
POND
FIGURE 8
WATERSHED MAP
HARTFORD
HILL
SMH
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In addition to addressing storm water runoff rates the three (3) detention ponds will also serve as extended dry detention basins (EDDBs) for the treatment of storm water. As EDDBs, the proposed basins will fulfill the requirement for Post Construction Best Management Practices for all of Hartford Hill. There will be no requirement for each individual development project as a part of Hartford Hill to meet this requirement individually. This is discussed in further detail in Technical Supplement No. 3.

Phasing for construction of the three (3) detention basins should occur as development in each of the watersheds where detention structures are located occurs. However, it may not be necessary for one sub-development of the larger area in a watershed containing a planned detention structure to construct the entirety of the structure. Phased construction of the planned detention structure is proposed as long as phased construction accounts for ultimate build-out of the detention structure and as long as each development provides its impactful volume. It is envisioned that each developer will only be responsible for their contribution to that structure on a percentage basis. For example, if a sub-development is resulting in the development of 20% of that particular basin then that sub-development will be responsible for raising the dam structure enough to create 20% of the volume. The first development in that particular basin will be responsible for the control structure.

All storm water management regulations of the City will be followed in the design and construction of the development. In addition, attention will be given to the post-construction requirements of the city as well.

It is the intent of the developer to create a home owners association which will be responsible for the maintenance of the detention basins.

Traffic Impacts

A traffic impact study has been completed based upon the proposed land use plan for Hartford Hill. Recognized and appropriate engineering standards, using trip generation rates found in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition, have been used to estimate traffic volumes that will be produced by the development. Those volumes have been distributed from the development to the existing and proposed roadway network outside of Hartford Hill. For purposes of this study, and because it is not possible to assume with accuracy what Kansas State University might do with its land in the future, it is estimated that all the traffic from Hartford Hill will exit at either the northeast or southeast connections as shown on the roadway network. For analysis purposes, 85% of the traffic has been assigned to the southeast and 15% to the northeast.

For purposes of this study a development density of 2.5 dwelling units per gross acre was used. This should prove to be a very conservative factor given the known values that have been realized in other areas of similar terrain. For example, the current density within the adjacent Grand Mere Development is approximately 1.6 dwelling units per acre.

Intersection analyses have been performed using accepted methodologies outlined in the Highway Capacity Manual 2010 (HCM2010) as well as McTrans Highway Capacity Software (HCS) 2010.

Traffic volumes have been estimated based upon the following assumptions:

- "Existing" volumes are what they imply, actual volumes counted during the fall of 2014, while schools were in session.
- "Expected" volumes are composed of existing plus anticipated volumes to be added to the traffic network once all of the Grand Mere development is complete.
- "Development" volumes are only those estimated to be generated by the Hartford Hill project.
- "20" is a component of traffic volume added to the roadway network to represent background growth of the City. This traffic will be generated by other areas, some distant from Hartford Hill, but will use the major intersections that have been studied. This component was derived by applying a growth factor of 2% per year, over 20 years.
- Existing + Expected + Development + 20 is self-explanatory.

Existing traffic volumes for the intersection of Kimball Avenue and Vanesta Drive were provided by the City of Manhattan. Those were used to determine the peak hours for traffic in this area. Subsequently, new counts during the peak hours were taken by SMH Consultants at the intersection of Kimball Avenue and Grand Mere Parkway, as well as the intersection of Kimball Avenue and Vanesta Drive.

Google Earth was used to help approximate existing traffic volumes for Marlatt Avenue. The number of residences, businesses, and KSU facilities served by Marlatt Avenue were determined and used to estimate the trips on that roadway.

The traffic study was extended outside the boundaries of Hartford Hill to determine the impact on the intersections of Grand Mere Parkway and Kimball Avenue, Grand Mere Parkway and Marlatt Avenue, and Kimball Avenue and Vanesta Drive. At the southeast corner of Hartford Hill, the proposed intersection of Road A with Grand Mere Parkway was also analyzed. Within Hartford Hill the only intersection analyzed was the "T" where Road A meets Road B.

Results of the traffic impact study are summarized in the following paragraphs, and in the tables and drawings shown on Figures 9-16. In addition, raw data and intersection analysis sheets can be found in Technical Supplement No. 4.

Summary of Intersection Delays and LOS

Level of Service (LOS)	Signalized Intersection (seconds)	Unsignalized Intersection (seconds)
A	<10	<10
B	10-20	10-15
C	20-35	15-25
D	35-55	25-35
E	55-80	35-50
F	>80	>50

Intersection at the Southeast Corner of Hartford Hill; Road A with Grand Mere Parkway.
This future intersection was analyzed and determined under "existing + expected + development + 20" to operate satisfactorily with Road A stopped at Grand Mere Parkway. The movement with the highest delay will be the eastbound approach operating at a level of service C with a 95% queue length of approximately 115 feet.

Intersection of Road A with Road B.
This future intersection was analyzed with Road A stopping for Road B. Under "existing + expected + development + 20" the PM movement with the highest delay was determined to be the westbound approach and will operate at a level of service F when full development is reached if the approach is one lane wide. An additional analysis was performed after adding a westbound left turn lane and the levels of service for the left turn and right turn were D and B respectively.

Marlatt Avenue. Marlatt Avenue is currently a rural section, narrow, gravel road. Contacts with officials of Riley County confirm that a definite plan is not in place to improve Marlatt Avenue. There are no policies in place, either at the county or city levels of government, that provide definitive direction as to what will happen when urban development catches up with rural infrastructure. The proposed connection of Grand Mere Parkway to Marlatt Avenue has been identified in planning documents since the formal adoption of the Grand Mere Master Plan in 2000. It is recognized that the intersection configuration between Road B, Marlatt Avenue, and Grand Mere Parkway is very important. The actual design of that intersection, or intersections, will follow provisions within MATS, and will require cooperation and coordination from multiple land owners including Kansas State University. If past practice holds true in the future, improvements to public roadways such as Marlatt Avenue will occur as a matter of public/private cooperation. Marlatt Avenue is already a public roadway, and continues to become more important to the travel demands of the public in this portion of the community. Those improvements may happen because of actions by Riley County which is the governmental agency with jurisdiction over the roadway at the time of this report. Or it could occur because of actions by the City of Manhattan as urban growth continues north and west of the community.

Kimball Avenue and Vanesta Drive. The intersection of Kimball Avenue and Vanesta Drive is currently controlled by a traffic signal. Analyses as described above indicate the intersection operates during the AM and PM peak hours at level of service B under existing conditions. Under even the maximum conditions studied, the intersection will continue to operate during both peak hours at level of service C in 20 years.

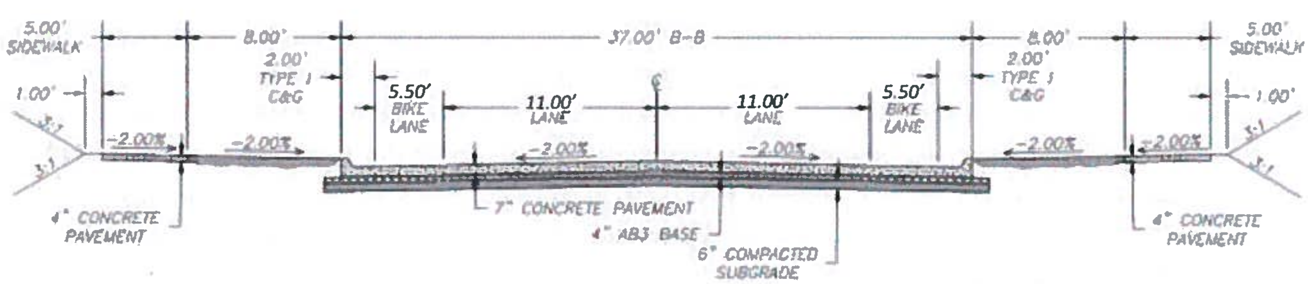
Kimball Avenue and Grand Mere Parkway. The intersection of Kimball and Grand Mere Parkway is currently controlled by a single-lane roundabout. Analyses as described above indicate the intersection operates during the AM and PM peak hours at a level of service A under existing conditions. After adding traffic volumes from the "expected" and full "development" scenarios, the level of service is C. It is not until the 20 years of the background growth factor is added that the intersection begins to reach capacity. At that time the AM peak is estimated to produce a level of service of E, and the PM peak reaches F. The City of Manhattan has recognized the future need for upgrading Kimball Avenue. The City's Capital Improvement Program includes a 2019 project to add lanes to Kimball from Hudson Avenue to Anderson

Avenue. That project will provide enhancements to this intersection as well, presumably in the form of a 2-lane roundabout, which without question will handle the future traffic volumes at this location. If the 2019 City of Manhattan CIP Project does not occur, a revaluation of the intersection of Grand Mere Parkway and Kimball Avenue may be required before development beyond Development Areas A and B occur.

The Manhattan Department of Fire Services has indicated a desire to see the northeast roadway connection (Road B) from Hartford Hill happen as soon as possible, to provide a second access to the development. To accommodate that desire the developers of Hartford Hill have agreed that the Road B connection to Marlatt Avenue will happen after Development Area A is complete, but before Development Area B begins.

Road A will follow a path from Grand Mere Parkway to Road B by climbing the hill to reach the ridgeline. The primary interior roadways within Hartford Hill, Road B and Road C, will likely follow the ridgelines around the development. A concept for such a roadway system is shown on Figure 2. All three of these roadways will likely be functionally classified as "minor collectors". These roadways will provide direct access to adjacent properties via individual driveways, but only at locations that cannot be reasonably accommodated on local side streets because of the steep grades and narrow hilltops. Driveways onto Roads A, B, and C will be minimized as much as possible. Whenever a corner lot is created with one side on Road B or Road C and the other side on a local street, the driveway will be located on the side street. When driveways are located on Road B or Road C they will be spaced a minimum of 100 feet apart, center to center. This proposed configuration was developed in concert with the staff of the City's Public Works Department. Roads A, B, and C will also provide access to a number of culdesacs because of the terrain throughout the development. Some of those culdesacs will be longer than the recommended 200 to 400 feet length as written in the new version of MATS, because of the lay of the land. All streets will be designed to meet the standards of the City at the time in terms of widths, grades, and curvature. Recognizing the new MATS, and current subdivision standards, appropriate connections between blocks and ends of culdesacs will be provided. However, it will be impossible in some cases to provide ADAs accessible facilities, resulting in signing the paths as "non-ADA accessible".

Because of the growing importance of multi-modal transportation elements, the owners of Hartford Hill plan to create a roadway typical cross section on the minor collectors that accommodates all modes of transportation. A basic sketch of the proposed cross section of such a roadway is shown below.



