



March 2, 2020

Massport Logan Express Framingham Garage Expansion

**Expanded Environmental Notification
Form**

Submitted to:

Executive Office of Energy
& Environmental Affairs
MEPA Office
100 Cambridge Street – Suite 900
Boston, MA 02114

Prepared for:

Massachusetts Port Authority
One Harborside Drive – Suite 200S
Boston, MA 02128

Prepared by:

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March 2, 2020

The Honorable Kathleen A. Theoharides, Secretary
Executive Office of Energy and Environmental Affairs

Attn: MEPA Office
100 Cambridge Street, Suite 900,
Boston, Massachusetts 02114

Re: Framingham Logan Express Expansion Project, Framingham, MA

Dear Secretary Theoharides and Director Kim:

On behalf of the Massachusetts Port Authority (Massport), we are pleased to submit for your review an *Expanded Environmental Notification Form* (EENF) for the expansion of the existing Framingham Logan Express facility. As we have outlined in the recent Logan Airport *Environmental Status and Planning Report* (ESPR, EEA #3247), Massport's Logan Express network is a centerpiece of our High Occupancy Vehicle (HOV) strategy for passenger and employee ground access in and out of Logan Airport. Logan Express is currently the seventh largest transit system in the Commonwealth and is critical to reducing trips, congestion and emissions throughout its market area. The Framingham Logan Express site has been very effective in serving the MetroWest area and is estimated to eliminate over 450,000 annual trips along the Massachusetts Turnpike (I-90) in a highly congested corridor between the Framingham area and Logan Airport. Within the next ten years, we expect the number of avoided trips to annually exceed 1 million. This can only happen with added spaces at Framingham and the increase in express bus trips from 2 per hour to 3 per hour once the new spaces are opened.

The original Logan Express facility at this location was constructed in 1995; that facility was replaced in 2015 with the current integrated terminal and garage structure totalling 1,082 parking spaces. Almost immediately upon opening, the new garage facility was at full capacity during peak travel periods and parking demand at this location has continued to show strong growth for both airline passengers and Logan Airport employees.

Massport's current plan is to expand the garage within the existing footprint to its maximum structural capacity of seven (7) levels. This expansion was envisioned during the 2014 MEPA review process (EEA #15144) which described that the foundations were designed for future levels. Within the existing footprint and structural capacity, a total of 998 additional spaces can be added. Even with these new spaces, Massport expects to continue operation of the adjacent satellite overflow parking lot along Flutie Pass which has a capacity of 565 spaces.

By building out this facility and adding to Massport's system-wide Logan Express HOV capacity, we estimate that use of Logan Express will be able to double from nearly 2 million annual users in 2019 to over 4 million annual users. This translates to a significant reduction in regional vehicle miles travelled (VMT) and associated vehicle emissions. The greenhouse gas (GHG) analyses demonstrate that expanding the garage to provide an additional 998 parking spaces and expanded services, the project will reduce GHG emissions by

over 7,200 tons per year compared to the existing condition– this is the equivalent of eliminating emissions from the annual energy usage of over 750 homes.

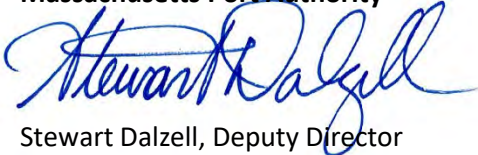
As part of the garage expansion, Massport will be adding a new solar PV array along the south-facing building façade; this new array will offset 100% of the additional energy demand of the new parking levels and some of the energy demand for the existing facility.

As part of our planning for the project, we have already met with the City of Framingham to discuss the proposed improvements and our procedures for handling facility operations during the planned construction later this year. We continue to appreciate the City's support of the project.

We look forward to discussing these important HOV improvements with you and the MEPA Office staff and we would be pleased to meet with you at the site or in your office at your earliest convenience. I can be reached at 617-568-3524 or via email at sdalzell@massport.com to answer any project questions you may have.

Sincerely,

Massachusetts Port Authority



Stewart Dalzell, Deputy Director
Environmental Planning and Permitting

Attachments

Cc: MEPA Distribution List (EENF Attachment H)
Framingham Mayor Yvonne Spicer
State Senator Karen Spilka
State Representative Carmine Gentile
State Representative Maria Robinson
State Representative Jack Lewis

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Attachment D: 2014 MEPA Certificate

Attachment E: Massachusetts Historical Commission Concurrence

Attachment F: Greenhouse Gas Emissions Analysis

Attachment G: Logan Express Parking Garage Shade Study

Attachment H: ENF Distribution List

Environmental Notification Form

<i>For Office Use Only</i>	
EEA#: _____	
MEPA Analyst: _____	

The information requested on this form must be completed in order to submit a document electronically for review under the Massachusetts Environmental Policy Act, 301 CMR 11.00.

Project Name: Logan Express Framingham - Garage Expansion		
Street Address: Shoppers World Drive at Burr Street Extension		
Municipality: Framingham, MA	Watershed: Suasco	
Universal Transverse Mercator Coordinates: Zone 19, 302754E, 4686322N	Latitude: 42° 18' 15"	Longitude: -71° 23' 35"
Estimated commencement date: 7/2020	Estimate completion date: 4/2021	
Project Type: Parking - Other/Lot	Status of project design: 15% complete	
Proponent: Massachusetts Port Authority		
Street Address: One Harborside Drive, Suite 200 S		
Municipality: Boston	State: MA	Zip Code: 02128
Name of Contact Person: Stewart Dalzell		
Firm/Agency: Massachusetts Port Authority	Street Address: One Harborside Drive, Suite 200 S	
Municipality: Boston	State: MA	Zip Code: 02128
Phone: (617) 568-3524	Fax: _____	E-mail: sdalzell@massport.com

Does this project meet or exceed a mandatory EIR threshold (see 301 CMR 11.03)? Yes No

If this is an Expanded Environmental Notification Form (ENF) (see 301 CMR 11.05(7)) or a Notice of Project Change (NPC), are you requesting:

- a Single EIR? (see 301 CMR 11.06(8)) Yes No
- a Special Review Procedure? (see 301CMR 11.09) Yes No
- a Waiver of mandatory EIR? (see 301 CMR 11.11) Yes No
- a Phase I Waiver? (see 301 CMR 11.11) Yes No

(Note: Greenhouse Gas Emissions analysis must be included in the Expanded ENF.)

Which MEPA review threshold(s) does the project meet or exceed (see 301 CMR 11.03)?

- **EIR - 301 CMR 11.03(6)(a)7. Construction of 1,000 or more New parking spaces at a single location.**
- **ENF - 301 CMR 11.03(6)(b)14. Generation of 1,000 or more New ADT on roadways providing access to a single location and construction of 150 or more New parking spaces at a single location.**

Which State Agency Permits will the project require?

- **State Building Permit, State Plumbing Permit**

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Identify any financial assistance or land transfer from an Agency of the Commonwealth, including the Agency name and the amount of funding or land area in acres:

- **The Massachusetts Port Authority (Massport) will fund this project**

Summary of Project Size & Environmental Impacts	Existing	Change	Total
Total site acreage	4.63		
New acres of land altered		0	
Acres of impervious area	3.14	0.006¹	3.15
Square feet of new bordering vegetated wetlands alteration		0	
Square feet of new other wetland alteration		0	
Acres of new non-water dependent use of tidelands or waterways		0	
Gross square footage	382,700	325,200	707,900
Number of housing units	0	0	0
Maximum height (feet)	36.3'	33.0'	69.3
Vehicle trips per day	3,304	1,496	4,800
Parking spaces	1,779²	998	2,777
Water Use (Gallons per day)	450	440	890
Water withdrawal (GPD)	0	0	0
Wastewater generation/treatment (GPD)	405	400	805
Length of water mains (miles)	0	0	0
Length of sewer mains (miles)	0	0	0
Has this project been filed with MEPA before? <input type="checkbox"/> Yes (EEA #) <input checked="" type="checkbox"/> No			
Has any project on this site been filed with MEPA before? <input checked="" type="checkbox"/> Yes (EEA # 15144, 12412) <input type="checkbox"/> No			

1 Creating new right-turn only lane from the garage short-term parking lot to Shopper’s World Drive.

2 Existing parking consists of 1,082 parking spaces in the existing garage and 697 leased overflow parking spaces at adjacent properties.

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GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:

The Massachusetts Port Authority (Massport) is proposing improvements to the existing Logan Express parking garage facility in the City of Framingham located near the Massachusetts Turnpike (I-90) at the corner of Burr Street and Shoppers World Drive (Figure 1). Massport proposes to increase the capacity of the garage by 998 parking spaces, from the existing 1,082 spaces to 2,080 spaces, by constructing three additional levels on top of the existing four-level garage. Massport also anticipates continued lease of 565 overflow parking spaces at AMC Theatres.

The proposed garage expansion project is planned to meet the existing and future demand for parking at the Logan Express facility in Framingham. Since the garage opened in 2015, ridership at Massport's Logan Express facility in Framingham has exceeded projected demand increasing 34.1 percent from 431,000 riders in 2015 to 578,000 riders in 2018. The proposed project is a key component of Massport's overall commitment to reduce roadway congestion and associated greenhouse gas (GHG) emissions by increasing high-occupancy vehicle (HOV) ridership to Logan Airport by expanding Logan Express service and improving facilities. Massport has a strategic plan to increase the HOV mode share to Logan Airport to 40 percent by 2027. The doubling of Logan Express ridership from 2 million to 4 million annual riders is a centerpiece of this program.

Massport will use this opportunity to implement a number of new sustainability elements to the garage to enhance efficiency, reduce electricity demand, and reduce facility-wide emissions. These sustainability elements include new façade solar panels, high-efficiency LED lighting, additional electric vehicle (EV) charging stations and an automated parking guidance system to minimize vehicle circulation. Additionally, a third hourly express bus trip will be added, going from every 30 minutes to every 20 minutes.

Describe the existing conditions and land uses on the project site:

The existing Logan Express Framingham facility is on a 4.63-acre parcel, of which approximately 3.14 acres are impervious. The remainder of the site is a mix of lawn, landscaping around the building perimeter, storm drainage facilities and forested upland and wetland (Figure 2). The existing garage is approximately 382,700 gross square feet (GSF), having four levels (grade + 3 decks) and 1,082 parking spaces.

Massport currently leases an additional 565 parking spaces from adjacent property owners, including 490 spaces at AMC Theatres and 75 spaces at Fran's Florist. During peak travel periods, up to 132 additional parking spaces can be accessed at the Shopper's World parking area. Thus, a total of 697 overflow parking spaces are currently available for Logan Express Framingham customers.

Once the parking garage was opened in 2015, it was almost immediately regularly filled to capacity because of the attractiveness of this service combined with growth in passenger levels at Logan Airport and Massport's strong emphasis on HOV travel. The existing parking facility includes parking decks, bus loading areas, waiting area, ticket office, vending area, restrooms and space for utilities. Existing conditions are further described in Attachment A, Project Narrative.

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Describe the proposed project and its programmatic and physical elements:

NOTE: The project description should summarize both the project's direct and indirect impacts (including construction period impacts) in terms of their magnitude, geographic extent, duration and frequency, and reversibility, as applicable. It should also discuss the infrastructure requirements of the project and the capacity of the municipal and/or regional infrastructure to sustain these requirements into the future.

Massport proposes the vertical expansion of the existing parking garage. Three parking levels will be added to the existing four-level structure, increasing the capacity of the garage by 998 spaces, from the existing 1,082 to 2,080 spaces. Massport intends to continue to lease 565 existing parking spaces along the adjacent Flutie Pass for use on an as-needed basis during peak travel periods. See Attachment A, Project Narrative.

Describe the on-site project alternatives (and alternative off-site locations, if applicable), considered by the proponent, including at least one feasible alternative that is allowed under current zoning, and the reasons(s) that they were not selected as the preferred alternative:

NOTE: The purpose of the alternatives analysis is to consider what effect changing the parameters and/or siting of a project, or components thereof, will have on the environment, keeping in mind that the objective of the MEPA review process is to avoid or minimize damage to the environment to the greatest extent feasible. Examples of alternative projects include alternative site locations, alternative site uses, and alternative site configurations.

