Douglass Square Infill Development

of Champaign County, IL



Included analysis:

- Neighborhood Context and Opportunity
- Pro Forma Estimation
- Stormwater Calculations
- Stormwater Management and Green Infrastructure
- Urban Design Paradigms
- Street Pattern and Design

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Executive Summary

The Douglass Square site in Northeast Champaign has significant potential for earning a profit if developed as an infill residential lot. Specifically, multiuse, high-rise apartments and single family homes are proposed in a design vision that brings livability to prospective residents. To outline the success of this proposed infill development, this report covers various topics: site context, economic feasibility, stormwater calculations, stormwater management and green infrastructure design, the overall vision for the site, and the street layout.

When researching site context, it's shown that the surrounding neighborhoods have many low-income residents. So in order for a developer to avoid backlash from residents and activists, the site should include affordable rental units and homes mixed in with higher income properties. Developing the site in-line with Campustown style development (high-rise, multiuse buildings) looks promising due to the site's proximity to the University of Illinois campus.

A pro forma in this report shows the site as economically feasible if developed in this manner. Two scenarios are given where the rental units are 70% occupied (optimal) and 30% occupied (suboptimal). The optimal scenario is the only realistic version. This is due to the high rental occupancy rates in Champaign county. Thus, development of the site can be confident in generating income due to this high occupancy rate and to developing in high-rise apartments. Multiple floors means more rental units can fit in a single plot of land.

This report includes calculations of stormwater runoff from different scenarios such as pre-development, farmland, development with green infrastructure, and conventional development, which give an overall understanding of how development should occur. It shows that cropland and conventional development that uses many impermeable surfaces is poor for stormwater management. Using green infrastructure BMPs can significantly reduce stormwater runoff. Thus, a site that uses green infrastructure is the best scenario when considering site design.

Also included in this report is the type and location of green infrastructure BMPs. It's important to use these elements to the greatest effect on the site. Rain gardens, bioswales, swales and technologies such as silva cells and CU soil were used in sit design to capture and filter stormwater. These also can be viewed as amenities. For instance, a bike trail follows the central swale of the site.

Not only is green infrastructure design important for the site's design, but an overall vision should be achieved that improves the livability and eco-friendliness of residents. The paradigm that was followed is the LEED for Neighborhood Development rating system. This allows for a developer to achieve credits and advertise that he has done so in areas of walkability, street connections, and creating lively public streets and plazas.

Finally, a layout of the street pattern is included to give an overall framework to the design. It's important to have a hierarchy of streets. For instance, a collector road through the middle of the site takes travelers from their homes to the site periphery. Residential streets have a lower speed limit and offer sidewalks, protected from travel lanes through vegetative buffers. The plaza street type is free from cars and thus can incorporate more creativity and site amenities such as a bioswale, parklets, and benches.

A master plan was created that incorporated the best ideas from these elements.

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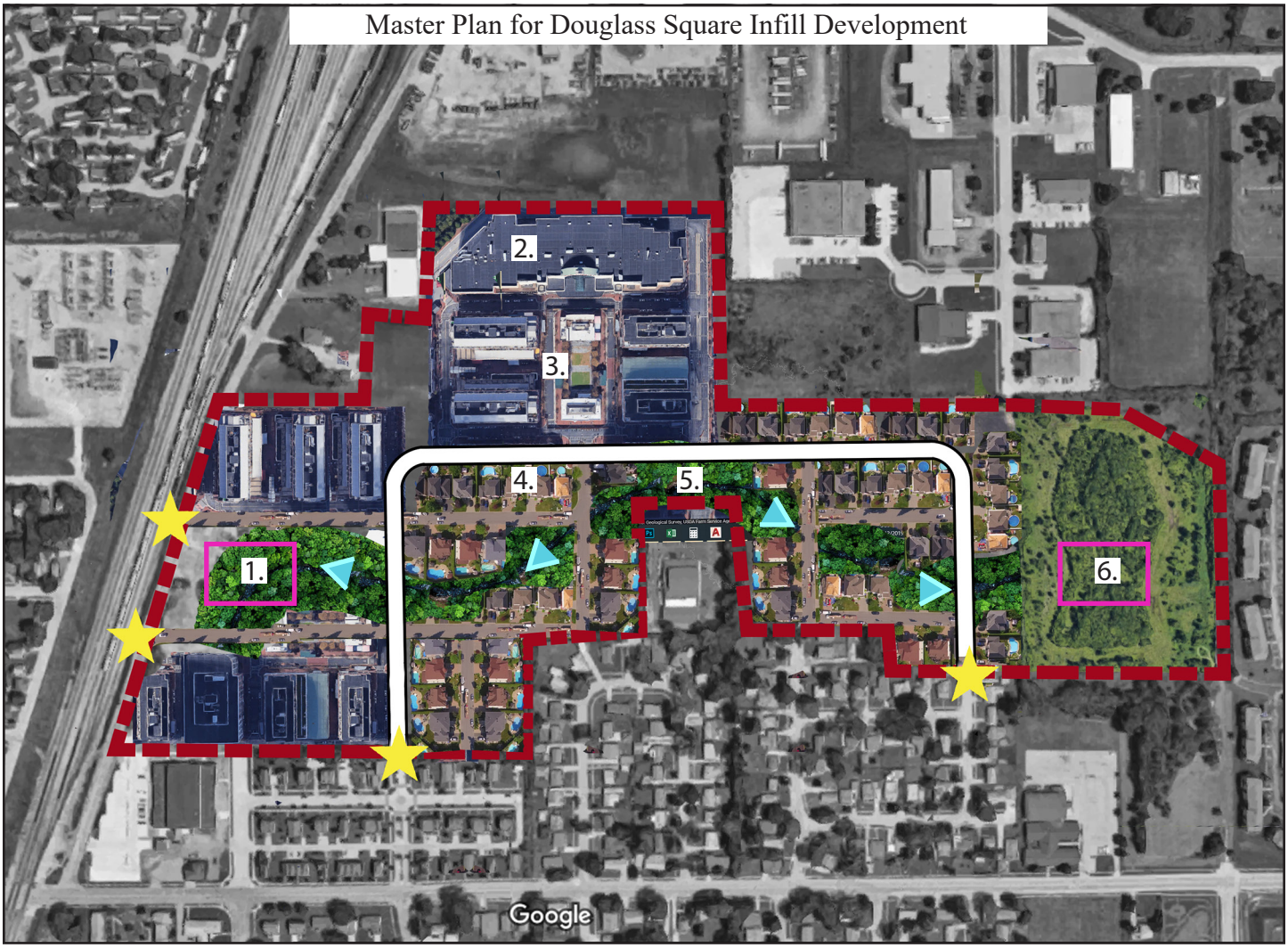


Project Description and Master Plan

The Douglass Square site is located in Northeast Champaign and is largely an abandoned commercial area that has been converted into green area over time. It is a prime spot for developing mostly residential buildings, since these have been successful in the area due to the draw from the University of Illinois (UIUC) nearby.

See the Master Plan below for the following description. There are 11 multiuse buildings that include groundfloor retail and upper floor apartments. A central shopping plaza lies in the middle of the north building block. Single family homes are small and keep with the character of the adjacent neighborhood to the south. A large swale runs through the middle of the site along which a bike path runs to the park preserve to the east, which will also include trails. A collector road in white brings residents outside of the site, while residential streets allow traveling to one's home. Sidewalks are included on all streets and connect to each other and to off-site sidewalks. The street network also connects to streets off-site. The report following this master plan justifies and details the selection of design elements that form the plan as a whole.

Master Plan for Douglass Square Infill Development



Ex. Storm Sewer Connection

Collector Road

Stormwater Flow Direction

Detention Basins

Scale: 1″ = 500′ - 0″

0′ 250′ 500′ 1000′ 1500′ 2000′

N

1. Detention Basin 2. Multiuse Buildings 3. Plaza
4. Single Family Residential 5. Swale Highpoint 6. Preserve

First, the report examines the social, econimic, and demographic context of the site and adjacent areas.