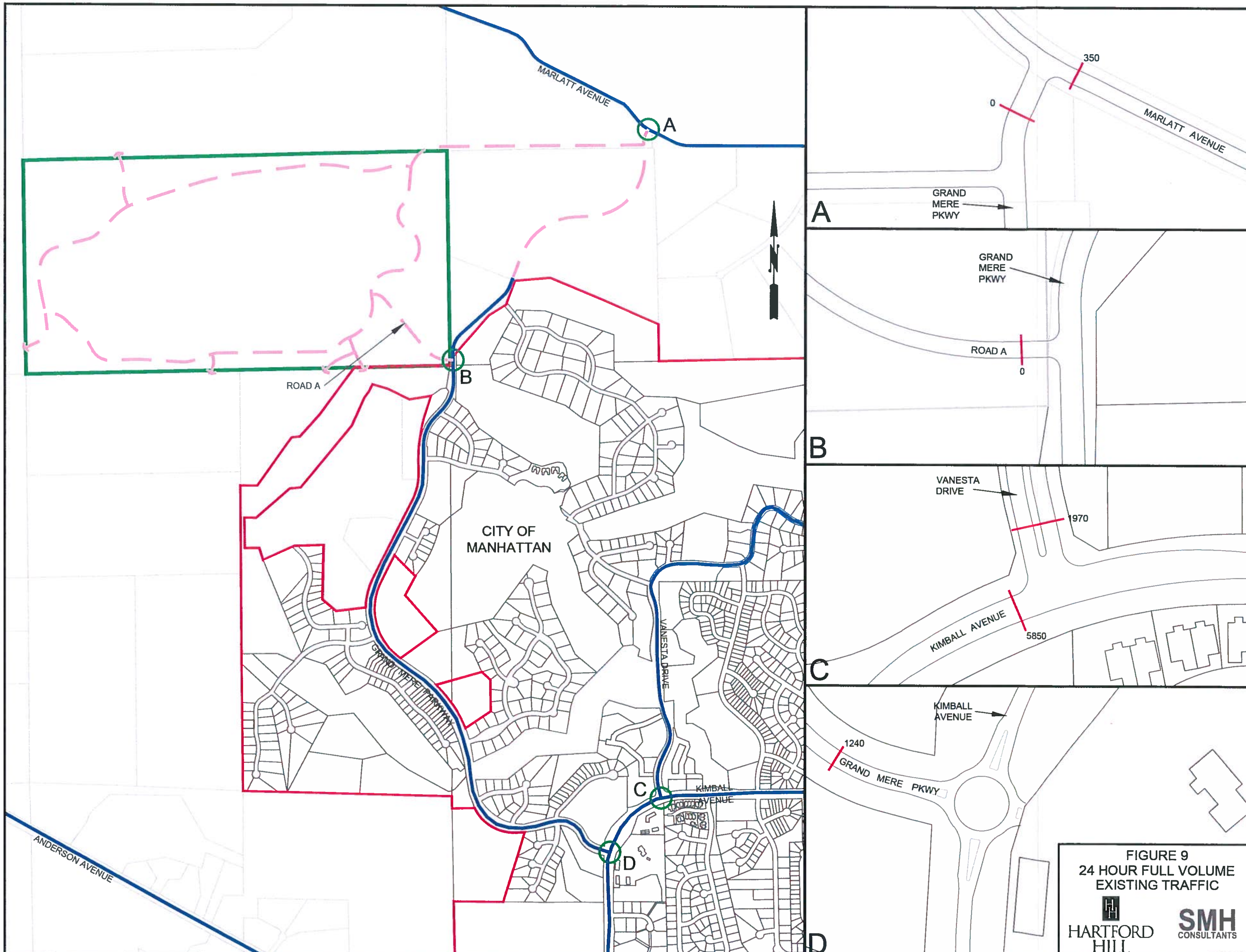


FIGURE 9
24 HOUR FULL VOLUME
EXISTING TRAFFIC

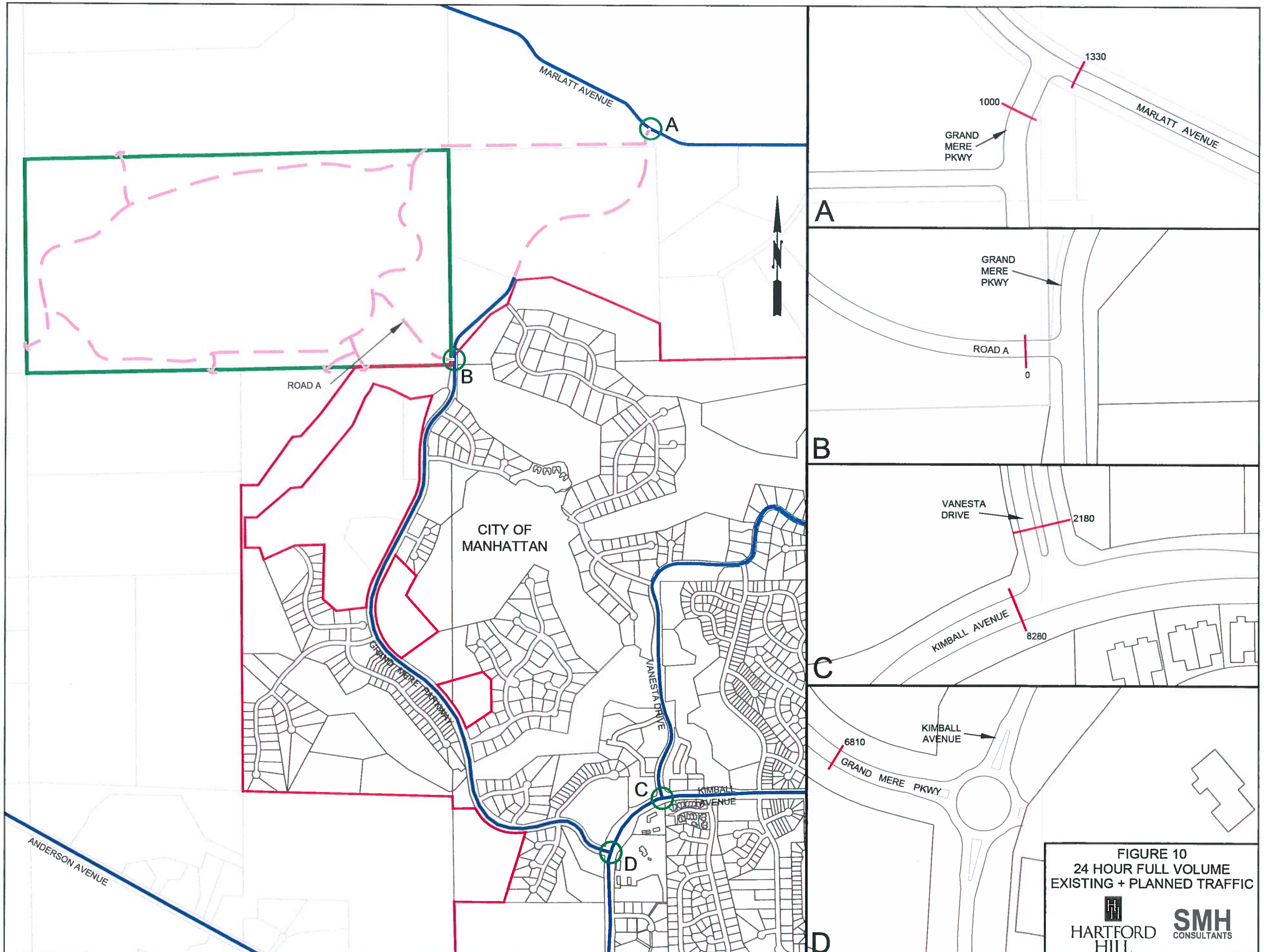


FIGURE 10
24 HOUR FULL VOLUME
EXISTING + PLANNED TRAFFIC

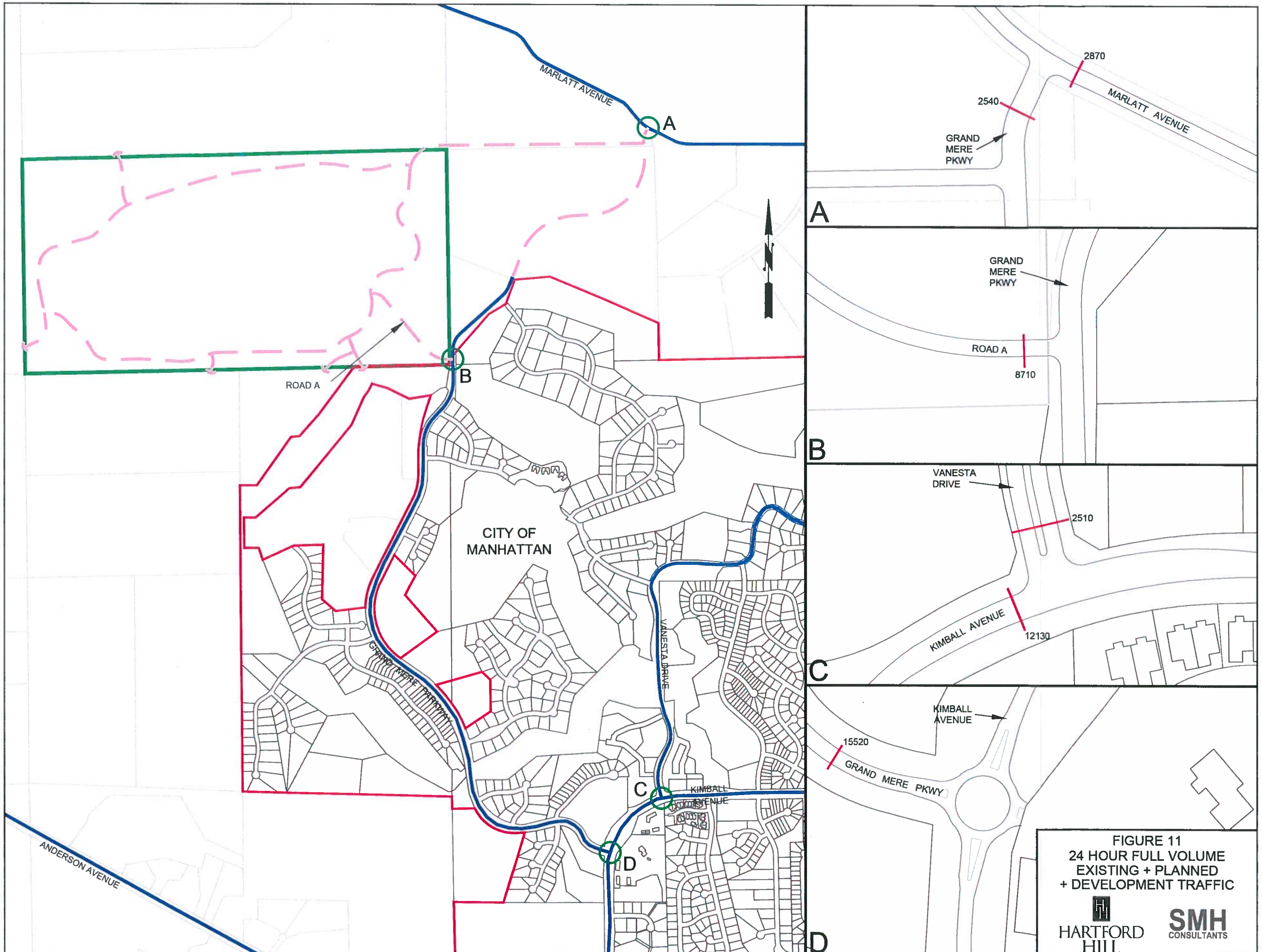


FIGURE 11
24 HOUR FULL VOLUME
EXISTING + PLANNED
+ DEVELOPMENT TRAFFIC

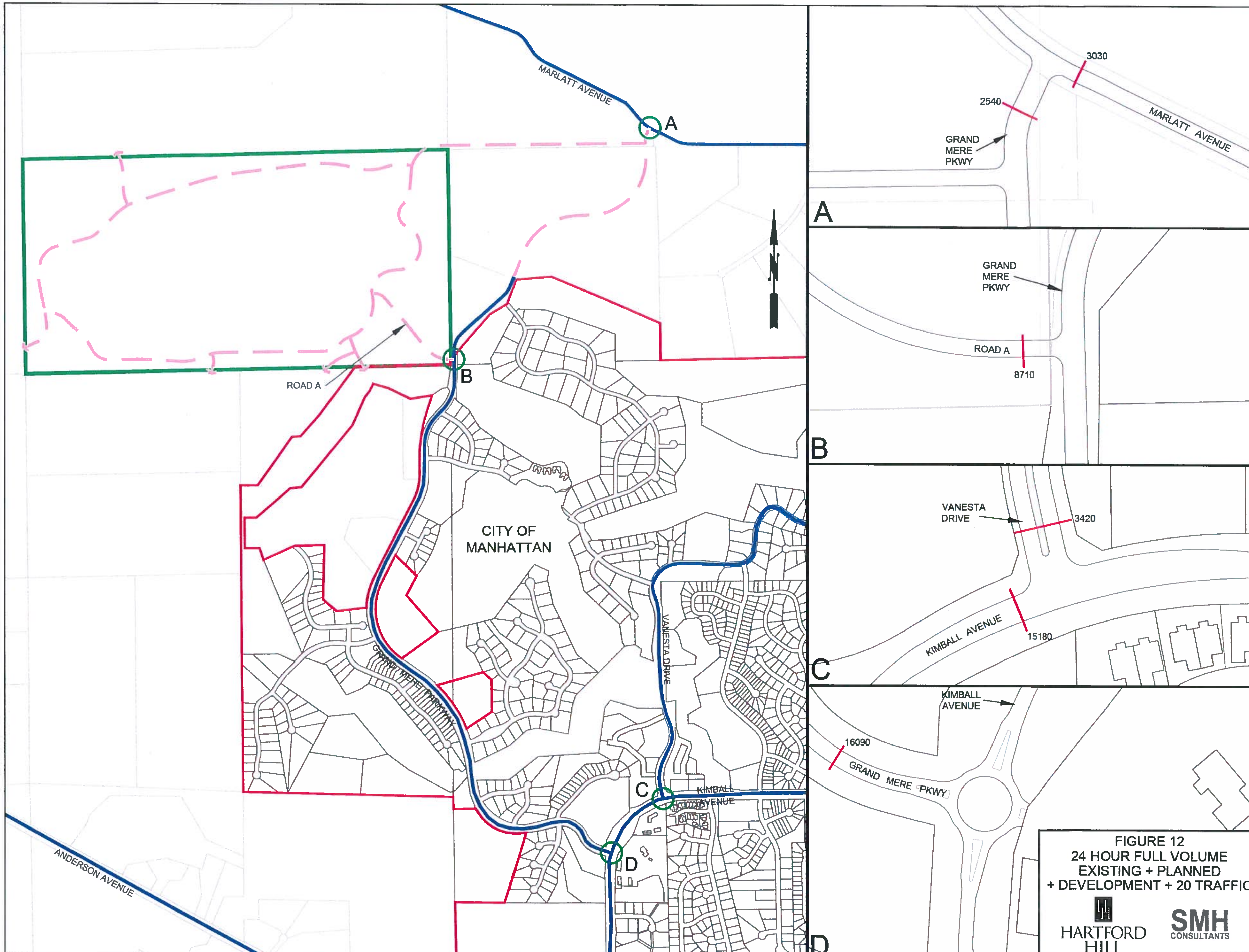


FIGURE 12
24 HOUR FULL VOLUME
EXISTING + PLANNED
+ DEVELOPMENT + 20 TRAFFIC

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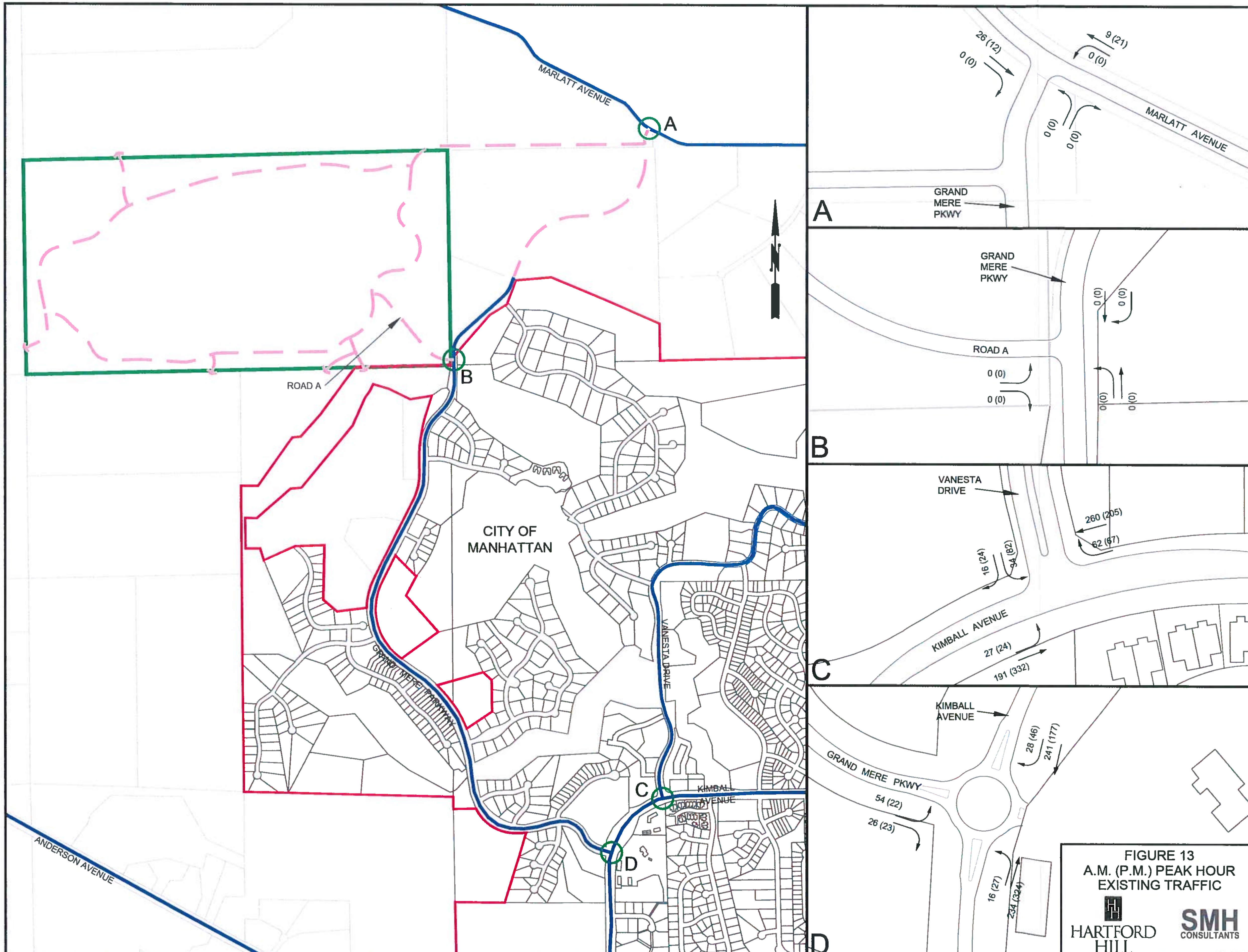

FIGURE 13
A.M. (P.M.) PEAK HOUR
EXISTING TRAFFIC

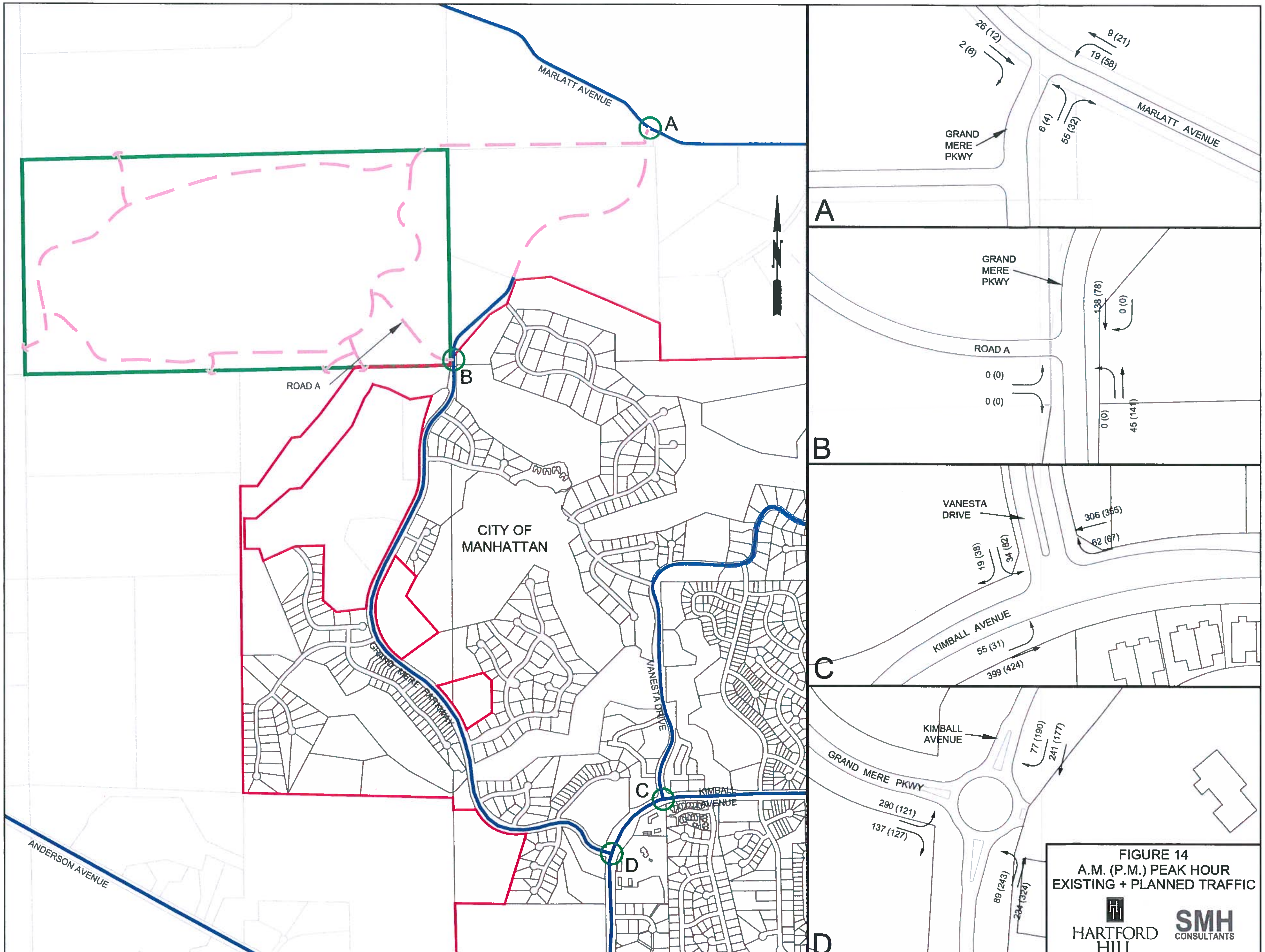

FIGURE 14
A.M. (P.M.) PEAK HOUR
EXISTING + PLANNED TRAFFIC

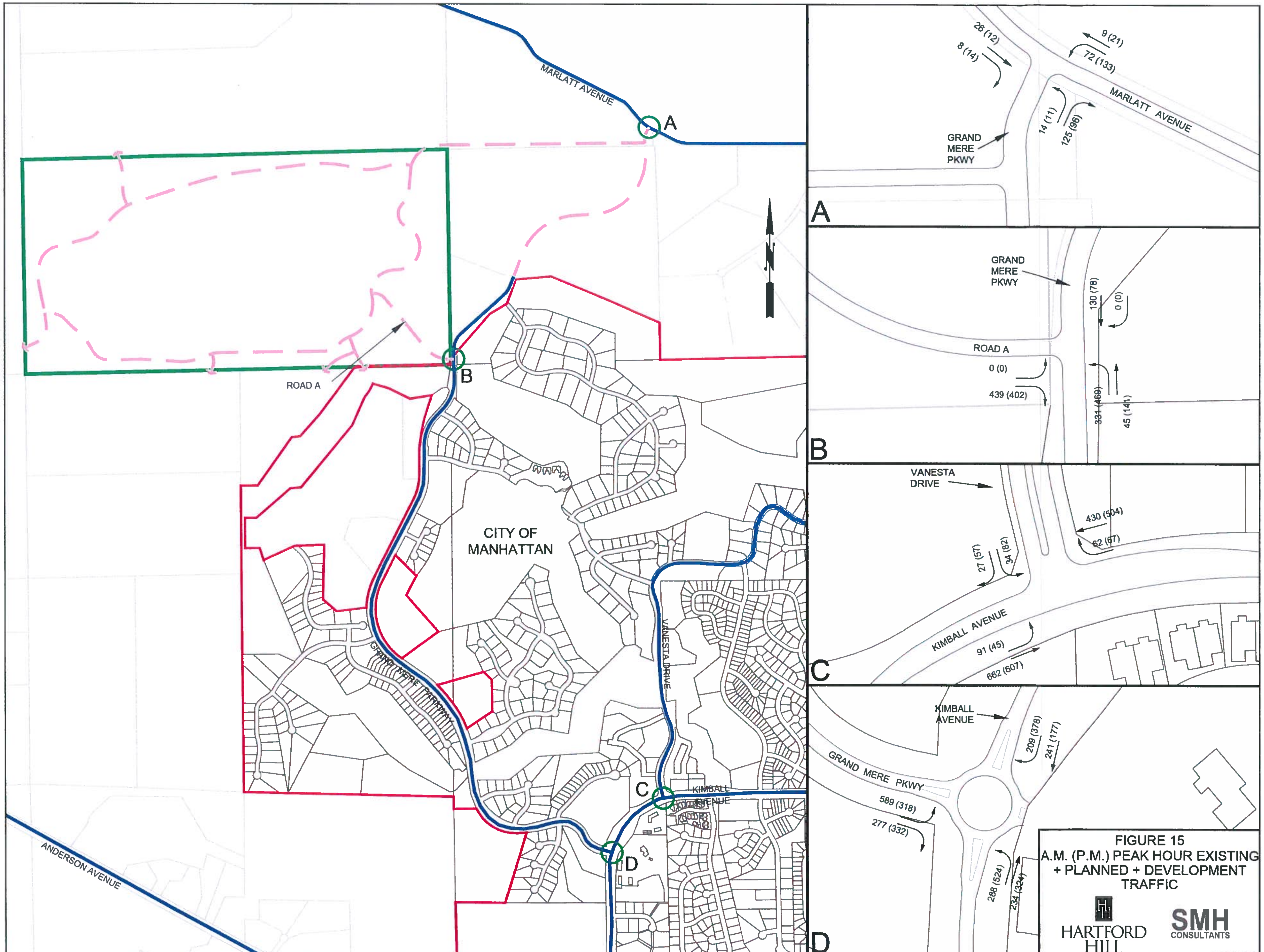

FIGURE 15
A.M. (P.M.) PEAK HOUR EXISTING + PLANNED + DEVELOPMENT TRAFFIC

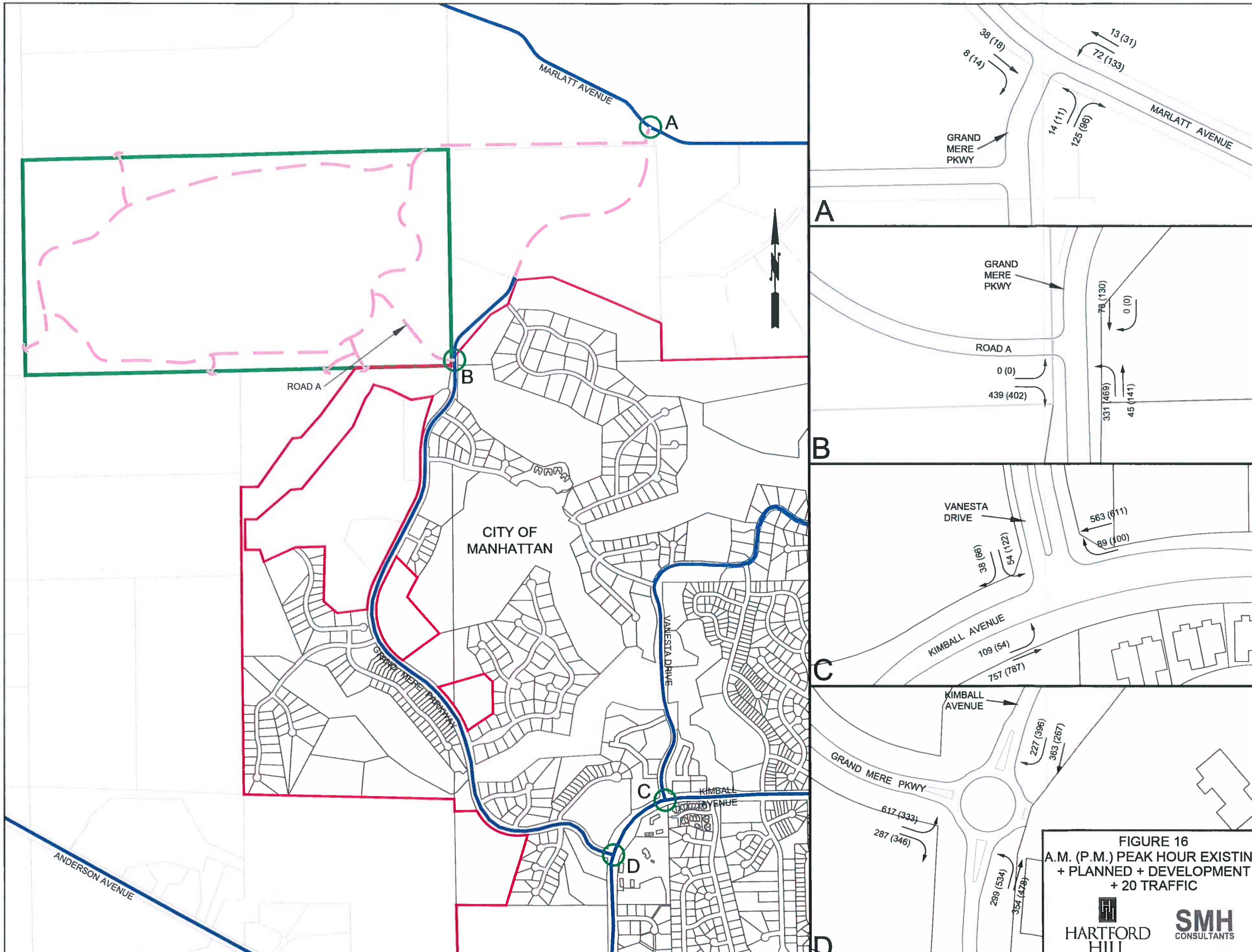

FIGURE 16
A.M. (P.M.) PEAK HOUR EXISTING + PLANNED + DEVELOPMENT + 20 TRAFFIC

Parks and Trails

In the updated 2015 edition of the Manhattan Area Transportation Strategy, the City has developed very strong statements regarding the future of pedestrian and bicycle transportation elements. Hartford Hill will complement those by meeting the Comprehensive Plan Objectives of planning appropriate sidewalks, bike facilities in some form, and connections to other similar City and County facilities adjacent to this development area. In all likelihood, bike and trail facilities will take several forms as part of actual design, and will generally follow the MUACP and MATS policies and standards. As shown above, the bikeway along the roadway that more or less circles the development will be integral with the roadway. There will be opportunities within the "bike park and open space" for both hiking and biking trails that are not paved. They could take the form of the examples demonstrated by the following photos of existing facilities that have proven to be very successful in other places.

Steamboat Springs, CO

Konza Prairie, Riley County

All of the parks and trails are intended to be open to the public, with public access appropriately provided. The site of a neighborhood park is shown on Figure 2. The developer is willing to work with the City and donate park land, but expects the City to own and maintain it.

Much work is needed northeast of Hartford Hill to connect back to the east to Washington Memorial Park, across Seth Child Road, and along Marlatt Avenue eventually to Tuttle Creek Boulevard. The same can be said of the corridor along Kimball Avenue south of Grand Mere Parkway. It is presumed that the City will see to it that those improvements are accomplished.