Massport evaluated several alternatives to identify the option that best satisfied the project purpose of reducing congestion and associated GHG emissions by increasing HOV ridership to Logan Airport through improved Logan Express services and facilities. These alternatives included a No-Build Alternative and two on-site build alternatives: a two-level vertical expansion of the garage including 661 new parking spaces; and a three-level vertical expansion including 998 new parking spaces. See Attachment A, Project Narrative for additional information on the evaluation of project alternatives.

Massport is exempt from local zoning requirements. However, the project is a continuation of the existing use and the garage would conform with the height restrictions found in the municipal Business and Light Manufacturing zoning districts.

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative:

In developing a preferred concept for the garage expansion, avoidance and minimization of impacts to natural resources, including wetlands, was examined thoroughly. The result of that effort was the avoidance of direct impact to Bordering Vegetated Wetlands (BVW) and minimization of work within the wetland buffer zone at the northeast corner of the garage structure to up to approximately 7,675 square feet of temporary construction-phase impact. See Attachment A, Project Narrative.

If the project is proposed to be constructed in phases, please describe each phase:

This Project is proposed to be constructed in a single phase.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:

Is the project within or adjacent to an Area of Critical Environmental Concern? Yes No; Specify:

if yes, does the ACEC have an approved Resource Management Plan? Yes No;
If yes, describe how the project complies with this plan.

Will there be stormwater runoff or discharge to the designated ACEC? Yes No;

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If yes, describe and assess the potential impacts of such stormwater runoff/discharge to the designated ACEC.

RARE SPECIES:

Does the project site include Estimated and/or Priority Habitat of State-Listed Rare Species? (see http://www.mass.gov/dfwele/dfw/nhosp/regulatory_review/priority_habitat/priority_habitat_home.htm)
 Yes No; Specify:

HISTORICAL /ARCHAEOLOGICAL RESOURCES:

Does the project site include any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth? Yes No; Specify:

If yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? Yes No; Specify:

WATER RESOURCES:

Is there an Outstanding Resource Water (ORW) on or within a half-mile radius of the project site?
(NOTE: Outstanding Resource Waters include Class A public water supplies, their tributaries, and bordering wetlands; active and inactive reservoirs approved by MassDEP; certain waters within Areas of Critical Environmental Concern, and certified vernal pools. Outstanding resource waters are listed in the Surface Water Quality Standards, 314 CMR 4.00.)
 Yes No; Specify: ; if yes, identify the ORW and its location.

Are there any impaired water bodies on or within a half-mile radius of the project site? Yes No; Specify:
if yes, identify the water body and pollutant(s) causing the impairment:

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? Yes No

STORMWATER MANAGEMENT:

Generally describe the project's stormwater impacts and measures that the project will take to comply with the standards found in MassDEP's Stormwater Management Regulations:

The project is considered a redevelopment project and therefore the stormwater management system will be designed to meet stormwater standards to the maximum extent practicable, while improving upon existing conditions. Conformance with the stormwater standards will be achieved in accordance with the Massachusetts Stormwater Handbook (Jan 2008). The 2015 garage construction involved substantial improvements to the stormwater management system.

The existing stormwater system consists of an open and closed drainage system with Low Impact Development (LID) measures and Best Management Practices (BMPs) for controlling the stormwater discharges. Roof runoff from the facility is directed to a new proprietary treatment unit prior to discharging to a stormwater basin, while the limited amount of runoff from the interior levels of the garage will be directed to the sewer system. Pollutants entering the stormwater will be minimized as roof parking will be only be used during peak operation, and snow-melting machines will be utilized in place of de-icing chemicals.

During the construction period, to provide a level work area for a crane to operate fill may be temporarily placed in the 100' wetland buffer zone and a portion of the detention pond on the northeast side of the garage. It is anticipated that the temporary fill placed within the stormwater basin will not significantly affect the basin's ability to manage stormwater from the site. Since stormwater flows through the water quality unit prior to discharge to the stormwater basin, stormwater flowing through the basin and toward the adjacent BVW is anticipated to be relatively clean, with little turbidity. The basin would be restored to pre-construction condition after construction.

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MASSACHUSETTS CONTINGENCY PLAN:

Has the project site been, or is it currently being, regulated under M.G.L.c.21E or the Massachusetts Contingency Plan? Yes No; if yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification):

The following list was obtained from the MassDEP Bureau of Waste Cleanup database:

Two RTNs exist on site:

RTN	Site Name/Location Aid	Status	Class	Phase
3-4286	1 Worcester Road; Shoppers World Mall (Framingham Logan Express)	WCSP RM	n/a	n/a
3-21193	1 Worcester Road; Shoppers World (Framingham Logan Express)	RAO	B1	n/a

Two RTNs about the site (unrelated to Massport property or activities):

RTN	Site Name/Location Aid	Status	Class	Phase
3-13907	375 Cochituate Road	RAO	A2	n/a
3-15808	Southwest Corner of Cochituate Road	DPS	n/a	n/a

One RTN is at the northwest corner of Cochituate Road and Burr Street, in close proximity to the site:

RTN	Site Name/Location Aid	Status	Class	Phase
3-13200	510 Cochituate Road	RAO	A2	III

Massport’s standard construction specifications include requirements for the proper management of contaminated soil and groundwater in the event that such conditions are encountered during excavation.

Is there an Activity and Use Limitation (AUL) on any portion of the project site? Yes No; if yes, describe which portion of the site and how the project will be consistent with the AUL:

Are you aware of any Reportable Conditions at the property that have not yet been assigned an RTN? Yes No; if yes, please describe:

SOLID AND HAZARDOUS WASTE:

If the project will generate solid waste during demolition or construction, describe alternatives considered for re-use, recycling, and disposal of, e.g., asphalt, brick, concrete, gypsum, metal, wood:

For capital construction projects, Massport requires construction contractors to recycle the construction and demolition waste (C&D) generated by their projects. According to the ‘Sustainable Massport – Annual Sustainability & Resiliency Report’ (2019), Massport tracks the amount of materials recycled during capital construction projects. Massport recycled nearly 100% of the C&D materials from capital construction projects.

(NOTE: Asphalt pavement, brick, concrete, and metal are banned from disposal at Massachusetts landfills and waste combustion facilities and wood is banned from disposal at Massachusetts landfills. See 310 CMR 19.017 for the complete list of banned materials.)

Will your project disturb asbestos containing materials? Yes No; if yes, please consult state asbestos requirements at <http://mass.gov/MassDEP/air/asbhom01.htm>

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Describe anti-idling and other measures to limit emissions from construction equipment:

Massport's Sustainable Design Standards and Guidelines (SDSG) requires that all projects' heavy construction equipment be furnished with diesel particulate filters or diesel oxidation catalysts in accordance with the Massachusetts Department of Environmental Protection (MassDEP) Clean Air Construction Initiative (CACI).

Furthermore, Massport will work closely with bus operators to enforce all state and federal anti-idling regulations. Massport will also provide signage throughout the garage and pick-up drop-off areas reminding users of anti-idling requirements.

DESIGNATED WILD AND SCENIC RIVER:

Is this project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River? Yes No; if yes, specify name of river:

If yes, does the project have the potential to impact any of the "outstandingly remarkable" resources of a federally Wild and Scenic River or the stated purpose of a state designated Scenic River? Yes No;

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ATTACHMENTS:

1. List of all attachments to this document
Attachment A: Project Narrative
Attachment B: Project Figures
Attachment C: Traffic Impact Analysis
Attachment D: 2014 MEPA Certificate
Attachment E: Massachusetts Historical Commission Concurrence
Attachment F: Greenhouse Gas Emissions Analysis
Attachment G: Logan Express Parking Garage Shade Study
Attachment H: ENF Distribution List
2. U.S.G.S. map (good quality color copy, 8-½ x 11 inches or larger, at a scale of 1:24,000) indicating the project location and boundaries. **Attachment B**
3. Plan, at an appropriate scale, of existing conditions on the project site and its immediate environs, showing all known structures, roadways and parking lots, railroad rights-of-way, wetlands and water bodies, wooded areas, farmland, steep slopes, public open spaces, and major utilities. **Attachment B**
4. Plan, at an appropriate scale, depicting environmental constraints on or adjacent to the project site such as Priority and/or Estimated Habitat of state-listed rare species, Areas of Critical Environmental Concern, Chapter 91 jurisdictional areas, Article 97 lands, wetland resource area delineations, water supply protection areas, and historic resources and/or districts. **Attachment B**
5. Plan, at an appropriate scale, of proposed conditions upon completion of project (if construction of the project is proposed to be phased, there should be a site plan showing conditions upon the completion of each phase). **Attachment B**
6. List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2). **Attachment H**
7. List of municipal and federal permits and reviews required by the project, as applicable.
Massachusetts Wetlands Protection Act Order of Conditions from the Framingham Conservation Commission for Construction Activities

LAND SECTION – all proponents must fill out this section

I. Thresholds / Permits

A. Does the project meet or exceed any review thresholds related to **land** (see 301 CMR 11.03(1)). Yes No; if yes, specify each threshold:

II. Impacts and Permits

Describe, in acres, the current and proposed character of the project site, as follows:

	Existing	Change	Total
Footprint of buildings	2.50	0.0	2.50
Internal roadways	0.0	0.0	0.0
Parking and other paved areas	0.65	0.006	0.66
Other altered areas	0.98	(0.006)	0.97
Undeveloped areas	0.50	0.0	0.63
Total Project Site Acreage:	4.63	0.00	4.63

B. Has any part of the project site been in active agricultural use in the last five years? Yes No; if yes, how many acres of land in agricultural use (with prime state or locally important agricultural soils) will be converted to nonagricultural use?

C. Is any part of the project site currently or proposed to be in active forestry use?
 Yes No; if yes, please describe current and proposed forestry activities and indicate whether any part of the site is the subject of a forest management plan approved by the Department of Conservation and Recreation:

D. Does any part of the project involve conversion of land held for natural resources purposes in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth to any purpose not in accordance with Article 97? Yes No; if yes, describe:

E. Is any part of the project site currently subject to a conservation restriction, preservation restriction, agricultural preservation restriction or watershed preservation restriction?
 Yes No;
 if yes, does the project involve the release or modification of such restriction? Yes No;
 if yes, describe:

F. Does the project require approval of a new urban redevelopment project or a fundamental change in an existing urban redevelopment project under M.G.L.c.121A?
 Yes No; if yes, describe:

G. Does the project require approval of a new urban renewal plan or a major modification of an existing urban renewal plan under M.G.L.c.121B? Yes No; if yes, describe:

III. Consistency

A. Identify the current municipal comprehensive land use plan
 Title: **Framingham Master Plan** Date **2012**

B. Describe the project’s consistency with that plan with regard to:
 1) economic development

The Framingham Master Plan outlines the need to “establish a strong transportation system between the major economic hubs within the Town and regional transportation.” The Logan Express facility provides a key transit link to and from Logan Airport in the community. The Metro West Regional Transit Authority system can be accessed via a bus

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stop at Shopper's World, within walking distance from the Logan Express facility.

2) adequacy of infrastructure

This Logan Express facility is a key node in the regional transit system. Construction of a larger garage will reduce trips from the Metrowest area to Logan Airport and encourage growth in HOV access to Logan.

3) open space impacts

The project is consistent with goals to protect and preserve natural resource areas and ensure no net loss of total wetlands.

4) compatibility with adjacent land uses

The project supports the Master Plan goal to improve the transportation system within the Golden Triangle (district adjacent to Concord Street, Old Connecticut Path, Speen Street, Worcester Road and Cochituate Road). The ability to serve a greater number of Logan Express users will also contribute to the overall goal to create a sustainable community (i.e. improved regional traffic conditions and air quality).

