

Natural Systems Suitability Report

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EXECUTIVE SUMMARY

The Natural Systems Suitability Report (NSSR), carries out suitability analysis for the development of an international terminal extension of the University of Illinois Willard Airport.

Two proposals are examined for natural systems suitability in terms of soil and slope, water, and ecology. The analysis for soil and slope is carried out by studying the soil characteristics and slope gradation, respectively, and representing the suitability for both on a composite map. Soil and slope are found to be relatively less detrimental thus are given the least weight.

Water suitability in terms of vulnerability to flooding is examined, with floodzones being considered as unsuitable areas for development, as per FAA guidelines. Water suitability is given a moderate degree of importance since floodzones have been avoided altogether as an unsuitable site for development. The water flow is determined to assess the degree to which movement of water would aid or hamper drainage flow. This report recommends a pump-based drainage system to compensate to account for sites located in softer soils.

Green infrastructure is considered critical infrastructure and is considered to be of the highest level of importance.

The report concludes that the new site chosen for development sits on a floodplain, and thus recommends moving forward with the plans to develop a terminal extension at Willard Airport.

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INTRODUCTION

"With more than 50,000 total students for the first time in university history, the University of Illinois at Urbana-Champaign has welcomed a record-breaking freshman class for the start of the 2019 academic year. The new freshman class is also the largest, most academically talented, and most diverse in the history of the university."

– University of Illinois at Urbana Champaign

University of Illinois Willard Airport serves as the domestic air transport facility for Champaign County. The airport is connected to 150 cities around the world, albeit with a single stop. It primarily transfers flights to Chicago O'Hare Int'l Airport, Dallas/Fort Worth Int'l Airport, and Charlotte Douglass Int'l Airport.

Champaign County as a whole, is also experiencing considerable development, particularly in the Champaign-Urbana region and Mahomet. The flagship institution of the University of Illinois system, UIUC sits at the heart of Champaign County and has always been the catalyst for the region's growth. The growth of the county is accompanied by the demand for a larger and comprehensive transportation network, to keep up with the pace of progress.

Willard Airport is a central driver of the region's economy, with \$74,325,994 worth of annual economic impact and a \$204,000 daily impact within Champaign County (Champaign County Economic Development Corporation, 2016).

Willard Airport has serviced domestic flights until now, but with the massive influx of international students at UIUC, it can be repurposed to cater international flights. The new proposed extension to Willard Airport will service international flights from global transport hubs such as London, Mumbai, Frankfurt, Dubai, and Beijing. This extension project also aims to increase the plane capacity at Willard Airport.

The Natural Systems Suitability Report (NSSR) for Willard Airport carries out a suitability analysis for the new development, in terms of soil & slope suitability, water suitability, and ecological suitability.

The analysis process for the report considered two of the following scenarios and exercised the optimal option, best suited in terms of the considered categories of analysis;

1. Development of new international terminal
2. Extension of existing terminals at Willard Airport

Champaign County Soil Suitability Map



Soil Suitability
Unsuitable Suitable

Figure 1 Soil Suitability Map

Map illustration by Shanay Patel, MUP1



SOIL & SLOPE SUITABILITY

Slope and soil suitability analysis are carried out to determine the most suitable area for the development of a new airport.

Soil influences the design of foundations and also dictates excavation efforts.

- Construction in soft soils may leave the building foundations vulnerable to settlement;
- Harder soils would need intensive excavation, often requiring heavy machinery and advanced equipment.
- For the construction of the airport, an economically feasible and workable soil is selected considering settlement risk.

For considerations of soil type, the development focuses on the workability of soil and the resulting impact on foundation costs, which are to be minimized.

Drainage problems arising due to the selection of softer soils have been accounted for by installing a sophisticated pump-based drainage layout.

The soil profile for Champaign County consists of various soil combinations, as outlined in the adjacent table.

SOIL TYPE	WORKABILITY	FOUNDATION COST	SUITABILITY
Fl-Dr-Ca	Excellent	Low	Suitable
Dr-Pl-El	Excellent	Low	Suitable
Sw-By-Mok	Good	Medium	Suitable
Va-El-As	Good	Medium	Suitable
By-Sw	Good	High	Unsuitable
Mo-BI-Be	Bad	High	Unsuitable
Mi-St-He	Bad	High	Unsuitable
Mo-Ma-As	Bad	High	Unsuitable

Drummer soil is an agricultural soil and is considered to be extremely workable (Illinois State Soil Booklet, 2017), and thus Drummer soil combinations are considered suitable for construction, applicable to this project alone.