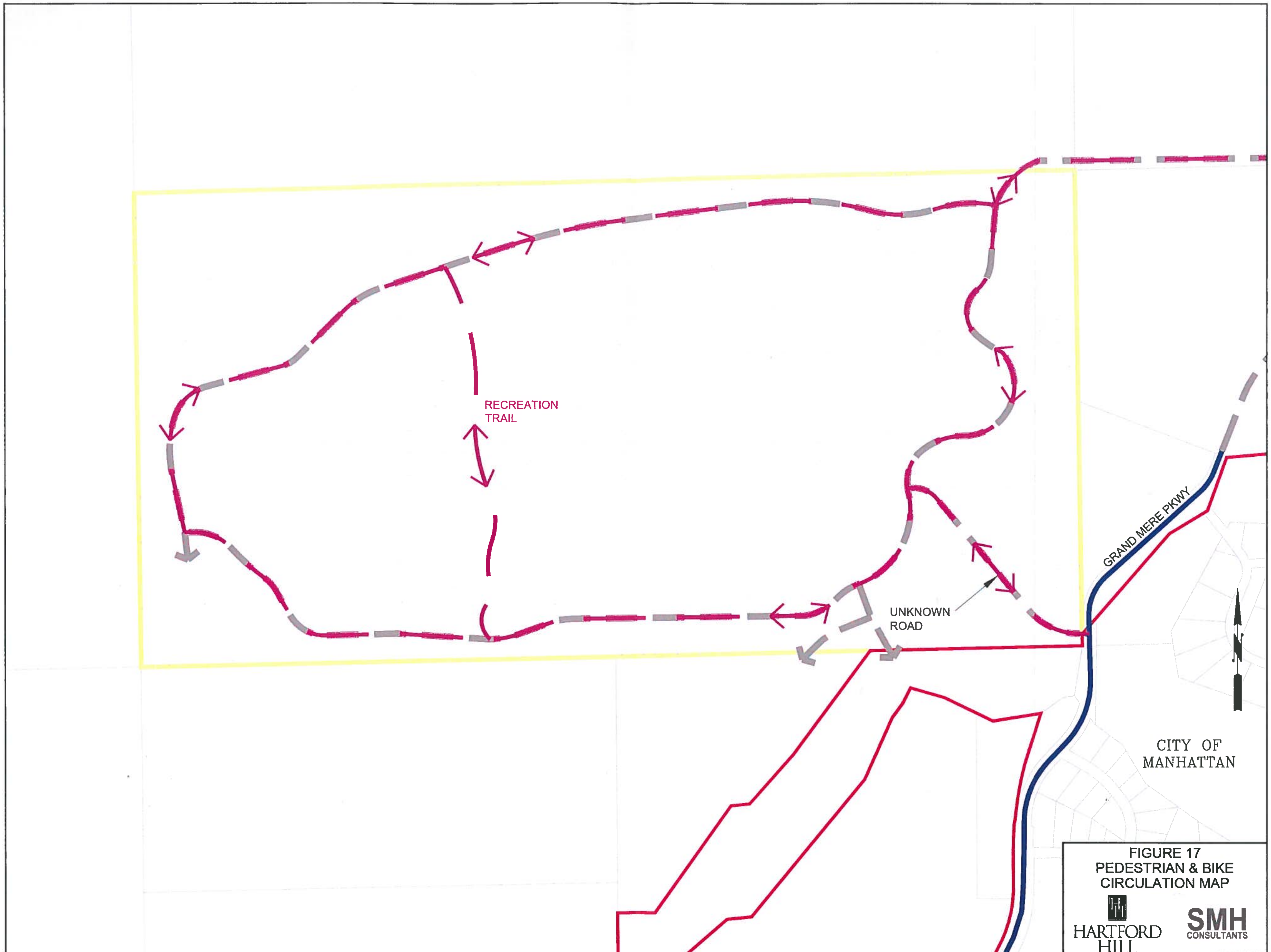

FIGURE 17
PEDESTRIAN & BIKE
CIRCULATION MAP

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Ft. Riley Noise Hazard Zone

Ft. Riley has traditionally published maps showing several noise levels that are to be used for planning purposes while considering development in and around Manhattan. The current map is shown at Figure 18. All of Hartford Hill is impacted by the Ft. Riley map, being within what is called the Critical Area. More specifically Hartford Hill is within the least impacted designation of Land Use Planning Zone (LUPZ). Text from the reports indicates:

> *The noise environment at the installation varies daily and seasonally because operations are not consistent 365 days a year. To provide a planning tool that can be used to account for days of higher than average operations, a Land Use Planning Zone (LUPZ), the zone where the large caliber weapons firing noise averaged over the course of a year is less than 62 dB* (decibels) *but is greater than 57 dB, is included on this noise zone map.*

K.S.A. 12-773 created a memorandum of understanding concerning potential to expose persons to noise greater than 65 decibels. The most recent 2015 LUPZ impact line is understood to be in the range of 57-62 decibels as cited above. Property located within the LUPZ, by definition, is not exposed to noise greater than 65 db.

In other parts of Manhattan affected by the noise map, developers and builders have addressed the issue by including disclosure statements to prospective buyers. The owners of Hartford Hill intend to do that as a matter of routine for any land within the LUPZ. Builders in Hartford Hill should consider incorporating noise attenuation construction techniques to further mitigate indoor noise levels resulting from training activity at Fort Riley.

In addition, the following text will be included on any final plat of land within Hartford Hill:

> *NOTICE OF POTENTIAL IMPACT DUE TO MILITARY TRAINING*
>
> *The Lots within this subdivision are situated in an area that may be subjected to conditions resulting from military training at Fort Riley. Such conditions may include the firing of small and large caliber weapons, the over flight of both fixed-wing and rotary-wing aircraft, the movement of vehicles, the use of generators and other accepted and customary military training activities. These activities ordinarily and necessarily produce noise, dust, smoke and other conditions that may not be compatible with the permitted land uses intended to be located in this subdivision according to established federal guidelines, state guidelines or both.*

The owner of Hartford Hill understands the importance of minimizing the potential for noise complaints and will implement the following tools to address the issue:

> Noise Disclosure. Noise disclosure will be provided to prospective and future buyers, through the note on plats, disclosure statements filed on the deed of each lot that is platted, and by working with builders and realtors to provide noise disclosure through marketing and MLS documents.

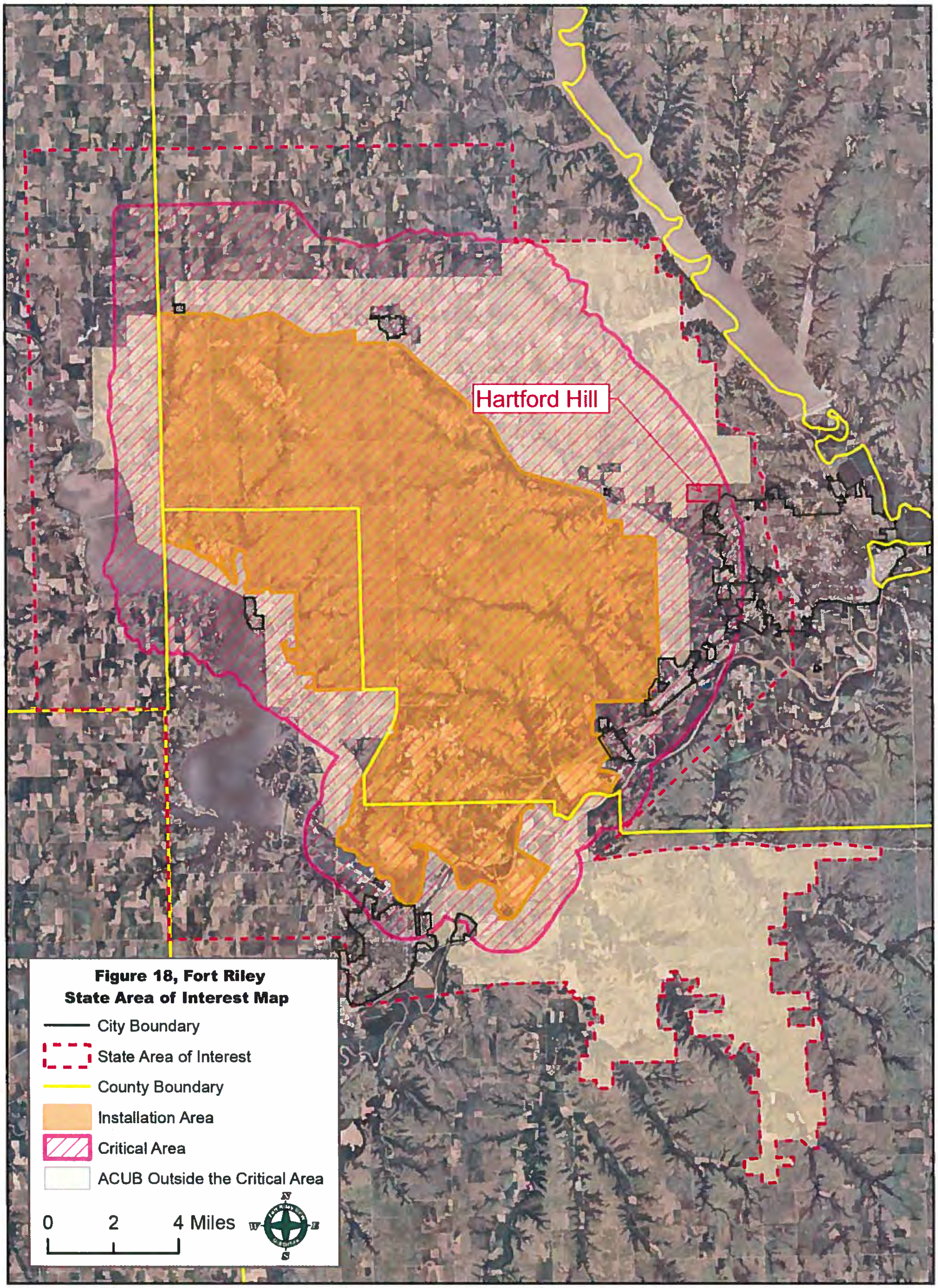
Building Siting and Orientation. In order to reduce interior noise impacts and minimize the potential for noise complaints, the developer will establish best management practices for builders including:

- Lot by lot analysis of the placement and orientation of structures.
- Minimize placement on ridge tops and western facing slopes.
- Orientation of structures so that longer exterior walls are not perpendicular to percussion waves that may be coming from the impact area on the Fort.
- Orientation of structures so that corners face the impact area.
- Incorporation of noise attenuation construction techniques.

School District Boundaries

All of Hartford Hill falls within the Riley School District. School district officials have been advised of this development and its potential impact to its attendance levels from Manhattan. Discussions have taken place between the owners of Hartford Hill and the school district regarding the possibility of identifying a site within Hartford Hill for a new elementary school. A supporting letter is included as Technical Supplement No. 5. For purposes of master planning, a site has been designated as a potential location for a school, even though no firm plans have been identified. As this development process evolves, a better site might be identified, and it must be recognized that flexibility for such modifications is necessary.

If the Riley School District develops a site in Hartford Hill, it should incorporate noise attenuation construction techniques.


Hartford Hill
Figure 18, Fort Riley
State Area of Interest Map
City Boundary
State Area of Interest
County Boundary
Installation Area
Critical Area
ACUB Outside the Critical Area
0
2
4 Miles
N
W
E
S

SITE CONCEPTS

A range of land use designations are proposed throughout the 320 acres of Hartford Hill as shown on Figure 2. Most will be associated in some fashion with "residential" uses of varying densities. However, a small component of other land uses such as "commercial" for professional offices are included. A small parcel is also shown for the inclusion of a "research park". As previously mentioned, the potential for a "school" site is also included, even though under current zoning regulations a school is a permitted use within all residential zones.

Other areas will include open spaces that are just that, open and undisturbed. Or there may also be open spaces that are developed with amenities like hiking and biking trails.

The overall development approach is to begin with Development Area A and proceed westward through Development Area E.

Areas with steep slopes, generally defined as greater than 20%, will be avoided except for the occasional crossing of a buried utility, or roadway, or nature trail.

Areas that contain steep, natural ravines will generally be maintained as riparian open spaces to help with stormwater management and quality of stormwater runoff. Most of these areas will be privately owned.

The proposed vision for development of Hartford Hill is shown in Figure 2. Flexibility is the key to any master plan that involves a 320 acre parcel that will take years to develop. As development evolves over the years, market and other conditions may change and minor adjustments to the proposed land use designations in Figure 2 may become necessary.

Residential land uses are shown on the Development Diagram in shades of yellow consistent with the color codes used in the MUACP. Densities with the yellow shading are consistent with the low to medium (0 to 11 dwelling units per acre) category.

All other potential land uses are also depicted in colors consistent with the MUACP.

If the future market conditions eliminate any of the potential uses shown on the Development Diagram that are not "residential", it is probable the back-up land use will be low to medium density residential.

It should be understood that even though the City's residential density categories include large ranges, it is highly likely the residential areas within Hartford hill will develop at much less dense coverage. The actual number will be very close to the lower end of each of the categories. History has proven that even when efforts are made to create more dense settings within residential plats in hilly terrain, the resulting density ratio is about 1.6 dwelling units per gross acre. Assuming Hartford Hill develops in a similar manner, which is the plan, a likely number of total dwelling units for the entire 320 acres will be between 500 and 600.

There is no desire on the part of the developer to incorporate a commercial, retail component in this master plan. There are two such commercial nodes within Grand Mere just east of Hartford Hill. One is less than ½ mile east, and the other is approximately 1 ½ miles south.

The developer of Hartford Hill plans to establish master homeowner's association that will be governed by private covenants. This association will include a private design review committee that will be involved in the review and approval of individual site/structure designs to be constructed within Hartford Hill.

HARTFORD HILL

Technical Supplements

SMH CONSULTANTS

FIELDHOUSE DEVELOPMENT, INC.

TECHNICAL SUPPLEMENT NO. 1

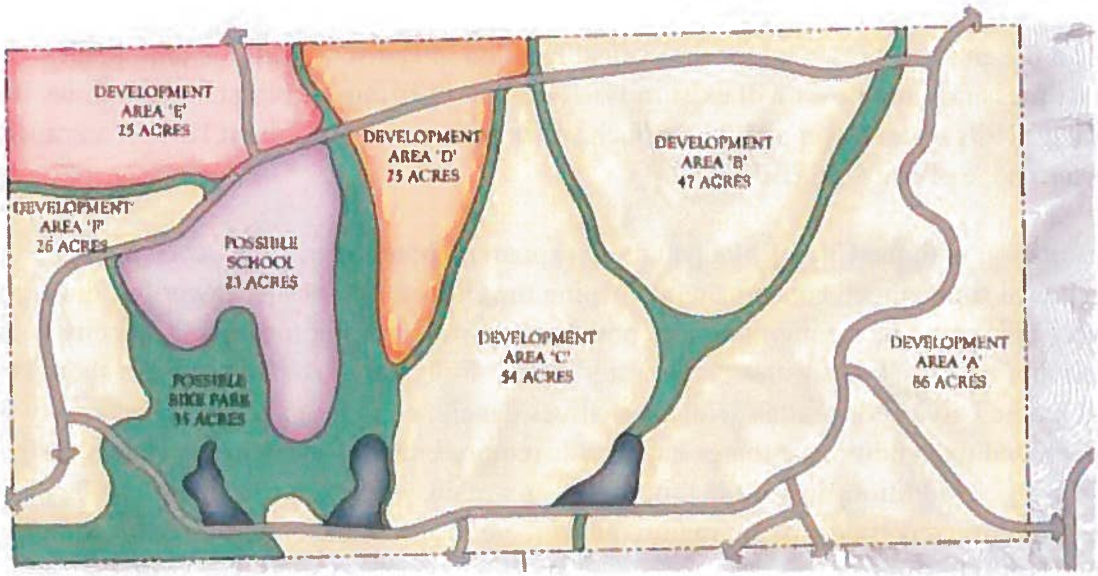
Water Supply Analysis

June 2015

Jeffrey Hancock, P.E., SMH Consultants
Todd Anderson, P.E., SMH Consultants

Water service for Hartford Hill is planned to be provided by the City of Manhattan. The entire development can be served by the Colbert Hills water tower which is less than one-half (1/2) mile north of Hartford Hill's northern boundary. It is anticipated that a water main will loop around the development generally following the "ring road" that essentially circles Hartford Hill. Figure 1 shows the development plan for Hartford Hill including the planned "ring road".

Figure 1 Hartford Hill Development Plan



The estimated daily water demand, utilizing Kansas Department of Health and Environment (KDHE) standards, is 319,200 gallons per day or 222 gallons per minute. Utilizing a peak hour factor of three (3) and then doubling the peak hour flow, the resultant approximate maximum peak water demand from Hartford Hill is 1,330 gallons per minute. These estimates include 750 living units and a school in Hartford Hill.

Reportedly, the water tower is full at elevation 1477. As part of this analysis, flow at Fire Hydrant 6353, as identified in the Riley County Community GIS system and north of Colbert Hills Drive along Grand Mere Parkway, was provided by the City of Manhattan. This fire hydrant is at approximate elevation 1270. Since static pressure was not provide by the City at this particular hydrant, it was assumed and calculated that being approximately 203 feet below the Colbert Hill's water tower (tower 4-feet below full), pressure at the fire hydrant would be approximately 88 psi. The flow reported by the City at this hydrant when tested was 1482 gallons per minute. Friction loss over the 2,300-feet in the 16-inch water from the tower to the tested hydrant was calculated at only 4 psi when the hydrant flow is 1482 gallons per minute.

The high point in the Hartford Hill tract is approximately at elevation 1350. If the water elevation in the tower is 1473 (tower 4-feet below full) the elevation difference between the tower and the highest point in Hartford Hill is 123 feet which equates to a minimum water pressure in Hartford Hill of 53 psi. The highest point in Hartford Hill would require approximately 5,900 feet of water main from the tower. If all of the water main to the high point in Hartford Hill is 16-inch diameter, the friction loss is 3.2 psi when the water demand is 1,330 gallons per minute as discussed above (peak condition) resulting in a dynamic pressure of 50 psi. If in lieu of a 16-inch water main, 12-inch water main is utilized from the 16-inch main to the high point in Hartford Hill, the friction loss is 8.1 psi at 1,330 gallons per minute demand resulting a dynamic pressure of approximately 45 psi. The minimum water pressure for domestic water service required by the KDHE is 20 psi.

Based on the analysis presented for the critical location in Hartford Hill (the high point), adequate pressures and flows will exist in Hartford Hill utilizing the pressures and flows from the Colbert Hills water tower and the 16-inch water main from the Colbert Hills Water tower on the eastern edge of Hartford Hill.

In consultation with the City of Manhattan it is apparent that there may be, even as of the date of this technical supplement, concerns with keeping the Colbert Hills water tower full during peak demand. This could be a combination of both capacity in the water tower and capacity in the transmission main that gets water to the water tower. Full analysis of this concern should be studied by the City of Manhattan with alternatives developed to best address any capacity issues. If it is realized that additional storage capacity is required, land is available in Hartford Hill for such storage. In addition, any of the proposed water mains within Hartford Hill can be increased in size to address any transmission requirements to get water to the new storage location in Hartford Hill if desired.

TECHNICAL SUPPLEMENT NO. 2

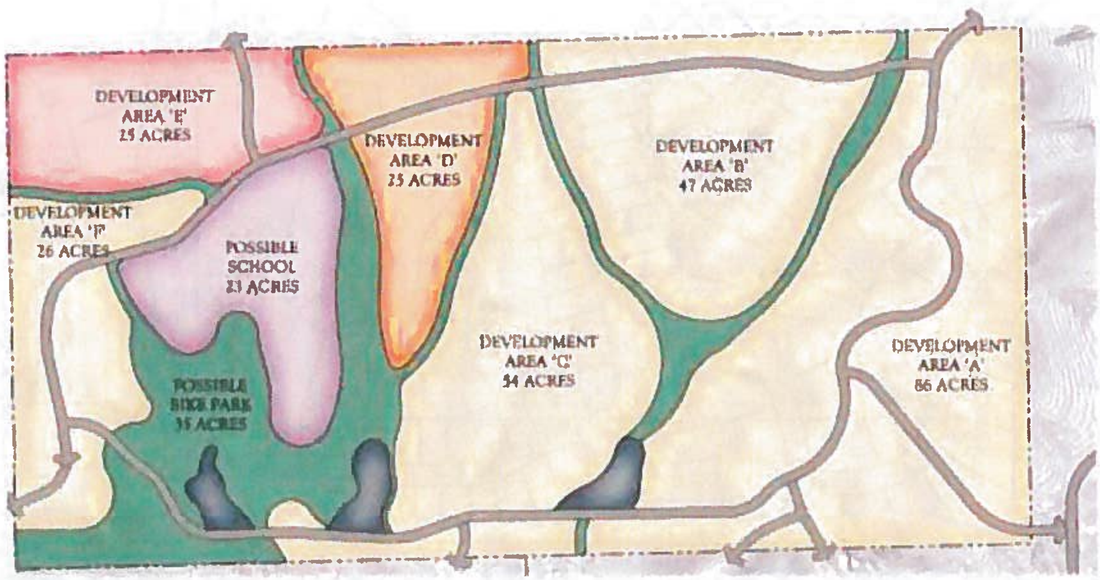
Sanitary Sewer Analysis

August 2015
Jeffrey Hancock, P.E., SMH Consultants
Todd Anderson, P.E., SMH Consultants

SMH CONSULTANTS

Sanitary sewer service for Hartford Hill is planned to be provided by the City of Manhattan. Most of the development will be served by three (3) primary lift stations that will pump waste from the three (3) primary drainage basins of the development back to the east and to the gravity system downstream. The approximately thirty (30) east acres of Hartford Hill defined by the eastern most ridgeline in the development will gravity flow eastward. Figure 1 below is the anticipated development plan for Hartford Hill

Figure 1 Hartford Hill Development Plan



In evaluating the impact of flows from Hartford Hill, three primary locations of concern were considered. All of the flows from Hartford Hill will flow via 8-inch sanitary sewer mains to manhole 3-5832-C as identified on the Riley County Community GIS Website. At this manhole several flows come together from a common basin before they go through an 8-inch sanitary sewer main through Cedar Glen Addition. In addition to the 8-inch through Cedar Glen, Bartlett and West Engineers modeled Hartford Hill's pumped flows from manhole 3-552 south of Cedar Glen to the Wildcat Creek Lift Station to determine if there were any potential issues downstream of this point.

In evaluating the flows to manhole 3-5832-C, existing development and future development were considered from all known and planned development upstream. This included lots already built on, lots platted but not yet built on, and un-platted tracts within the basin. Estimated flows from each of these development areas were utilized to derive estimated total flows at manhole 3-5832-C. Standard flow estimates and peak flows per living unit, as provided by the Kansas Department of Health and Environment (KDHE), were used to develop total flows. Table 1 below provides a summary of estimated dwelling units and flow volumes based on existing and future development within the basin at manhole 3-5832-C.