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)

RPA: **Metropolitan Area Planning Council**

Title: **MetroFuture** Date **May 2008**

D. Describe the project's consistency with that plan with regard to:

1) economic development

The Logan Express facility provides a convenient service to and from Logan Airport for employees and people traveling for business and pleasure. An improved facility will be attractive to existing and future businesses, as well as workers that live in and commute from the area.

2) adequacy of infrastructure

Both the MetroFuture plan and Logan Express program strive to reduce traffic congestion and provide more alternative options for travel.

3) open space impacts

The project is consistent with the plan's goal to reduce greenhouse gas emissions and use less energy. The project aims to generate more trips to Logan Airport via high-occupancy vehicles and reduce traffic congestion.

RARE SPECIES SECTION

I. Thresholds / Permits

- A. Will the project meet or exceed any review thresholds related to **rare species or habitat** (see 301 CMR 11.03(2))? Yes No; if yes, specify, in quantitative terms:
(NOTE: If you are uncertain, it is recommended that you consult with the Natural Heritage and Endangered Species Program (NHESP) prior to submitting the ENF.)
- B. Does the project require any state permits related to **rare species or habitat**? Yes No
- C. Does the project site fall within mapped rare species habitat (Priority or Estimated Habitat?) in the current Massachusetts Natural Heritage Atlas (attach relevant page)? Yes No.

If you answered "No" to all questions A, B and C, proceed to the **Wetlands, Waterways, and Tidelands Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Rare Species section below.

II. Impacts and Permits

- A. Does the project site fall within Priority or Estimated Habitat in the current Massachusetts Natural Heritage Atlas (attach relevant page)? Yes No. If yes:
1. Have you consulted with the Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)? Yes No;
if yes, have you received a determination as to whether the project will result in the "take" of a rare species? Yes No; if yes, attach the letter of determination to this submission.
 2. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? Yes No;
if yes, provide a summary of proposed measures to minimize and mitigate rare species impacts
 3. Which rare species are known to occur within the Priority or Estimated Habitat?
 4. Has the site been surveyed for rare species in accordance with the Massachusetts Endangered Species Act? Yes No
 5. If your project is within Estimated Habitat, have you filed a Notice of Intent or received an Order of Conditions for this project? Yes No;
if yes, did you send a copy of the Notice of Intent to the Natural Heritage and Endangered Species Program, in accordance with the Wetlands Protection Act regulations? Yes No
- B. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? Yes No; if yes, provide a summary of proposed measures to minimize and mitigate impacts to significant habitat:

WETLANDS, WATERWAYS, AND TIDELANDS SECTION

I. **Thresholds / Permits**

- A. Will the project meet or exceed any review thresholds related to **wetlands, waterways, and tidelands** (see 301 CMR 11.03(3))? Yes No; if yes, specify, in quantitative terms:
- B. Does the project require any state permits (or a local Order of Conditions) related to **wetlands, waterways, or tidelands**? Yes No; if yes, specify which permit:

Order of Conditions from the Framingham Conservation Commissions under the MA Wetlands Protection Act

If you answered "No" to both questions A and B, proceed to the **Water Supply Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wetlands, Waterways, and Tidelands Section below.

II. **Wetlands Impacts and Permits**

- A. Does the project require a new or amended Order of Conditions under the Wetlands Protection Act (M.G.L. c.131A)? Yes No;
if yes, has a Notice of Intent been filed? Yes No;
if yes, list the date and MassDEP file number:
if yes, has a local Order of Conditions been issued? Yes No;
Was the Order of Conditions appealed? Yes No.
Will the project require a Variance from the Wetlands regulations? Yes No.

- B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site:

No direct impact to wetlands resources are anticipated. During construction, cranes will operate at various locations around the perimeter of the garage site. Work on the northeast side of the garage may temporarily impact up to approximately 7,675 square feet of ground surface within the 100-foot wetlands buffer zone. Depending on the selected constructed methodology, temporary fill may be placed within the 100' wetland buffer zone to provide a level work platform for a crane to operate. This would be determined when a construction contractor is selected. If the wetland buffer is temporarily impacted during construction, appropriate sedimentation controls will be installed around the construction work area and the landscaped area within the wetlands buffer zone will be restored to existing conditions once the construction period is complete.

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C. Estimate the extent and type of impact that the project will have on wetland resources, and indicate whether the impacts are temporary or permanent:

	Area (square feet) or Length (linear feet)	Temporary or Permanent Impact?
<u>Coastal Wetlands</u>	0	#
Land Under the Ocean	0	#
Designated Port Areas	0	#
Coastal Beaches	0	#
Coastal Dunes	0	#
Barrier Beaches	0	#
Coastal Banks	0	#
Rocky Intertidal Shores	0	#
Salt Marshes	0	#
Land Under Salt Ponds	0	#
Land Containing Shellfish	0	#
Fish Runs	0	#
Land Subject to Coastal Storm Flowage	0	#
<u>Inland Wetlands</u>		
Bank (If)	0	#
Bordering Vegetated Wetlands	0	#
Isolated Vegetated Wetlands	0	#
Land under Water	0	#
Isolated Land Subject to Flooding	0	#
Bordering Land Subject to Flooding	0	#
Riverfront Area	0	#

- D. Is any part of the project:
1. proposed as a **limited project**? Yes No; if yes, what is the area (in sf)?
 2. the construction or alteration of a **dam**? Yes No; if yes, describe:
 3. fill or structure in a **velocity zone** or **regulatory floodway**? Yes No
 4. dredging or disposal of dredged material? Yes No; if yes, describe the volume of dredged material and the proposed disposal site:
 5. a discharge to an **Outstanding Resource Water (ORW)** or an **Area of Critical Environmental Concern (ACEC)**? Yes No
 6. subject to a wetlands restriction order? Yes No; if yes, identify the area (in sf):
 7. located in buffer zones? Yes No; if yes, how much (in sf) **Up to approx. 7,675 SF**

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E. Will the project:

1. be subject to a local wetlands ordinance or bylaw? Yes No

Massport is exempt from local legislation as established in Section 2 of Massport’s Enabling Act at “CHAPTER 465 OF THE ACTS OF 1956 AS AMENDED THROUGH AUGUST 7, 2010”.

2. alter any federally-protected wetlands not regulated under state law? Yes No; if yes, what is the area (sf)?

III. **Waterways and Tidelands Impacts and Permits**

A. Does the project site contain waterways or tidelands (including filled former tidelands) that are subject to the Waterways Act, M.G.L.c.91? Yes No;

if yes, is there a current Chapter 91 License or Permit affecting the project site?

Yes No;

if yes, list the date and license or permit number and provide a copy of the historic map used to determine extent of filled tidelands:

B. Does the project require a new or modified license or permit under M.G.L.c.91? Yes No;

if yes, how many acres of the project site subject to M.G.L.c.91 will be for non-water-dependent use? _____ Current _____ Change _____ Total

C. For non-water-dependent use projects, indicate the following:

Area of filled tidelands on the site:

Area of filled tidelands covered by buildings:

For portions of site on filled tidelands, list ground floor uses and area of each use:

Does the project include new non-water-dependent uses located over flowed tidelands?

Yes No

Height of building on filled tidelands

Also show the following on a site plan: Mean High Water, Mean Low Water, Water-dependent Use Zone, location of uses within buildings on tidelands, and interior and exterior areas and facilities dedicated for public use, and historic high and historic low water marks.

D. Is the project located on landlocked tidelands? Yes No; if yes, describe the project’s impact on the public’s right to access, use and enjoy jurisdictional tidelands and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

E. Is the project located in an area where low groundwater levels have been identified by a municipality or by a state or federal agency as a threat to building foundations? Yes No; if yes, describe the project’s impact on groundwater levels and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

F. Is the project non-water-dependent **and** located on landlocked tidelands **or** waterways or tidelands subject to the Waterways Act **and** subject to a mandatory EIR? Yes No; (NOTE: If yes, then the project will be subject to Public Benefit Review and Determination.)

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G. Does the project include dredging? Yes No; if yes, answer the following questions:

What type of dredging? Improvement Maintenance Both

What is the proposed dredge volume, in cubic yards (cys)?

What is the proposed dredge footprint? length (ft) width (ft) depth (ft)

Will dredging impact the following resource areas?

Intertidal Yes No___; if yes, sq ft

Outstanding Resource Waters Yes No___; if yes, sq ft

Other resource area (i.e. shellfish beds, eel grass beds) Yes No;
if yes, sq ft

If yes to any of the above, have you evaluated appropriate and practicable steps to:

1) avoidance; 2) if avoidance is not possible, minimization; 3) if either avoidance or minimize is not possible, mitigation? If no to any of the above, what information or documentation was used to support this determination?

Provide a comprehensive analysis of practicable alternatives for improvement dredging in accordance with 314 CMR 9.07(1)(b).

Physical and chemical data of the sediment shall be included in the comprehensive analysis.

Sediment Characterization

Existing gradation analysis results? Yes No: if yes, provide results.

Existing chemical results for parameters listed in 314 CMR 9.07(2)(b)6? Yes No;
if yes, provide results.

Do you have sufficient information to evaluate feasibility of the following management options for dredged sediment? If yes, check the appropriate option.

- Beach Nourishment
- Unconfined Ocean Disposal
- Confined Disposal:
 - Confined Aquatic Disposal (CAD)
 - Confined Disposal Facility (CDF)
 - Landfill Reuse in accordance with COMM-97-001
- Shoreline Placement
- Upland Material Reuse
- In-State landfill disposal
- Out-of-state landfill disposal

IV. **Consistency:**

A. Does the project have effects on the coastal resources or uses, and/or is the project located within the Coastal Zone? Yes No; if yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management:

B. Is the project located within an area subject to a Municipal Harbor Plan? Yes No; if yes, identify the Municipal Harbor Plan and describe the project's consistency with that plan:

WATER SUPPLY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **water supply** (see 301 CMR 11.03(4))? Yes No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **water supply**? Yes No; if yes, specify which permit:

If you answered "No" to both questions A and B, proceed to the **Wastewater Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Water Supply Section below.

II. Impacts and Permits

A. Describe, in gallons per day (gpd), the volume and source of water use for existing and proposed activities at the project site:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Municipal or regional water supply	#	#	#
Withdrawal from groundwater	#	#	#
Withdrawal from surface water	#	#	#
Interbasin transfer	#	#	#

(NOTE: Interbasin Transfer approval will be required if the basin and community where the proposed water supply source is located is different from the basin and community where the wastewater from the source will be discharged.)

B. If the source is a municipal or regional supply, has the municipality or region indicated that there is adequate capacity in the system to accommodate the project? Yes No

C. If the project involves a new or expanded withdrawal from a groundwater or surface water source, has a pumping test been conducted? Yes No; if yes, attach a map of the drilling sites and a summary of the alternatives considered and the results.

D. What is the currently permitted withdrawal at the proposed water supply source (in gallons per day)? _____ Will the project require an increase in that withdrawal? Yes No; if yes, then how much of an increase (gpd)?

E. Does the project site currently contain a water supply well, a drinking water treatment facility, new water main, or other water supply facility, or will the project involve construction of a new facility? Yes No. If yes, describe existing and proposed water supply facilities at the project site:

	<u>Permitted Flow</u>	<u>Existing Avg Daily Flow</u>	<u>Project Flow</u>	<u>Total</u>
Capacity of water supply well(s) (gpd)	#	#	#	#
Capacity of water treatment plant (gpd)	#	#	#	#

F. If the project involves a new interbasin transfer of water, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or proposed?

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G. Does the project involve:

1. new water service by the Massachusetts Water Resources Authority or other agency of the Commonwealth to a municipality or water district? Yes No
2. a Watershed Protection Act variance? Yes No; if yes, how many acres of alteration?
3. a non-bridged stream crossing 1,000 or less feet upstream of a public surface drinking water supply for purpose of forest harvesting activities? Yes No

III. Consistency

Describe the project's consistency with water conservation plans or other plans to enhance water resources, quality, facilities and services:

WASTEWATER SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wastewater** (see 301 CMR 11.03(5))? Yes No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **wastewater**? Yes No; if yes, specify which permit:

If you answered "No" to both questions A and B, proceed to the **Transportation - Traffic Generation Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wastewater Section below.