Douglass Square Infill Development Location



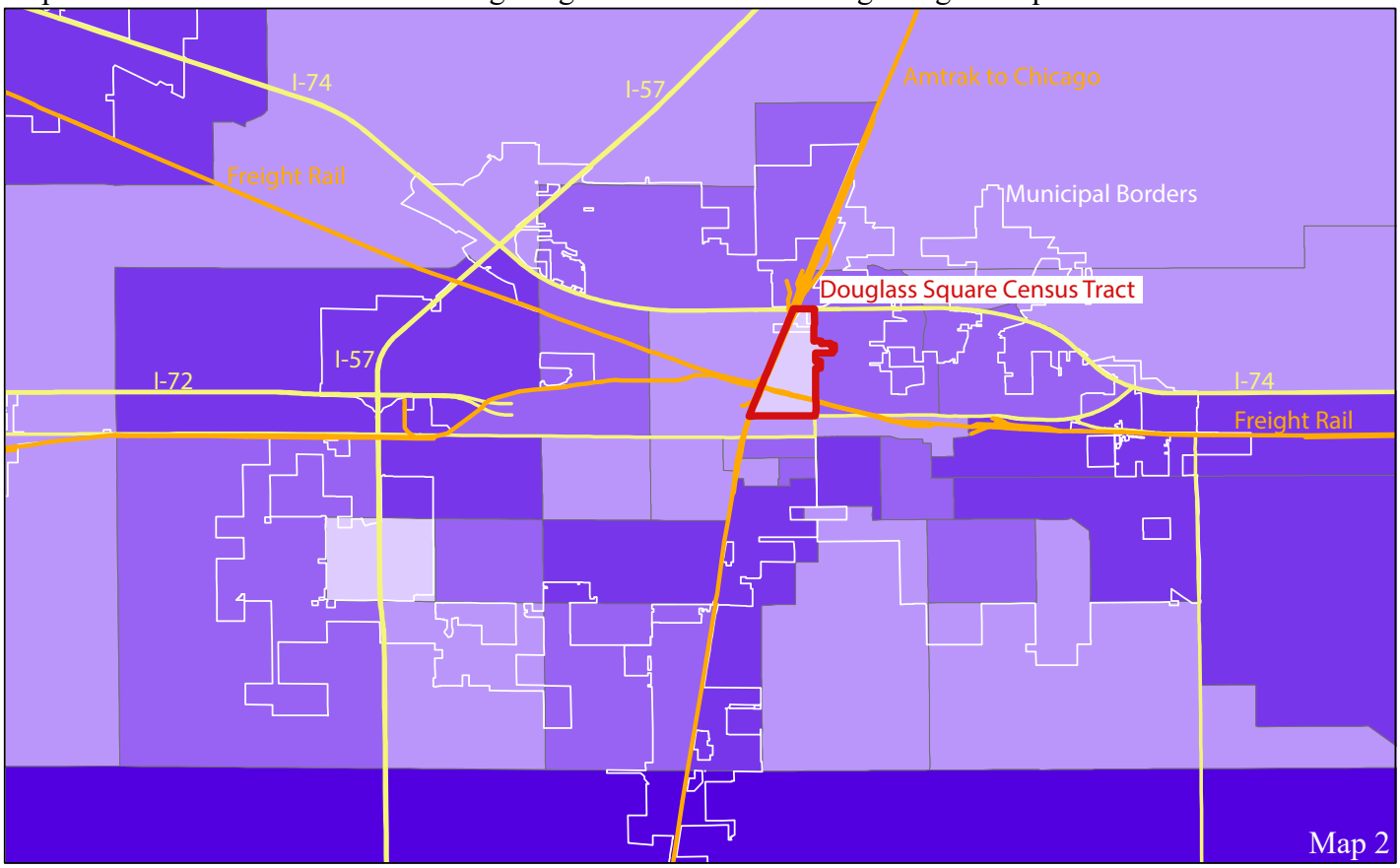
Location & Introduction

Douglass Square is a 47.5 ac site (see map 1) in north Champaign located just south of the intersection of the Amtrak line and I-74. This report will outline the strengths, weaknesses, opportunities, and threats to developing infill residential here.

Strengths

Perhaps the greatest strength is the population distribution of adjacent neighborhoods. Although the tract that includes Douglass Square only has 1,693 residents, areas close by range from 4,000 - nearly 7,000 people (see map 2). This indicates the area is developing well and Douglass Square remains a pocket of vacant land that would fit well into a larger density of surrounding tracts if developed into infill residential housing.

Population Distribution of Surrounding Neighborhoods Surrounding Douglass Square



Census Track Population:
- 1,690 - 1,830
- 1,831 - 3,930
- 3,931 - 5,060
- 5,061 - 7,140
- 7,141 - 9,300

N

0 .75 1.5 2.25 3 6 Miles

Scale: 1:100,000

Source: U.S. Census Bureau

Strengths (Continued)

Social Explorer lists the median age for the Douglass Square census tract as 28.6 for males and 34.5 for females. Seventy-six percent of the residents are African American while 21% are Caucasian. This indicates residents who are old enough to hold purchasing power to rent or own apartments, condos, or homes on small lots characteristic of infill developments. Yet, the surrounding neighborhoods are small, single family residential homes, so perhaps this type of development is in line with neighborhood context. According to Zillow, the homes in adjacent neighborhoods are affordable: around 1,000 sq. ft. of space sells for 55k - 65k. So, homes that are approximately an equivalent size and price would sell well.

Weakenesses

The medium income for the area is shown in the chart to the right. As around 70% of households make less than 35,000 per year, this indicates most of the census tract is at or below the federal poverty level. Yet, the unemployment rate was less than 5% in 2016, according to HUD. So, many residents are employed in menial-wage jobs. Thus, constructing homes at any price point and expecting them to sell will be challenging. Apartments constructed would have to be affordable, constructed at a lower price point.

Census Tract 2, Champaign County, Illinois	
Households: More than $10,000	83.78% 656
Households: More than $35,000	30.52% 239
Households: More than $100,000	2.94% 23
Households: More than $200,000	0% 0
Percent base: Households:	783

Table from Social Explorer

Opportunities

The low median income could be looked at as an advantage. Constructing homes or apartments with an affordability mechanism built in would be promising. This might include constructing small, single family homes in line with the neighborhood or including affordable, subsidized condos or apartments, such as with government vouchers. These could be mixed in with higher priced units in the same buildings to provide more return on investment. Providing affordable homes or apartments helps fight gentrification. If only expensive apartments or condos such as those of Campustown were built, property taxes would escalate and neighbors of Douglass Square would be priced out of their own homes.

A large opportunity for selling or renting homes in Douglass Square is its proximity to the University of Illinois and the Amtrak train line. The college attracts students, faculty, staff, and retirees looking for an exciting, affordable town. Commuters to campus and even to Chicago can cycle to work, as the train station is less than a mile away and campus is ~1.5 miles away. Perhaps parking requirements can be reduced due to this opportunity.

Threats

The residents suffer from a range of social issues, which may make owning and renting property more difficult. Zillow lists a number of foreclosures in the area. The Opportunity Atlas lists the area's incarceration rate as a high 5.9%, the teen pregnancy rate as 50%, percent married as 5.1, and the percent of single parents as 76%. This will make it difficult to residents to continually pay taxes and mortgage payments to avoid tax liens and foreclosures. Another large threat is that while job density (the availability of jobs) is higher in surrounding tracts, ranging from 1.5k/mi to to 9.5k/mi, jobs density of the Douglass Square tract is only 282/mi.

Overall, the college presents an important draw for people outside of the adjacent neighborhoods wanting to buy or rent homes in this tract . While there would be challenges to selling or renting expensive homes to existing neighbors, doing so at affordable rates would curb gentrification and could generate a mix of incomes.



Pro Forma Analysis

Now that the context of the site is established, it's important to consider which type of construction is profitable for developers.

Development Concept

Douglass Square is to be developed with large, mixed-use buildings of 1,647,400 sq. ft. of apartments and commercial spaces (706,000 sq. ft. of retail and 91,370 sq. ft. offices. See the "Typical Building Mix" image below for a conceptual, vertical model. Retail on the 1st floor of the buildings will create street interest (see "Street Interest" below). There will also be small houses on .25 acre lots, equivalent to neighboring development to the south (see "Neighborhood Context"). Allowing only small homes will preserve affordability for this low-income neighborhood. Also, a certain percent of apartments in the mixed use buildings should be made affordable in regards to the area median income and be given to qualifying low-income people. In total, 82% of the site is developed, with leaving ~8 ac for green space.

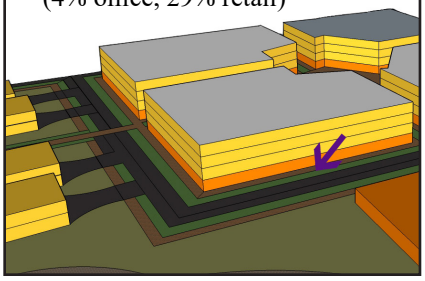
Neighborhood Context



Typical Building Mix:

Residential (67%)

Commercial (4% office, 29% retail)



Street Interest



Pro Forma Introduction

A pro forma was used to assess the costs, revenues, and incomes for this development style. Two scenarios for ROI, optimal and suboptimal, are contrasted. Developing vertically allows for a greater diversity, density, and profit of uses. The ground floor of the multiuse buildings is reserved for retail space. Limited office space is available and the upper floors are dedicated to apartments. Overall, from this development style, the developer can expect a solid return on investment.

Costs

Costs are broken down into construction and operating expenses. For land acquisition of the required 46.6 ac, the developer would pay $3,495,000. The construction of office space, being the least percentage of total use, is $5,697,074. Construction costs for retail and multifamily residential are $24,481,152 and $92,300,000 respectively. There are homes on small lots, and the construction costs for these are $1,360,000. In total, the construction costs are $127,333,226. By allowing more retail than office space, the construction costs are also lowered. This is due to office construction costs being $124.70/sq. ft., while retail costs are only $46.12/sq. ft.

Operating costs should also be factored into the return on investment. For office space, the first year operating costs are $296,960. The operating costs for retail are $3,444,828 for the first year and the costs for the apartments are $6,589,600, also for the first year. Thus, the total operating costs for the first year are $10,331,388. Although the operating expenses seem high, the income from reasonably occupied units will see the return on investment consuming the operating costs. Other costs to consider include any infrastructure related costs set out by the city. Yet, park space, the 8 ac of green space that is set aside, can perhaps be developed in conjunction with city interests as recreational or athletic fields and sold back to the city to maintain as a public amenity.

Revenue

Revenues take into account two scenarios, optimal, where 75% of apartments, retail, and office spaces are leased in several years and all homes sold within 4 years. There is also a suboptimal scenario, where only 30% of the mixed use units are leased within several years and only half of the homes have sold within 4 years.