Figure 1 – Manholes 3-5832-C & 3-552 Locations

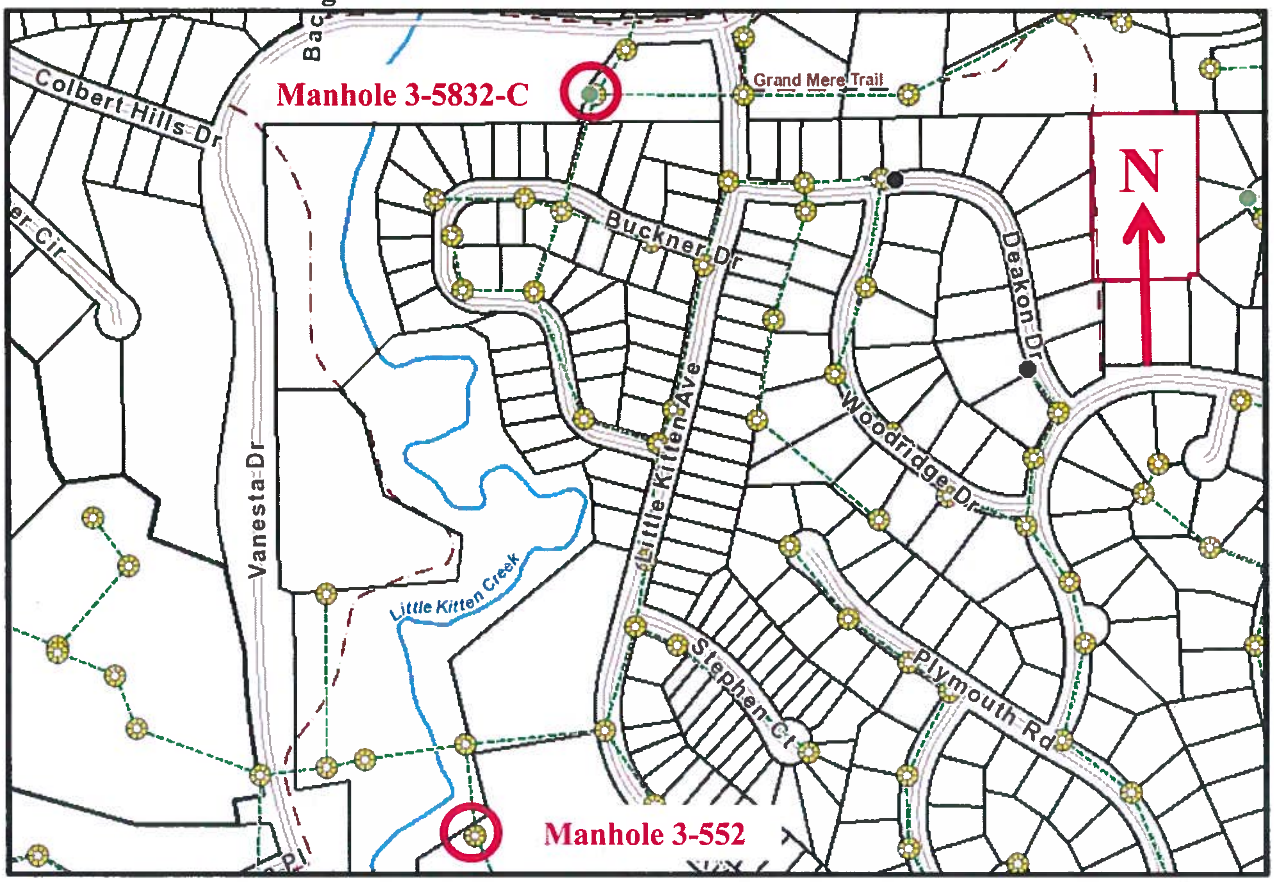


Table 1 Summary of Existing and Future Development Sanitary Sewer Flows @ MH 3-5832-C[1]

Subdivision	Units	Daily Volume (Gallons)	Average Flow (GPM)	Peak Flow (GPM)	70% Peak Flow (GPM)
Hartford Hill Gravity	44	13200	9	28	19
Pinehurst	16	4800	3	10	7
Turnberry	22	6600	5	14	10
Baltusrol	26	7800	5	16	11
Muirfield	24	7200	5	15	11
Olympic	55	16500	11	34	24
Grand Estates	12	3600	3	8	5
Interlachen Units 1 & 2	43	12900	9	27	19
Vanesta Vacant Lots	60	13500	9	28	20
100 AC GM @1.6 per Acre	160	48000	33	100	70
Founders	8	2400	2	5	4
Sub-Totals		**141000**	**98**	**294**	**206**
Hartford Hill Gravity Pumped			150	150	150
Grand Totals (Future and Existing)[3]			**248**	**444**	**356[2]**

Notes:

1. **Rounding to Whole Numbers May Result in Minor Discrepancies of Calculations**
2. **70% Design Total Does Not Include a Reduction of Pumped Flows**
3. **All Flows are Estimated, not Actual**

For design purposes KDHE requires an assumption that for each household three (3) occupants will each waste through the sanitary sewer collection system 100 gallons of water per day. Actual usage is actually closer to 70 gallons per day per occupant. Therefore, 70% design totals have also been provided in Table 1 to compare historical flows versus design flows.

South of manhole 3-5832-C, the 8-inch sanitary sewer main through Cedar Glen is constructed at the minimum grade of 0.40%. Flowing at two-thirds (2/3) full this main has a capacity of 271 gallons per minute. Flowing full the same main has a capacity of 343 gallons per minute.

Based on peak flows and development of the entire basin, the 8-inch sanitary sewer through Cedar Glen could potentially reach its capacity at some point in the future if flows from Hartford Hill are not regulated. However, as subsequently discussed later in this technical supplement, there is a means to address this issue (as it relates to Hartford Hill) through pumping from Hartford Hill during off peak flow time frames at metered rates if required.

Bartlett and West is currently under contract with the City of Manhattan to model sanitary sewer flows in the existing basin of the Wildcat Creek Lift Station. As part of that modeling effort, at the request of SMH, Bartlett and West has estimated design flows from Hartford Hill's anticipated pump stations. In turn they modeled flows at manhole 3-552 just south of Cedar Glen to the Wildcat Creek Lift Station. The sanitary sewer main is a 10-inch main downstream of manhole 3-552. Table 2 below summarizes all future and existing flows to manhole 3-552. Some of these flows are actual flows based on measurement and others are estimate flows based on KDHE criteria.

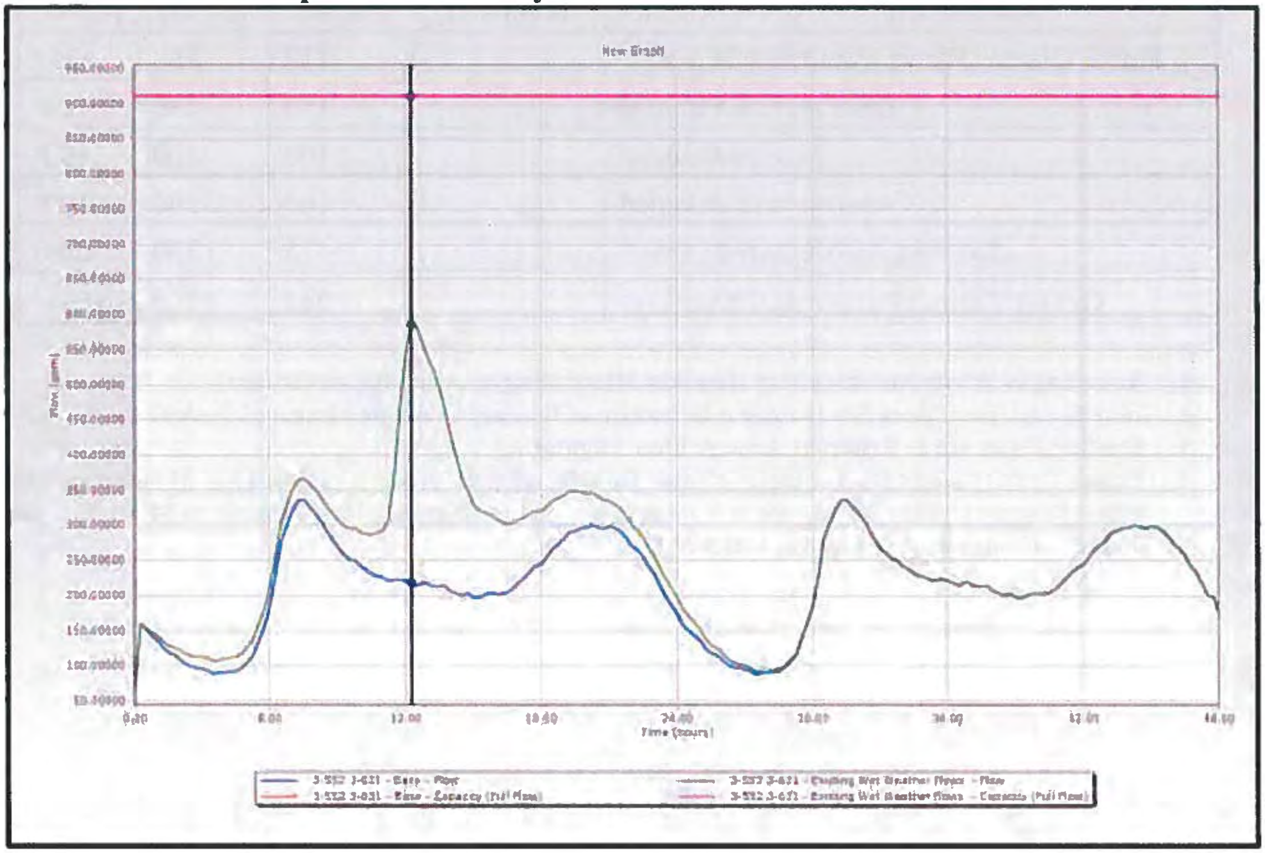
Table 2 Summary of Existing and Future Development Sanitary Sewer Flows @ MH 3-552[1]

Subdivision	Units	Daily Volume (Gallons)	Average Flow (GPM)	Peak Flow (GPM)	70% Peak Flow (GPM)
Grand Luxe	18	5400	4	11	8
Enclave 1	11	3300	2	7	5
Enclave 2	12	3600	3	8	5
Grand Champions	44	13200	9	28	19
Grand Mere Townhome #3[4]	26	7800	5	16	11
Grand Mere Villa #3[4]	15	4500	3	9	7
Sub-Totals			**26**	**79**	**55**
Future Gravity Flows to US MH 3-5832-C[5]			93	279	196
Hartford Hill Pumped			150	150	150[2]
Merion Pumped			100	100	100[2]
Congressional Pumped			100	100	100[2]
Existing As-Measured Flows[3]			175	430	430
Grand Totals (Future and Existing)			**644**	**1138**	**1031[2]**

1. **Rounding to Whole Numbers May Result in Minor Discrepancies of Calculations**
2. **70% Design Total Does Not Include a Reduction of Pumped Flows or Measured Peak Flows**
3. **Existing Flows are as Reported through Flow Monitoring**
4. **Estimated at 1.6 Dwelling Units per Acre based on Grand Mere Historical Density**
5. **Future Gravity Flows do Not Include Flows from Developed Land at the time Flow Monitoring Took Place (Founders Village & 15 Lots in Vanesta)**

The graph below shows base flows and wet weather flows at manhole 3-552 (including 150 gallons per minute from Hartford Hill's anticipated pump stations). The main in this location has a full flow capacity of a little over 900 gallons per minute. The anticipated average daily and 70% peak design flow from all future flows in the basin to manhole 3-552 are 644 and 1031 gallons per minute. This includes all future gravity and pumped flows, which are a combination of estimates and existing flows. Again, if required there is a means to address this over capacity issue (as it relates to Hartford Hill) through pumping from Hartford Hill during off peak flow time frames at metered rates if required.

Graph 1 – Flow Analysis Downstream of Manhole 3-552



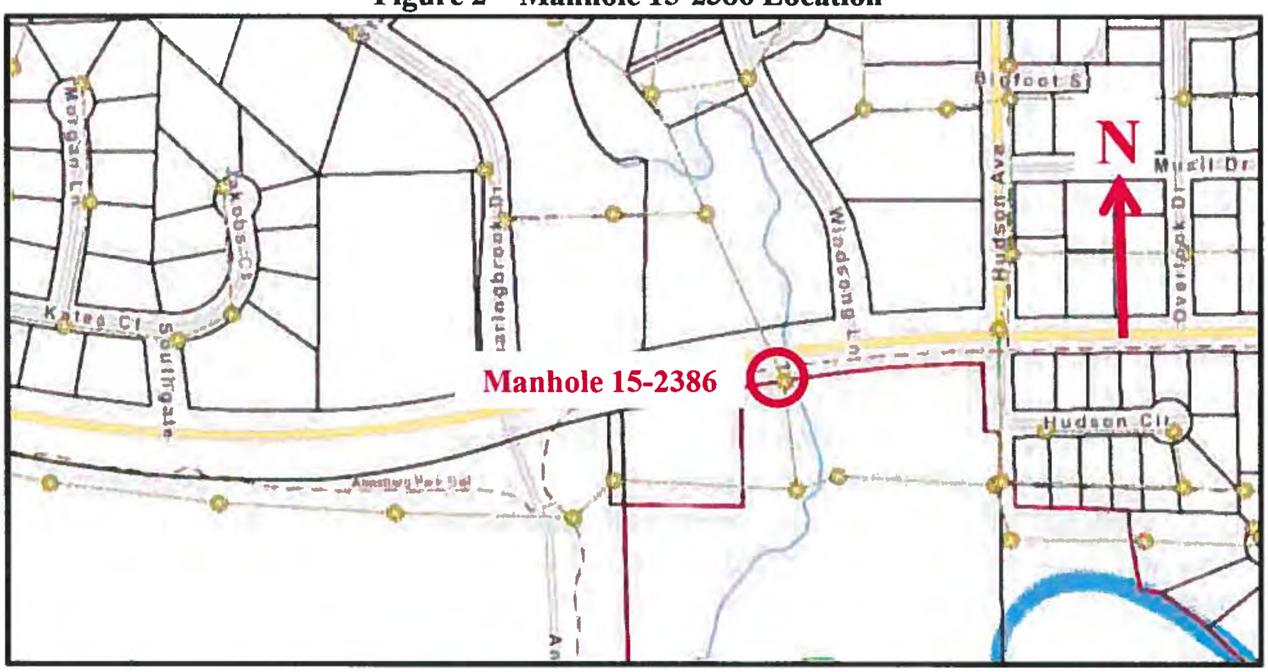
In addition to the 10-inch sanitary sewer main directly south of Cedar Glen, Bartlett and West also modeled flows at manhole 15-2386. At this manhole, flows converge into a 24-inch sanitary sewer main. Manhole 15-2386 is on the south side of Anderson Avenue near its intersection with Windsong Lane. Table 3 summarizes the existing and estimated future flows to this manhole. Graph 2 shows flows, including an estimated 150 gallons per minute from Hartford Hill's anticipated pump stations, at manhole 15-2386. Based on existing base and wet weather flows at this manhole (including an estimated 150 gallons per minute from Hartford Hill's anticipated pump stations) capacity in the downstream main to accept these flows is available. The main downstream of manhole 15-2386 has an estimated capacity as reported by Bartlett and West of 2,250 gallons per minute flowing full. Again, if required there is a means to address capacity issues (as it relates to Hartford Hill) through pumping from Hartford Hill during off peak flow time frames at metered rates if required.

Table 3 Summary of Existing and Future Development Sanitary Sewer Flows @ MH 15-2386[1]

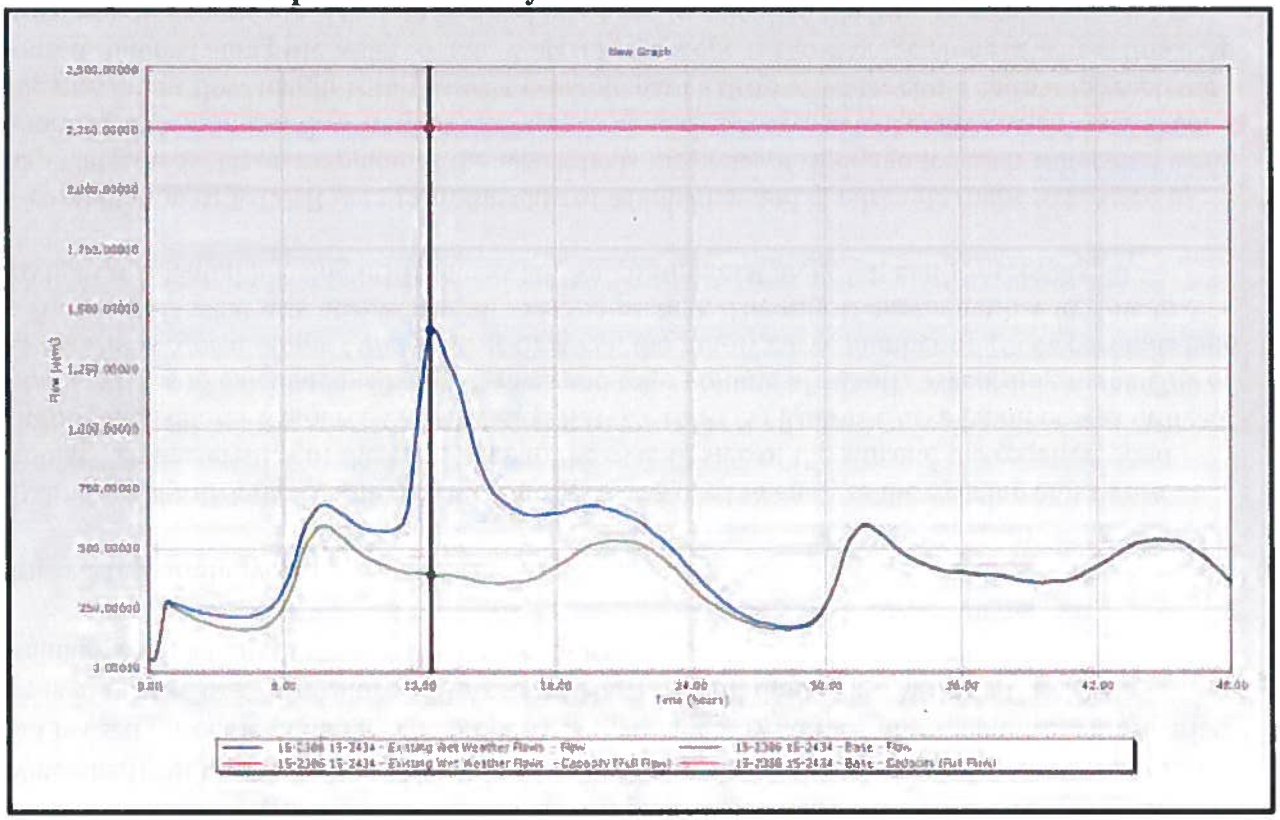
Subdivision	Units	Daily Volume (Gallons)	Average Flow (GPM)	Peak Flow (GPM)	70% Peak Flow (GPM)
Future Gravity Flows from US MH 3-552[4]			119	358	251
Hartford Hill Pumped			150	150	150[2]
Merion Pumped			100	100	100[2]
Congressional Pumped			100	100	100[2]
Existing As-Measured Flows[3]			475	1250	1250
Grand Totals (Future and Existing)			**944**	**1958**	**1851[2]**

1. **Rounding to Whole Numbers May Result in Minor Discrepancies of Calculations**
2. **70% Design Total Does Not Include a Reduction of Pumped Flows or Measured Peak Flows**
3. **Existing Flows are as Reported through Flow Monitoring**
4. **Future Gravity Flows Do Not Include Flows from Developed Land at the time Flow Monitoring Took Place (Founders Village & 15 Lots in Vanesta), nor do they Include Flows Pumped to MH 3-552, nor do they include measure flows at MH 3-552**

Figure 2 – Manhole 15-2386 Location



Graph 2 – Flow Analysis Downstream of Manhole 3-2386



With the relatively low densities which Hartford Hill and other properties in the basin are expected to develop at, and given the option to meter and discharge from Hartford Hill at off peak times, the gravity system in place downstream is anticipated to accommodate this new development.

In the event flows reach a point downstream that tax the system, technology of today is available to allow off-peak pumping of wastewater. A simple communication system can be implemented. A permanently mounted flow measuring device, or if necessary devices, can be installed in a strategically located manhole that acts as the control location in the sewer system. This device would be equipped with a transmitter that, when the flow in the sewer is at a level in which wastewater can be passed safely, a signal is given to the pump stations within Hartford Hill to release their flow. The pump stations will have to include slightly larger than normal wet wells in order to temporarily store the wastewater. This means the unused capacity of the existing sewer system would be used in an efficient and safe manner during off-peak periods.

TECHNICAL SUPPLEMENT NO. 3

Storm Water Management & Post Construction BMPs

July 2015

Jeffrey Hancock, P.E., SMH Consultants
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Introduction

Existing Conditions

The following drainage analysis was conducted to determine the storm water impacts of the Hartford Hill and the proposed plan for mitigating those impacts. The analysis was completed in accordance with the most recent storm water management requirements as provided by the City of Manhattan.

Hartford Hill is located on 320 acres north and west of Grand Mere. The site rests upon a ridge and consists of 8 partial watersheds shown in Figure 8 (attached). Watershed 1 (Bike Gulch Watershed), watershed 2 (Single Track Watershed), and watershed 3 (Home Watershed) will drain to respective proposed detention ponds. Watershed 4 (Kickoff Watershed), watershed 5 (New England Watershed), watershed 6 (Washington Watershed), watershed 7 (California Watershed), and watershed 8 (Baja Watershed) drain offsite. The land is currently County AG and is used for cattle grazing. The property is dominated by native tallgrass prairie with riparian areas in the ravines. The entire 320 Acres of Hartford Hill drains into Wildcat Creek, via drainage connections at three different locations.

Study Methodology

Hydraflow Hyrdrographs software by Autodesk was used to analyze the existing and future drainage characteristics of the area. Due to the overall size of the site and the required pond routing, the Natural Resource Conservation Service (NRCS) Runoff Curve Number was utilized in all analyses to calculate peak runoff rates and total volume of runoff. According to the *City of Manhattan's Storm Water Management Criteria*, the runoff curve number of 100% pervious land is 70, which is what was utilized for all existing pasture. The runoff curve number for low to medium residential housing utilized was 80; for commercial areas 94; and for schools 90.

A combination of LiDAR data from the City of Manhattan and quadrangle maps were used to map watersheds. Upon mapping of the watersheds the areas of drainage for each watershed were determined. Maximum flow lengths and watercourse slope were calculated for each watershed. The maximum flow length is the longest possible path a drop of water could follow to reach the point of interest along the watercourse. Watercourse slope is the average slope in which this drop of water will experience. The Lag Method was used to calculate the time of concentration for each watershed.

For comparing the impacts to Wildcat Creek the Primary Point of Confluence (PPC) of all three drainages from Hartford Hill along Wildcat Creek for each of the watersheds was considered. In addition, Points of Intermediate Confluence (PIC) were also analyzed for watershed specific characteristics before and after development as they pertain to Hartford Hill. These confluence points are noted in Figure 1 below. The 2, 10 and 100 year storm events were utilized as the basis for determining flow rates for: existing, existing with no ponds, and existing with ponds.