II. Impacts and Permits

A. Describe the volume (in gallons per day) and type of disposal of wastewater generation for existing and proposed activities at the project site (calculate according to 310 CMR 15.00 for septic systems or 314 CMR 7.00 for sewer systems):

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Discharge of sanitary wastewater	<u>#</u>	<u>#</u>	<u>#</u>
Discharge of industrial wastewater	<u>#</u>	<u>#</u>	<u>#</u>
TOTAL	<u>#</u>	<u>#</u>	<u>#</u>

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Discharge to groundwater	<u>#</u>	<u>#</u>	<u>#</u>
Discharge to outstanding resource water	<u>#</u>	<u>#</u>	<u>#</u>
Discharge to surface water	<u>#</u>	<u>#</u>	<u>#</u>
Discharge to municipal or regional wastewater facility	<u>#</u>	<u>#</u>	<u>#</u>
TOTAL	<u>#</u>	<u>#</u>	<u>#</u>

B. Is the existing collection system at or near its capacity? Yes No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

C. Is the existing wastewater disposal facility at or near its permitted capacity? Yes No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

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- D. Does the project site currently contain a wastewater treatment facility, sewer main, or other wastewater disposal facility, or will the project involve construction of a new facility? Yes No; if yes, describe as follows:

	<u>Permitted</u>	<u>Existing Avg Daily Flow</u>	<u>Project Flow</u>	<u>Total</u>
Wastewater treatment plant capacity (in gallons per day)	<u>#</u>	<u>#</u>	<u>#</u>	<u>#</u>

- E. If the project requires an interbasin transfer of wastewater, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or new? (*NOTE: Interbasin Transfer approval may be needed if the basin and community where wastewater will be discharged is different from the basin and community where the source of water supply is located.*)
- F. Does the project involve new sewer service by the Massachusetts Water Resources Authority (MWRA) or other Agency of the Commonwealth to a municipality or sewer district? Yes No
- G. Is there an existing facility, or is a new facility proposed at the project site for the storage, treatment, processing, combustion or disposal of sewage sludge, sludge ash, grit, screenings, wastewater reuse (gray water) or other sewage residual materials? Yes No; if yes, what is the capacity (tons per day):

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Storage	<u>#</u>	<u>#</u>	<u>#</u>
Treatment	<u>#</u>	<u>#</u>	<u>#</u>
Processing	<u>#</u>	<u>#</u>	<u>#</u>
Combustion	<u>#</u>	<u>#</u>	<u>#</u>
Disposal	<u>#</u>	<u>#</u>	<u>#</u>

- H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal.

III. Consistency

- A. Describe measures that the proponent will take to comply with applicable state, regional, and local plans and policies related to wastewater management:
- B. If the project requires a sewer extension permit, is that extension included in a comprehensive wastewater management plan? Yes No; if yes, indicate the EEA number for the plan and whether the project site is within a sewer service area recommended or approved in that plan:

TRANSPORTATION SECTION (TRAFFIC GENERATION)

I. Thresholds / Permit

- A. Will the project meet or exceed any review thresholds related to **traffic generation** (see 301 CMR 11.03(6))? Yes No; if yes, specify, in quantitative terms:

The Project would result in the creation of 998 New parking spaces and generate 1,496 vehicle trips per day. Therefore, the Project would exceed the following ENF Traffic Generation threshold:

301 CMR 11.03 (6)(b)14. Generation of 1,000 or more New adt on roadways providing access to a single location and construction of 150 or more New parking spaces at a single location.

- B. Does the project require any state permits related to **state-controlled roadways**?
 Yes No; if yes, specify which permit:
- C. If you answered "No" to both questions A and B, proceed to the **Roadways and Other Transportation Facilities Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Traffic Generation Section below.

II. Traffic Impacts and Permits

- A. Describe existing and proposed vehicular traffic generated by activities at the project site:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Number of parking spaces	<u>1,779</u>	<u>998</u>	<u>2,777</u>
Number of vehicle trips per day	<u>3,304</u>	<u>1,496</u>	<u>4,800</u>
ITE Land Use Code(s):	<u>090</u>	<u>-</u>	<u>090</u>

- B. What is the estimated average daily traffic on roadways serving the site?

<u>Roadway</u>	<u>Existing (2019)</u>	<u>Change (2029)¹</u>	<u>Total (2029)¹</u>
1. <u>Shoppers World Drive</u>	<u>13,036</u>	<u>3,138</u>	<u>16,174</u>
2. <u>Burr Street</u>	<u>5,943</u>	<u>1,334</u>	<u>7,277</u>
3. <u>Route 30</u>	<u>27,785</u>	<u>3,583</u>	<u>31,368</u>

- C. If applicable, describe proposed mitigation measures on state-controlled roadways that the project proponent will implement:

The Traffic Impact Analysis indicated that the roadways and intersections can accommodate the construction of the proposed project. It is not anticipated that improvements to the roadway or traffic signal timings at the study area intersections, including those at state-controlled Route 30, are needed to improve the operations of intersections.

¹ Increase in daily traffic volumes includes forecast 1% annual growth in traffic volumes in the project area during the 10-year period between 2019 and 2029, traffic generated from other planned development projects in the study area, and Project-generated traffic.

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- D. How will the project implement and/or promote the use of transit, pedestrian and bicycle facilities and services to provide access to and from the project site?

The purpose of the project is to promote HOV travel between the Metrowest area and Massport's Boston Logan International Airport. The garage facility provides secure bicycle storage for passengers and Massport employees.

- E. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? Yes No; if yes, describe if and how the project will participate in the TMA:

The MetroWest TMA operates in the Framingham area. Massport's Logan Express facility in Framingham is an HOV service provider. As such, participation in a TMA is not necessary.

- F. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation facilities? Yes No; if yes, generally describe:

Transit facilities closest to the Logan Express garage are the two MBTA Commuter Rail stations on the Framingham Line; The LEX garage is approximately 2.5 miles from the Natick Center station and 4.2 miles from the West Natick Station.

- G. If the project will penetrate approach airspace of a nearby airport, has the proponent filed a Massachusetts Aeronautics Commission Airspace Review Form (780 CMR 111.7) and a Notice of Proposed Construction or Alteration with the Federal Aviation Administration (FAA) (CFR Title 14 Part 77.13, forms 7460-1 and 7460-2)?

III. Consistency

Describe measures that the proponent will take to comply with municipal, regional, state, and federal plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services:

The Logan Express operation complies with the goals of municipal, regional, state and federal policy to encourage increased use of high-occupancy, public transportation. In so-doing, traffic volumes and related GHG greenhouse gas emissions are decreased. Regarding the latter, Massport's entire Logan Express operation, including the Framingham site, has been particularly effective in reducing traffic levels on key roadways, notably the Massachusetts Turnpike (I-90) and harbor tunnels leading to and from Logan Airport.

The Logan Express service has also been effective in reducing demand for parking at Logan Airport. The resulting reduced traffic levels have had a positive effect on regional air quality. Annual ridership on the Logan Express system exceeded 1.8 million persons in 2018. Massport estimates that in 2019 operation of the Logan Express Framingham HOV transit facility results in the reduction of approximately 450,000 vehicles annually from the Massachusetts Turnpike.

The proposed improvements to the Framingham Logan Express site will serve to provide continuing and increased encouragement to use the public transportation services. The increase in the total number of spaces being provided for the Framingham operation will further promote use of the high-occupancy vehicles that provide service to and from the terminal facility.

TRANSPORTATION SECTION (ROADWAYS AND OTHER TRANSPORTATION FACILITIES)

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **roadways or other transportation facilities** (see 301 CMR 11.03(6))? Yes No; if yes, specify, in quantitative terms:

EIR - 301 CMR 11.03(6)(a)7. Construction of 1,000 or more New parking spaces at a single location.

B. Does the project require any state permits related to **roadways or other transportation facilities**? Yes No; if yes, specify which permit:

If you answered "No" to both questions A and B, proceed to the **Energy Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Roadways Section below.

II. Transportation Facility Impacts

A. Describe existing and proposed transportation facilities in the immediate vicinity of the project site:

The project site itself is a public transportation facility. It serves as a transfer point between automobiles and high-occupancy vehicle (bus) service to Logan Airport in Boston. The site is convenient to MetroWest residents/visitors with easy access from/to I-90, Route 9, Route 30, Route 126, and the MetroWest Regional Transit Authority bus line. See Attachment A, Project Narrative.

B. Will the project involve any:

- | | |
|--|----------|
| 1. Alteration of bank or terrain (in linear feet)? | 0 |
| 2. Cutting of living public shade trees (number)? | 0 |
| 3. Elimination of stone wall (in linear feet)? | 0 |

III. Consistency

Describe the project's consistency with other federal, state, regional, and local plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services, including consistency with the applicable regional transportation plan and the Transportation Improvements Plan (TIP), the State Bicycle Plan, and the State Pedestrian Plan:

The Logan Express operation complies with the goals of municipal, regional, state, and federal policy to encourage increased use of high-occupancy, public transportation and, in so-doing, decrease traffic volumes. With regard to the latter, Massport's entire Logan Express operation, including the Framingham site, has been particularly effective in reducing traffic levels, and related GHG emissions, on key roadways, particularly the Massachusetts Turnpike (I-90) and harbor tunnels leading to and from Logan Airport.

The Logan Express service has been effective in reducing demand for parking at Logan Airport. Resulting reduced traffic levels have had a positive effect on regional air quality. Annual ridership on the Logan Express system exceeded 1.8 million persons in 2018. Massport estimates that in 2019 operation of the Logan Express Framingham HOV transit facility results in the reduction of 450,000 vehicles annually from the Massachusetts Turnpike and other Logan Airport gateway roadways.

ENERGY SECTION

I. Thresholds / Permits

- A. Will the project meet or exceed any review thresholds related to **energy** (see 301 CMR 11.03(7))?
 Yes No; if yes, specify, in quantitative terms:
- B. Does the project require any state permits related to **energy**? Yes No; if yes, specify permit:
 If you answered "No" to both questions A and B, proceed to the **Air Quality Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Energy Section below.

II. Impacts and Permits

- A. Describe existing and proposed energy generation and transmission facilities at the project site:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Capacity of electric generating facility (megawatts)	<u>#</u>	<u>#</u>	<u>#</u>
Length of fuel line (in miles)	<u>#</u>	<u>#</u>	<u>#</u>
Length of transmission lines (in miles)	<u>#</u>	<u>#</u>	<u>#</u>
Capacity of transmission lines (in kilovolts)	<u>#</u>	<u>#</u>	<u>#</u>

- B. If the project involves construction or expansion of an electric generating facility, what are:
1. the facility's current and proposed fuel source(s)?
 2. the facility's current and proposed cooling source(s)?
- C. If the project involves construction of an electrical transmission line, will it be located on a new, unused, or abandoned right of way? Yes No; if yes, please describe:
- D. Describe the project's other impacts on energy facilities and services:

III. Consistency

Describe the project's consistency with state, municipal, regional, and federal plans and policies for enhancing energy facilities and services:

AIR QUALITY SECTION

I. Thresholds

- A. Will the project meet or exceed any review thresholds related to **air quality** (see 301 CMR11.03(8))? Yes No; if yes, specify, in quantitative terms:
- B. Does the project require any state permits related to **air quality**? Yes No; if yes, specify which permit:
 If you answered "No" to both questions A and B, proceed to the **Solid and Hazardous Waste Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Air Quality Section below.