By the second year for an optimal unit occupancy (75%), annually the office space will yield $1,027,939. The retail space has an annual revenue of $7,949,604 at this time, while the apartments offer $16,314,765 per year. Home sales from the single family homes will be $873,950. Thus, the **total revenue** in an **optimal scenario** is **$26,166,258**. For a suboptimal occupancy rate of 30% by year 2, the revenue from office space will be $164,470, the cashflow from retail is $3,179,841, and the revenue from apartments is $6,525,906. If only 2 home sell in a year, the cash from those sales is $349,580. Accordingly, the total revenue from a **suboptimal occupancy** rate of 30% and a situation when only 2 homes sell in a year is **$10,219,797**.

Incomes

The net operating income differs between optimal and suboptimal scenarios. The net operating income was taken from the 2nd year of operation. In an optimal scenario, the net operating income for office space is $886,769. For retail space, the net operating income is $4,994,118. The apartment space yields the most profit, and has an operating income of $9,527,477. The **total net operating income** in an **optimal scenario** is **$15,408,364** for the 2nd year.

A suboptimal, net operating income has no yield, and actually sees the developer's balance in the red for the second year. For office space, the net operating income for a suboptimal scenario of 30% occupancy is $31,770. For retail, the net operating income is -$430,692. For the apartments, the net operating income is also in the red, at -$261,382. Thus, at 30% occupancy, the developer would expect to lose **$660,304** in a **suboptimal scenario**.

Analysis

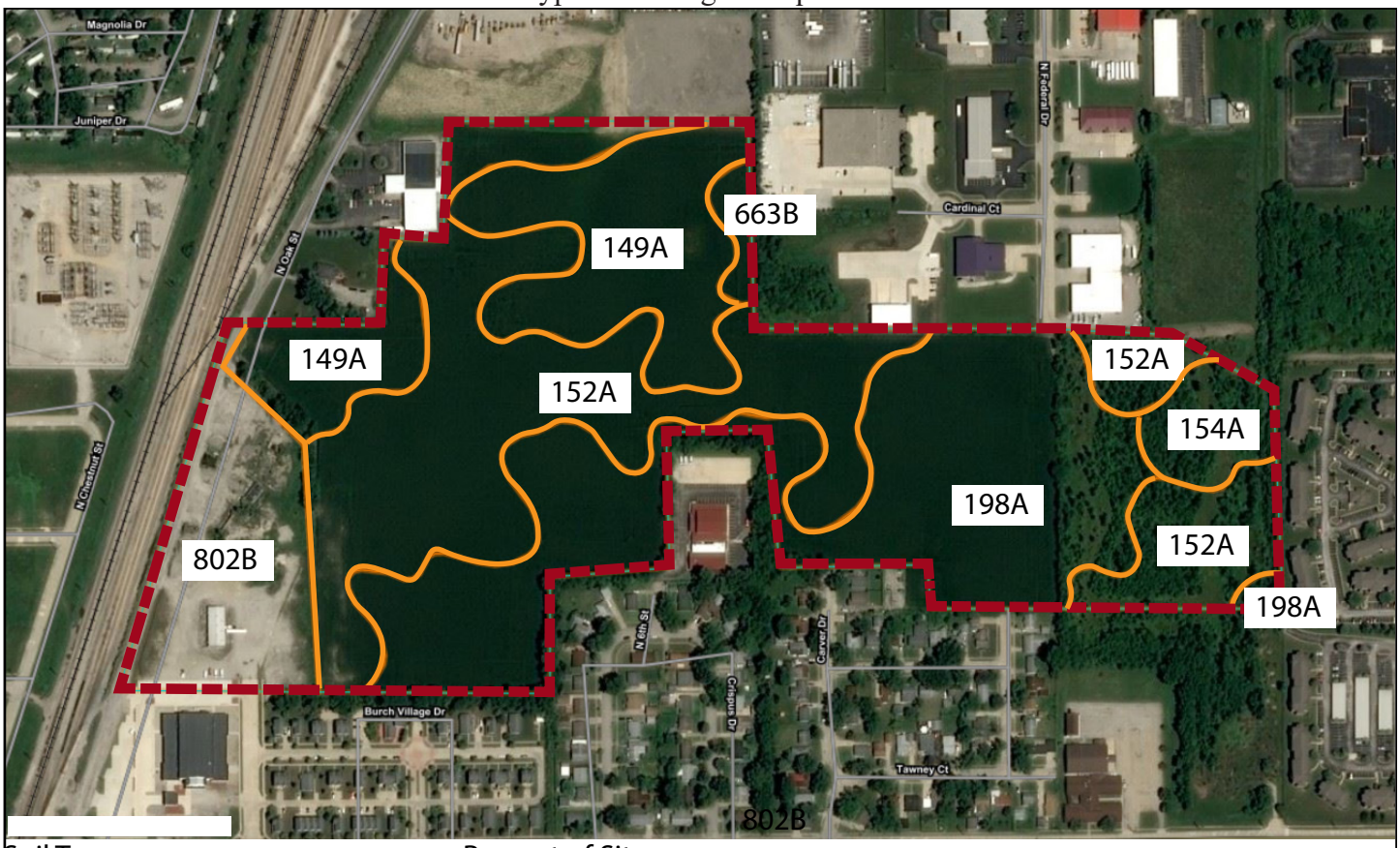
The analysis of profits for both scenarios proves that the most important factor is the leasing rates. They determine whether the project will make money or lose funds. Yet, of the two scenarios, the suboptimal scenario is not realistic if we look at market data for rentals for Champaign County. According to Devonshire Realty, Champaign retail has a 92% average occupancy rate, where Urbana has a 94% occupancy rate. For office space, Champaign has a 90% occupancy rate while Urbana has an 84% occupancy rate.

Rental housing also looks promising. According to Vogt Santer Insights, Champaign county residential rentals have a leasing rate of 96%. This includes both subsidized and unsubsidized housing, both of which are recommended since the project should include an affordability mechanism. Thus, according to market rates, the developer should expect to make significantly more than the optimal scenario presented above, or greater than **$15,408,364.** The high confidence in a large return on investment makes sense due to the University of Illinois' presence in Champaign County. Tens of thousands of students require rental housing each year, and high rise structures can make a large profit due to the ability to include many rentals in a dense space, reducing land costs. Coordination with the city should occur to ensure bus routes to campus and other infrastructure make this development attractive to students. Ground floor retail should also be tailored to attract students' business.

So, the site looks viable from an economic perspective. But how should the site design and infrastructure occur? First, the important considerations of stormwater movement and overall management is calculated.

Analyses were performed to determine the effect of ground cover on stormwater management. Specifically, in scenarios of pre-development (native, precolonial) cover, agricultural cover, conventional development, and development using green infrastructure best management practices (BMPs), the stormwater amount and rate of discharge varies. Concludingly, we see that green infrastructure BMPs significantly reduce stormwater runoff. In determining the highest infiltration rates, predevelopment is the highest. Thus, in implementing BMPs pre-development, natural land should be imitated. These might include installing rain gardens, bioswales, complete streets, silva cells and CU soil infrastructure, permeable walkways and streets, street trees, public parks and gardens, and preserving the most natural areas of the site such as forests and prairies.

Soil Types for Douglass Square Infill



Soil Type:	Percent of Site
152A: Drummer silty clay loam	35.4
198A: Elburn silt loam	31.2
149A: Brenton silt loam	17.2
802B Orthents loamy undulating	11.7
154A: Flanagan silt loam	3.4
663B: Clare silt loam	1.1

0 200 400 600 800 1000 1200 1400 1600 FEET

Scale: 1:2,830

N

Data Source: Web Soil Survey

Soil Types

Web Soil Survey was used to create the map, "Soil Types for Douglass Square Infill." The site lists the natural drainage class of each soil type (see "Soil Infiltration Rating" table below). The USDA describes a moderately well drained soil as one where "water is removed from the soil somewhat slowly [but where] soils are wet for only a short time within the rooting depth" of plants (USDA). This is the most well drained soil of the site, and is only moderately well drained. Soils in this drainage class comprise only 12.8% of the site, and the remaining soils mostly consist of somewhat poorly drained classification. In total, there is 12.8% soil of a B rating, 51.8% C rating soil, and 35.4% D rating soil.

The USDA defines this class where "water is removed slowly so that the soil is wet at a shallow depth for significant periods" (USDA). Multiple factors contribute to a soil's being poorly drained. These might include depth to the water table, the infiltration rate of the most limiting soil layer (called Ksat), and the soil texture or combination of sand, silt, and clay particles. As most of Illinois is of silt and clay soils, has a shallow depth to the water table due to its low elevation, and has few coarse, well drained, sandy soils, it's not surprising that most of the site is naturally poorly drained.

Soil Infiltration Rating

	Soil Type	Natural Drainage Class*	Soil Group Rating	Percent of Site
	152A: Drummer silty clay loam	Poorly drained	D	35.4
	198A: Elburn silt loam	Somewhat poorly drained	C	31.2
	149A: Brenton silt loam	Somewhat poorly drained	C	17.2
	802B Orthents loamy undulating	Moderately well drained	B	11.7
	154A: Flanagan silt loam	Somewhat poorly drained	C	3.4
	663B: Clare silt loam	Moderately well drained	B	1.1

Moderately well drained
Somewhat poorly drained
Poorly Drained
*Defined by USDA

Pre-Development

Precolonial Illinois was approximately 39% forest and 61% prairie. These percentages were put into meadow and forest categories in a stormwater, hydro model with respect to the site's percent of B, C, and D soil ratings. For example, the meadow (prairie) category consists of 21.594% D soil (61% of the site is prairie x 35.4% of the site is D rating) as well as B and C rating percentages. The results (see "Hydrograph for Douglass Square Infill Development") show the pre-development as having the least peak discharge (least runoff) from the site. This makes sense as natural prairie and forest infiltrate much water through plant uptake of water, plant interception of raindrops, and the rooting layer contributing to infiltration at the ground level.