Champaign County Slope Suitability Map

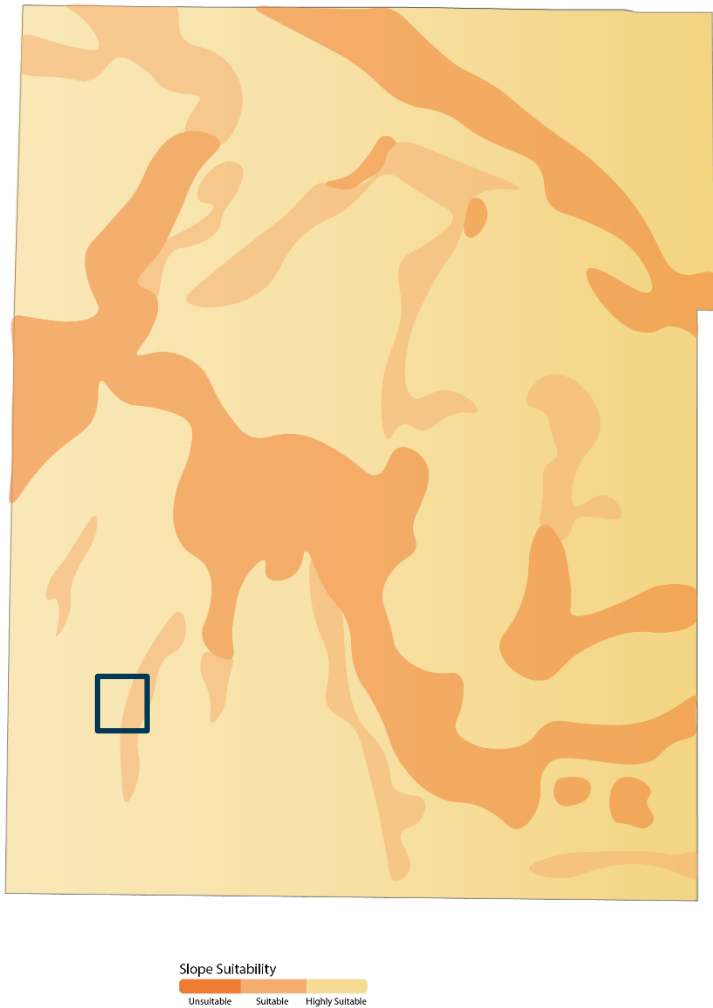


Figure 2 Slope Suitability Map

Map illustration by Shanay Patel, MUP1



SOIL & SLOPE

Slope is a critical facet in selecting a site for the construction of a new project. It often has detrimental effects on building services and overall accessibility.

The permissible slope varies for different types of development as it influences the following:

- Slope influences the design of the grade slab
- Utilities need to be laid down considering the slope of the land
- Excess slope hampers the flow of drainage
- Water supply will need pumping if it is being supplied from a source located downhill from the site of development
- Slope influences the design of the foundation, having significant impacts on costs

Considering the development of a utility airport, the slope needs to be gradual enough to allow for smooth takeoff and landing taxis for airplanes. FAA provides slope allowances for airports as follows:

1. Utility airports servicing light aircraft (shorter runways) – 2% or 1.2 degrees of slope
2. Commercial airports servicing air carriers (longer runways) – 3.5% or 2 degrees of slope

The adjacent composite map shows soil and slope suitability for Champaign County. The slope gradation ranges from 0%-0.8%, thus it is surmised from the map that the slope is relatively flat throughout the county, and has a negligible effect on the selection of the site.

Preliminary site selection is carried out based on the adjacent composite map:

The proposal for the new development can be located southwest of Willard Airport

The extension of Willard Airport is also possible southward, as shown.