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II. Impacts and Permits

A. Does the project involve construction or modification of a major stationary source (see 310 CMR 7.00, Appendix A)? Yes No; if yes, describe existing and proposed emissions (in tons per day) of:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Particulate matter	<u>#</u>	<u>#</u>	<u>#</u>
Carbon monoxide	<u>#</u>	<u>#</u>	<u>#</u>
Sulfur dioxide	<u>#</u>	<u>#</u>	<u>#</u>
Volatile organic compounds	<u>#</u>	<u>#</u>	<u>#</u>
Oxides of nitrogen	<u>#</u>	<u>#</u>	<u>#</u>
Lead	<u>#</u>	<u>#</u>	<u>#</u>
Any hazardous air pollutant	<u>#</u>	<u>#</u>	<u>#</u>
Carbon dioxide	<u>#</u>	<u>#</u>	<u>#</u>

B. Describe the project's other impacts on air resources and air quality, including noise impacts:

III. Consistency

A. Describe the project's consistency with the State Implementation Plan:

B. Describe measures that the proponent will take to comply with other federal, state, regional, and local plans and policies related to air resources and air quality:

SOLID AND HAZARDOUS WASTE SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **solid or hazardous waste** (see 301 CMR 11.03(9))? Yes No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **solid and hazardous waste**? Yes No; if yes, specify which permit:

If you answered "No" to both questions A and B, proceed to the **Historical and Archaeological Resources Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Solid and Hazardous Waste Section below.

II. Impacts and Permits

A. Is there any current or proposed facility at the project site for the storage, treatment, processing, combustion or disposal of solid waste? Yes No; if yes, what is the volume (in tons per day) of the capacity:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Storage	<u>#</u>	<u>#</u>	<u>#</u>
Treatment, processing	<u>#</u>	<u>#</u>	<u>#</u>
Combustion	<u>#</u>	<u>#</u>	<u>#</u>
Disposal	<u>#</u>	<u>#</u>	<u>#</u>

B. Is there any current or proposed facility at the project site for the storage, recycling, treatment or disposal of hazardous waste? Yes No; if yes, what is the volume (in tons or gallons per day) of the capacity:

	<u>Existing</u>	<u>Change</u>	<u>Total</u>
Storage	<u>#</u>	<u>#</u>	<u>#</u>

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Recycling	<u> # </u>	<u> # </u>	<u> # </u>
Treatment	<u> # </u>	<u> # </u>	<u> # </u>
Disposal	<u> # </u>	<u> # </u>	<u> # </u>

- C. If the project will generate solid waste (for example, during demolition or construction), describe alternatives considered for re-use, recycling, and disposal:
- D. If the project involves demolition, do any buildings to be demolished contain asbestos? Yes No
- E. Describe the project's other solid and hazardous waste impacts (including indirect impacts):

III. Consistency

Describe measures that the proponent will take to comply with the State Solid Waste Master Plan:

HISTORICAL AND ARCHAEOLOGICAL RESOURCES SECTION

I. Thresholds / Impacts

- A. Have you consulted with the Massachusetts Historical Commission? Yes No; if yes, attach correspondence. For project sites involving lands under water, have you consulted with the Massachusetts Board of Underwater Archaeological Resources? Yes No; if yes, attach correspondence.

Prior to the 2014 construction of the existing parking garage, Massport submitted a letter, dated November 7, 2013, to MHC requesting concurrence that the existing Logan Express building and site in Framingham are not listed or eligible for listing on the National Register of Historic Places, and that the proposed action does not constitute an Adverse Effect under M.G.L. Chapter 9, Sections 26-27C, as amended by Chapter 254 of the Acts of 1988 [950 CMR 71.04(2)]. The Massachusetts Historical Commission determined that this project is unlikely to affect significant historical or archeological resources. See Attachment E. This project will be contained within the footprint of that past construction.

- B. Is any part of the project site a historic structure, or a structure within a historic district, in either case listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? Yes No; if yes, does the project involve the demolition of all or any exterior part of such historic structure? Yes No; if yes, please describe:
- C. Is any part of the project site an archaeological site listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? Yes No; if yes, does the project involve the destruction of all or any part of such archaeological site? Yes No; if yes, please describe:
- D. If you answered "No" to all parts of both questions A, B and C, proceed to the **Attachments and Certifications** Sections. If you answered "Yes" to any part of either question A or question B, fill out the remainder of the Historical and Archaeological Resources Section below.

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II. **Impacts**

Describe and assess the project's impacts, direct and indirect, on listed or inventoried historical and archaeological resources:

The Massachusetts Historical Commission determined that this project is unlikely to affect significant historical or archeological resources. See Attachment E.

III. **Consistency**

Describe measures that the proponent will take to comply with federal, state, regional, and local plans and policies related to preserving historical and archaeological resources:

No historical/archaeological resources have been identified at the project site (see II. Impacts, above).

CERTIFICATIONS:

1. The Public Notice of Environmental Review has been/will be published in the following newspapers in accordance with 301 CMR 11.15(1):

Metrowest Daily News on or before March 11, 2020

2. This form has been circulated to Agencies and Persons in accordance with 301 CMR 11.16(2).

Signatures:

3/2/20 Stewart Dalzell
Date Signature of Responsible Office or Proponent

3/2/20 Michael Paiewonsky
Date Signature of person preparing ENF (if different from above)

Stewart Dalzell
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ATTACHMENT A
Project Narrative

1.0 PROJECT NARRATIVE

1.1 INTRODUCTION

The Massachusetts Port Authority (Massport) is proposing improvements to the existing Logan Express parking garage facility in the City of Framingham. The garage is located near the Massachusetts Turnpike (I-90) at the corner of Burr Street and Shoppers World Drive (Figure 1).

Massport proposes to increase the capacity of the garage by 998 parking spaces, from the existing 1,082 spaces to 2,080 spaces by constructing three additional levels on top of the existing four-level garage. Massport also anticipates continued lease of 565 overflow parking spaces at AMC Theatres. No additional land would be used for the Project.

Logan Express is a high-occupancy vehicle (HOV) transit service offered by Massport, transporting passengers by bus between each of its five satellite locations in Peabody, Woburn, Framingham, Braintree and Boston (Back Bay), and Boston- Logan International Airport (Logan Airport). At each of the four suburban facilities, including Framingham, users can park their personal vehicles at relatively low cost and travel directly to Logan Airport's passenger terminals using the Logan Express bus service. Some suburban users of the Logan Express bus service are also dropped off/picked up at the facility and do not use the parking facilities provided. The Back Bay Logan Express is an urban facility which does not offer parking.

As described in Massport's recent Environmental Status and Planning Report (ESPR, EEA No. 3247) for Logan Airport, Massport has a comprehensive, multi-pronged, trip reduction strategy to diversify and enhance ground transportation options for passengers and employees traveling to and from Logan Airport. The trip reduction strategy is designed to offer passengers traveling to and from Logan Airport with a choice of HOV, transit, and shared-ride options that are convenient and reliable, and that reduce environmental and community impacts.

As one important element of that diverse trip reduction strategy, Massport has a goal to double ridership on the Logan Express system from 2 million to 4 million annual passengers, thereby reducing vehicle miles traveled (VMT), regional and local roadway congestion, and air quality emissions, through the following measures:

Planned Improvements to Logan Express Access

- Increase Braintree Logan Express service from two to three trips per hour (implemented in 2019).
- Add parking capacity at the LEX Braintree site that is nearing capacity.
- Provide security line priority status to Logan Express Back Bay riders (implemented in 2019).
- Execute a sustained marketing campaign to support the Logan Express strategy and increase ridership.
- Implement Logan Express electronic ticketing.
- Open a new urban Logan Express site in Boston at North Station (mid-2020).

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- Evaluate new Logan Express suburban locations, with a plan to open at least one new site.
- Explore Ride Apps (Uber/Lyft, etc.) to provide ‘last mile’ connections to/from LEX facilities.
- Rebrand Logan Express sites as remote terminals.
- Continue to monitor parking capacity at all Logan Express sites.

Improvements to High-Occupancy Vehicle Access

- Doubling the number of MBTA Silver Line vehicles purchased by Massport for the Silver Line service to the Airport, making it more convenient to use the transit line for Airport access. Massport has partnered with the MBTA to promote its Silver Line access to the Airport. Massport’s financial support of the MBTA Silver Line has included Airport route subsidization (including paying for free boarding at the Airport), the prior purchase of eight MBTA Silver Line buses, and a commitment to purchase eight more MBTA Silver Line buses in the future.
- Continuing to provide free, clean-fuel shuttle bus service for passengers between the MBTA Blue Line Airport Station and all terminals.

The Framingham Logan Express facility was last expanded in 2015. Almost immediately following opening of that new garage, the facility began to fill to capacity during peak travel periods. This growth in ridership at Framingham occurred ahead of forecast for that site and demonstrated the latent regional demand for a convenient, reasonable cost and well run HOV facility.

1.2 PRIOR MEPA FILINGS

An ENF was filed by Massport in December 2013 for the construction of a five-level, 1,500-space garage (EEA#15144) that would replace the existing surface parking lot and terminal at this location. On February 28, 2014, the Secretary determined that the preparation an Environmental Impact Report (EIR) was not required and that the project could advance to the permitting phase. The Secretary’s Certificate for the 2014 ENF is provided as Attachment D.

Note that in 2001, MEPA approvals were secured for additional/structured parking at this site (EEA#12412), but following the events of 9/11/2001, that garage was not constructed.

The garage was constructed and opened in 2015, having only four-levels with 1,037 parking spaces (with an additional 45 spaces for valet and short-term parking, see Table 1). Massport intended to discontinue the use of overflow parking areas with the opening of the new garage (and reported this in the 2013 ENF). However, once the parking garage was opened in 2015, it was almost immediately regularly filled to capacity because of continued growth in passenger levels at Logan Airport, the attractiveness of the LEX service and Massport’s strong emphasis on HOV travel. For this reason, use of the overflow lots continued from the opening of the garage in 2015 to today.

The current Project would increase the garage’s capacity by 998 parking spaces, from the existing 1,082 spaces to 2,080 spaces. Massport also anticipates continued use of the 565

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overflow parking spaces at AMC Theatres. Use of overflow parking at Shopper's World would be discontinued upon opening of the new garage levels.

The purpose of this document is to evaluate the potential environmental impact of the proposed 998 new parking spaces in the garage together with the anticipated continued use of 565 overflow parking spaces.

Therefore, the project exceeds the following MEPA review thresholds:

- EIR - 301 CMR 11.03(6)(a)7. Construction of 1,000 or more New parking spaces at a single location.
- ENF - 301 CMR 11.03(6)(b)14. Generation of 1,000 or more New ADT on roadways providing access to a single location and construction of 150 or more New parking spaces at a single location.

1.3 PURPOSE AND NEED

The purpose of this project is to expand reliable and convenient access for HOV service to Boston - Logan International Airport for passengers and employees in the MetroWest/Framingham area.

The Logan Express system annually provides HOV bus service to and from Logan Airport for more than 2.1 million passengers and employees. Throughout 2018, the demand for parking spaces at the Logan Express Framingham facility exceeded supply 11 months of the year. Parking demand is forecast to substantially increase over the next decade.

The proposed garage expansion project is planned to meet the existing and future demand for parking at the Logan Express facility in Framingham. The proposed garage expansion will be a key component of Massport's overall commitment to reduce congestion and associated GHG emissions by increasing HOV ridership to Logan Airport by expanding Logan Express service and improving facilities. This is consistent with Massport's strategic plan to increase the Logan Airport HOV mode share to 40 percent by 2027. For further information see Chapter 5 *Ground Access to and from Logan Airport* of the ESRP which can be viewed on Massport's website:

<http://www.massport.com/massport/about-massport/project-environmental-filings/logan-airport/>

1.4 SINGLE EIR WAIVER REQUEST

Massport is respectfully requesting the EEA Secretary consider the following request that the project be allowed to advance through the MEPA review process with the submission of a Single EIR.