Farmland

Given that the soil types yield 12.8% soil of a B rating, 51.8% C rating soil, and 35.4% D rating soil, I input these percentages into cultivated land (and for all scenarios). However, I saved 5% of land for infrastructure needed by farmers, such as their homes and the streets that run through the cropland. Of the 5%, 2% were reserved for paved parking lots and building roofs while 3% were saved for streets. When looking at the hydrograph, it's not suprising that farmland has the second highest rate of runoff. Crops such as corn provide some rain interception and water uptake, but are a poor cover for building a healthy network of root absorbtion.

Conventional Development

For conventional development, the site is split into large, multiuse buildings (59.22% of site) of the commercial/business input category, single-family homes of 1/4 ac (7.4%), infrastructure such as streets and parking for these uses (25.38%), and open space such as parks and athletic fields (8%). When viewing the results of the hydrograph, the conventional model has the highest rate of runoff and peak discharge of the site. It has more than double the discharge when looking at cubic feet per second (CFS). Conventional development involves much impermeability, such as asphalt streets, concrete walkways, and few green space such as parks or natural forest preserves. This means rain will hit the impermeable surfaces, not infiltrate, and discharge at high rates offsite.

Green Development

For green development, the site is split into large, multiuse buildings (41% of site) and single-family homes (7.4%). The streets and hardscape infrastructure (21.75% of site) are converted to permeable paver streets, allowing 85% permeability (input under 'gravel' to mimic drainage of permeable pavers). Some hardscape is also broken up by street trees. These use silva cells and CU soil, which allows permeability yet strength required by hardscape elements. The streets also include islands and walkways that are broken up by rain garden plantings. Larger bioswales are used in place of conventional grey stormwater, pipe infrastructure in recessed areas requiring water detention and infiltration. Thus, the 21.75% of the site that was previously grey infrastructure (impermeable streets, walkways) is now very permeable due to green BMPs.

There is open space such as parks and athletic fields (8%), and natural, preserved land (21.85%). Of the natural land, 11% is forest and 10.85% is prairie. The development should follow cluster development, where development is clustered to the east of the site, as this has the most existing transportation access. Also, the most natural area of the site, the lot existing grass and forest area to the east, is part of the conserved land in the cluster development. This area will provide much ecosystem services as well as increase the selling point of homes and apartments due to the propensity of new residents being able to enjoy this natural amenity. When looking at the hydrograph results, we see green infrastructure BMPs as having an enormous effect on reducing CFS runoff.

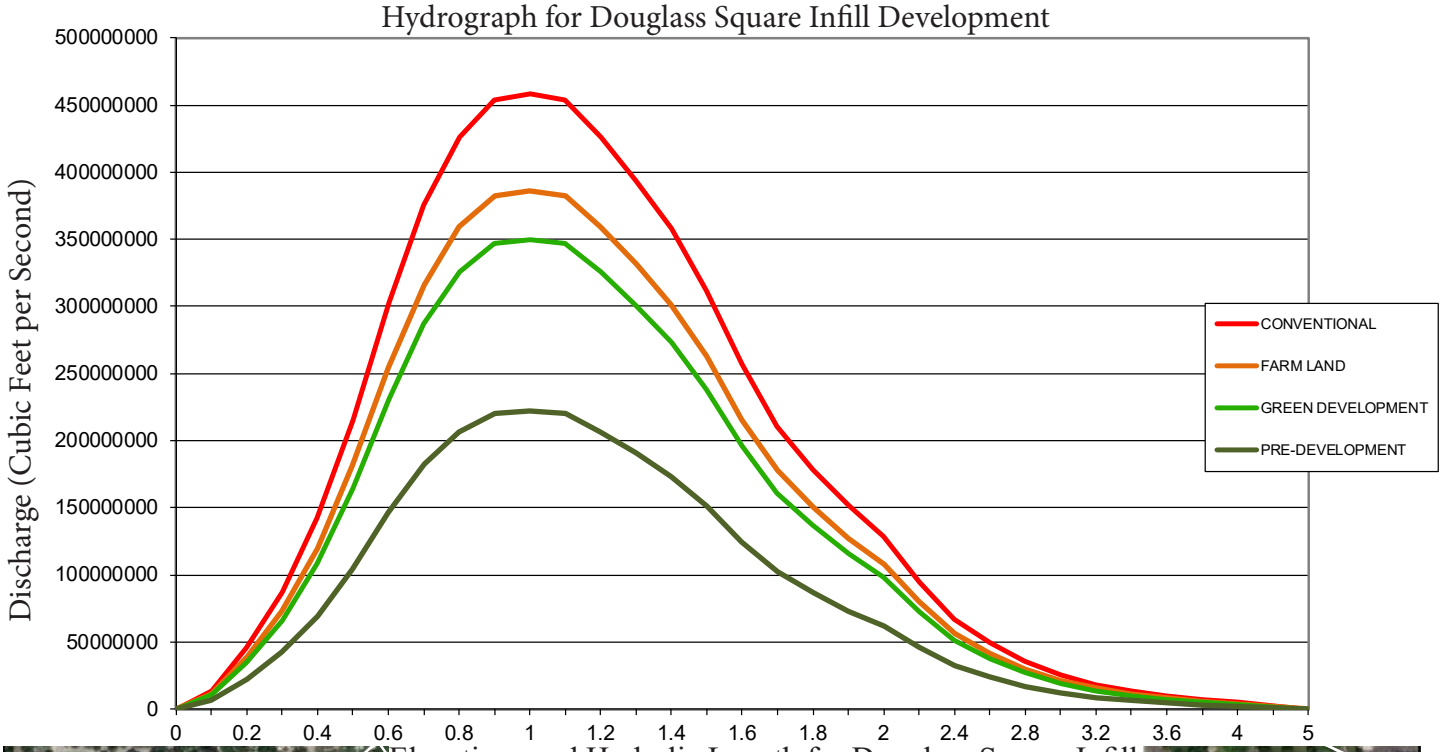
Hydrolic Length Calculation

The longest length that water could travel if it fell on a corner of the site to a lower elevation was calculated as 2,112 ft. The slope fell 3 feet over the total site area. Thus, 3'/2112' = 0.00142045 or a 0% average slope for the hydrolic path of travel. Please see the map created, "Elevations and Hydrolic Length for Douglass Square Infill".

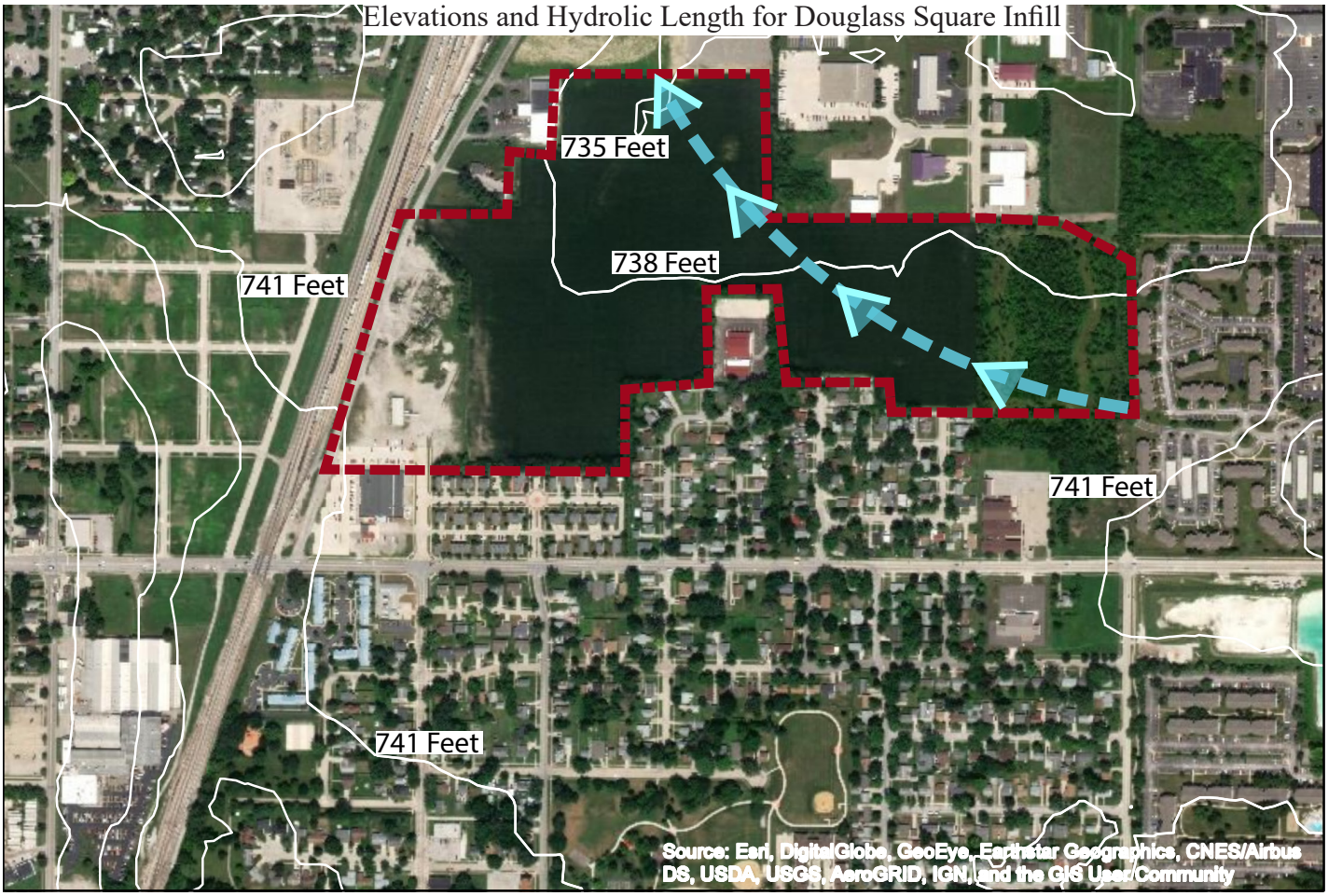
Conclusion

The implementation of green infrastructure can have great effect on reducing stormwater runoff from conventional development. The key is to allow infiltration, capture the rainfall where it falls in rain gardens, permeable paver areas, and bioswales. These smaller areas can have significant impact on infiltration. Yet the dominance of the pre-development scenario in reducing CFS discharge teaches a lesson. The best way to allow infiltration is to mimic natural areas with green infrastructure. Where possible, techniques such as cluster development which conserve large natural areas is key to capturing and infiltrating much stormwater.