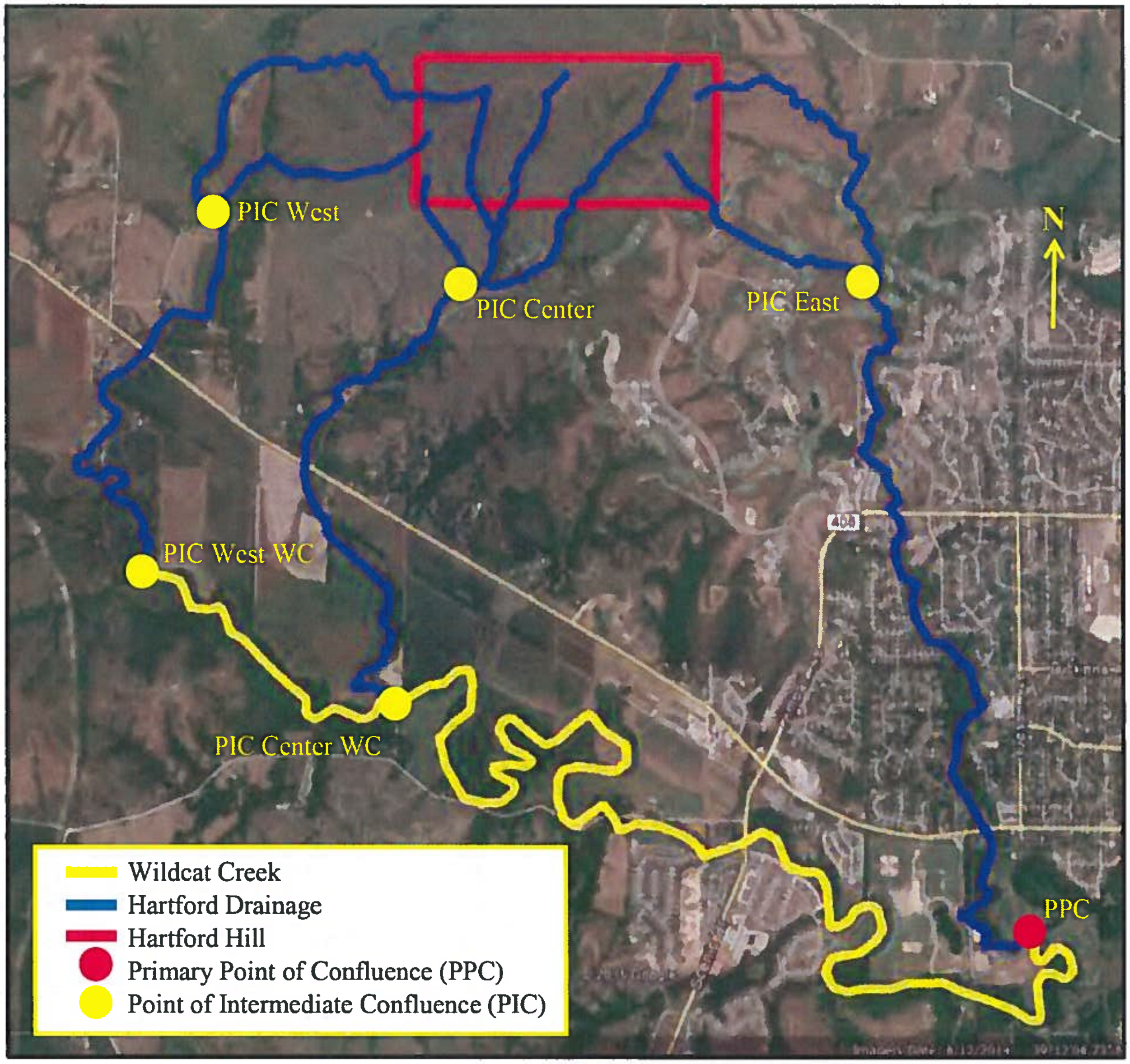


Figure 1 Points of Confluence from Hartford Hill

Analysis

Tables 1 and 2 below provide the watershed characteristics for the existing and developed conditions at Hartford Hill for each of the watersheds respectively.

Table 1 Existing Watershed Characteristics						
Watershed #	**Watershed Name**	**Area (ac)**	**Longest Flow Path (ft)**	**Hydraulic Slope (%)**	**Runoff Curve Number**	**Time of Concentration (minutes)**
Watershed 1	Bike Gulch	48.6	2,165	5.08	70	34.97
Watershed 2	Single Track	54.2	2,851	4.14	70	48.28
Watershed 3	Home	124.4	3,379	3.26	70	62.33
Watershed 4	Kickoff	30.7	1,338	5.98	70	21.90
Watershed 5	New England	9.6	485	9.69	70	7.65
Watershed 6	Washington	48.7	1,320	6.97	70	20.10
Watershed 7	California	4.8	389	1.80	70	14.80
Watershed 8	Baja	4.4	516	11.43	70	7.40

Table 2 Developed Watershed Characteristics						
Watershed #	**Watershed Name**	**Area (ac)**	**Longest Flow Path (ft)**	**Hydraulic Slope (%)**	**Runoff Curve Number**	**Time of Concentration (minutes)**
Watershed 1	Bike Gulch	48.6	2,165	5.08	75	30.43
Watershed 2	Single Track	54.2	2,851	4.14	79	37.32
Watershed 3	Home	124.4	3,379	3.26	80	46.71
Watershed 4	Kickoff	30.7	1,338	5.98	80	16.40
Watershed 5	New England	9.6	485	9.69	80	5.70
Watershed 6	Washington	48.7	1,320	6.97	89	11.00
Watershed 7	California	4.8	389	1.80	80	11.10
Watershed 8	Baja	4.4	516	11.43	80	5.50

Tables 3, 4 and 5 below provide the comparable flow rates for the 2, 10, and 100-year events respectively at Hartford Hill. In addition to watershed specific flow rates, the flow rates at Points of Intermediate Confluence and the Primary Point of Confluence have also been provided.

Table 3 Flow Rate Comparison – 2 Year				
Watershed # Or Point of Confluence	**Watershed Name or Point of Confluence**	**Existing (cfs)**	**Developed w/o Detention (cfs)**	**Developed w/ Detention (cfs)**
Watershed 1	Bike Gulch	14.89	26.08	1.65
Watershed 2	Single Track	13.26	34.68	1.69
Watershed 3	Home	25.54	76.24	1.88
Watershed 4	Kickoff	13.05	36.12	36.12
Watershed 5	New England	6.86	15.65	15.65
Watershed 6	Washington	23.00	108.18	108.18
Watershed 7	California	2.54	6.53	6.53
Watershed 8	Baja	3.14	7.17	7.17
PIC West	PIC West	7.69	42.75	42.75
PIC Center	PIC Center	41.83	115.91	7.52
PIC East	PIC East	8.86	24.90	24.90
PIC West WC	PIC West WC	3.43	18.04	18.04
PIC Center WC	PIC Center WC	22.86	64.62	14.06
PPC	PPC	4.35	11.34	5.86

Table 4 Flow Rate Comparison – 10 Year				
Watershed # Or Point of Confluence	**Watershed Name or Point of Confluence**	**Existing (cfs)**	**Developed w/o Detention (cfs)**	**Developed w/ Detention (cfs)**
Watershed 1	Bike Gulch	79.17	103.83	11.53
Watershed 2	Single Track	71.14	117.08	10.69
Watershed 3	Home	137.44	248.77	13.57
Watershed 4	Kickoff	67.85	115.36	115.36
Watershed 5	New England	32.13	47.82	47.82
Watershed 6	Washington	117.02	262.43	262.43
Watershed 7	California	12.61	20.62	20.62
Watershed 8	Baja	14.73	21.92	21.92
PIC West	PIC West	56.10	127.39	127.39
PIC Center	PIC Center	237.16	419.16	35.94
PIC East	PIC East	57.31	93.84	93.84
PIC West WC	PIC West WC	24.74	57.21	57.21
PIC Center WC	PIC Center WC	152.82	270.06	61.99
PPC	PPC	30.82	53.12	28.44

Table 5 Flow Rate Comparison – 100 Year				
Watershed # Or Point of Confluence	**Watershed Name or Point of Confluence**	**Existing (cfs)**	**Developed w/o Detention (cfs)**	**Developed w/ Detention (cfs)**
Watershed 1	Bike Gulch	151.66	186.21	16.79
Watershed 2	Single Track	136.90	200.59	16.24
Watershed 3	Home	265.39	421.78	17.34
Watershed 4	Kickoff	129.66	193.48	193.48
Watershed 5	New England	60.17	79.56	79.56
Watershed 6	Washington	223.38	403.48	403.48
Watershed 7	California	23.96	34.54	34.54
Watershed 8	Baja	27.58	36.46	36.46
PIC West	PIC West	119.51	212.04	212.04
PIC Center	PIC Center	465.86	732.94	51.09
PIC East	PIC East	117.94	167.32	167.32
PIC West WC	PIC West WC	55.63	98.59	98.59
PIC Center WC	PIC Center WC	325.67	501.91	99.73
PPC	PPC	73.56	109.76	51.12

Discussion

There are several ways to consider the impacts of Hartford Hill on downstream drainage dependent on the primary area of concern. The most comprehensive assessment, the one that takes into account all of Hartford Hill, is to consider what is happening at the PPC. For all but the 2-year event the impact is substantial and positive with the 100-year event resulting in a 22-cfs decrease in the peak flow at the PPC between the existing watershed and the fully developed watershed. The 2-year event results in a slight increase of 1.51-cfs, however his does not consider Watersheds 4 and 5 being routed through the existing Vanesta Lake facility at Grand Mere that provides additional detention before discharge into Wildcat Creek.

Another important perspective in considering the impact of Hartford Hill is to evaluate the impact at the PICs. These are where the various drainages from Hartford Hill combine. Detention is proposed to be provided for only Watersheds 1, 2, and 3; but as these watersheds are combined with watershed 8 at a common PIC the impact is huge. As these flows are carried down, the impact at PIC Center WC results in a decrease of 225-cfs for the 100-year event between the existing watershed and the fully developed watershed. PIC Center WC is where watersheds 1, 2, 3, 6, 7 and 8 join at Wildcat Creek. As a result, a reduction in flows is realized on Wildcat Creek, under the Scenic Drive bridge and to the PPC east of Anneberg Park.

Watershed 6, on its own shows a large increase in flow rate from the undeveloped to the developed condition. This increase in flow rate will need to be throttled to address any downstream erosion issues if it develops as modeled. There are opportunities for storm water detention in Watershed 6 that would be fairly simple to accomplish, but they have purposely been initially not proposed in the master plan. Watershed 6 is proposed for a research/office park to be marketed to KSU and could ultimately be something related to agriculture given it abuts KSU agricultural land on two sides. If it stays predominantly agricultural there may be little need to do anything to address downstream erosion concerns. Regardless, it is proposed that when Watershed 6 develops and how it develops will drive the need for detention or other means for slowing storm water down coming from the watershed.

Detention

To realize the positive impacts noted that Hartford Hill has on Wildcat Creek, detention facilities are required. The facilities proposed are to be a result of the grading required for crossing the large ravines with streets where the detention facilities will be located. Embankment for roadway fills will provide the necessary dams. Outlet structures will be final designed as part of the roadway design process to yield the reduction in outflows noted. Table 6 below summarizes the required hydraulic volume that each structure will be required to detain for a 100-year event.

Table 6 100 Year Required Hydraulic Storage Volume		
Watershed #	**Detention Structure**	**Required Hydraulic Storage Volume (Acre-Feet)**
Watershed 1	Bike Gulch Pond	10.41
Watershed 2	Single Track Pond	13.55
Watershed 3	Home Pond	37.25

Post Construction Best Management Practices (BMPs)

Hartford hill is dominated by soils of hydrologic soils group D. Based on an estimate of the impervious to pervious ratio, Post Construction BMPs will be required at Hartford Hill as stipulated in the City of Manhattan's most recently adopted Post Construction Storm Water BMP Manual. This analysis is presented below.

1. Total Approximate Acres = 320
2. Soil Group D
3. Impervious
    a. Assumed Approximate Structures and Associated Paving = 73 Acres (800 Structures with an estimated 4,000 SF of impermeable area each)(Assumed 2.5 Dwelling Units Per Acre as Estimated in Master Plan)
    b. Assumed Approximate Streets and Sidewalks = 10 Acres
4. Pervious
    a. Native Areas, Yard, Etc. = 237

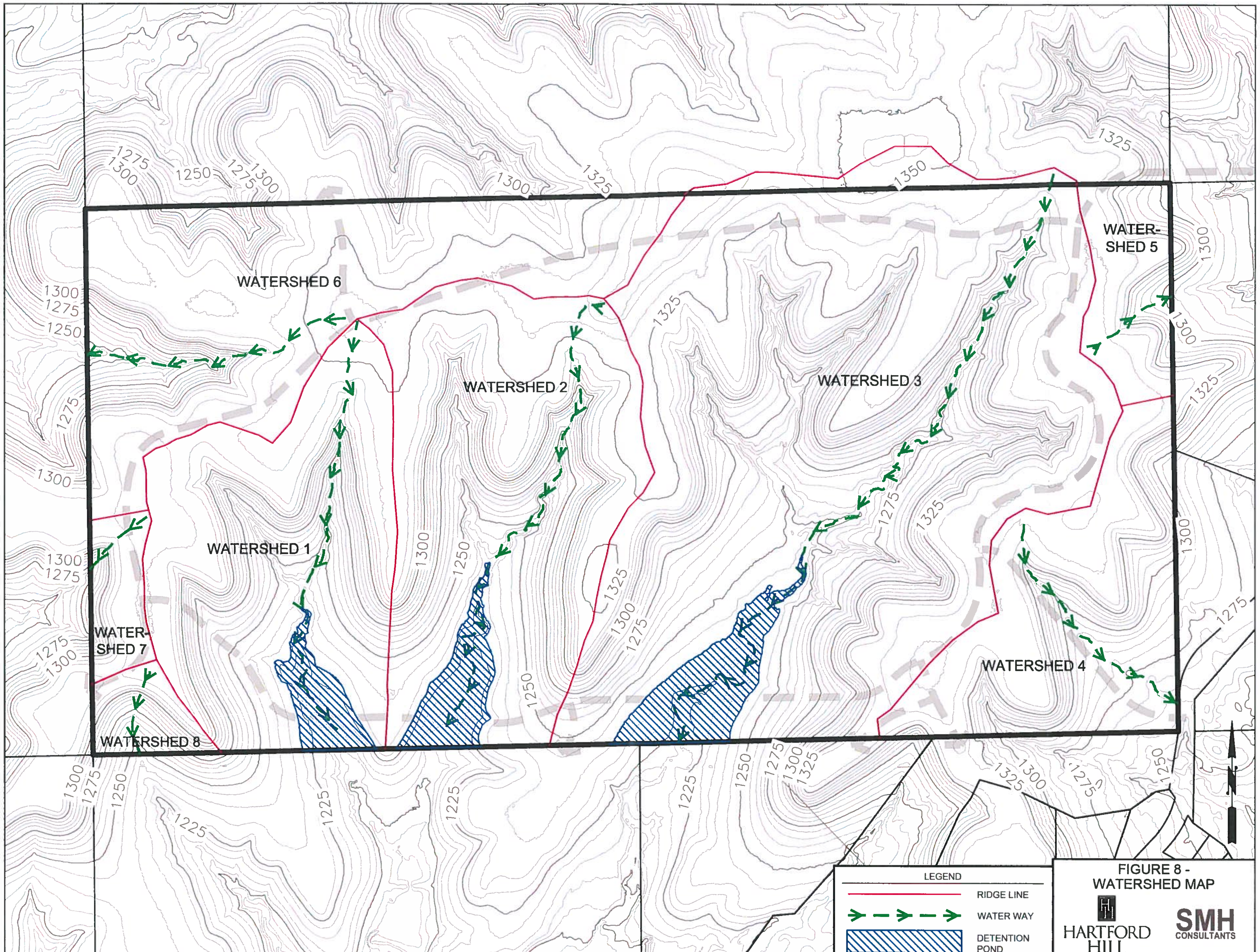
5. Impervious/Pervious Ratio = 0.35
6. Within Shaded Area of Appendix H of Post Construction Manual - 90% Event Chart

Since Post Construction BMPs are required in Hartford Hill the next step is to determine the water quality volume (WQ_v). For Manhattan the 90% Water Quality Rainfall Event, based on Section 4 of the Post Construction BMP Manual is 1.10-inches. Utilizing equations 4.1 and 4.4 of the Post Construction BMP Manual, the WQ_v is calculated to be 10.71 acre-feet.

The WQ_v is the volume of water that is required to be treated for water quality. This will be accomplished utilizing the proposed detention basins as Extended Dry Detention Basins (EDDBs). EDDBs are designed to detain the WQ_v for 40 hours to allow particles and associated pollutants to settle. According to the City's Post Construction BMP Manual, EDDBs that store water for 24 hours or more will remove 90% of the pollutants.

By over detaining in the proposed detention basins to capitalize on decreasing flows to Wildcat Creek, the proposed detention basins can store and treat the WQ_v for a minimum of 40 hours. The smallest storm analyzed as part of the hydrologic analysis, the 2-year event, results in the storage of approximately 12.20 acre-feet of water and the three ponds release this volume over a time period in excess of 90 hours. The design volume for the WQ_v, as required by the City's Post Construction BMP Manual, is $1.2(WQ_v)$. For Hartford Hill this equates to 12.85 acre-feet of water that is to be released over a minimum of 40 hours. The proposed ponds at Hartford Hill have a combined estimated total storage capacity of 84 acre-feet, of which 73% is actually utilized for the 100-year event leaving ample additional capacity to insure treatment of the WQ_v if final design of the detention ponds reveals such need.

Storm Water Analysis
Watershed Map &
Hydraflow Output


WATERSHED 1
WATERSHED 2
WATERSHED 3
WATERSHED 4
WATER-
SHED 5
WATERSHED 6
WATER-
SHED 7
WATERSHED 8
1225
1250
1275
1300
1325
1350
LEGEND
RIDGE LINE
WATER WAY
DETENTION
POND
FIGURE 8 -
WATERSHED MAP
HARTFORD
HILL
SMH
CONSULTANTS

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	14.89	2	738	87,869	----	------	------	Watershed 1-Bike Gulch (Existing)
2	SCS Runoff	13.26	2	746	99,120	----	------	------	Watershed 2-Single Track (Existing)
3	SCS Runoff	25.54	2	756	228,998	----	------	------	Watershed 3-Home (Existing)
4	SCS Runoff	13.05	2	728	57,146	----	------	------	Watershed 4-Kickoff (Existing)
5	SCS Runoff	6.855	2	720	17,556	----	------	------	Watershed 5-New England (Existing)
6	SCS Runoff	23.00	2	726	89,062	----	------	------	Watershed 6-Washington (Existing)
7	SCS Runoff	2.542	2	724	8,559	----	------	------	Watershed 7-California (Existing)
8	SCS Runoff	3.142	2	720	8,047	----	------	------	Watershed 8-Baja (Existing)
9	Reach	11.45	2	752	82,257	1	------	------	HH 1 Outfall to Inter Con
10	Reach	11.43	2	762	95,511	2	------	------	HH2 Outfall to Inter Con
11	Reach	21.76	2	778	225,306	3	------	------	HH 3 Outfall to Inter Con
12	Reach	6.843	2	748	89,028	6	------	------	HH 6 Outfall to Inter Con
13	Reach	0.884	2	740	8,536	7	------	------	HH 7 Outfall to Inter Con
14	Combine	7.687	2	746	97,564	12, 13	------	------	PIC West
15	Reach	3.425	2	862	97,486	14	------	------	PIC West to WC
16	Reach	1.640	2	728	8,039	8	------	------	HH 8 Outfall to Inter Con
17	Combine	41.83	2	764	411,113	9, 10, 11, 16	------	------	PIC Center
18	Reach	22.34	2	816	411,068	17	------	------	PIC Center to WC
19	Reach	7.730	2	744	57,133	4	------	------	HH 4 Outfall to Inter Con
20	Reach	1.129	2	746	17,512	5	------	------	HH 5 Outfall to Inter Con
21	Combine	8.859	2	744	74,646	19, 20	------	------	PIC East
22	Reach	2.044	2	864	74,514	21	------	------	PIC East to WC
23	Reach	1.888	2	1122	97,308	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	22.86	2	818	508,376	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	3.484	2	1530	476,613	24	------	------	3.06 Up to PPC
26	Combine	4.345	2	1198	551,128	22, 25	------	------	PPC

Hartford Hill Existing SCS.gpw	Return Period: 2 Year	Friday, Jun 19, 2015

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	79.17	2	736	368,146	----	------	------	Watershed 1-Bike Gulch (Existing)
2	SCS Runoff	71.14	2	744	415,285	----	------	------	Watershed 2-Single Track (Existing)
3	SCS Runoff	137.44	2	752	959,434	----	------	------	Watershed 3-Home (Existing)
4	SCS Runoff	67.85	2	728	239,426	----	------	------	Watershed 4-Kickoff (Existing)
5	SCS Runoff	32.13	2	720	73,556	----	------	------	Watershed 5-New England (Existing)
6	SCS Runoff	117.02	2	724	373,144	----	------	------	Watershed 6-Washington (Existing)
7	SCS Runoff	12.61	2	722	35,859	----	------	------	Watershed 7-California (Existing)
8	SCS Runoff	14.73	2	720	33,713	----	------	------	Watershed 8-Baja (Existing)
9	Reach	66.17	2	744	344,658	1	------	------	HH 1 Outfall to Inter Con
10	Reach	64.15	2	752	400,187	2	------	------	HH2 Outfall to Inter Con
11	Reach	122.77	2	766	944,002	3	------	------	HH 3 Outfall to Inter Con
12	Reach	50.27	2	740	373,122	6	------	------	HH 6 Outfall to Inter Con
13	Reach	6.193	2	734	35,844	7	------	------	HH 7 Outfall to Inter Con
14	Combine	56.10	2	740	408,966	12, 13	------	------	PIC West
15	Reach	24.74	2	794	408,919	14	------	------	PIC West to WC
16	Reach	10.20	2	724	33,708	8	------	------	HH 8 Outfall to Inter Con
17	Combine	237.16	2	756	1,722,554	9, 10, 11, 16	------	------	PIC Center
18	Reach	146.52	2	790	1,722,526	17	------	------	PIC Center to WC
19	Reach	48.74	2	738	239,418	4	------	------	HH 4 Outfall to Inter Con
20	Reach	9.099	2	730	73,529	5	------	------	HH 5 Outfall to Inter Con
21	Combine	57.31	2	738	312,948	19, 20	------	------	PIC East
22	Reach	14.77	2	790	312,866	21	------	------	PIC East to WC
23	Reach	13.39	2	922	408,823	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	152.82	2	792	2,131,348	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	24.28	2	1156	2,123,014	24	------	------	3.06 Up to PPC
26	Combine	30.82	2	940	2,435,887	22, 25	------	------	PPC