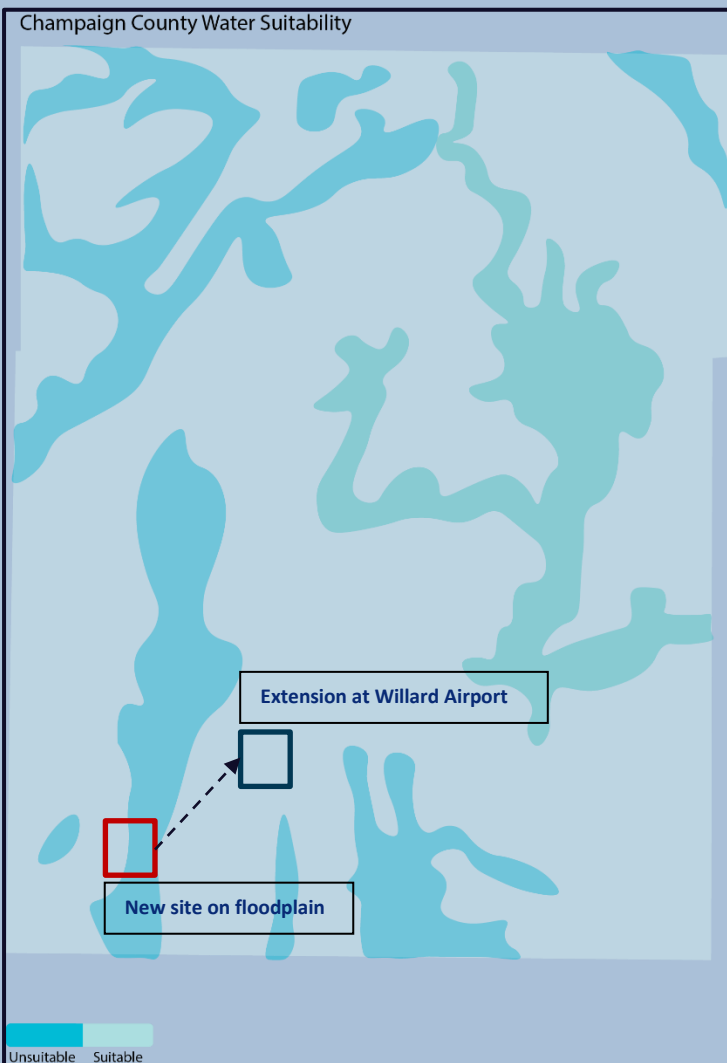


Figure 3 Water Suitability Map

Map illustration by Shanay Patel, MUP1



WATER SUITABILITY

Water suitability analysis is carried out to determine the most suitable area for the development of a new airport.

Floodplains have an adverse effect on any planned or new development. The new airport is to be situated such that it is safe from inundation and can maintain normal function in the face of water hazards, such as:

- Flooding due to excessive rainfall
- Clogging of drainage outlets
- Deterioration of structures due to moisture or salination
- Overflowing of nearby water reservoirs

Considering these factors, the new site has been foregone in favor of extending the existing terminal at Willard Airport.

The extension site (south of Willard Airport) fits the soil and slope criteria

Floodplains are avoided as per FAA guidelines

Water flow is outward hence not hampering any new development criteria

The new development location selected is shown in the adjacent map.

FAA guidelines require airport developments to avoid floodplains, if no other practical alternative exists;

1. The site chosen for the airport in Soil & Suitability Analysis sits on a floodplain; hence, the airport site must be relocated.

2. Buffer provisions are not made since floodplains are to be avoided altogether since a potentially feasible alternative location exists.