Hydrograph for Douglass Square Infill Development



Elevations and Hydrolic Length for Douglass Square Infill



Hydrolic Length (2,112'):

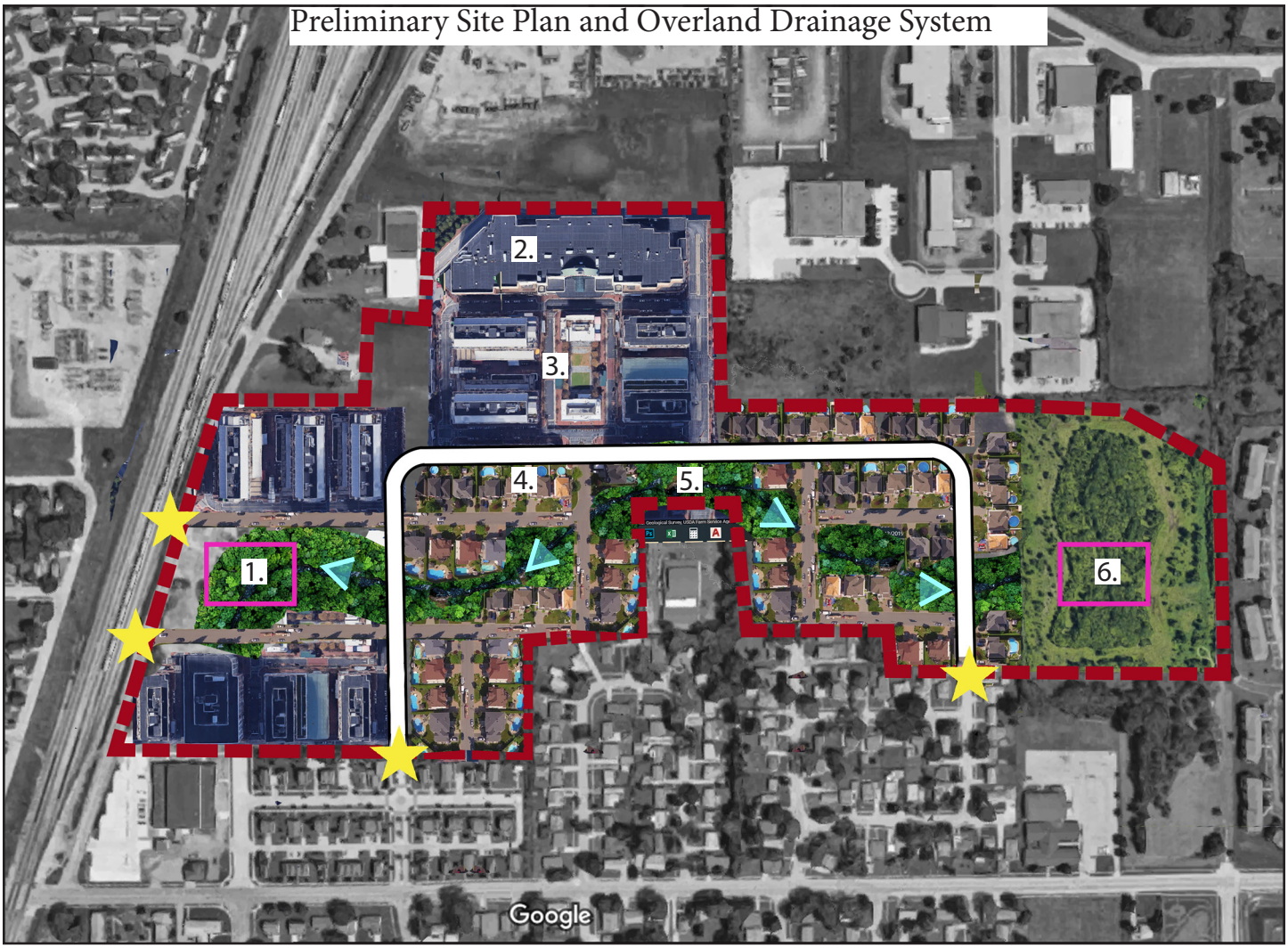
0 345 690 1380 2070 2760 Feet

Scale: 1: 8,000

N

One sees by the previous section's calculations that green infrastructure can mean a significant reduction in runoff and increase infiltration. Now that the overall justification is given for using green infrastructure in place of grey infrastructure for stormwater pipes, the next step is to locate and specify these elements on site.

Green infrastructure BMPs were employed throughout the Douglass Square infill development. These include rain gardens, bioswales, and technologies such as CU soil and Silva cells. The site design uses a large swale that interrupts the use areas and provides the major drainage system for the site. A bicycle path along the swale also adds to the concept that green infrastructure becomes an aesthetic and environmental amenity and has major benefits over using traditional, grey stormwater infrastructure systems.



The Important of Green Infrastructure for Stormwater Engineering

Stormwater involves moving water from higher to lower elevations. Ponding on streets and sidewalks can be dangerous to drivers and pedestrians, so water conveyance is important. Yet, the traditional method of moving water through grey infrastructure, such as concrete gutters, larger, impermeable swales, and simple detention ponds leaves much to be desired.

Instead this plan proposes using green infrastructure BMPs to focus on infiltration - capturing rain water and absorbing it where it lands, rather than moving it off site as quickly as possible. The latter method overwhelms streams and natural bodies of water that are downstream of outfall points of conventional grey water development. This means stream bank erosion and aquatic habitat degradation from overflow. Also, conventional stormwater systems do not clean the water. Green infrastructure allows biomaterial such as plants, soil, and rock to filter pollutants from the water before it reaches natural water bodies. Stormwater surface pollutants might include oil, gas, and auto products, lawn fertilizers and chemicals, and road salts.

Preliminary Site Plan Summary

There are several main areas to the plan: multiuse areas to the north and west, single family, 1/4 ac lots to the south and east, and a large swale that interrupts the site to convey stormwater to the detention basins. The single family residential area is close to the existing church and similar neighborhood offsite to encourage a quiet atmosphere for these neighbors. The detention basins in total require .41 ac of 3 feet depth basins (see "Detention Basin Calculations", below). This will be split between 2 basins: 1 to the west (#1 on the preliminary site plan) and 1 to the east (#6 on the plan). Number 6 will be a basin constructed in an existing turf area in the natural area here. This natural area is preserved from development and will provide ecosystem services as well as recreational opportunities for the residents.

Detention Basin Calculations

Square Feet Required	Detention Factor (ft.)	Basin Depth (ft.)	Basin Surface Size (ac)
Multiuse: 787,610	0.06667	3	0.4
Single Family Residential: 52,509	0.01666	3	0.007
Total Surface Basin Size Required:	0.41		

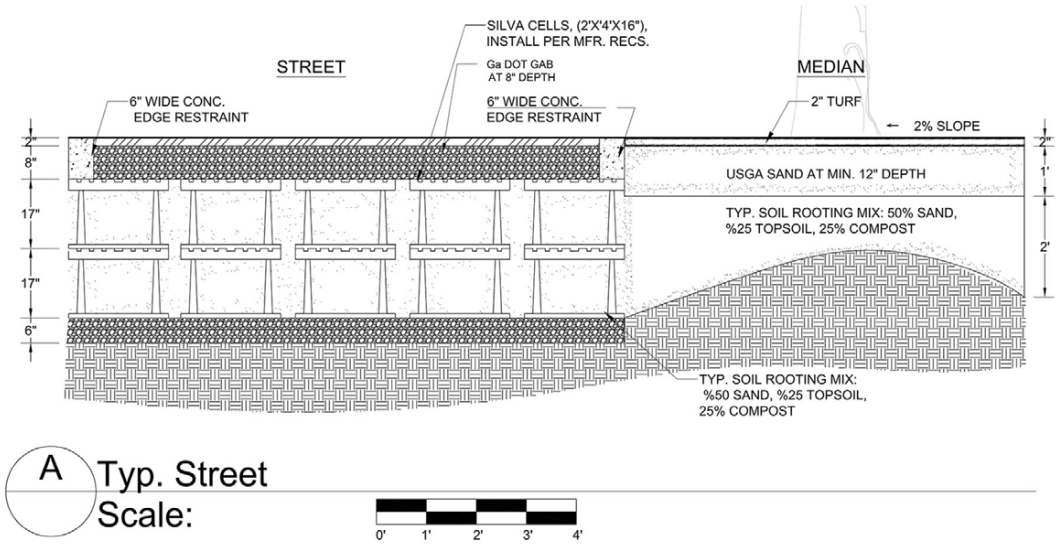
The following water conveyance summary will follow stormwater's route from small land plots throughout the site to the detention basins. For instance, several BMPs placed in the sidewalk buffer (area between the curb and the sidewalk) include rain gardens and larger bioswales. These would be effective to use in the single family residential neighborhood areas as well as the curbs of the multiuse building areas. Rain gardens and bioswales filter, purify, and capture rainwater before it is sent to the storm sewer drains (green BMPs are connected to the drains). The drain pipes along the streets drain to the central swale. This has a highpoint, which allows water to drain to the east or west, and the water then goes to the 2 detention basins. Offsite, several street connections to existing roads are starred on the map. These are also opportunities for the storm sewer pipes of the detention basins and storm pipes to connect to existing storm sewer piping beneath streets offsite.