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	151.66	2	734	689,514	----	------	------	Watershed 1-Bike Gulch (Existing)
2	SCS Runoff	136.90	2	744	777,803	----	------	------	Watershed 2-Single Track (Existing)
3	SCS Runoff	265.39	2	752	1,796,961	----	------	------	Watershed 3-Home (Existing)
4	SCS Runoff	129.66	2	726	448,431	----	------	------	Watershed 4-Kickoff (Existing)
5	SCS Runoff	60.17	2	718	137,766	----	------	------	Watershed 5-New England (Existing)
6	SCS Runoff	223.38	2	724	698,875	----	------	------	Watershed 6-Washington (Existing)
7	SCS Runoff	23.96	2	722	67,161	----	------	------	Watershed 7-California (Existing)
8	SCS Runoff	27.58	2	718	63,143	----	------	------	Watershed 8-Baja (Existing)
9	Reach	130.46	2	742	645,528	1	------	------	HH 1 Outfall to Inter Con
10	Reach	125.61	2	750	749,529	2	------	------	HH2 Outfall to Inter Con
11	Reach	241.96	2	762	1,768,066	3	------	------	HH 3 Outfall to Inter Con
12	Reach	107.18	2	738	698,856	6	------	------	HH 6 Outfall to Inter Con
13	Reach	13.01	2	732	67,149	7	------	------	HH 7 Outfall to Inter Con
14	Combine	119.51	2	738	766,004	12, 13	------	------	PIC West
15	Reach	55.63	2	780	765,966	14	------	------	PIC West to WC
16	Reach	20.66	2	724	63,138	8	------	------	HH 8 Outfall to Inter Con
17	Combine	465.86	2	752	3,226,260	9, 10, 11, 16	------	------	PIC Center
18	Reach	307.87	2	782	3,226,234	17	------	------	PIC Center to WC
19	Reach	98.91	2	736	448,424	4	------	------	HH 4 Outfall to Inter Con
20	Reach	20.60	2	728	137,744	5	------	------	HH 5 Outfall to Inter Con
21	Combine	117.94	2	736	586,168	19, 20	------	------	PIC East
22	Reach	34.28	2	776	586,102	21	------	------	PIC East to WC
23	Reach	31.08	2	878	765,891	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	325.67	2	784	3,992,128	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	58.16	2	1028	3,989,873	24	------	------	3.06 Up to PPC
26	Combine	73.56	2	896	4,575,980	22, 25	------	------	PPC

Hartford Hill Existing SCS.gpw	Return Period: 100 Year	Friday, Jun 19, 2015

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	26.08	2	734	126,769	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	34.68	2	738	178,077	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	76.24	2	742	429,055	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	36.12	2	722	104,167	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	15.65	2	718	31,321	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	108.18	2	720	281,208	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	6.529	2	722	17,226	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	7.175	2	718	14,355	----	------	------	Watershed 8-Baja (Developed)
9	Reach	21.75	2	746	126,763	1	------	------	HH 1 Outfall to Inter Con
10	Reach	30.99	2	748	178,072	2	------	------	HH2 Outfall to Inter Con
11	Reach	64.46	2	756	429,047	3	------	------	HH 3 Outfall to Inter Con
12	Reach	40.06	2	732	281,185	6	------	------	HH 6 Outfall to Inter Con
13	Reach	2.697	2	732	17,209	7	------	------	HH 7 Outfall to Inter Con
14	Combine	42.75	2	732	298,394	12, 13	------	------	PIC West
15	Reach	18.04	2	790	298,343	14	------	------	PIC West to WC
16	Reach	4.283	2	722	14,349	8	------	------	HH 8 Outfall to Inter Con
17	Combine	115.91	2	750	748,232	9, 10, 11, 16	------	------	PIC Center
18	Reach	60.03	2	784	748,196	17	------	------	PIC Center to WC
19	Reach	21.89	2	732	104,157	4	------	------	HH 4 Outfall to Inter Con
20	Reach	3.054	2	726	31,285	5	------	------	HH 5 Outfall to Inter Con
21	Combine	24.90	2	732	135,443	19, 20	------	------	PIC East
22	Reach	5.006	2	808	135,335	21	------	------	PIC East to WC
23	Reach	9.508	2	922	298,237	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	64.62	2	786	1,046,434	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	9.324	2	1306	1,026,476	24	------	------	3.06 Up to PPC
26	Combine	11.34	2	1060	1,161,812	22, 25	------	------	PPC

Hartford Hill SCS Developed Without Ponds.gpReturn Period: 2 Year	Friday, Jun 19, 2015

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	103.83	2	734	452,027	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	117.08	2	736	568,189	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	248.77	2	740	1,333,795	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	115.36	2	722	323,822	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	47.82	2	716	97,366	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	262.43	2	720	705,110	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	20.62	2	720	53,551	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	21.92	2	716	44,626	----	------	------	Watershed 8-Baja (Developed)
9	Reach	93.37	2	740	452,023	1	------	------	HH 1 Outfall to Inter Con
10	Reach	109.68	2	744	568,185	2	------	------	HH2 Outfall to Inter Con
11	Reach	223.09	2	750	1,333,790	3	------	------	HH 3 Outfall to Inter Con
12	Reach	116.91	2	732	705,092	6	------	------	HH 6 Outfall to Inter Con
13	Reach	10.54	2	730	53,538	7	------	------	HH 7 Outfall to Inter Con
14	Combine	127.39	2	730	758,630	12, 13	------	------	PIC West
15	Reach	57.21	2	770	758,592	14	------	------	PIC West to WC
16	Reach	15.44	2	722	44,620	8	------	------	HH 8 Outfall to Inter Con
17	Combine	419.16	2	746	2,398,617	9, 10, 11, 16	------	------	PIC Center
18	Reach	251.06	2	772	2,398,592	17	------	------	PIC Center to WC
19	Reach	80.60	2	730	323,815	4	------	------	HH 4 Outfall to Inter Con
20	Reach	13.88	2	724	97,341	5	------	------	HH 5 Outfall to Inter Con
21	Combine	93.84	2	730	421,156	19, 20	------	------	PIC East
22	Reach	22.96	2	772	421,082	21	------	------	PIC East to WC
23	Reach	31.84	2	862	758,518	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	270.06	2	774	3,157,112	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	42.73	2	1044	3,153,321	24	------	------	3.06 Up to PPC
26	Combine	53.12	2	904	3,574,404	22, 25	------	------	PPC

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	186.21	2	732	804,475	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	200.59	2	736	974,258	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	421.78	2	740	2,266,743	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	193.48	2	722	550,326	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	79.56	2	716	165,470	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	403.48	2	720	1,111,872	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	34.54	2	720	91,009	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	36.46	2	716	75,840	----	------	------	Watershed 8-Baja (Developed)
9	Reach	171.23	2	740	804,471	1	------	------	HH 1 Outfall to Inter Con
10	Reach	190.38	2	742	974,254	2	------	------	HH2 Outfall to Inter Con
11	Reach	385.62	2	750	2,266,739	3	------	------	HH 3 Outfall to Inter Con
12	Reach	192.94	2	730	1,111,856	6	------	------	HH 6 Outfall to Inter Con
13	Reach	19.10	2	730	90,997	7	------	------	HH 7 Outfall to Inter Con
14	Combine	212.04	2	730	1,202,853	12, 13	------	------	PIC West
15	Reach	98.59	2	764	1,202,819	14	------	------	PIC West to WC
16	Reach	26.92	2	722	75,837	8	------	------	HH 8 Outfall to Inter Con
17	Combine	732.94	2	744	4,121,301	9, 10, 11, 16	------	------	PIC Center
18	Reach	465.30	2	768	4,121,278	17	------	------	PIC Center to WC
19	Reach	142.39	2	730	550,320	4	------	------	HH 4 Outfall to Inter Con
20	Reach	26.86	2	724	165,450	5	------	------	HH 5 Outfall to Inter Con
21	Combine	167.32	2	730	715,769	19, 20	------	------	PIC East
22	Reach	45.52	2	764	715,707	21	------	------	PIC East to WC
23	Reach	56.54	2	842	1,202,759	15	------	------	PIC West @ WC to PIC Center @ W
24	Combine	501.91	2	770	5,324,032	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	88.44	2	968	5,323,059	24	------	------	3.06 Up to PPC
26	Combine	109.76	2	868	6,038,765	22, 25	------	------	PPC

Hartford Hill SCS Developed Without Ponds.gpw | Return Period: 100 Year | Friday, Jun 19, 2015

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	26.08	2	734	126,769	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	34.68	2	738	178,077	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	76.24	2	742	429,055	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	36.12	2	722	104,167	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	15.65	2	718	31,321	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	108.18	2	720	281,208	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	6.529	2	722	17,226	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	7.175	2	718	14,355	----	------	------	Watershed 8-Baja (Developed)
9	Reach	40.06	2	732	281,185	6	------	------	HH 6 Outfall to Inter Con
10	Reach	2.697	2	732	17,209	7	------	------	HH 7 Outfall to Inter Con
11	Combine	42.75	2	732	298,394	9, 10	------	------	PIC West
12	Reach	18.04	2	790	298,343	11	------	------	PIC West to WC
13	Reach	4.283	2	722	14,349	8	------	------	HH 8 Outfall to Inter Con
14	Reach	21.89	2	732	104,157	4	------	------	HH 4 Outfall to Inter Con
15	Reach	3.054	2	726	31,285	5	------	------	HH 5 Outfall to Inter Con
16	Combine	24.90	2	732	135,443	14, 15	------	------	PIC East
17	Reach	5.006	2	808	135,335	16	------	------	PIC East to WC
18	Reach	9.508	2	922	298,237	12	------	------	PIC West @ WC to PIC Center @ W
19	Reservoir	1.649	2	984	126,766	1	1213.08	69,072	Bike Gulch Pond
20	Reservoir	1.690	2	1104	178,072	2	1213.09	111,938	Single Track Pond
21	Reservoir	1.881	2	1462	427,808	3	1230.06	350,235	Home Pond
22	Combine	7.524	2	724	746,996	13, 19, 20, 21	------	------	PIC Center
23	Reach	5.169	2	1454	745,331	22	------	------	PIC Center to WC
24	Combine	14.06	2	940	1,043,568	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	5.181	2	1872	948,579	24	------	------	3.06 Up to PPC
26	Combine	5.858	2	1456	1,083,914	17, 25	------	------	PPC

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	103.83	2	734	452,027	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	117.08	2	736	568,189	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	248.77	2	740	1,333,795	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	115.36	2	722	323,822	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	47.82	2	716	97,366	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	262.43	2	720	705,110	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	20.62	2	720	53,551	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	21.92	2	716	44,626	----	------	------	Watershed 8-Baja (Developed)
9	Reach	116.91	2	732	705,092	6	------	------	HH 6 Outfall to Inter Con
10	Reach	10.54	2	730	53,538	7	------	------	HH 7 Outfall to Inter Con
11	Combine	127.39	2	730	758,630	9, 10	------	------	PIC West
12	Reach	57.21	2	770	758,592	11	------	------	PIC West to WC
13	Reach	15.44	2	722	44,620	8	------	------	HH 8 Outfall to Inter Con
14	Reach	80.60	2	730	323,815	4	------	------	HH 4 Outfall to Inter Con
15	Reach	13.88	2	724	97,341	5	------	------	HH 5 Outfall to Inter Con
16	Combine	93.84	2	730	421,156	14, 15	------	------	PIC East
17	Reach	22.96	2	772	421,082	16	------	------	PIC East to WC
18	Reach	31.84	2	862	758,518	12	------	------	PIC West @ WC to PIC Center @ W
19	Reservoir	11.53	2	806	452,024	1	1218.22	237,493	Bike Gulch Pond
20	Reservoir	10.69	2	840	568,182	2	1217.78	330,144	Single Track Pond
21	Reservoir	13.57	2	974	1,269,987	3	1234.46	894,209	Home Pond
22	Combine	35.94	2	832	2,334,810	13, 19, 20, 21	------	------	PIC Center
23	Reach	33.25	2	984	2,328,470	22	------	------	PIC Center to WC
24	Combine	61.99	2	892	3,086,988	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	25.88	2	1440	3,015,919	24	------	------	3.06 Up to PPC
26	Combine	28.44	2	1342	3,437,002	17, 25	------	------	PPC

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	186.21	2	732	804,475	----	------	------	Watershed 1-Bike Gulch (Developed)
2	SCS Runoff	200.59	2	736	974,258	----	------	------	Watershed 2-Single Track (Develope
3	SCS Runoff	421.78	2	740	2,266,743	----	------	------	Watershed 3-Home (Developed)
4	SCS Runoff	193.48	2	722	550,326	----	------	------	Watershed 4-Kickoff (Developed)
5	SCS Runoff	79.56	2	716	165,470	----	------	------	Watershed 5-New England (Develope
6	SCS Runoff	403.48	2	720	1,111,872	----	------	------	Watershed 6-Washington (Developed
7	SCS Runoff	34.54	2	720	91,009	----	------	------	Watershed 7-California (Developed)
8	SCS Runoff	36.46	2	716	75,840	----	------	------	Watershed 8-Baja (Developed)
9	Reach	192.94	2	730	1,111,856	6	------	------	HH 6 Outfall to Inter Con
10	Reach	19.10	2	730	90,997	7	------	------	HH 7 Outfall to Inter Con
11	Combine	212.04	2	730	1,202,853	9, 10	------	------	PIC West
12	Reach	98.59	2	764	1,202,819	11	------	------	PIC West to WC
13	Reach	26.92	2	722	75,837	8	------	------	HH 8 Outfall to Inter Con
14	Reach	142.39	2	730	550,320	4	------	------	HH 4 Outfall to Inter Con
15	Reach	26.86	2	724	165,450	5	------	------	HH 5 Outfall to Inter Con
16	Combine	167.32	2	730	715,769	14, 15	------	------	PIC East
17	Reach	45.52	2	764	715,707	16	------	------	PIC East to WC
18	Reach	56.54	2	842	1,202,759	12	------	------	PIC West @ WC to PIC Center @ W
19	Reservoir	16.79	2	818	804,471	1	1221.94	453,542	Bike Gulch Pond
20	Reservoir	16.24	2	846	974,254	2	1221.24	590,281	Single Track Pond
21	Reservoir	17.34	2	1052	2,133,743	3	1238.13	1,622,820	Home Pond
22	Combine	51.09	2	822	3,988,306	13, 19, 20, 21	------	------	PIC Center
23	Reach	49.34	2	1016	3,982,002	22	------	------	PIC Center to WC
24	Combine	99.73	2	862	5,184,750	18, 23	------	------	3.06 Miles Upstream of Scenic Bridge
25	Reach	46.23	2	1410	5,126,093	24	------	------	3.06 Up to PPC
26	Combine	51.12	2	774	5,841,807	17, 25	------	------	PPC

TECHNICAL SUPPLEMENT NO. 4

Traffic Impact

July, 2015
Jeffrey Hancock, P.E., SMH Consultants
Brett Louk, P.E. SMH Consultants

SMH CONSULTANTS

A traffic impact study has been completed based upon the proposed land use plan for Hartford Hill. Recognized and appropriate engineering standards, using trip generation rates found in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition, have been used to estimate traffic volumes that will be produced by the development. Those volumes have been distributed from the development to the existing and proposed roadway network outside of Hartford Hill. For purposes of this study, and because it is not possible to assume with accuracy what Kansas State University might do with its land in the future, it is estimated that all the traffic from Hartford Hill will exit at either the northeast or southeast connections as shown on the roadway network. For analysis purposes, 85% of the traffic has been assigned to the southeast and 15% to the northeast.

For purposes of this study a development density of 2.5 dwelling units per gross acre was used. This should prove to be a very conservative factor given the known values that have been realized in other areas of similar terrain. For example, the current density within the adjacent Grand Mere Development is approximately 1.6 dwelling units per acre.

Intersection analyses have been performed using accepted methodologies outlined in the Highway Capacity Manual 2010 (HCM2010) as well as McTrans Highway Capacity Software (HCS) 2010.

Traffic volumes have been estimated based upon the following assumptions:

- "Existing" volumes are what they imply, actual volumes counted during the fall of 2014, while schools were in session.
- "Expected" volumes are composed of existing plus anticipated volumes to be added to the traffic network once all of the Grand Mere development is complete.
- "Development" volumes are only those estimated to be generated by the Hartford Hill project.
- "20" is a component of traffic volume added to the roadway network to represent background growth of the City. This traffic will be generated by other areas, some distant from Hartford Hill, but will use the major intersections that have been studied. This component was derived by applying a growth factor of 2% per year, over 20 years.
- Existing + Expected + Development + 20 is self-explanatory.

The pages that follow are the summaries of the intersection analyses for each of the intersections that were studied, and for each of the conditions described above.

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned A.M.*

East/West Street: *Marlatt Ave* | North/South Street: *Grand Mere Parkway*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*26*	*2*		*19*	*9*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*6*	*0*	*55*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*0*	*0*
Configuration		*LTR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LTR*				
v (veh/h)		*19*		*61*				
C (m) (veh/h)		*1599*		*1040*				
v/c Ratio		*0.01*		*0.06*				
95% Queue Length		*0.04*		*0.19*				
Control Delay (s/veh)		*7.3*		*8.7*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)			*8.7*					
Approach LOS			*A*					

 HCS+™ Version 5.6 Generated: 1/13/2015 8:50 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development AM*	
East/West Street: *Marlatt Ave*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *East-West*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*26*	*8*		*72*	*9*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*14*		*125*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*78*		*150*				
C (m) (veh/h)		*1588*		*1009*				
v/c Ratio		*0.05*		*0.15*				
95% Queue Length		*0.15*		*0.52*				
Control Delay (s/veh)		*7.4*		*9.2*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)			*9.2*					
Approach LOS			*A*					

 HCS+™ Version 5.6 Generated: 1/13/2015 9:39 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs AM*	
East/West Street: *Marlatt Ave*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *East-West*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*38*	*8*		*72*	*13*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*14*		*125*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*78*		*150*				
C (m) (veh/h)		*1571*		*992*				
v/c Ratio		*0.05*		*0.15*				
95% Queue Length		*0.16*		*0.53*				
Control Delay (s/veh)		*7.4*		*9.3*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)			*9.3*					
Approach LOS			*A*					

 HCS+™ Version 5.6 Generated: 6/24/2015 11:39 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description: *Existing + Planned PM*

East/West Street: *Marlatt Ave* | North/South Street: *Grand Mere Parkway*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*12*	*6*		*58*	*21*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*4*		*32*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*58*		*36*				
C (m) (veh/h)		*1612*		*1034*				
v/c Ratio		*0.04*		*0.03*				
95% Queue Length		*0.11*		*0.11*				
Control Delay (s/veh)		*7.3*		*8.6*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)			*8.6*					
Approach LOS			*A*					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development PM*

East/West Street: *Marlatt Ave*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *East-West*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*12*	*14*		*133*	*21*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*11*		*96*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*144*		*115*				
C (m) (veh/h)		*1599*		*993*				
v/c Ratio		*0.09*		*0.12*				
95% Queue Length		*0.30*		*0.39*				
Control Delay (s/veh)		*7.5*		*9.1*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)				*9.1*				
Approach LOS				*A*				

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk*	Intersection:	*Grand Mere Parkway & Marlatt*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*1/13/2015*	Analysis Year:	*2014*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs PM*	
East/West Street: *Marlatt Ave*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *East-West*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound				Westbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*18*	*14*		*133*	*31*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*11*		*96*			
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*144*		*115*				
C (m) (veh/h)		*1591*		*983*				
v/c Ratio		*0.09*		*0.12*				
95% Queue Length		*0.30*		*0.40*				
Control Delay (s/veh)		*7.5*		*9.1*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)				*9.1*				
Approach LOS				*A*				

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Grand Mere Parkway & Road A*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*2/16/2015*	Analysis Year:	*2014*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned AM*

East/West Street: *Road A* | North/South Street: *Grand Mere Parkway*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		19	45				130	3
Percent Heavy Vehicles		0	0	0		0	0	0
Median Type	Undivided							
Storage	1							
RT Channelized				0				0
Lanes		1	1	0		0	1	0
Configuration		L	T					TR
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	7		43			
Percent Heavy Vehicles	0			0	0	0
Left-Turn Lane Storage						
Percent Grade (%)	0			0		
Flared Approach			N			N
Storage			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
v (veh/h)	20						53	
C (m) (veh/h)	1464						852	
v/c Ratio	0.01						0.06	
95% Queue Length	0.04						0.20	
Control Delay (s/veh)	7.5						9.5	
Movement LOS	A						A	
Approach Delay (s/veh)						9.5		
Approach LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	*Brett Louk, P.E.*
Agency/Co.:	*SMH Consultants*
Date Performed:	*2/16/2015*
Analysis Time Period:	*7:00-8:00 am*

Site Information

Intersection:	*Grand Mere Parkway & Road A*
Jurisdiction:	
Analysis Year:	*2014*
Peak Hour Factor:	

Project Description: *Existing + Planned + Development AM*

East/West Street: *Road A* | North/South Street: *Grand Mere Parkway*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		*350*	*45*				*130*	*3*
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*1*	*1*	*0*		*0*	*1*	*0*
Configuration		*L*	*T*					*TR*
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*7*		*482*			
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*						*LR*	
v (veh/h)	*380*						*530*	
C (m) (veh/h)	*1464*						*834*	
v/c Ratio	*0.26*						*0.64*	
95% Queue Length	*1.04*						*4.66*	
Control Delay (s/veh)	*8.3*						*16.5*	
Movement LOS	*A*						*C*	
Approach Delay (s/veh)						*16.5*		
Approach LOS						*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	*Brett Louk, P.E.*
Agency/Co.:	*SMH Consultants*
Date Performed:	*2/16/2015*
Analysis Time Period:	*7:00-8:00 am*