In accordance with the MEPA regulations, 301 CMR 11.11 (1), Standards for all waivers - the Secretary may waive any provision or requirement in 301 CMR 11.00 not specifically required by MEPA and may impose appropriate and relevant conditions or restrictions, provided that the Secretary finds that strict compliance with the provision or requirement would:

(a) result in an undue hardship for the Proponent, unless based on delay in compliance by the Proponent; and

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(b) not serve to avoid or minimize Damage to the Environment.

Damage to the Environment is defined in the MEPA regulations as follow:

Damage to the Environment: *Any destruction or impairment (not including insignificant damage or impairment), actual or probable, to any of the natural resources of the Commonwealth including, but not limited to, air pollution, GHG emissions, water pollution, improper sewage disposal, pesticide pollution, excessive noise, improper operation of dumping grounds, reduction of groundwater levels, impairment of water quality, increases in flooding or storm water flows, impairment and eutrophication of rivers, streams, flood plains, lakes, ponds or other surface or subsurface water resources, destruction of seashores, dunes, marine resources, underwater archaeological resources, wetlands, open spaces, natural areas, parks, or historic districts or sites.*

Massport provides the following responses to these provisions.

a) Result in undue hardship for the proponent:

Response: Preparation of a draft and final EIR would result in postponement of the construction of the additional levels of the garage. This would postpone the availability of additional parking spaces for Logan Airport customers and employees who wish to use HOV service to travel to Logan Airport from the Metrowest area.

The proposed garage expansion is a key component of Massport's overall commitment to reduce congestion and associated GHG emissions by increasing HOV ridership to Logan Airport by expanding Logan Express service and improving facilities.

Preparation of a draft and final EIR would postpone the fulfillment of Massport's strategic plan to increase the Logan Airport HOV mode share to 40 percent by 2027 with the resultant reduction in congestion on gateway roadways to Massport and associated reductions in emissions.

b) Not serve to minimize damage to the environment:

Response: Preparation of a draft and final EIR would not serve to minimize damage to the environment. The project is limited to the vertical expansion of the existing parking garage, with no land being permanently affected. During the construction period there may be a temporary impact to the 100-foot wetlands buffer of approximately 7,675 square feet. Three signalized intersections proximate to the garage may experience an increase in delay ranging from 3- to 9-seconds. These intersections include:

- Shoppers Word Drive at Route 30
- Shoppers World Drive at Burr St Extension
- Burr Street Extension at Route 30

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Increasing capacity of the LEX Framingham garage will result in substantial environmental benefits, particularly for regional air quality and GHG emissions. Compared to the existing condition, increasing the capacity of the LEX Framingham garage by 998 spaces, while continuing the use of 565 overflow parking spaces during peak periods, will reduce the number of vehicles on I-90 and other Logan Airport gateway roadway by 650,000 vehicles annually, resulting in the avoidance of 7,260 tons-per-year of greenhouse gas emissions (GHG - specifically, tons of carbon dioxide equivalent known as CO₂E).

The following provides responses to the presumptions to be rebutted for an EIR waiver.

(a) the Project is likely to cause no Damage to the Environment:

Response: The project is limited to the vertical expansion of the existing parking garage, with no land being permanently affected. During the construction period there would be no direct impact to wetland resources. There may be a temporary impact to the 100-foot wetlands buffer of approximately 7,675 square feet. Three signalized intersections proximate to the garage may experience an increase in delay ranging from 3- to 9-seconds. These intersections include:

- Shoppers World Drive at Route 30
- Shoppers World Drive at Burr St Extension
- Burr Street Extension at Route 30

The project will not result in water pollution, improper sewage disposal, pesticide pollution, excessive noise, improper operation of dumping grounds, reduction of groundwater levels, impairment of water quality, increases in flooding or storm water flows, impairment and eutrophication of rivers, streams, flood plains, lakes, ponds or other surface or subsurface water resources, destruction of seashores, dunes, marine resources, underwater archaeological resources, wetlands, open spaces, natural areas, parks, or historic districts or sites.

Increasing capacity of the LEX Framingham garage will result in substantial environmental benefits, particularly for regional air quality and GHG emissions. Compared to the existing condition, increasing the capacity of the LEX Framingham garage by 998 spaces, while continuing the use of 565 overflow parking spaces during peak periods, will reduce the number of vehicles on I-90 and other Logan Airport gateway roadway by 650,000 vehicles annually, resulting in the avoidance of 7,260 tons-per-year of CO₂E² greenhouse gas emissions.

² CO₂E = Carbon dioxide equivalent.

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(b) ample and unconstrained infrastructure facilities and services exist to support the Project.

Response:

The project is limited to the vertical expansion of the existing parking garage. The garage is currently served by water, sewer, electrical, internet utilities available in the project area. The proposed vertical expansion of the garage will result in a minor increase in the use of water, sewer and electrical utility services. The project design consultant has reviewed the availability of these services in the study area and determined them to be adequate.

The new solar PV array will offset 100% of the additional energy demand of the new parking levels and some of the energy demand for the existing facility.

1.5 EXISTING CONDITIONS

1.5.1 Existing Facility and Area Land Uses

The Logan Express Framingham facility parcel is 4.63 acres, of which approximately 3.14 acres are impervious. The remainder of the site is a mix of lawn, landscaping around the building, and adjacent storm drainage facilities, forested upland and wetland (Figure 2). The existing garage is approximately 382,700 gross square feet (GSF). This space includes parking decks, bus loading areas, waiting area, ticket office, vending area, restrooms and space for utilities.

The garage facility is within the highly developed Massachusetts Turnpike (I-90)/Route 30/Route 9 corridor in the Framingham/ Natick area. Nearby land uses include the Shoppers World Plaza, REI store, the AMC Premium Cinema, Liberty Mutual office building, Home Goods/Target stores and numerous other retail, restaurant and commercial buildings and associated surface parking lots.

To meet growing customer demand for HOV service to Logan Airport, particularly during peak travel periods, Massport currently leases an additional 565 parking spaces from adjacent property owners, including 490 spaces at AMC Theatres, 75 spaces at Fran's Florist. During peak travel periods, up to 132 additional parking spaces can be accessed at the Shopper's World parking area. Thus, a total of 697 overflow parking spaces are available for Logan Express Framingham customers.

1.5.2 Existing Services and Traffic Conditions

On weekdays, Massport's Logan Express service provides trips departing from Framingham to Logan Airport at 2:15 a.m. and 3:15 a.m., then run every half hour from 4:00 a.m. to 11:00 p.m. Return trips from Logan Airport to Framingham are scheduled every 30 minutes from 6:30 a.m. to midnight, with the last bus departing for Framingham at 1:15 a.m.

In support of the LEX garage expansion planning efforts, a Traffic Impact and Access Study (Attachment C) was completed in November 2019. Automatic traffic recorder counts found that approximately 3,304 vehicle trips are made into or out of the Framingham Logan Express

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parking lot system (including the overflow parking lots) during a typical Monday-Friday weekday. Approximately 48% of these trips are related to long-term garage parking for Logan Airport passengers and employees. The remaining are related to bus trips and drop-off/pick-up trips (either private vehicles or Ride App companies such as Uber and Lyft).

None of the intersections observed for the Access Study indicate operations worse than Level-of-Service (LOS) D – on a range of A to F – during the AM peak hour. However, several intersections along Cochituate Road (Route 30) operate at a LOS F during the PM peak hour due to heavy traffic volumes. These include the intersection of Cochituate Road (Route 30) at Shoppers World Drive and Burr Street.

1.6 SITE HISTORY

Massport first started Logan Express service from the Framingham area in the mid-1980s, focusing on selected peak travel periods. In 1994, Massport formalized this service with the opening of a small terminal building and associated surface parking lot of 374 spaces. Within a few years, as demand for the service grew, Massport seasonally leased existing parking spaces from adjacent retail business to meet peak parking demand. In 2001, approvals were secured for additional/structured parking at this site (EEA#12412), but following the events of 9/11/2001, that garage was not constructed.

After a number of years of sustained growth in ridership, in 2015, Massport constructed a four-level, 1,082-space parking garage at the Project site. This parking garage replaced a 374-space surface-level parking lot at the Site. This garage was designed to allow for future vertical expansion to seven levels to provide Massport the ability to meet demand for HOV Bus service if program ridership continued to grow.

Once the parking garage was opened in 2015, it was almost immediately regularly filled to capacity because of continued growth in passenger levels at Logan Airport, the attractiveness of the service and Massport's strong emphasis on HOV travel. For this reason, Massport has continued to use overflow lots from the opening of the garage in 2015 to today. Founded on the continued strong regional and national economies, passenger levels at Logan Airport have continued to grow, increasing 21% from 33.8 million to 40.9 million annual passengers from 2015 to 2018. Since the garage opened in 2015, ridership at Massport's Framingham Logan Express facility has grown at an even faster rate, increasing 34.1 percent from 431,000 riders in 2015 to 578,000 riders in 2018.

Massport estimates that in 2018 the Logan Express service in Framingham resulted in the avoidance of approximately 450,000 vehicle trips on the Logan Airport gateway entrances/exits including the Sumner and Callahan Tunnels and the Williams Tunnel (I-90), resulting in a reduction in CO₂E of approximately 4,344 ton per year.

1.7 PROPOSED IMPROVEMENTS

Due to consistently high and growing demand for the Logan Express bus service, Massport is seeking to increase the number of parking spaces available at the Framingham location. By

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expanding Logan Express service and improving facilities, this HOV project will advance a key component of Massport's overall commitment to reduce regional roadway congestion and associated GHG emissions.

Consistent with the original description in the 2013 ENF, Massport plans to add three additional levels to the existing four-level parking garage. This will increase the capacity of the garage by 998 parking spaces, from the existing 1,082 spaces to 2,080 spaces. Massport intends to continue to lease 565 existing parking spaces along the adjacent Flutie Pass for use on an as-needed basis during peak travel periods. Use of overflow parking at Shopper's World would be discontinued upon opening of the new garage levels.

The capacity of the existing and proposed garage, by level, is provided in Table 1.

Massport forecasts that by 2030 expanding the parking capacity at the Logan Express service in Framingham by 998 spaces and the continued use of the overflow parking spaces, as needed, will annually eliminate 1,100,000 vehicle trips on the Logan Airport gateway entrances/exits including the Sumner and Callahan Tunnels and the Williams Tunnel (I-90). By 2029, these avoided trips would result in a reduction of 11,605 tons per year in GHG (as measured in CO₂E). This is 62% more (7,261 tons of CO₂E) than the Future No-Build Alternative. This would more than double the existing annual number of avoided trips between MetroWest and Logan Airport that result from Massport's operation of the Framingham Logan Express facility.

The 2019 Traffic Impact and Access Study determined that, on an average weekday, in the future-build year (2029) the proposed garage will add approximately 1,496 vehicle trips to the surrounding road network. During the weekday morning peak hours, approximately 88 vehicle trips (45 in and 43 out) will be added to the surrounding road network, while during the evening peak hour approximately 117 (58 in and 59 out) vehicle trips will be added.

Approximately half of the trips will be drop-off/pick-up and bus movements trips with the remaining half of the trips will be for long-term parking at the garage. From a traffic operations perspective, the differences between the No-Build and Build Alternative's effect on local traffic operations are relatively minor. Site bus operations should improve with the proposed reconfiguration of the facility, with reduced pedestrian/vehicle conflicts.

In line with Massport's authority-wide sustainability planning, as part of the expansion project, Massport will implement a number of new elements to the garage to enhance efficiency, reduce electricity demand and facility-wide emissions. These new measures are described below.

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Table 1 LEX Framingham Garage Parking Capacity

Garage Level	Existing Garage	Proposed Garage¹
<i>Short Term & Valet</i>	45	40
<i>Ground Level</i>	176	175
<i>2nd Level</i>	216	213
<i>3^d Level</i>	341	337
<i>4th Level (Roof of Existing)</i>	304	337
<i>New 5th Level</i>	0	337
<i>New 6th Level</i>	0	337
<i>New Roof Level</i>	0	304
<i>Garage Total</i>	1,082	2,080
<i>Increase in Garage Parking Spaces</i>		998
<i>Leased Parking Spaces</i>	697	565 ²

¹ Parking space capacity is reduced on lower levels due to new electrical equipment rooms and improvements to the vehicle travel lanes.