Green Stormwater BMPs Locations

The first detail, the rain garden, can be used in many areas. For instance, it is versatile enough to be used along residential streets alongside the curb, as well as in the plaza (#3 on the plan). For example, in the plaza area, rain gardens can be used alongside visible sidewalk corridors since rain gardens beautify the street and attract shoppers. It also is a statement that the developer is "forward thinking", in using green infrastructure.

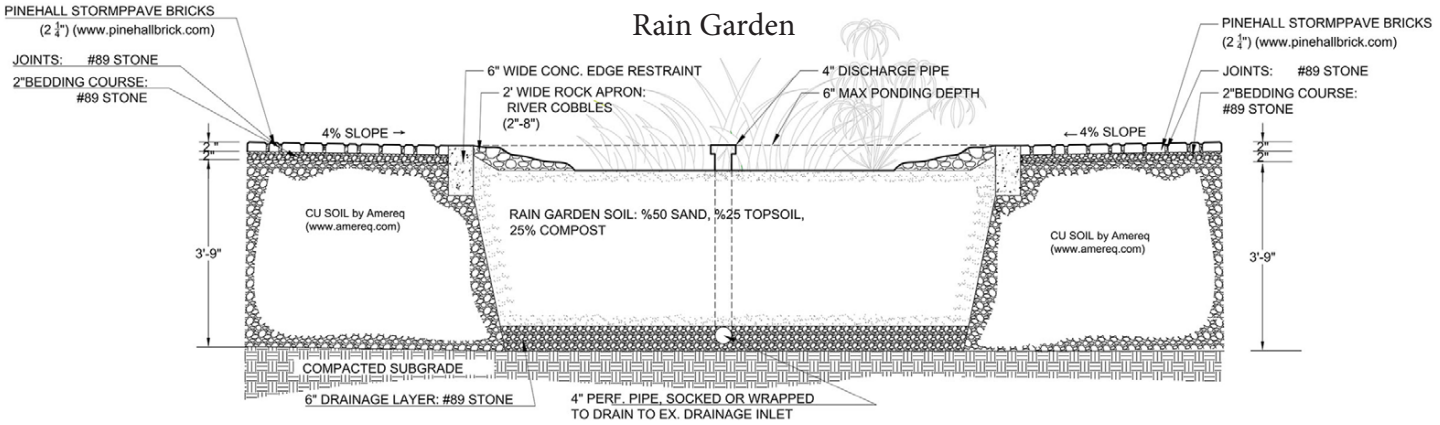
Construction Details for Green BMPs

Silva Cells



A Typ. Street Scale: 0' 1' 2' 3' 4'

Rain Garden



B Typ. Rain Garden Section Scale: 0' 1' 2' 3' 4'

Green Stormwater BMPs Functions

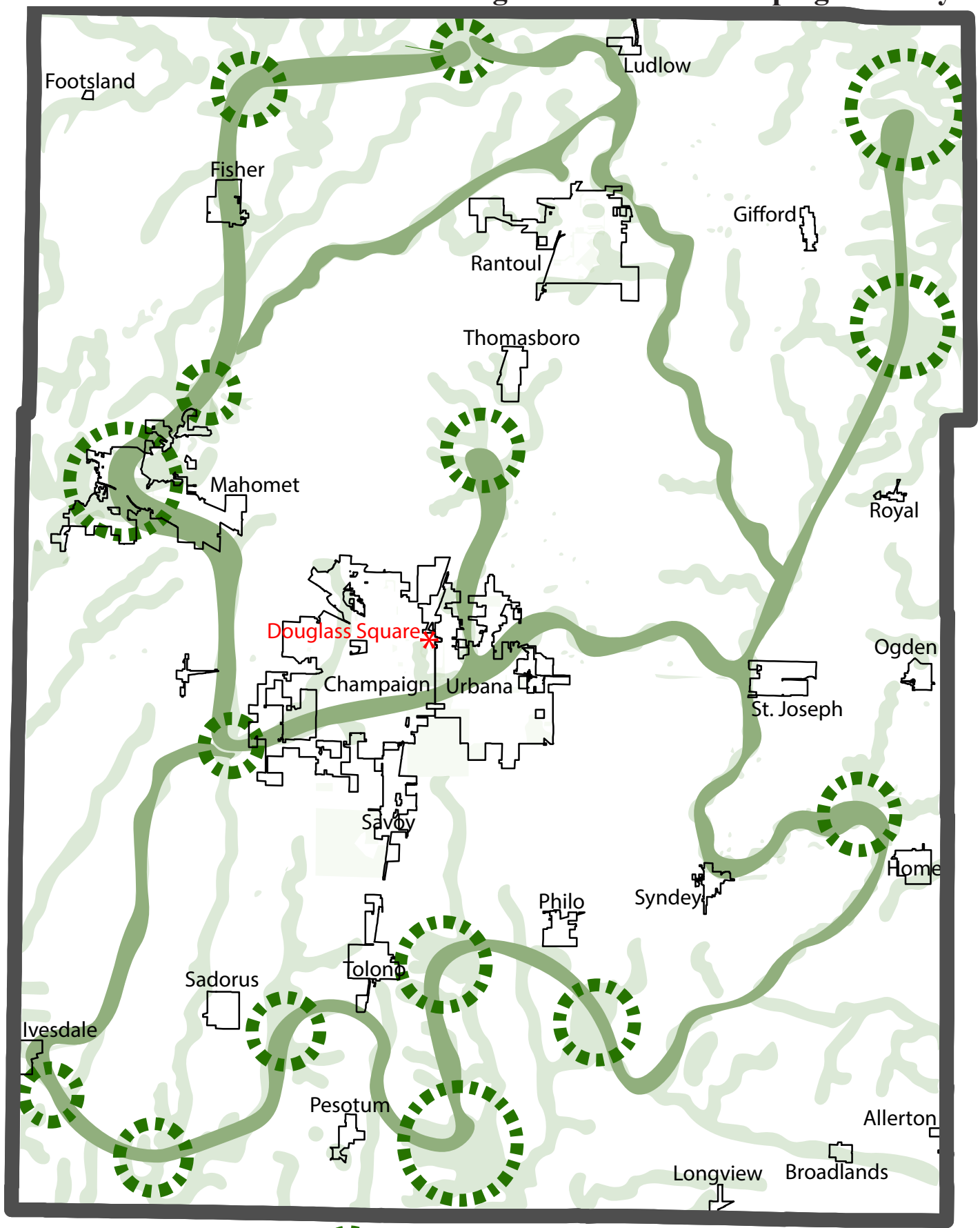
The rain garden (2nd detail above) filters surface runoff pollutants mentioned earlier and also allows infiltration. Rain gardens also add aesthetic value to neighborhood streets and plazas. They will provide habitat for birds and insects, and can aid the wildlife corridors that these fauna travel to. Silva cells and CU soil are technologies that allow structural support for vehicles or pedestrians above, a growing medium for plants, and permeability if pavers are on the surface of the subsurface CU soil or silva cell area.

Connection to Regional Scale Green Infrastructure

Refer to the following map for a description of the connection to green infrastructure at a regional scale.