Site Information

Intersection:	*Grand Mere Parkway & Road A*
Jurisdiction:	
Analysis Year:	*2014*
Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs AM*	
East/West Street: *Road A*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		*350*	*45*				*130*	*3*
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*1*	*1*	*0*		*0*	*1*	*0*
Configuration		*L*	*T*					*TR*
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*7*		*482*			
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*						*LR*	
v (veh/h)	*380*						*530*	
C (m) (veh/h)	*1464*						*834*	
v/c Ratio	*0.26*						*0.64*	
95% Queue Length	*1.04*						*4.66*	
Control Delay (s/veh)	*8.3*						*16.5*	
Movement LOS	*A*						*C*	
Approach Delay (s/veh)							*16.5*	
Approach LOS							*C*	

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	*Brett Louk, P.E.*
Agency/Co.:	*SMH Consultants*
Date Performed:	*2/16/2015*
Analysis Time Period:	*5:00-6:00 pm*

Site Information

Intersection:	*Grand Mere Parkway & Road A*
Jurisdiction:	
Analysis Year:	*2014*
Peak Hour Factor:	

Project Description: *Existing + Planned PM*

East/West Street: *Road A*

North/South Street: *Grand Mere Parkway*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		*60*	*141*				*78*	*11*
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*1*	*1*	*0*		*0*	*1*	*0*
Configuration		*L*	*T*					*TR*
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*		*27*			
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*						*LR*	
v (veh/h)	*65*						*34*	
C (m) (veh/h)	*1519*						*861*	
v/c Ratio	*0.04*						*0.04*	
95% Queue Length	*0.13*						*0.12*	
Control Delay (s/veh)	*7.5*						*9.4*	
Movement LOS	*A*						*A*	
Approach Delay (s/veh)							*9.4*	
Approach LOS							*A*	

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	Brett Louk, P.E.
Agency/Co.:	SMH Consultants
Date Performed:	2/16/2015
Analysis Time Period:	5:00-6:00 pm

Site Information

Intersection:	Grand Mere Parkway & Road A
Jurisdiction:	
Analysis Year:	2014
Peak Hour Factor:	

Project Description: Existing + Planned + Development PM

East/West Street: Road A | North/South Street: Grand Mere Parkway

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		529	141				78	11
Percent Heavy Vehicles		0	0	0		0	0	0
Median Type	Undivided							
Storage	1							
RT Channelized				0				0
Lanes		1	1	0		0	1	0
Configuration		L	T					TR
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	5		429			
Percent Heavy Vehicles	0			0	0	0
Left-Turn Lane Storage						
Percent Grade (%)	0			0		
Flared Approach			N			N
Storage			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
v (veh/h)	574						471	
C (m) (veh/h)	1519						850	
v/c Ratio	0.38						0.55	
95% Queue Length	1.79						3.47	
Control Delay (s/veh)	8.8						14.4	
Movement LOS	A						B	
Approach Delay (s/veh)						14.4		
Approach LOS						B		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	*Brett Louk, P.E.*
Agency/Co.:	*SMH Consultants*
Date Performed:	*2/16/2015*
Analysis Time Period:	*5:00-6:00 pm*

Site Information

Intersection:	*Grand Mere Parkway & Road A*
Jurisdiction:	
Analysis Year:	*2014*
Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs PM*	
East/West Street: *Road A*	North/South Street: *Grand Mere Parkway*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)		*529*	*141*				*78*	*11*
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*1*	*1*	*0*		*0*	*1*	*0*
Configuration		*L*	*T*					*TR*
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*		*429*			
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				
Proportion Time Blocked						

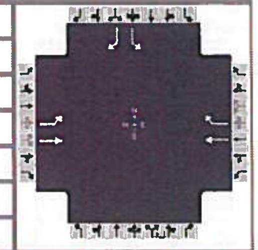
Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*						*LR*	
v (veh/h)	*574*						*471*	
C (m) (veh/h)	*1519*						*850*	
v/c Ratio	*0.38*						*0.55*	
95% Queue Length	*1.79*						*3.47*	
Control Delay (s/veh)	*8.8*						*14.4*	
Movement LOS	*A*						*B*	
Approach Delay (s/veh)							*14.4*	
Approach LOS							*B*	

 HCS+™ Version 5.6 Generated: 7/22/2015 9:14 AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	7:45-8:45 am	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	27	191			260	62				34		16

Signal Information										
Cycle, s	112.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	20.0	45.0	30.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, ($Y+R_c$), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (g_s), s	2.7	7.2		13.7				3.7
Green Extension Time (g_e), s	0.0	1.0		1.0				0.1
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.00		0.00				0.00

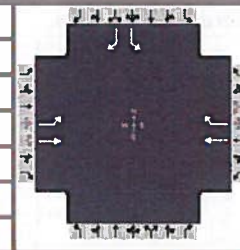
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	29	208			283	67				37		17
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	0.7	5.2			11.7	2.9				1.7		0.9
Cycle Queue Clearance Time (g_c), s	0.7	5.2			11.7	2.9				1.7		0.9
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	718	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.041	0.175			0.370	0.104				0.076		0.040
Available Capacity (c_a), veh/h	718	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	0.3	2.0			5.1	1.1				0.8		0.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.06	0.00			0.00	0.13				0.00		0.00
Uniform Delay (d_1), s/veh	10.1	8.8			23.5	20.9				30.6		30.3
Incremental Delay (d_2), s/veh	0.0	0.0			0.1	0.0				0.0		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	10.1	8.9			23.7	20.9				30.7		30.4
Level of Service (LOS)	B	A			C	C				C		C
Approach Delay, s/veh / LOS	9.0	A		23.1	C		0.0			30.6	C	
Intersection Delay, s/veh / LOS	18.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 8:43:23 AM

HCS 2010 Signalized Intersection Results Summary

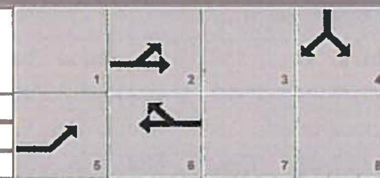
General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	7:45-8:45 am	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned AM.xus				
Project Description	Existing + Planned AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	55	399			306	62				34		19

Signal Information			
Cycle, s	112.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.0	45.0	30.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, (*Y*+*R*c), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (g_s), s	3.5	14.4		16.2				3.7
Green Extension Time (g_e), s	0.1	1.5		1.5				0.1
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.00		0.00				0.00

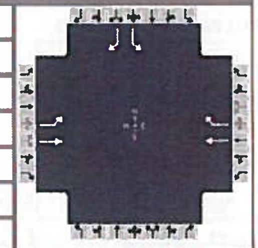
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	60	434			333	67				37		21
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	1.5	12.4			14.2	2.9				1.7		1.1
Cycle Queue Clearance Time (g_c), s	1.5	12.4			14.2	2.9				1.7		1.1
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	680	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.088	0.365			0.436	0.104				0.076		0.048
Available Capacity (c_a), veh/h	680	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	0.6	4.7			6.2	1.1				0.8		0.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.12	0.00			0.00	0.13				0.00		0.00
Uniform Delay (d_1), s/veh	10.6	10.2			24.3	20.9				30.6		30.4
Incremental Delay (d_2), s/veh	0.0	0.1			0.1	0.0				0.0		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	10.6	10.3			24.4	20.9				30.7		30.4
Level of Service (LOS)	B	B			C	C				C		C
Approach Delay, s/veh / LOS	10.3	B		23.8	C		0.0			30.6	C	
Intersection Delay, s/veh / LOS	17.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	1.1	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 8:45:31 AM

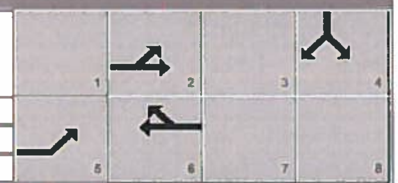
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	7:45-8:45 am	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned + Development AM.xus				
Project Description	Existing + Planned + Development AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	91	662			430	62				34		27

Signal Information										
Cycle, s	112.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	20.0	45.0	30.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, (*Y*+*R*c), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (*g*s), s	4.6	27.6		23.9				3.7
Green Extension Time (*g*e), s	0.1	2.4		2.5				0.1
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.02		0.01				0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	99	720			467	67				37		29
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (*g*s), s	2.6	25.6			21.9	2.9				1.7		1.5
Cycle Queue Clearance Time (*g*c), s	2.6	25.6			21.9	2.9				1.7		1.5
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	582	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.170	0.606			0.612	0.104				0.076		0.068
Available Capacity (*c*a), veh/h	582	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	1.0	9.9			9.7	1.1				0.8		0.6
Queue Storage Ratio (*RQ*) (50th percentile)	0.20	0.00			0.00	0.13				0.00		0.00
Uniform Delay (*d*1), s/veh	12.4	12.7			26.6	20.9				30.6		30.6
Incremental Delay (*d*2), s/veh	0.1	0.6			1.1	0.0				0.0		0.0
Initial Queue Delay (*d*3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	12.5	13.3			27.6	20.9				30.7		30.6
Level of Service (LOS)	B	B			C	C				C		C

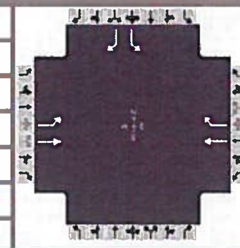
Approach / Intersection	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	13.2	B	26.8	C	0.0		30.6	C
Intersection Delay, s/veh / LOS	19.1				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.8	A	1.4	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:24:26 AM

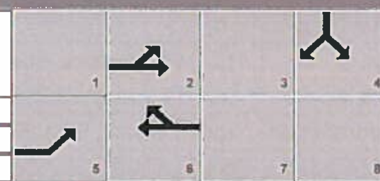
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	7:45-8:45 am	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned + Development + 20 AM.xus				
Project Description	Existing + Planned + Development + 20 yrs AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	109	757			563	89				54		38

Signal Information										
Cycle, s	112.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	20.0	45.0	30.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, (*Y+R*c), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (*g*s), s	5.2	34.1		33.8				4.7
Green Extension Time (*g*e), s	0.1	2.8		2.8				0.2
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.19		0.18				0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	118	823			612	97				59		41
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (*g*s), s	3.2	32.1			31.8	4.3				2.7		2.2
Cycle Queue Clearance Time (*g*c), s	3.2	32.1			31.8	4.3				2.7		2.2
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	484	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.245	0.693			0.802	0.150				0.121		0.096
Available Capacity (*c*a), veh/h	484	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	1.2	12.6			15.0	1.6				1.2		0.8
Queue Storage Ratio (*RQ*) (50th percentile)	0.24	0.00			0.00	0.18				0.00		0.00
Uniform Delay (*d*1), s/veh	15.6	13.9			29.6	21.3				31.0		30.8
Incremental Delay (*d*2), s/veh	0.1	1.5			5.7	0.0				0.0		0.0
Initial Queue Delay (*d*3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	15.7	15.4			35.3	21.4				31.1		30.8
Level of Service (LOS)	B	B			D	C				C		C

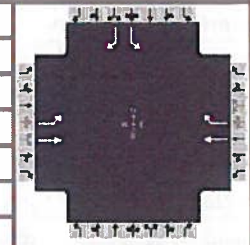
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	15.4	B	33.4	C	0.0		31.0	C
Intersection Delay, s/veh / LOS	23.6				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	2.0	B	1.7	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:28:37 AM

HCS 2010 Signalized Intersection Results Summary

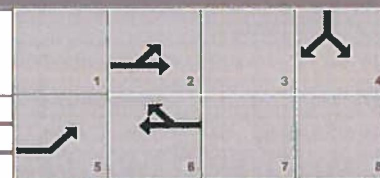
General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	5:00-6:00 pm	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	24	332			205	67				82		24

Signal Information				
Cycle, s	112.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.0	45.0	30.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, ($Y+R_c$), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.2
Queue Clearance Time (g_s), s	2.7	11.8		10.9				6.2
Green Extension Time (g_e), s	0.0	1.2		1.2				0.2
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.00		0.00				0.00

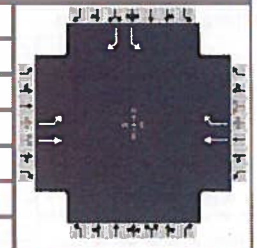
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	26	361			223	73				89		26
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	0.7	9.8			8.9	3.2				4.2		1.4
Cycle Queue Clearance Time (g_c), s	0.7	9.8			8.9	3.2				4.2		1.4
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	766	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.034	0.304			0.292	0.113				0.184		0.060
Available Capacity (c_a), veh/h	766	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	0.2	3.7			3.9	1.2				1.9		0.5
Queue Storage Ratio (*RQ*) (50th percentile)	0.05	0.00			0.00	0.14				0.00		0.00
Uniform Delay (d_1), s/veh	9.7	9.7			22.7	21.0				31.6		30.5
Incremental Delay (d_2), s/veh	0.0	0.1			0.1	0.0				0.1		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	9.7	9.8			22.8	21.0				31.6		30.5
Level of Service (LOS)	A	A			C	C				C		C
Approach Delay, s/veh / LOS	9.8		A	22.3		C	0.0			31.4		C
Intersection Delay, s/veh / LOS	17.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	1.0	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:02:39 AM

HCS 2010 Signalized Intersection Results Summary

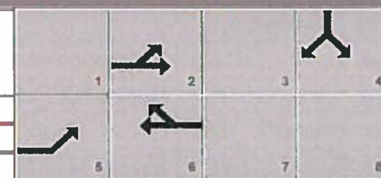
General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	5:00-6:00 pm	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned PM.xus				
Project Description	Existing + Planned PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	31	424			335	67				82		38

Signal Information			
Cycle, s	112.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.0	45.0	30.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, ($Y+R_c$), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (g_s), s	2.9	15.5		17.9				6.2
Green Extension Time (g_e), s	0.0	1.6		1.6				0.2
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.00		0.00				0.00

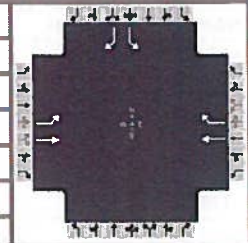
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	34	461			364	73				89		41
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	0.9	13.5			15.9	3.2				4.2		2.2
Cycle Queue Clearance Time (g_c), s	0.9	13.5			15.9	3.2				4.2		2.2
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	656	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.051	0.388			0.477	0.113				0.184		0.096
Available Capacity (c_a), veh/h	656	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	0.3	5.1			6.9	1.2				1.9		0.8
Queue Storage Ratio (*RQ*) (50th percentile)	0.07	0.00			0.00	0.14				0.00		0.00
Uniform Delay (d_1), s/veh	10.7	10.4			24.8	21.0				31.6		30.8
Incremental Delay (d_2), s/veh	0.0	0.1			0.2	0.0				0.1		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	10.7	10.5			25.0	21.0				31.6		30.8
Level of Service (LOS)	B	B			C	C				C		C
Approach Delay, s/veh / LOS	10.5	B		24.3	C		0.0			31.4	C	
Intersection Delay, s/veh / LOS	18.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	1.2	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:06:15 AM

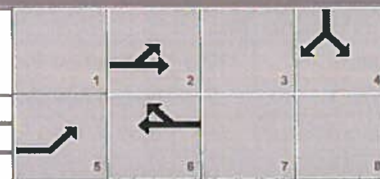
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	5:00-6:00 pm	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned + Development PM.xus				
Project Description	Existing + Planned + Development PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	45	607			504	67				82		57

Signal Information										
Cycle, s	112.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	20.0	45.0	30.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, (Y+R_c), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (g_s), s	3.3	24.3		29.1				6.2
Green Extension Time (g_e), s	0.0	2.5		2.4				0.3
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.01		0.03				0.00

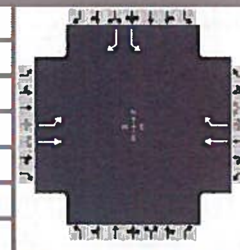
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (v), veh/h	49	660			548	73				89		62
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	1.3	22.3			27.1	3.2				4.2		3.3
Cycle Queue Clearance Time (g_c), s	1.3	22.3			27.1	3.2				4.2		3.3
Green Ratio (g/C)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (c), veh/h	526	1187			763	647				485		431
Volume-to-Capacity Ratio (X)	0.093	0.556			0.718	0.113				0.184		0.144
Available Capacity (c_a), veh/h	526	1187			763	647				485		431
Back of Queue (Q), veh/ln (50th percentile)	0.5	8.5			12.3	1.2				1.9		1.3
Queue Storage Ratio (RQ) (50th percentile)	0.10	0.00			0.00	0.14				0.00		0.00
Uniform Delay (d_1), s/veh	13.3	12.1			28.2	21.0				31.6		31.2
Incremental Delay (d_2), s/veh	0.0	0.3			2.8	0.0				0.1		0.1
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (d), s/veh	13.3	12.4			31.0	21.0				31.6		31.3
Level of Service (LOS)	B	B			C	C				C		C
Approach Delay, s/veh / LOS	12.5		B	29.8		C	0.0			31.5		C
Intersection Delay, s/veh / LOS	21.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.7	A	1.5	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:52:16 AM

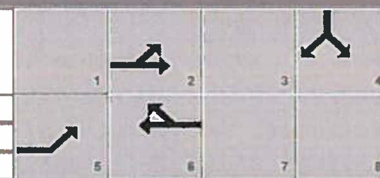
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SMH Consultants			Duration, h	0.25
Analyst	Brett Louk	Analysis Date	Jan 13, 2015	Area Type	Other
Jurisdiction		Time Period	5:00-6:00 pm	PHF	0.92
Intersection	Kimball & Vanesta	Analysis Year	2014	Analysis Period	1> 7:00
File Name	Kimball & Vanesta - Existing + Planned + Development + 20 PM.xus				
Project Description	Existing + Planned + Development + 20 yrs PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	54	787			611	100				122		66

Signal Information											
Cycle, s	112.0	Reference Phase	2								
Offset, s	0	Reference Point	End	Green	20.0	45.0	30.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	25.0	76.0		51.0				36.0
Change Period, (*Y*+*R*c), s	5.0	6.0		6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0		3.0				3.3
Queue Clearance Time (g_s), s	3.5	36.4		38.0				8.5
Green Extension Time (g_e), s	0.1	2.8		2.5				0.4
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	0.00	0.34		0.47				0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	59	855			664	109				133		72
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1900			1900	1610				1810		1610
Queue Service Time (g_s), s	1.5	34.4			36.0	4.9				6.5		3.8
Cycle Queue Clearance Time (g_c), s	1.5	34.4			36.0	4.9				6.5		3.8
Green Ratio (*g/C*)	0.60	0.62			0.40	0.40				0.27		0.27
Capacity (*c*), veh/h	450	1187			763	647				485		431
Volume-to-Capacity Ratio (*X*)	0.130	0.720			0.870	0.168				0.274		0.166
Available Capacity (c_a), veh/h	450	1187			763	647				485		431
Back of Queue (*Q*), veh/ln (50th percentile)	0.6	13.6			17.7	1.8				2.9		1.5
Queue Storage Ratio (*RQ*) (50th percentile)	0.12	0.00			0.00	0.21				0.00		0.00
Uniform Delay (d_1), s/veh	16.3	14.3			30.8	21.5				32.4		31.4
Incremental Delay (d_2), s/veh	0.0	1.9			10.2	0.0				0.1		0.1
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	16.4	16.2			41.0	21.5				32.5		31.5
Level of Service (LOS)	B	B			D	C				C		C
Approach Delay, s/veh / LOS	16.2		B	38.3		D	0.0			32.1		C
Intersection Delay, s/veh / LOS	27.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	2.0	A	1.8	A				F

 HCS 2010™ Streets Version 6.60 Generated: 1/13/2015 9:55:36 AM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball Avenue*
Time Period	*7:30-8:30 am*	Analysis Year	*2014*
Peak Hour Factor	*0.92*	Project ID	*Existing A.M.*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*								*LT*				*TR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*54*	*0*	*26*	*0*	*0*	*0*	*0*	*0*	*16*	*234*	*0*	*0*	*0*	*241*	*28*	*0*
Heavy Veh. Adj. (f_{HV}), %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h		*262*			*330*			*59*			*17*	
Exiting Flow (V_{ex}), pc/h		*0*			*48*			*313*			*290*	
Entry Flow (V_e), pc/h		*87*			*0*			*272*			*292*	
Entry Volume veh/h		*87*						*272*			*292*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*1112*			*0*			*1359*			*1416*	
Capacity (*c*), veh/h		*1112*			*0*			*1359*			*1416*	
v/c Ratio (X)		*0.08*						*0.20*			*0.21*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*3.9*						*4.3*			*4.2*	
Lane LOS		*A*			*F*			*A*			*A*	
Lane 95% Queue		*0.3*						*0.7*			*0.8*	
Approach Delay, s/veh		*3.90*						*4.31*			*4.23*	
Approach LOS, s/veh		*A*						*A*			*A*	
Intersection Delay, s/veh	*4.22*											
Intersection LOS	*A*											

 HCS 2010™ 6.60 Roundabouts Generated: 1/13/2015 10:06 AM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	Brett Louk	Intersection	Grand Mere Parkway & Kimball
Agency or Co.	SMH Consultants	E/W Street Name	Grand Mere Parkway
Date Performed	1/13/2015	N/S Street Name	Kimball Avenue
Time Period	7:30-8:30 am	Analysis Year	2014
Peak Hour Factor	0.92	Project ID	Existing + Planned A.M.