² With the completion of the garage expansion, remote parking at Shoppers World will be discontinued.

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In addition to the added parking spaces and overall trip reduction, Massport is evaluating the following facility and bus service improvements at LEX Framingham:

Service Improvements

- Increase bus frequency from two to three times hourly.
- Initiate E-ticketing for improved customer convenience and speed up boarding.

Facility Improvements

- Modifications to terminal building to simplify and speed up passenger loading and unloading, including:
 - Clear signage directing vehicles picking up passengers to short-term lot
 - New garage automated parking guidance system to direct persons to available parking spaces.
- Addition of two new elevators and extension, by three levels, of existing two elevators.
- Expansion of closed caption television system.
- New passenger assistance call boxes on all new levels
- Ticketing kiosks at overflow parking lot

Environmental Enhancements

Massport will design and construct the facility in accordance with their Sustainable Design Standards and Guidelines (SDSG). Environmental initiatives for the garage and terminal facility to be included in the design of the facility include:

- Solar power panels on garage facade
- LED lighting
- Bike Racks
- Water saving restroom fixtures
- EV Charging Stations/Alternative fuel vehicle priority parking locations

Roof runoff from the new facility will continue to be directed to the existing stormwater system on the site, while the runoff from the interior levels of the garage will be directed to the sewer system. Stormwater pollutants will be minimized as the roof parking will be only be used during peak operation, and snow-melting machines will be utilized in place of de-icing chemicals.

1.8 GREEN HOUSE GAS EMISSIONS ANALYSIS

This section presents a greenhouse gas (GHG) analysis, prepared by Epsilon Associates, that complies with the MEPA Greenhouse Gas Emissions Policy and Protocol (GHG Policy) of May 2010.

1.8.1 Introduction and Project Overview

MEPA Greenhouse Gas Emissions Policy and Protocol

This section addresses GHG emissions generated by operation of the Project and associated traffic and options that may reduce those emissions in accordance with the MEPA GHG Policy. The GHG Policy requires, for certain projects undergoing review by the MEPA Office and required to prepare an EIR, that GHG emissions be quantified and measures to avoid, minimize, or mitigate such emissions be identified. The GHG Policy requires Massport to quantify the impact of proposed mitigation in terms of energy savings and GHG emissions.

Pursuant to the GHG Policy, Massport consulted with the MEPA Office to confirm that an expanded Environmental Notification Form (EENF), with GHG analysis, is required for the submission.

The analysis provided herein focuses on emissions of carbon dioxide (CO₂). As noted in the GHG Policy, although there are other GHGs, CO₂ is the predominant contributor to global warming. Furthermore, CO₂ is by far the predominant GHG emitted from the types of sources related to the Project, and CO₂ emissions can be calculated for these source types with readily available data.

GHG emissions sources can be categorized into two groups: stationary sources, or emissions related to activities that are stationary on the site; and mobile sources, or emissions related to transportation. Stationary sources can be further broken down into direct sources and indirect sources. Direct sources include GHG emissions from fuel combustion, and indirect sources include GHG emissions associated with electricity and other forms of energy that are imported from off-site power plants via the regional electrical grid or local steam distribution system for use on-site.

Stationary Source Methodology

The Project consists of 3 levels of parking garage to be constructed on top of an existing parking garage. The GHG Policy requires Massport to calculate and compare the GHG emissions for two cases; base and proposed, each of which considers stationary source and transportation components.

The base case is the baseline from which progress in energy use and GHG emissions reductions is measured. Per the GHG Policy, the baseline is a building designed to meet the applicable state building code (Code) that is in effect at the time the EENF is filed. In this case, the Code at the time of this filing is the 10th Edition, amended to incorporate the building energy provisions of

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International Energy Conservation Code (IECC) 2018. This, together with the guidance of the modeling protocol of ASHRAE 90.1 Attachment F defines the baseline for this GHG analysis.

For the stationary sources component, Case 2 presents the proposed Project including GHG mitigation measures anticipated to be incorporated into the building designs.

Mobile Source Methodology

The mobile source GHG analysis was developed using the traffic study presented in Attachment F. Transportation-related GHG emissions are presented for three typical cases: 2019 Existing, 2029 No-Build, and 2029 Build.

For the GHG analysis, Massport can only take credit for improvements above and beyond the Project at its minimum requirements (“base” case). However, traffic is expected to change due to other development in the area. Thus, the difference between the Build cases and the No-Build case are the GHG emissions attributable to the Project.

Project Overview

This Project relates to the construction of three (3) additional levels to an existing Massport LEX garage. The scope of the project is fairly limited as the energy elements of the proposed Project consists solely of lighting and on-site photovoltaics (PV) as discussed further in Section 3.2. This project has no new ventilation, heating, cooling, or water use. The existing garage that the three additional levels are being added to is already a highly efficient building. The existing structure energy demands consists solely of reduced power density lighting for the garage, elevator banks, and a small lobby building with electric heating and cooling. Consideration of mobile sources is presented for the Project in Section 3.3. The addition of more parking at this garage will allow for fewer car trips into and out of Boston. By reducing the number of cars on the highways that lead to and from Logan Airport, GHG emissions are decreased significantly.

1.8.2 Stationary Sources

Informed by consultation with MEPA and DOER, Massport evaluated the practicality of means and measures to minimize greenhouse gas emissions from the Project stationary sources, focusing on the following categories:

- Lighting efficiencies
- On-site Solar PV

This section evaluates the impacts of alternatives for each of these categories.

Lighting

The Project proposes highly efficient lighting that will incorporate motion sensors and ambient light sensors to further reduce energy usage. The proposed lighting design will use 29 kilowatts (kW) less than required by Massachusetts Energy Code (International Energy Conservation Code 2018, Table C405.3.2(2)) which is an energy use reduction of 66.5%. The installed motion sensors and ambient light sensors further reduce the energy use of the proposed lighting design to a 75% reduction below Massachusetts Energy Code requirements. Analysis of the energy use for the proposed lighting shows that 783.9 kilowatt-hours (kWh) are saved daily compared to

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Massachusetts Energy Code standards for the building which equates to approximately 286 Megawatt-hours (MWh) of saved energy annually. At a carbon dioxide emission factor of 682 pounds per Megawatt-hour (lb/MWh)³, the 286 MWh per year reduction in energy use accounts for a 97.5 ton per year reduction in GHG emissions compared to baseline. Please refer to Attachment F for the Lighting Report.

Solar PV

The Project includes the addition of Solar PV on the façade of the building. A solar canopy was considered for the Project. However, in discussions with the City of Framingham, it was determined that the construction of a solar canopy above the top level of the parking garage would trigger fire protection requirements that would significantly increase Project costs by requiring fire suppression throughout the entire garage building, including retrofitting existing levels that are not part of the proposed project. An additional concern is the added height of a solar canopy casting a shadow on the offsite adjacent REI PV panels. As such, the Project proposes to add Solar PV on the façade of building instead of the roof.

Simulations were run with two different scenarios for the façade PV. Solar modeling has been performed using PVsyst v.6.8.6 using Meteonorm data. This modeling was further updated using NREL Data. Building PV orientation was at an Azimuth of S41°E with two outputs generated. Option 1 sets all PV modules at 90° Tilt and Option 2 includes five rows of modules at various tilts (90°, 75°, 65°, 55°, 45°) from vertical. Due to limitations in the PVSyst software, Option 2 ended up with a slightly higher DC value of 1.64kW; however, this would be negligible as it amounts to roughly 4 additional modules. Even though shading losses on Option 2 were higher, this variant was able to collect a higher amount of available irradiance than Option 1. Massport is currently reviewing both options to determine which option will be the preferred option. To be conservative, the lesser of the two alternatives has been included in the GHG summary. This annual production of 163.5 MWh annually equates to approximately 55.8 tons of CO2 offset.

The results of the PV modeling are presented in Table 2 below. Refer to Attachment F for the PV Report.

³ 2017 ISO New England Electric Generator Air Emissions Report, Table 1-1 (https://www.iso-ne.com/static-assets/documents/2019/04/2017_emissions_report.pdf)

Table 2 Solar PV Model Results

Item	Option 1 (90° only)	Option 2 (90°, 75°, 65°, 55°, 45°)
Specific Production (kWh/kWp/Year)	968	1,114
Average Performance Ratio (%)	81.7%	75.4%
Near Shadings Losses (%)	4.3%	10.9%
Electrical Shadings Loss (%)	0.2%	2.4%
Soiling Loss (%)	2.4%	2.4%
Energy Injected to Grid (MWh) [For first year – solar typically depreciates at a rate of 0.4% per year)	163.5	190.0

1.8.3 Mobile Source Emissions

Local Traffic GHG Analysis

In accordance with the MEPA GHG Policy, GHG emissions were estimated for mobile sources within the transportation study area (see Attachment C – Traffic Impact Analysis). For mobile source GHG emissions, the methodology follows the same methodology that is outlined in MassDEP guidance for mesoscale analyses. The analysis includes a comparison of the future Build Conditions to the No-Build Condition. If emissions are greater for the Build Conditions, reasonable and feasible mitigation measures will be evaluated. The methodology and parameters for the mesoscale analysis follow methodology approved by MassDEP.

The mesoscale analysis performed for the Project predicts the change in local CO₂e emissions due to the proposed Project. The total vehicle pollutant burden was estimated for the 2019 Existing Scenario and the No-Build and Build conditions for the year 2029. Traffic conditions are described in more detail in Attachment C – Traffic Impact Analysis.

MOVES was used to estimate motor vehicle emission factors of CO₂e on the roadway network in the Project area. A peak travel day (estimated to be a weekday in March) was used in MOVES. Daily and yearly emission estimates were calculated using the vehicle count data, mileage between intersections, modeled signalized intersection delay times, and emission factors.

The traffic volumes provided in Attachment C form the basis of the study. Peak hour traffic volumes were provided and estimates of Average Daily Trips (ADT) were made from the peak hour volumes assuming a 10% K-Factor. Average speeds were assumed for all roadways. Distances for the links were estimated with mapping software.

Average per-vehicle idle times were based on delay times reported in the SYNCHRO intersection modeling output reports provided (see Attachment C) to calculate emissions from idling vehicles.

All related calculations, including the 2019 and 2029 emissions estimates, are presented in Attachment F.

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GHG Analysis Cases

The transportation analysis presented three cases: 2019 Existing, 2029 No Build, and 2029 Build. These traffic analyses are described in more detail in Attachment C.

For the GHG analysis, Massport can take credit for improvements above and beyond the project at its minimum requirements (“base” case). In this analysis, there is no GHG mitigation proposed.

Local Traffic GHG Analysis Results

Table 3 represents the difference between the 2019 Existing case and the 2029 No Build case. Anticipated improvements in vehicle engine and emissions technologies, which are expected to reduce the per-vehicle emission rates, typically reduce future emissions.

Typically, a decrease in total emissions, even with the modest increases in traffic vehicle miles traveled (VMT), is attributable to anticipated improvements in vehicle engine and emissions technologies, which are expected to reduce the per-vehicle emission rates. Even with increases in VMT, large reductions are often realized due to improved fleet vehicle emissions.

This results in a 10% decrease between years 2019 and 2029.

**Table 3 Local Traffic GHG Emissions Analysis Summary
(Existing to Future No Build)**

Pollutant	CO ₂ e (lbs/day)	CO ₂ e (tons/yr)
2019 Existing	79,699	14,545
2029 No Build	71,683	13,082
Difference	-8,016	-1,463
Difference (%)	-10%	-10%

Table 4 presents the difference between the 2029 No Build and Build cases. As shown, the 2029 Build case exhibits a 2% increase of carbon dioxide-equivalent (CO₂e) emissions compared to the 2029 No Build case. The increases are directly due to increased vehicle traffic attributable to the Project.