WATER

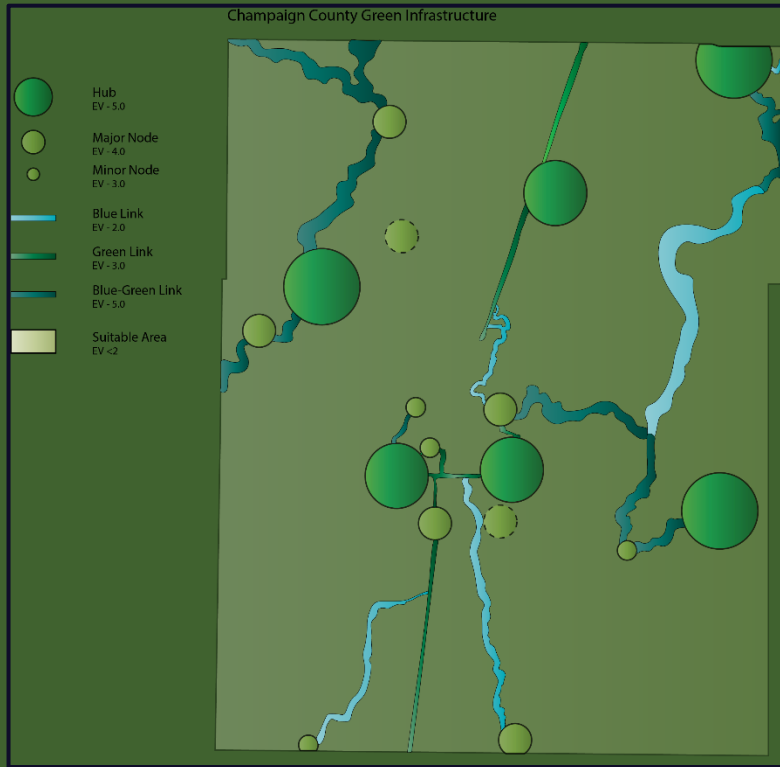


Figure 4 Green Infrastructure Map

Map illustration by Shanay Patel, MUP1



GREEN INFRASTRUCTURE SUITABILITY

This section carries out Green Infrastructure (GI) analysis in order to determine the ideal location for developing the new airport extension, without disrupting the natural environment and the surrounding ecosystem.

Green Infrastructure

Green Infrastructure is defined as “the interconnected network of land and water that supports biodiversity and provides habitat for diverse communities of native flora and fauna at the regional scale (Chicago Wilderness Green Infrastructure Vision, 2004).”

Hubs

Hubs are areas of natural vegetation, open spaces, or ecological preserves, that possess ecological value. They may include woodlands, savannas, prairies, wetlands, lakes, stream corridors, among other systems. Hubs of relatively smaller size are sometimes referred to as nodes.

Links

Hubs may be interconnected by green corridors or waterways, known as links that provide both buffers and opportunities for ecosystem restoration.

Effect of Green Infrastructure on Development

Introducing green infrastructure to supplement the existing gray infrastructure can promote urban livability and add to communities’ bottom line (EPA, 2018). Green Infrastructure systems have the following benefits:

- Water quality improvement
- Air quality improvement
- Climate resiliency
- Habitat improvement and enhanced connectivity through links/corridors (for flora and fauna)
- Better community living through parks and recreation; translates into healthy living and increased property values
- Flooding mitigation by slowing and reducing stormwater discharges

ECOLOGY

Champaign County Landcover & Floodzones

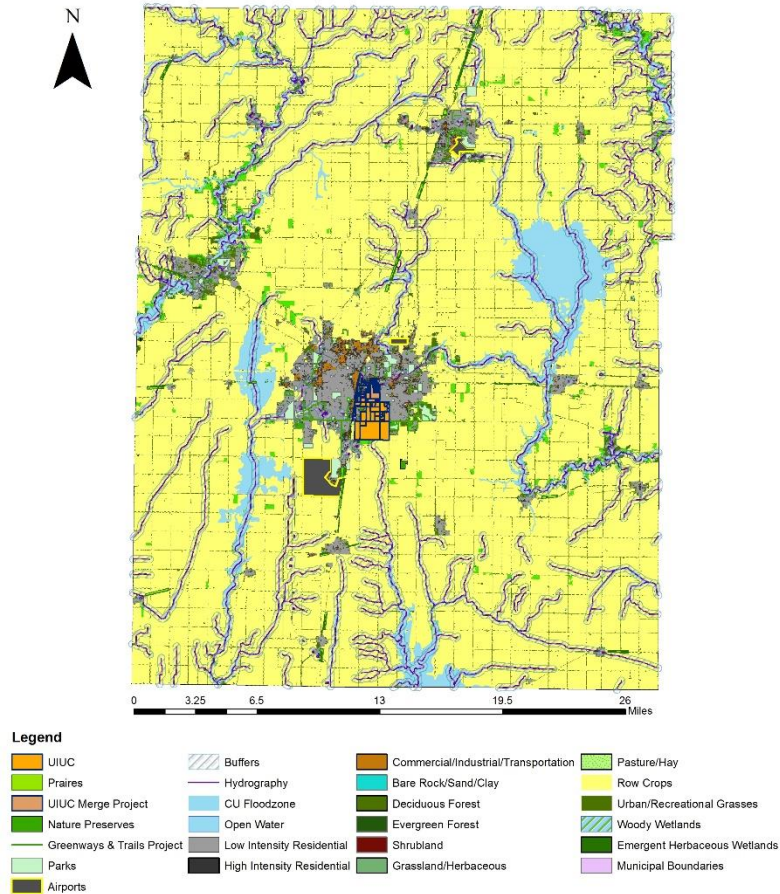


Figure 5 Landcover & Floodzones

Map illustration by Shanay Patel, MUP1



- Increase in efficiency of water supply systems

- Private and public cost savings through reduced development costs in terms of:

1. Site grading, paving, and landscaping
2. Negating the need for piping and storm-water detention facilities
3. Green-gray approaches reduce public expenditure on stormwater infrastructure

In order to preserve GI systems, prudence must be exercised in locating new developments such that they do not disrupt the existing system by breaking links or disturbing hubs and nodes.