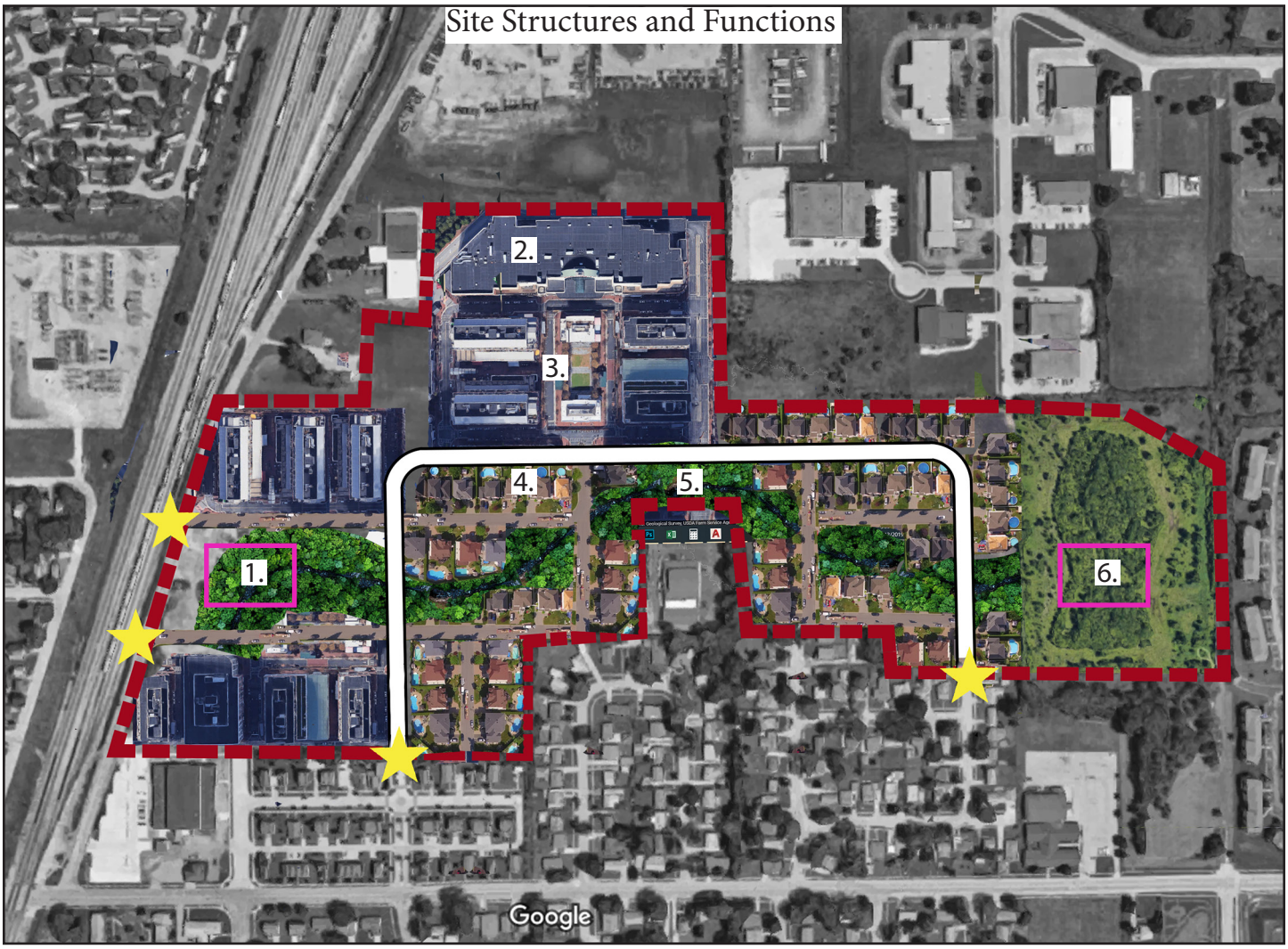
There are several offshoots of wildlife corridoors that link up to the Douglass square infill site. As such, it's important that these coridoors connect to the eastern most preserve on the site, as this is the largest area of the site that is preserved from development and offers the most ecological services.

Green Infrastructure and Ecological Areas of Champaign County



Now that it is justified to use green infrastructure and it is specified on site (type and location of green infrastructure elements), more elements of site design can be explored. A framework for how the site is designed should follow a paradigm, or vision, which allows for livability and ecofriendliness of residents.

A paradigm was used called LEED for Neighborhood Development (ND) to put form and function to the site. This rating system allows urban designers, cities, and developers to meet a certain amount of standards when designing or retrofitting a neighborhood. The LEED ND handbook has various credits that a developer may earn. Two categories include: Smart Location and Linkage (SLL) and Neighborhood Pattern and Design (NPD). Since I have my certification as a LEED for Neighborhood Development Accredited Professional, I chose this rating system to bring livability to the site design.



LEED Neighborhood Development for Douglass Square Development

The summary will describe 2 credit categories and how they are used in the site design for Douglass Square. Following the rating system allows a site to promote walkability, bike-ability, street interest, lively public spaces, and environmentally conscious design that includes energy conservation and natural area preservation.

Smart Location and Linkage (SLL)

This credit fights sprawl by encouraging infill development - redevelopment of brownfield or greyfield sites in lieu of greenfield development. When greenfields (farmland or natural forest or prairie) is developed, it takes up land that provides ecosystem services. It also is more wasteful since these lands require new infrastructure to be laid out for long distances since they are far from existing development that they need to connect to. Also, commuters driving from these satellite communities in greenfields use more gasoline each day since they must travel farther to destinations. These neighborhoods set off in greenfields have also been noted as being more isolating, providing inadequate social connection to programs and institutions of existing towns.

The site is in a prime location for SLL credits. For instance, the site is likely served by existing water and waste water infrastructure from the close neighborhoods surrounding the site. It is also an infill site, with much of the area being covered in a parking lot. It could also earn a credit for being in a location with adjacent connectivity: the square mile neighborhood to the south has about 200 intersections (street intersections) per square mile. This street grid is more efficient for drivers and produces less traffic, since there are multiple avenues to travel to one destination. It also is better for pedestrians and cyclists under the same logic. Access to jobs and quality transit are also important for this credit. Perhaps another bus route could service this area and travel to campus, where students and local residents can find employment.

Neighborhood Pattern and Design (NPD)

This credit category concerns the design of the built environment, buildings, sidewalks, streets, plazas and how they fit together to create more livable spaces. For instance, wide streets are discouraged. The building to street height ratio is measured to achieve a credit. Sidewalk accessibility is important. On the Douglass Square design, all single-family residential properties will have a sidewalk which connects them to other communities and to the commercial spaces of the multiuse areas. Residents of apartments in the multiuse areas will have access to plazas and sidewalks along the ground floor. Sidewalks along streets will connect within the site and also offsite, such as connecting to the single family residential neighborhood to the south.

Compact development and mixed uses also are incorporated in this rating system. The residential density of the multiuse buildings helps to meet this credit. The commercial uses at the base of the multiuse buildings also help contribute to street liveliness. Also, an availability of multiple types of housing is a credit. The apartment and single-family homes offer both renting and buying opportunities. The density of apartments also contributes to a reduced parking footprint. There are no large parking lots on the Douglass Square design. Instead, subterranean parking is offered in decks below the buildings.

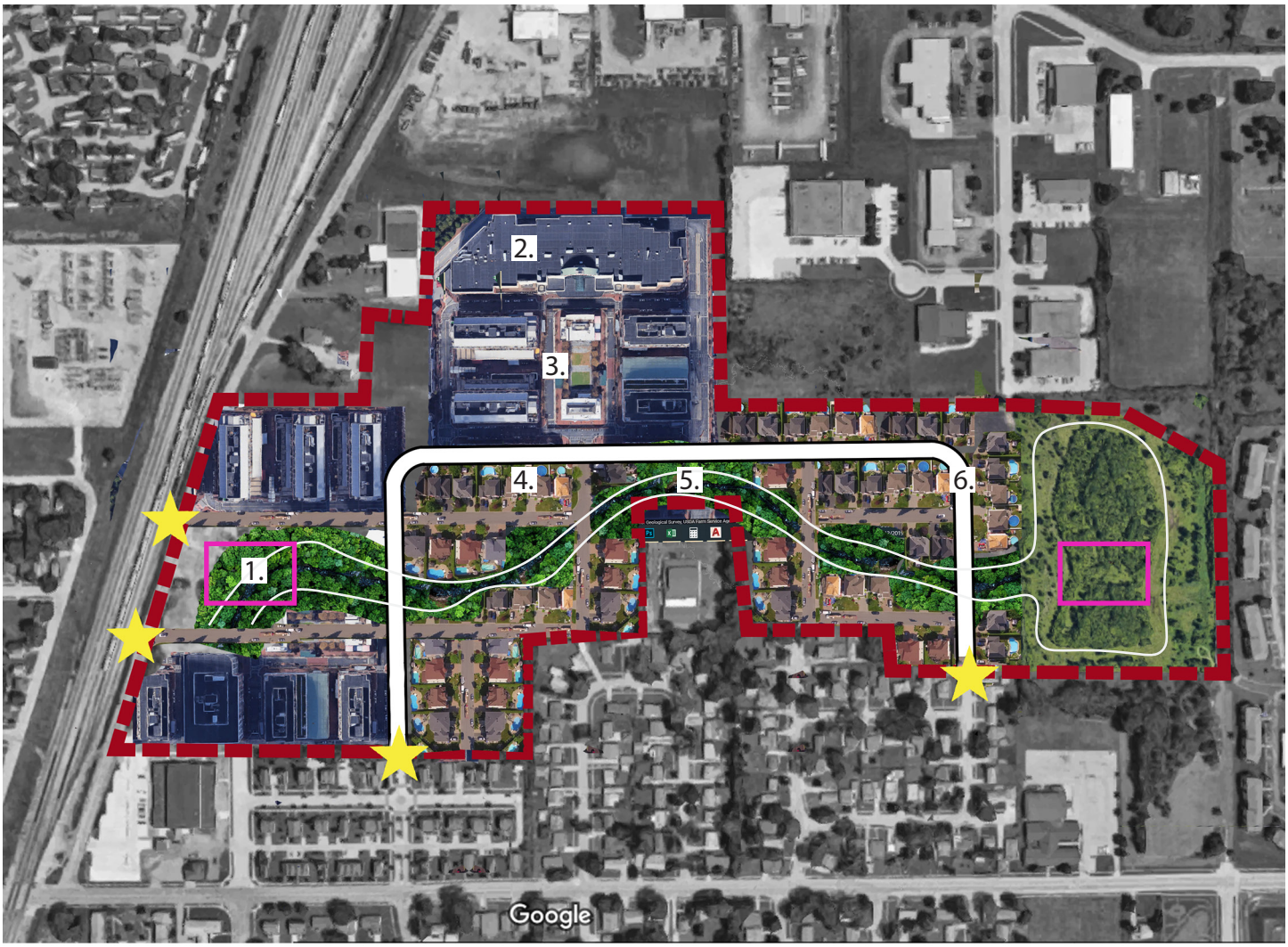
Conclusion

Consulting the LEED rating system is important to improve several factors when looking at the design of the space. Walkability, livability, and reduction of energy results when dense, non-car centric design is followed. This contributes to the improved health not only for the local residents of a neighborhood but also to the environment as a whole.