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	290	0	137	0	0	0	0	0	89	234	0	0	0	241	77	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	262			666			315			97		
Exiting Flow (V_{ex}), pc/h	0			180			570			411		
Entry Flow (V_e), pc/h		464			0			351			346	
Entry Volume veh/h		464						351			346	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		1112			0			1055			1309	
Capacity (c), veh/h		1112			0			1055			1309	
v/c Ratio (X)		0.42						0.33			0.26	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		7.6						6.8			5.1	
Lane LOS		A			F			A			A	
Lane 95% Queue		2.1						1.5			1.1	
Approach Delay, s/veh	7.62						6.77			5.06		
Approach LOS, s/veh	A						A			A		
Intersection Delay, s/veh	6.60											
Intersection LOS	A											

ROUNDABOUT REPORT

General Information		**Site Information**	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball Avenue*
Time Period	*7:30-8:30 am*	Analysis Year	*2014*
Peak Hour Factor	*0.92*	Project ID	*Existing + Planned + Development AM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	589	0	277	0	0	0	0	0	288	234	0	0	0	241	209	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	262			1207			640			313		
Exiting Flow (V_{ex}), pc/h	0			540			895			563		
Entry Flow (V_e), pc/h		941			489			567			489	
Entry Volume veh/h		941						567			489	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		1112			0			766			1058	
Capacity (c), veh/h		1112			0			766			1058	
v/c Ratio (X)		0.85						0.74			0.46	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		22.2						20.5			8.6	
Lane LOS		C			F			C			A	
Lane 95% Queue		10.9						6.7			2.5	
Approach Delay, s/veh	22.16						20.53			8.60		
Approach LOS, s/veh	C						C			A		
Intersection Delay, s/veh	18.38											
Intersection LOS	C											

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	
Time Period	*7:30-8:30 am*	Analysis Year	*2014*
Peak Hour Factor	*0.92*	Project ID	*Exist + Planned + Dev + 20 yrs AM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	617	0	287	0	0	0	0	0	299	354	0	0	0	363	227	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	395			1381			671			325		
Exiting Flow (V_{ex}), pc/h	0			572			1055			707		
Entry Flow (V_e), pc/h		983			641			710			641	
Entry Volume veh/h		983						710			641	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		976			0			743			1045	
Capacity (c), veh/h		976			0			743			1045	
v/c Ratio (X)		1.01						0.96			0.61	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		51.2						46.4			11.8	
Lane LOS		F			F			E			B	
Lane 95% Queue		19.6						14.4			4.4	
Approach Delay, s/veh	51.22						46.36			11.82		
Approach LOS, s/veh	F						E			B		
Intersection Delay, s/veh	38.92											
Intersection LOS	E											

 HCS 2010™ 6.60 Roundabouts Generated: 6/24/2015 11:34 AM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball*
Time Period	*4:45-5:45 pm*	Analysis Year	*2014*
Peak Hour Factor	*0.89*	Project ID	*Existing PM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	22	0	23	0	0	0	0	0	27	324	0	0	0	177	46	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	199			419			25			30		
Exiting Flow (V_{ex}), pc/h	0			82			389			225		
Entry Flow (V_e), pc/h		51			0			394			251	
Entry Volume veh/h		51						394			251	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		1184			0			1405			1398	
Capacity (*c*), veh/h		1184			0			1405			1398	
v/c Ratio (X)		0.04						0.28			0.18	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		3.4						5.0			4.0	
Lane LOS		A			F			A			A	
Lane 95% Queue		0.1						1.2			0.7	
Approach Delay, s/veh	3.39						4.96			4.04		
Approach LOS, s/veh	A						A			A		
Intersection Delay, s/veh	4.51											
Intersection LOS	A											

 HCS 2010™ 6.60 Roundabouts Generated: 1/13/2015 10:10 AM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball*
Time Period	*4:45-5:45 pm*	Analysis Year	*2014*
Peak Hour Factor	*0.89*	Project ID	*Existing + Planned PM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	121	0	127	0	0	0	0	0	243	324	0	0	0	177	190	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	199			773			136			273		
Exiting Flow (V_{ex}), pc/h	0			487			500			342		
Entry Flow (V_e), pc/h		279			0			637			412	
Entry Volume veh/h		279						637			412	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		1184			0			1259			1100	
Capacity (c), veh/h		1184			0			1259			1100	
v/c Ratio (X)		0.24						0.51			0.37	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.2						8.3			7.1	
Lane LOS		A			F			A			A	
Lane 95% Queue		0.9						3.0			1.8	
Approach Delay, s/veh	5.15						8.28			7.09		
Approach LOS, s/veh	A						A			A		
Intersection Delay, s/veh	7.25											
Intersection LOS	A											

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ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball*
Time Period	*4:45-5:45 pm*	Analysis Year	*2014*
Peak Hour Factor	*0.89*	Project ID	*Existing + Planned + Development PM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Lane Assignment			*LTR*								*LT*				*TR*	
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h	*318*	*0*	*332*	*0*	*0*	*0*	*0*	*0*	*524*	*324*	*0*	*0*	*0*	*177*	*378*	*0*
Heavy Veh. Adj. (f_{HV}), %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*	*5.1929*	*4.8000*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*	*3.1858*	*2.5000*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h		*199*			*1310*			*357*			*589*	
Exiting Flow (V_{ex}), pc/h		*0*			*1013*			*721*			*572*	
Entry Flow (V_e), pc/h		*730*			*0*			*953*			*624*	
Entry Volume veh/h		*730*						*953*			*624*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*1184*			*0*			*1012*			*806*	
Capacity (*c*), veh/h		*1184*			*0*			*1012*			*806*	
v/c Ratio (X)		*0.62*						*0.94*			*0.77*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*10.9*						*36.1*			*21.9*	
Lane LOS		*B*			*F*			*E*			*C*	
Lane 95% Queue		*4.5*						*15.6*			*7.7*	
Approach Delay, s/veh		*10.88*						*36.13*			*21.85*	
Approach LOS, s/veh		*B*						*E*			*C*	
Intersection Delay, s/veh	*24.28*											
Intersection LOS	*C*											

 HCS 2010™ 6.60 Roundabouts Generated: 1/13/2015 9:47 AM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*Brett Louk*	Intersection	*Grand Mere Parkway & Kimball*
Agency or Co.	*SMH Consultants*	E/W Street Name	*Grand Mere Parkway*
Date Performed	*1/13/2015*	N/S Street Name	*Kimball Ave*
Time Period	*4:45-5:45 pm*	Analysis Year	*2014*
Peak Hour Factor	*0.89*	Project ID	*Exist + Planned + Dev + 20 yrs PM*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	0	0		0	1	0		0	1	0	
Lane Assignment			LTR								LT				TR	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	333	0	346	0	0	0	0	0	534	478	0	0	0	267	396	0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929	5.1929	4.8000	5.1929
Follow-Up Headway (sec)	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858	3.1858	2.5000	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h		300			1511			374			600	
Exiting Flow (V_{ex}), pc/h		0			1045			911			689	
Entry Flow (V_e), pc/h		763			745			1137			745	
Entry Volume veh/h		763						1137			745	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		1071			0			996			797	
Capacity (c), veh/h		1071			0			996			797	
v/c Ratio (X)		0.71						1.14			0.93	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		14.8						94.1			40.5	
Lane LOS		B			F			F			E	
Lane 95% Queue		6.4						31.3			13.8	
Approach Delay, s/veh	14.77						94.05			40.51		
Approach LOS, s/veh	B						F			E		
Intersection Delay, s/veh	56.10											
Intersection LOS	F											

 HCS 2010™ 6.60 Roundabouts Generated: 6/24/2015 11:38 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	
Project Description:	*Existing + Planned AM*		
East/West Street:	*Road A*	North/South Street:	*Road B*
Intersection Orientation:	*North-South*	Study Period (hrs):	*0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*13*	*50*		*0*	*0*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*9*		*13*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*0*		*23*				
C (m) (veh/h)		*1546*		*1011*				
v/c Ratio		*0.00*		*0.02*				
95% Queue Length		*0.00*		*0.07*				
Control Delay (s/veh)		*7.3*		*8.6*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)				*8.6*				
Approach LOS				*A*				

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development AM*

East/West Street: *Road A*	North/South Street: *Road B*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*13*	*226*		*263*	*9*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*141*		*212*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*285*		*383*				
C (m) (veh/h)		*1317*		*518*				
v/c Ratio		*0.22*		*0.74*				
95% Queue Length		*0.82*		*6.22*				
Control Delay (s/veh)		*8.5*		*29.1*				
Movement LOS		*A*		*D*				
Approach Delay (s/veh)			*29.1*					
Approach LOS			*D*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs AM*	
East/West Street: *Road A*	North/South Street: *Road B*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*13*	*226*		*263*	*9*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*141*		*212*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*285*		*383*				
C (m) (veh/h)		*1317*		*518*				
v/c Ratio		*0.22*		*0.74*				
95% Queue Length		*0.82*		*6.22*				
Control Delay (s/veh)		*8.5*		*29.1*				
Movement LOS		*A*		*D*				
Approach Delay (s/veh)			*29.1*					
Approach LOS			*D*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*7:00-8:00 am*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development AM - WB Left Turn*

East/West Street: *Road A*	North/South Street: *Road B*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			13	226		263	9	
Percent Heavy Vehicles		0	0	0		0	0	0
Median Type	Undivided							
Storage	1							
RT Channelized				0				0
Lanes	0		1	0	0		1	0
Configuration				TR	LT			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				141		212
Percent Heavy Vehicles	0			0	0	0
Left-Turn Lane Storage						
Percent Grade (%)	0			0		
Flared Approach			N			N
Storage			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		R			
v (veh/h)		285	153		230			
C (m) (veh/h)		1317	313		918			
v/c Ratio		0.22	0.49		0.25			
95% Queue Length		0.82	2.54		0.99			
Control Delay (s/veh)		8.5	27.0		10.2			
Movement LOS		A	D		B			
Approach Delay (s/veh)			16.9					
Approach LOS			C					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	Brett Louk, P.E.	Intersection:	Road A & Road B
Agency/Co.:	SMH Consultants	Jurisdiction:	
Date Performed:	6/03/2015	Analysis Year:	2015
Analysis Time Period:	7:00-8:00 am	Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs AM - WB Left Turn*

East/West Street: *Road A*	North/South Street: *Road B*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			13	226		263	9	
Percent Heavy Vehicles		0	0	0		0	0	0
Median Type	Undivided							
Storage	1							
RT Channelized				0				0
Lanes	0		1	0	0		1	0
Configuration				TR	LT			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				141		212
Percent Heavy Vehicles	0			0	0	0
Left-Turn Lane Storage						
Percent Grade (%)	0			0		
Flared Approach			N			N
Storage			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		R			
v (veh/h)		285	153		230			
C (m) (veh/h)		1317	313		918			
v/c Ratio		0.22	0.49		0.25			
95% Queue Length		0.82	2.54		0.99			
Control Delay (s/veh)		8.5	27.0		10.2			
Movement LOS		A	D		B			
Approach Delay (s/veh)			16.9					
Approach LOS			C					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description:	*Existing + Planned PM*		
East/West Street:	*Road A*	North/South Street:	*Road B*
Intersection Orientation:	*North-South*	Study Period (hrs):	*0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
.	U	L	T	R	U	L	T	R
Volume (veh/h)			*8*	*32*		*0*	*0*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*28*		*43*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*0*		*76*				
C (m) (veh/h)		*1580*		*1032*				
v/c Ratio		*0.00*		*0.07*				
95% Queue Length		*0.00*		*0.24*				
Control Delay (s/veh)		*7.3*		*8.8*				
Movement LOS		*A*		*A*				
Approach Delay (s/veh)				*8.8*				
Approach LOS				*A*				

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst:	*Brett Louk, P.E.*
Agency/Co.:	*SMH Consultants*
Date Performed:	*6/03/2015*
Analysis Time Period:	*5:00-6:00 pm*

Site Information

Intersection:	*Road A & Road B*
Jurisdiction:	
Analysis Year:	*2015*
Peak Hour Factor:	

Project Description: *Existing + Planned + Development PM*

East/West Street: *Road A*

North/South Street: *Road B*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*8*	*193*		*241*	*12*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*216*		*324*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*261*		*586*				
C (m) (veh/h)		*1365*		*568*				
v/c Ratio		*0.19*		*1.03*				
95% Queue Length		*0.71*		*15.99*				
Control Delay (s/veh)		*8.3*		*73.2*				
Movement LOS		*A*		*F*				
Approach Delay (s/veh)			*73.2*					
Approach LOS			*F*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development + 20 yrs PM*

East/West Street:	*Road A*	North/South Street:	*Road B*
Intersection Orientation:	*North-South*	Study Period (hrs):	*0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*8*	*193*		*241*	*12*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes	*0*		*1*	*0*	*0*		*1*	*0*
Configuration				*TR*	*LT*			
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*216*		*324*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)	*0*			*0*		
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*261*		*586*				
C (m) (veh/h)		*1365*		*568*				
v/c Ratio		*0.19*		*1.03*				
95% Queue Length		*0.71*		*15.99*				
Control Delay (s/veh)		*8.3*		*73.2*				
Movement LOS		*A*		*F*				
Approach Delay (s/veh)			*73.2*					
Approach LOS			*F*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description: *Existing + Planned + Development PM - WB Left Turn*

East/West Street: *Road A* | North/South Street: *Road B*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			8	193		241	12	
Percent Heavy Vehicles		0	0	0		0	0	0
Median Type	Undivided							
Storage	1							
RT Channelized				0				0
Lanes		0	1	0		0	1	0
Configuration				TR		LT		
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				216		324
Percent Heavy Vehicles	0			0	0	0
Left-Turn Lane Storage						
Percent Grade (%)	0			0		
Flared Approach			N			N
Storage			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		R			
v (veh/h)		261	234		352			
C (m) (veh/h)		1365	355		947			
v/c Ratio		0.19	0.66		0.37			
95% Queue Length		0.71	4.48		1.73			
Control Delay (s/veh)		8.3	32.7		11.0			
Movement LOS		A	D		B			
Approach Delay (s/veh)			19.7					
Approach LOS			C					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst:	*Brett Louk, P.E.*	Intersection:	*Road A & Road B*
Agency/Co.:	*SMH Consultants*	Jurisdiction:	
Date Performed:	*6/03/2015*	Analysis Year:	*2015*
Analysis Time Period:	*5:00-6:00 pm*	Peak Hour Factor:	

Project Description:	*Existing + Planned + Development + 20 yrs PM - WB Left Turn*
East/West Street: *Road A*	North/South Street: *Road B*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound				Southbound			
Movement	1U	1	2	3	4U	4	5	6
	U	L	T	R	U	L	T	R
Volume (veh/h)			*8*	*193*		*241*	*12*	
Percent Heavy Vehicles		*0*	*0*	*0*		*0*	*0*	*0*
Median Type	*Undivided*							
Storage	*1*							
RT Channelized				*0*				*0*
Lanes		*0*	*1*	*0*		*0*	*1*	*0*
Configuration				*TR*		*LT*		
Proportion Time Blocked								

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*216*		*324*
Percent Heavy Vehicles	*0*			*0*	*0*	*0*
Left-Turn Lane Storage						
Percent Grade (%)		*0*			*0*	
Flared Approach			*N*			*N*
Storage			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*
Proportion Time Blocked						

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*	*L*		*R*			
v (veh/h)		*261*	*234*		*352*			
C (m) (veh/h)		*1365*	*355*		*947*			
v/c Ratio		*0.19*	*0.66*		*0.37*			
95% Queue Length		*0.71*	*4.48*		*1.73*			
Control Delay (s/veh)		*8.3*	*32.7*		*11.0*			
Movement LOS		*A*	*D*		*B*			
Approach Delay (s/veh)			*19.7*					
Approach LOS			*C*					

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TECHNICAL SUPPLEMENT NO. 5

USD 378 School Site

May 2015

Zachary J. Burton

FIELDHOUSE DEVELOPMENT, INC.

I received a phone call from Riley County School Board member David Higgins on February 12, 2015, inviting me to their upcoming school board meeting on February 16th. He said the school board was considering future plans for a new school somewhere near Manhattan, and wanted me to be available to comment on future growth projections within the Riley County school district in the City of Manhattan. He specifically wanted me to be present to answer any questions about Hartford Hill. He said he was aware of the large amount of development I'd already done in Grand Mere that fell within the Riley County school boundary.

I received a call from Riley County School Board member Tom Richard on February 16, 2015, encouraging me to attend the board meeting that evening. Tom verified that he'd received the copy of the Hartford Hill master plan map that I'd sent him a couple weeks earlier. Tom had requested the Hartford Hill master plan so he could share it with fellow school board members as they considered future growth possibilities into the Manhattan area.

I attended the Riley County School Board meeting the evening of February 16, 2015, at the Riley County High School library. Eric Cattell, with the City of Manhattan Community Development Department, spoke to the board regarding new housing developments on the west side of Manhattan. He gave estimates of the number of dwelling units predicted to fall within the USD 378 boundary line: short term (1-7 years) is 768 dwelling units; long term (20+ years) is 1,268-1,368 dwelling units. Mr. Cattell specifically mentioned the Hartford Hill master plan at this meeting and indicated to the board that a school site was included. I was not asked by the board for further comment after Mr. Cattell's presentation.

I had an in-person conversation with Riley County School Board member-elect Randy O'Boyle on May 1, 2015. We spoke about the need for Riley County to expand into the Manhattan area. Randy indicated he believed an elementary school would be a likely fit. He mentioned that Hartford Hill was a possible site that was under consideration, but that others were being explored as well. He said he would know much more after he began his service on the board July 1, 2015.

Sincerely,

Zachary J. Burton
President

PLANNING & DEVELOPMENT

STAFF REPORT

Regulation Amendment

PETITION: #15-14

APPLICANT: Board of Commissioners of Riley County

REQUEST: Amend Section 6 (Procedure for Plat Approval) of the Riley County Subdivision Regulations

PUBLIC NOTICE EXCERPT:

RILEY COUNTY SUBDIVISION REGULATIONS:

<u>SECTION 6 – PROCEDURE FOR PLAT APPROVAL</u>

2. <u>PRELIMINARY PLAT:</u>

   c. ~~The Planning Board shall approve, approve conditionally or disapprove the plat within sixty (60) days of its submission by the applicant. If the preliminary plat is disapproved or approved conditionally, the reason for such action shall be stated in writing, a copy of which, signed by the Secretary of the Planning Board, shall be attached to one (1) copy of the preliminary plat and transmitted to the applicant. If no action be taken by the Planning Board at the end of sixty (60) days after submission, the plat shall be deemed to have been approved.~~ *Upon receipt of a complete application for the review and approval of a Preliminary Plat, the Planning Department shall schedule the application for Public Hearing before the Riley County Planning Board. After such Hearing date has been established, the Planning Department shall proceed with the publication of a public notice for a Public Hearing before the Planning Board, as prescribed herein.*

   d. ~~The approval of the preliminary plat by the Planning Board does not constitute acceptance of the subdivision by the County Commission, but is merely an authorization to proceed with the preparation of the final plat.~~ *The Planning Board shall conduct a Public Hearing on any application for a Preliminary Plat. A Notice of Public Hearing shall be advertised once in the official County newspaper and at least twenty (20) days shall elapse between the date of publication and the date set for the Public Hearing. Such notice shall state the date, time and place of the Public Hearing and a general description of the proposed subdivision.*

   e. ~~The approval of the preliminary plat plan shall lapse unless a final plat plan based thereon is submitted within one (1) year from the date of such approval unless an extension of time is applied for and granted by the Planning Board.~~ *Notice of the Public Hearing shall be mailed at least twenty (20) days before the hearing to all owners of record of land within* *one thousand (1,000) feet of the area proposed to be platted. If the area to be platted is located adjacent to the City's limits, the area of notification shall extend two hundred (200) feet into the incorporated area.*

f. The Planning Board shall approve, approve conditionally or disapprove the plat within sixty (60) days of its submission by the applicant. If the preliminary plat is disapproved or approved conditionally, the reason for such action shall be stated in writing, a copy of which, signed by the Secretary of the Planning Board, shall be attached to one (1) copy of the preliminary plat and transmitted to the applicant. If no action be taken by the Planning Board at the end of sixty (60) days after submission, the plat shall be deemed to have been approved.

g. One (1) copy of the preliminary plat plan will remain in the Planning Board's files and the other will be returned to the subdivider with any notations specified at the time of approval or disapproval and any specified changes required.

h. The approval of the preliminary plat by the Planning Board does not constitute acceptance of the subdivision by the County Commission, but is merely an authorization to proceed with the preparation of the final plat.

i. The approval of the preliminary plat plan shall lapse unless a final plat plan based thereon is submitted within one (1) year from the date of such approval unless an extension of time is applied for and granted by the Planning Board.

5. <u>REPLATTING:</u>

Following approval of a Final Plat, a subdivider may at any time, submit an application for a Replat of all, or a portion, of the parcel controlled by said Final Plat. An application for a Replat shall be treated in the same manner as a Final Plat, except that when any plat or part thereof or street, alley or other public reservation, including, without limitation, easements, and/or access control, whether established by instrument, condemnation or earlier plats, is proposed to be vacated through replatting, written notice shall be given to all persons having property rights or interests affected by such Replat. Any plat or part thereof or street, alley or other public reservation, easement, and/or access control proposed to be vacated through a replat shall, upon filing of the replat with the Register of Deeds, be vacated both as to use and as to title without any further proceedings. Streets, alleys or other public reservations which may be vacated shall revert, as provided in K.S.A. 12-506 and amendments thereto.

BACKGROUND: The Riley County Planning & Development Department has recently received two separate applications requesting to replat several lots that also involve vacating utility easements and perhaps an unimproved road. Currently, due to statutorily required language missing from the Riley County Subdivision Regulations (but included in the Manhattan Urban Area Subdivision Regulations), this request must be completed in two, three or four separate petitions, depending on the circumstances. This is very costly and time consuming for the citizen. The proposed amendment would be consistent with the language found in K.S.A 12-512b, which states that in any area where there is a planning commission which has adopted subdivision regulations governing the platting or replatting of land, and the regulations provide for the giving of appropriate notice to all persons having property rights or interests affected by the platting or replatting, any plat or part thereof or street, alley or other public reservation, easements, dedicated building setback lines, and access control, may be vacated through the replatting process. Thus, the proposed language would allow the present multi-petition process to be reduced down to a one-petition process.

STAFF RECOMMENDATIONS:

Staff recommends that the Riley County Planning Board forward a recommendation of approval to the Board of County Commissioners amending Section 6 (Procedure for Plat Approval) of the Riley County Subdivision Regulations, as published.

POSSIBLE MOTION(S)

ACTION NEEDED:

A. Move to forward a recommendation of approval to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Subdivision Regulations as published.

Or

B. Move to forward a recommendation of approval to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Subdivision Regulations with the following changes:

Or

C. Move to forward a recommendation of denial to the Board of Commissioners of Riley County of the proposed amendment to the Riley County Subdivision Regulations as published.

Prepared by: Bob Isaac, Planner
August 31, 2015