Date & Methodology

ArcMap is used to locate existing Green Infrastructure in Champaign County. Regional hubs, nodes, and links have been identified.

Ecological Values (EV) have been assigned to the green infrastructure, in terms of ecological significance and indispensability towards preserving the environment. GI with lower EV may be considered reasonably suitable for the new development, if no feasible alternative exists, or the site is found promising in every other aspect.

The extension for Willard Airport is to be located immediately south of it. The site has been previously checked for soil and slope suitability and water suitability.

Thus, the GI analysis also serves secondarily to check that site's ecological suitability. If it is found to be of little ecological significance, the extension of Willard Airport may be carried out at the site.

Hubs, Nodes & Links

Hubs (EV – 5.0) are areas of highest EV, considered to be:

- Capable of sustaining key species and ecological processes
- Large clusters of green spaces, including parks and golf courses in close proximity

Golf courses are considered to be Green Infrastructure for this analysis, because of their excellent capacity for carbon sequestering. Golf courses are also a microcosm where all types of grass groups (fairway, green, and rough) and many intensively managed trees are found. Water bodies (hazards) also contribute to a diverse system. Golf courses also enhance the social well-being of people in the community or the city (Eriksson, Eriksson, & Ignatieva).

Nodes are smaller and of lower EV than hubs. These are isolated pockets of parks and short trail ways leading to other green spaces in close proximity.

Major Nodes (EV – 4.0): Larger in size (pockets of GI)

Minor Nodes (EV – 3.0): Smaller in size (isolated GI)

Champaign County Landcover Suitability Map

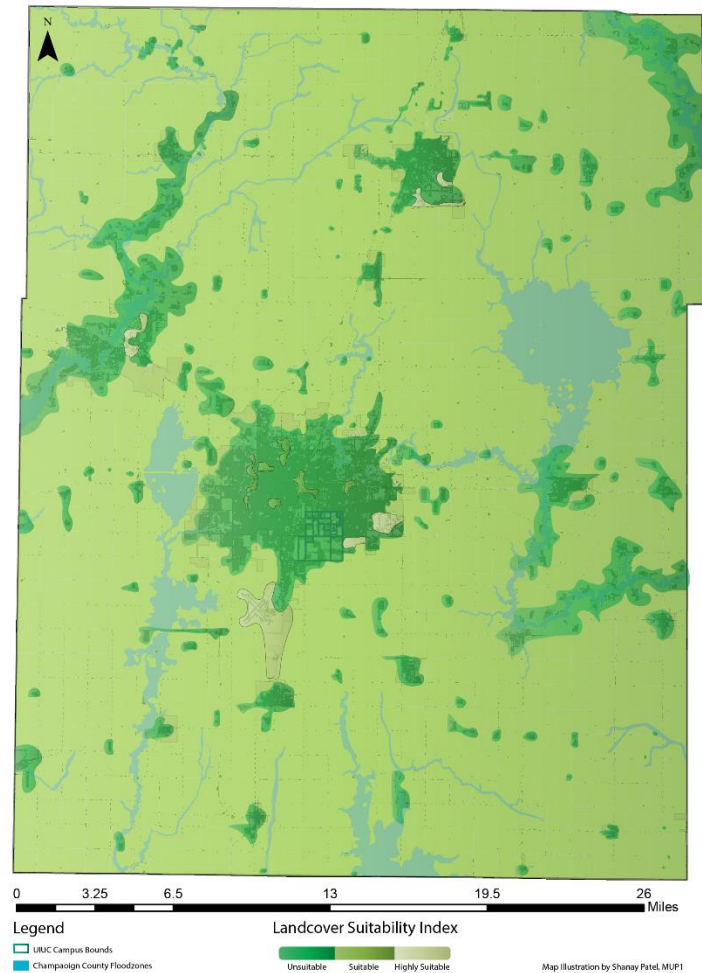


Figure 6 Landcover Suitability Map

Map illustration by Shanay Patel, MUP1



ECOLOGY

Links considered for this analysis are of three types:

- **Green Links (EV – 3.0):** Green corridors primarily consisting of trees, grasses, or prairie trails.
- **Blue Links (EV – 2.0):** Links established by Champaign County's hydrography; rivers, streams and other water bodies linking hubs and nodes
- **Blue-Green Links (EV – 4.0):** Rivers and streams augmented by green corridors or plantation clusters on their peripheries, serving as a connecting link of significant ecological importance, between hubs and major nodes.