The previous section established a vision for the site that includes walkability, connectivity, and overall livability. An important consideration to achieve these goals is the pattern of streets and pedestrian paths.

The purpose of this section is to propose various street patterns and designs for the Douglass Square Infill Development. The streets are in a hierarchy and consist of the collector road, the local residential roads, plazas surrounding the shopping areas, and the multiuse trail that travels throughout the middle portion of the site. Street patterns have different functions. For example, a neighborhood street takes drivers from the collector streets to their homes. The collector streets are typically wider, and more cars may travel on a collector street as it is required for more traffic. A plaza encourages pedestrian use and increases business for ground level retail.

Street Pattern for Douglass Square Infill Development



Ex. Storm Sewer Connection

Collector Road

Stormwater Flow Direction

Detention Basins

Scale: 1″ = 500′ - 0″

0′ 250′ 500′ 1000′ 1500′ 2000′

N

1. Multiuse trail 2. Multiuse Buildings 3. Plaza street type
4. Residential streets 5. Swale Highpoint 6. Collector street

Residential Street Type

This street type is 30’ wide, consisting of **2, 15’ wide travel lanes**, with no road marking down the center. The purpose of this width is that with street, parallel parking being allowed on one side of the street, 2 lanes may still function as travel lanes. This is shown in the diagram below in 3 cars actually being able to drive side by side with this width, even though the road is only a 2-way, typical residential street. This street width is common in residential streets.

The following summary of non-street areas of the diagram below discusses elements starting from the tree buffer and moving outward towards the homes. Between the street and the sidewalk is a vegetative buffer, or street trees. Placing trees along roadways has been shown to reduce vehicle speed. The speed limit on residential streets is 20 mph. The trees will also buffer between the travel lanes and the sidewalk area, which is 6’ in width. After this there is a small yard space for the residences. Often, front yard space goes unused in single-family home residential properties, since this is the side closest to the street and lacks privacy or has safety concerns with children playing here. As such, the backyards of the lots should have a greater depth than the front yards.



Collector Street Type

Collector streets carry cars from the residential streets out towards the periphery of the site. They can range from 25 mph to 45 mph. For this design, there is one collector street that runs through the site. Since this runs through a portion of residential neighborhoods and potential multiuse trail crossings, its speed limit is only 30 mph.

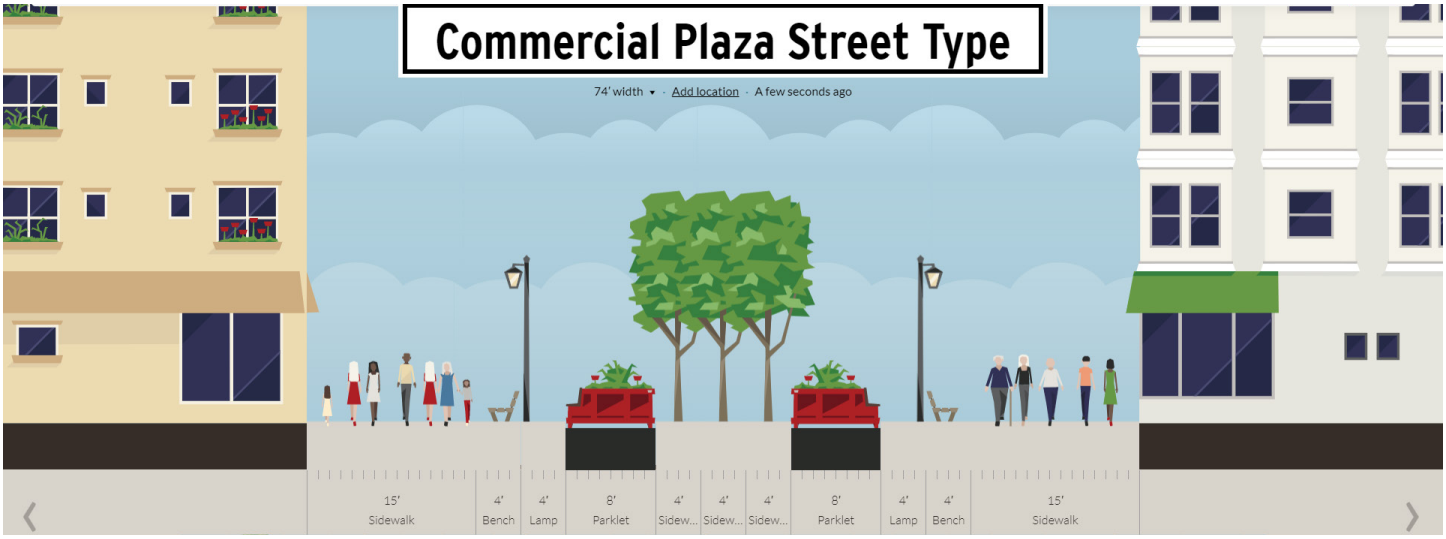
The collector street type diagram on the following page consists of travel lanes, street tree buffers, bench areas, and sidewalks. Since no street parking is allowed on the collector streets, only a 20’ width is required. This consists of 2 travel lanes. This street type has a larger vegetative buffer (street trees) than the residential street pattern. There are also benches that face a sidewalk area. The sidewalk area is furthest from the travel lanes for pedestrian safety.

This model shows two separate use areas, as the collector street runs through residential as well as commercial areas. For the residential side on the left, a larger buffer between the travel lane and the front of the home is designed in respect to the buffer width of the residential street type. For the commercial side of the model on the right, the sidewalk runs up against the wall of the building. This is to encourage street life for ground level shops. There is sufficient buffer between the street in this commercial area to be safe for pedestrians.



Commercial Plaza Street Type

The commercial plaza, #3 on the master plan, is entirely car free. It consists of a central. vegetative area with trees and natural plantings. This can also be engineered as a bioswale and depressed below the surrounding sidewalk to collect water. This is an important drainage feature which helps prevent ponding from pedestrian areas. There are also parklets under the shade of the street trees. This encourages social street life, which will also increase traffic to shops nearby. The sidewalks set up against the store fronts, also to increase shopping interest. Lastly, street lights, important to ward off crime, and benches provide needed amenities for shoppers.



Conclusion

A heirarchy of streets is important to serve multiple functions. Residential streets serve to bring people from their workplace or any other area outside of the site to their homes. The collector streets are geared more toward moving cars from residential areas to locations outside of the site, so provide for ease of traveling. The plaza street types allow for a complete pedestrian experience that also aids nearby, groundfloor commercial spaces. When designing street patterns, one has to take into account their purpose for serving the user. Yet, the purpose of streets is not only to serve human needs, but also should incorporate green infrastructure to mitigate the environmental harms that streets result in such as air pullution from car exhaust and nonpoint source pollution. This includes oil from parked cars and road salt from de-icing trucks entering stormwater infrastructure.



Conclusion

The report covered many topics for a developer to consider such as site context, economic feasibility, stormwater calculations, stormwater management and green infrastructure design, the overall vision for the site, and the street layout.

It's important to consider the context of the site. It's shown that the surrounding neighborhoods have many low-income residents. So in order for a developer to avoid backlash from residents and activists, affordability mechanisms should be built into the site. Developing the site in-line with Campustown style development (mid-rise, multiuse buildings) looks promising due to the site's proximity to the University of Illinois campus.

The pro forma shows the site as economically feasible if developed in this manner. Two scenarios were given, with the optimal scenario being the only realistic version. This is due to the high rental occupancy rates in Champaign county. Thus, development of the site can be confident in generating income due to this high occupancy rate and to developing in mid-rise apartments. Multiple floors means more rental units can fit in a single plot of land.

Calculating runoff from different scenarios such as pre-development, farmland, development with green infrastructure, and conventional development gives an overall understanding of how development should occur. It shows that cropland and conventional development that uses many impermeable surfaces is poor for stormwater management. Using green infrastructure BMPs can significantly reduce stormwater runoff.

The type and location of green infrastructure BMPs is important to use these elements to the greatest effect on the site. Rain gardens, bioswales, swales and technologies such as silva cells and CU soil were used on site to capture and filter stormwater. These also can be viewed as amenities. For instance, a bike trail follows the central swale of the site.

Not only is green infrastructure design important for the site's design, but an overall vision should be achieved that improves the livability and eco-friendliness of residents. The paradigm that was followed is the LEED for Neighborhood Development rating system. This allows for a developer to achieve credits and advertise that he has done so in areas of walkability, street connections, and creating lively public streets and plazas.

Perhaps one of the most important site design features that gives form to other elements is the layout of streets. It's important to have a hierarchy of streets. For instance, a collector road through the middle of the site takes travelers from their homes to the site periphery. Residential streets have a lower speed limit and offer sidewalks, protected from travel lanes through vegetative buffers. The plaza street type is free from cars and thus can incorporate more creativity and site amenities such as a bioswale, parklets, and benches.

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