Suitable Areas are of the lowest ecological significance (EV <2.0) and are considered suitable for development without disturbing the GI system.

Green Infrastructure Analysis

The GI analysis includes an overview of landcover and floodzones in Champaign County, in addition to GI layout and ecological value analysis. Maps include:

1. CU Landcover and Floodzones Representation Map

Unsuitable Land Covers:

- Open Water
- Low-Intensity Residential
- High-Intensity Residential
- Evergreen Forest

- Pasture/Hay
- Woody Wetlands
- Emergent Herbaceous Wetlands

Suitable with treatment:

- Comm/Ind/Transp.
- Deciduous Forest
- Row Crops (maximum land cover type; may require maneuvering local zoning ordinances for permission)

Suitable Land Covers:

- Bare Rock/Sand/Clay
- Shrubland
- Grassland/Herbaceous
- Urban/Recreational Grasses

2. Landcover Suitability (Suitability Map)

- The new airport avoids sites sitting on floodzones altogether (as per Ch12 Sec. 1 Cl. A of the FAA Guidelines).
- Landcover suitability marks floodzones but does not categorize it as either highly suitable, (suitable with treatment), or unsuitable. This is due to the aforementioned consideration of floodzones being avoided (thus unsuitable by default).

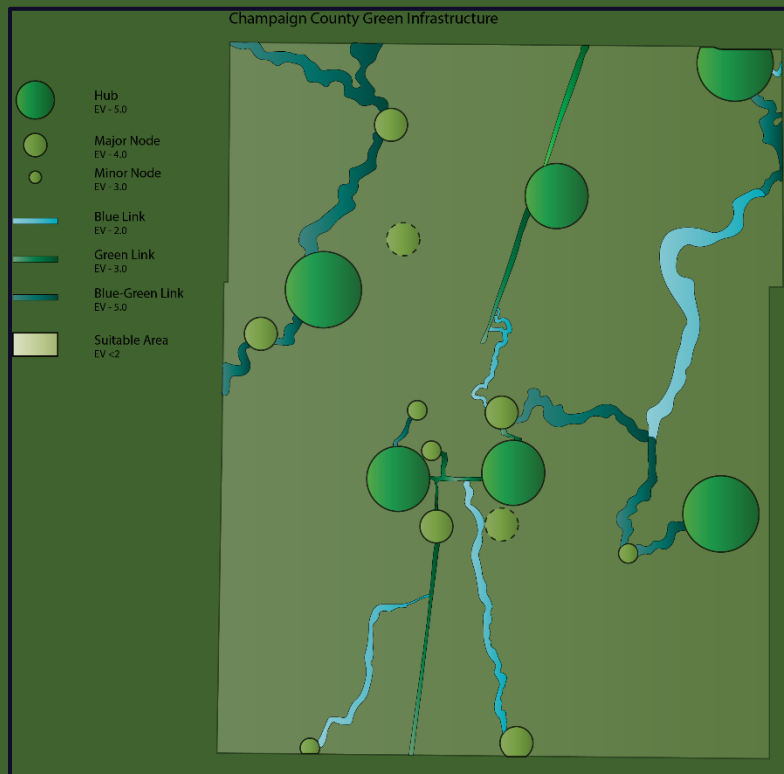


Figure 7 Green Infrastructure Layout

Map illustration by Shanay Patel, MUP1



3. CU Layout for GI Analysis

4. CU Green Infrastructure Map

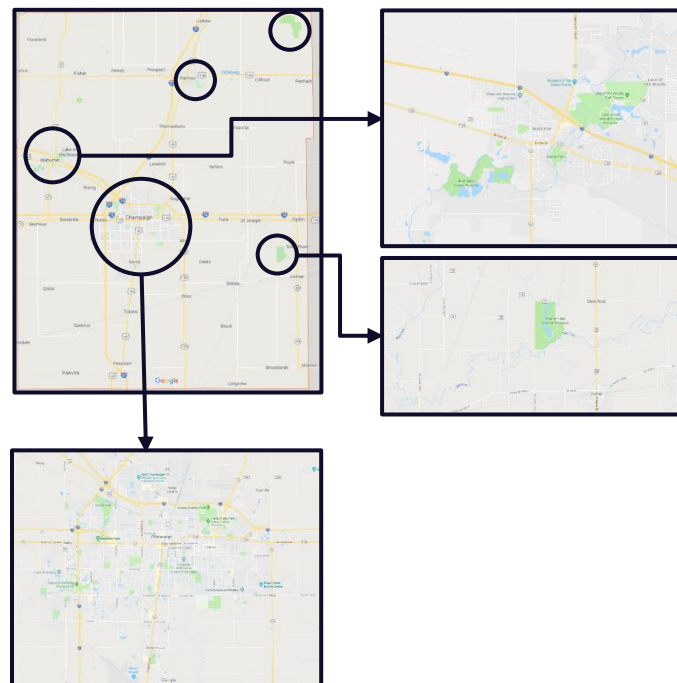
5. CU Green Infrastructure Analysis

6. Green Infrastructure (Suitability Map)

Lowest EV means the highest suitability

The extension site to the south of Willard Airport satisfies the GI suitability requirement and does not pose a detrimental risk to the surrounding ecology.

The hubs considered for Champaign County are shown in the graphic below:



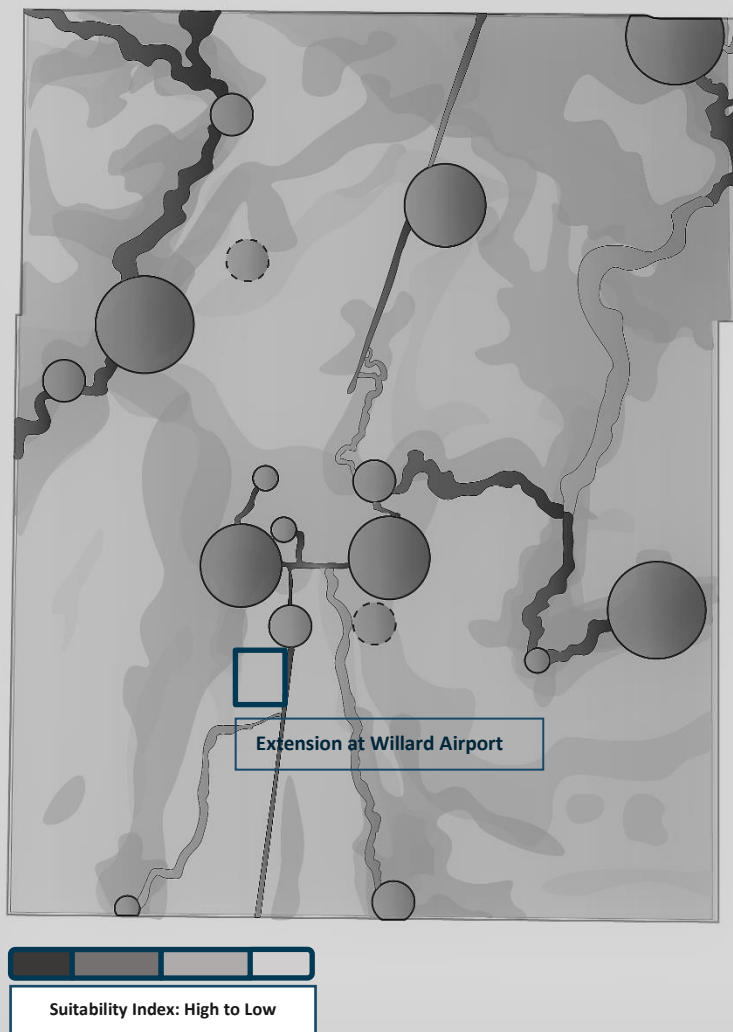


Figure 8 Natural Systems Suitability Map

Map illustration by Shanay Patel, MUP1



CONCLUSION

The terminal extension at Willard Airport will enhance plane capacity and improve air travel accessibility across the Midwestern United States.

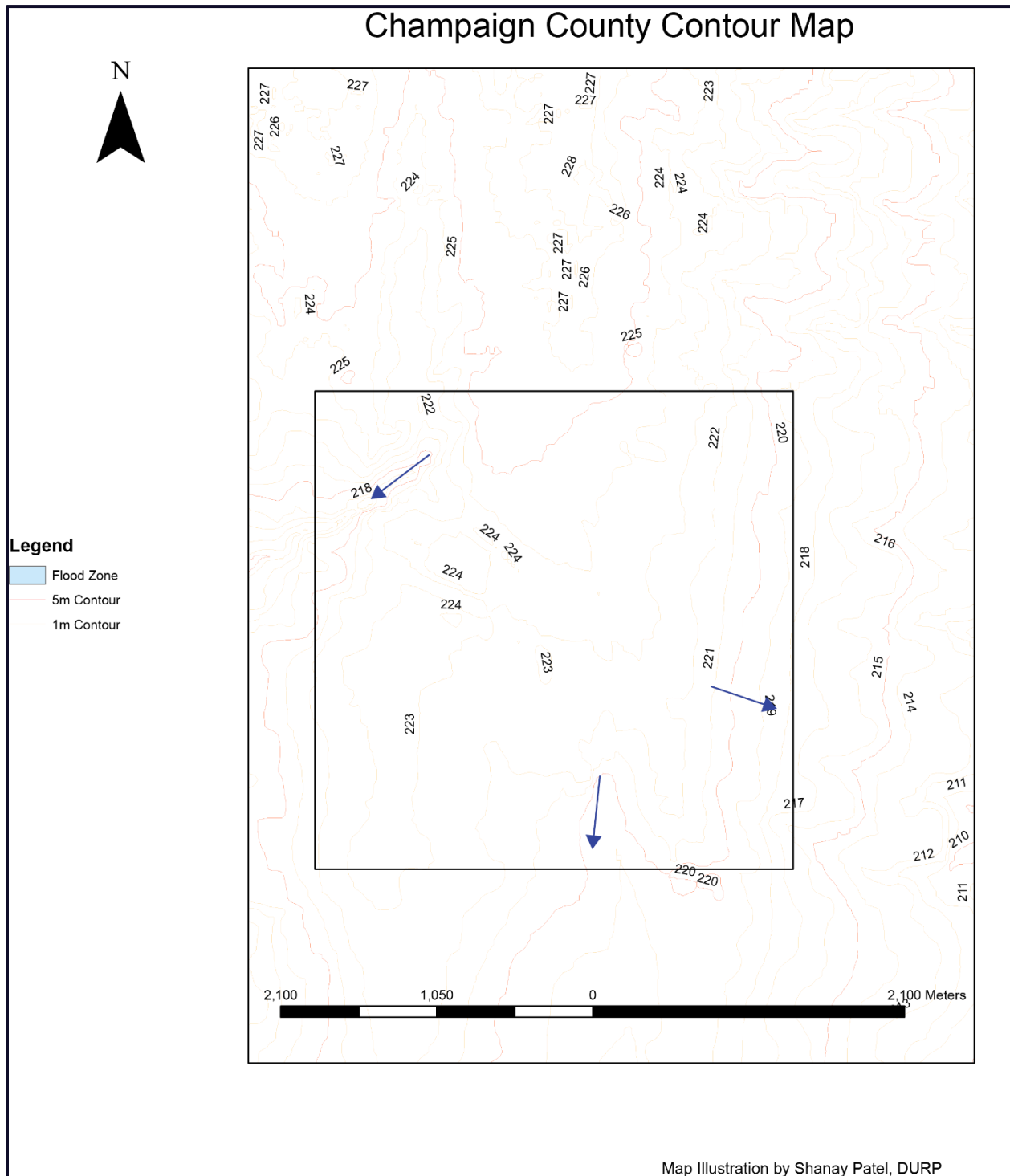
The site for the new development is selected/verified based on the suitability of the site in terms of:

1. Slope and soil
2. Water
3. Landcover (suitable with treatment)
4. Green Infrastructure

The Natural Systems Suitability Report (NSSR) for Willard Airport concludes:

1. Development of a new international terminal is to be ruled out since areas with an approximate size of 1800 acres, while suitable in terms of soil and slope, sit on a floodplain and hence should be avoided.
2. Extension of existing terminals at Willard Airport, is greenlit after careful consideration of soil and slope factors, water suitability, and surrounding ecological systems.

APPENDIX



Appendix 1 Contour Map (with water flow)