**Table 4 Local Traffic Emissions Analysis Summary
(Build to Future No Build)**

Pollutant	CO₂e (lbs/day)	CO₂e (tons/yr)
2029 No Build	71,683	13,082
2029 Build	72,775	13,282
Difference	1,092	199
Difference (%)	2%	2%

Other GHG Reduction Measures

In addition to the GHG changes attributable to traffic in the local project area, there are sometimes other project aspects that contribute to changes in GHG emissions. In this case, the expansion of the Logan Express parking garage by 998 spaces provides additional opportunities for commuters in the surrounding region to utilize the high-occupancy vehicle services provided, rather than commuting in private vehicles from the Metro-West area to Logan Airport. The reduction of private passenger vehicle trips created by the Logan Express service directly results in a reduction of GHG emissions.

Transportation analyses estimate that that the current garage is at or near capacity already. At capacity, it’s estimated that approximately 450,000 trips to and from Logan from Metro-West are removed from the Mass Pike I-90 using the Logan Express. This value would be expected to remain constant forward to the future forecast year. With a three-level expansion, it is estimated that a total of 1.1 Million trips will be saved annually, which is 650,000 trips more than the existing annual savings. With the expansion plan, additional bus service will be required to accommodate the increased ridership.

Using the trip estimates, 2029 emission factors from the MOVES database, and a round trip mileage from the Framingham garage to Logan and back, GHG reduction can be directly estimated. Table 5 provides a summary of the CO₂e reductions for each alternative.

As a result of the round trips to Logan removed from the region, it is expected that in 2029 with no expansion, GHG emissions would be reduced by 4,344 tons. With the three-level garage expansion, emissions would be reduced by 11,605 tons, a further reduction of 7,260 tons over the No-Build case.

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Table 5 GHG Reductions due to Avoided Trips to Logan Airport

Pollutant	Future No Build	Future Build (3 Levels)
Passenger Trips Removed	450,000	1,100,000
Passenger CO ₂ e Emissions Removed (tpy)	-5,366	-13,116
Bus Trips	14,196	21,008
Bus CO ₂ e Emissions (tpy)	1,021	1,512
Total CO ₂ e Emissions (tpy)	-4,344	-11,605
Difference from Existing/No Build (tpy)	-	-7,260

Summary

Table 6 shows the details of the GHG analysis from case to case. Changes are based on the preceding case to the left. Vehicle miles traveled (VMT) represents the approximate mileage of all vehicles traveling on the modeled roadway network, and the net VMT change represents the difference from the prior case. A zero change in VMT means there are no vehicles added or removed from the network for that case. Net delay represents the time sum of all idle traffic at all network intersections over the course of a day. Increases in intersection volumes without any revisions to the signal network tend to increase idling for vehicles waiting for signal lights to change. Typically, mitigation includes either adjusting existing signals to better handle traffic flow, or completely reconfiguring intersections, in turn reducing delay times and, as a result, idling emissions.

Table 6 Traffic GHG Emissions Analysis Summary – Comparison of Future No Build to Future Build

	Units	2019 Existing	2029 No Build	2029 Preferred Build
Daily VMT	veh-miles/day	88,454	100,199	101,127
Net Change	veh-miles/day	-	11,745	928
Net Delay	veh-hrs/day	1,613	2,865	2,967
Net Change	veh-hrs/day	-	1,252	102
Roadway CO ₂ e	tpy	12,435	10,363	10,465
Intersection CO ₂ e	tpy	2,110	2,720	2,817
Other CO ₂ e	tpy	-4,344	-4,344	-11,605
Total CO ₂ e	tpy	10,201	8,738	1,677
Net CO ₂ e Change	tpy	-	-1,463	-7,061

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Greenhouse gas emissions reductions through different build alternatives are measured against the emissions attributable to the base project. Therefore, for mobile source GHG emissions, the emissions due to background traffic must be removed. Table 7 shows the net emissions with the 2029 No-Build case results removed from the Build case. Roadway and Intersection GHG increase slightly due to the additional traffic local to the garage area while the removal of trips to and from Logan results in substantial reductions in GHG.

The garage expansion provides additional services to reduce overall GHG. It is expected that GHG reductions will approach roughly 7,061 tpy in 2029 as a result of the project, and its overall effect on vehicle trips.

Table 7 Traffic GHG Emissions Analysis Summary - Roadway Improvements

	units	Project-Related Differences
Roadway CO ₂ e	tpy	102
Intersection CO ₂ e	tpy	97
Reduction in trips to/from Logan	tpy	-7260
Net CO ₂ e Emissions	tpy	-7061

1.8.4 Summary and Mitigation Commitments

Project GHG Summary

The proposed project will include a reduced lighting density that will decrease energy by approximately 75% over a code baseline. In addition, the Project will include a PV installation that will generate approximately 163 MWh/year or 190 MWh/year, depending on the final configuration. Finally, the Project’s 998 new parking spaces will avoid approximately 1.1 Million trips between Framingham and Logan Airport, resulting in an over 80% reduction in the Project’s mobile source GHG emissions. Table 8 presents the Project’s GHG emissions for the baseline and proposed conditions.

Table 8 Project GHG Emissions Summary

	Baseline (tons/yr)	Proposed (tons/yr)	Difference	Percent Change
Stationary Sources	130.7	33.1	-97.5	-74.7%
New Photovoltaics	n/a	-55.8	-55.8	n/a
Mobile Sources	8,738 (2029 No Build)	1,677	-7,062	-80.8%

Proponent’s Commitments to GHG Reduction

Massport is committed to environmental stewardship and will encourage the continued evaluation of energy efficiency and renewable energy measures throughout the life of the Project.

Massport is committed to the following mitigation elements for the Project:

- Reduced lighting power densities
- A minimum of approximately 160 MWh/year in on-site solar PV generation

The design of the garage additions will include all feasible GHG emissions mitigation in order to avoid, reduce, minimize, or mitigate damage to the environment.

Massport is committed to implementing the energy efficiency and GHG emission reduction measures presented in this analysis. If, during design of the Project, a specific combination of design strategies proves more advantageous from an engineering, economic, or space utilization perspective, the design of the buildings may vary from what has been described herein. Energy performance minima and associated GHG emission reductions will be adhered to.

Upon completion of the building, Massport will submit a self-certification to the MEPA Office, prepared in accordance with the GHG Policy. Massport will provide an update on its GHG reduction initiatives in its Environmental Data Report (EDR) filed annually with the MEPA office.

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This certification will identify the GHG mitigation measures incorporated into the building and will illustrate the degree of GHG reduction from a Baseline case, as Baseline is defined herein, and how such reductions are achieved. Details of Massport’s implementation of operational measures will also be included.

1.9 PROJECT ALTERNATIVES

Several alternatives were evaluated to identify the option that best satisfied the project purpose of reducing regional roadway congestion and associated GHG emissions by increasing HOV ridership to Logan Airport by expanding Logan Express service and improving facilities. Massport has a strategic plan to increase the HOV mode share to Logan Airport to 40 percent by 2027.

1.9.1 No-Build Alternative

Under a No Build Alternative, there would be no improvements to the existing Logan Express Framingham parking garage and reduction of regional vehicle miles traveled and associated emissions.

This alternative was eliminated from further consideration because it does not satisfy the project purpose of providing Logan Airport employees and passengers in the Metrowest/Framingham area a reliable and convenient method of traveling to Logan Airport. The No-build alternative would not enhance HOV access to Logan Airport; with constrained parking at Logan Airport the demand is likely to be met by increased pick-up and drop-off at Logan Airport, representing a doubling of travel miles for each trip.

1.9.2 On-Site Alternatives

Massport evaluated two on-site alternatives for increasing HOV ridership to Logan Airport by expanding Logan Express service and improving facilities. As described below, these alternatives included the vertical expansion of the garage by two levels (661 new spaces) and three levels (998 new spaces). Each on-site alternative assumes the continued lease of 565 overflow parking spaces at AMC Theatres parking areas.

To compare these alternatives, Massport considered how well they met the project purpose as well as their potential impact on wetland resources, traffic conditions in the project area, and number of avoided trips to Logan Airport (and associated reduction in GHG emissions). The metrics used to compare traffic conditions include seconds of delay at key project area intersections during the weekday morning and evening peak periods and the forecast Level of Service (LOS) at these key intersections. The key intersections include:

- Shoppers World Drive at Route 30
- Shoppers World Drive at Burr St Extension
- Burr Street Extension at Route 30

Two Level Garage Expansion

Massport evaluated the vertical expansion of the existing garage by two parking levels, having 661 new parking spaces. Compared to the No-Build Alternative, this alternative would result in an increase of 1,700 vehicles per day traveling to and from the site resulting in an increase in delay of one- to six-seconds at key intersections in the Project area.

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Massport estimates that in 2030 expanding the parking capacity at the Logan Express service in Framingham by 661 spaces will annually eliminate 960,000 vehicle trips on the Logan Airport gateway entrances/exits -including the Sumner and Callahan Tunnels and the Massachusetts Turnpike (I-90). By 2029, these avoided trips would result in a reduction of 9,935 tons per year in GHG (as measured in CO₂E). This is 56% more (5,591 tons of CO₂E) than the Future No-Build Alternative. This estimate assumes that bus service frequency will be increased, as needed, to meet demand.

This alternative would require approximately 7,675 square feet of temporary impact to the 100-foot wetland buffer zone during the construction period. This area would be restored to pre-construction conditions.

This alternative was not selected because it does not satisfy as well as the preferred alternative the project purpose of providing Logan Airport employees and passengers in the Metrowest/Framingham area a reliable and convenient method of traveling to Logan Airport.

Three Level Garage Expansion (Preferred Alternative)

Massport also evaluated the vertical expansion of the existing garage by three parking levels, having 998 new parking spaces. Compared to the No-Build Alternative, this alternative would result in an increase of 2,032 vehicles per day traveling to and from the site resulting in an increase in delay of one- to nine-seconds at key intersections in the Project area.

However, Massport estimates that in 2030 expanding the parking capacity at the Logan Express service in Framingham by 998 spaces will annually eliminate 1,100,000 vehicle trips on the Logan Airport gateway entrances/exits including the Sumner and Callahan Tunnels and the Massachusetts Turnpike (I-90). By 2029, these avoided trips would result in a reduction of 11,605 tons per year in GHG (as measured in CO₂E). This is 62% more (7,261 tons of CO₂E) than the Future No-Build Alternative. This estimate assumes that bus service frequency will be increased, as needed, to meet demand.

This alternative would annually eliminate approximately 140,000 more trips (and 1,670 tons of CO₂E) from Logan's gateway entrances/exits than the Two-Level Garage Expansion alternative. Overall, this alternative more fully advance Massport's goal of increasing the HOV mode share to Logan Airport to 40 percent by 2027 while resulting in no additional natural resource impact.

This alternative was identified as the Preferred Alternative because it would better satisfy Massport's commitment to reduce congestion and associated GHG emissions by increasing HOV ridership to Logan Airport by expanding Logan Express service and improving facilities.

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Table 9 Comparison of Alternatives

Alternative	New Parking Spaces	Permanent Vegetated Wetland Resource Alteration	Temporary Work within 100-foot Wetland Buffer Zone (SF)	Project-Generated Increase in Average Daily Traffic (ADT)	Increase in Peak Period Traffic Volumes AM (PM)	Seconds of Delay at Key Intersections¹ Weekday Peak AM (PM)	LOS at Key Intersections¹ Weekday Peak AM (PM)	2029 Annual Reduction in Vehicles on Logan Gateway Roadways²	GHG Emission Reduction Due to Avoided Trips to Logan (tons per year in 2029)⁴
<i>Future No-Build</i>	0	0	0	0	Minor	1. 20 (110) 2. 13 (19) 3. 55 (208)	1. B (F) 2. B (B) 3. E (F)	450,000 ³	4,344
<i>On-Site Alternatives</i>									
<i>Two-Level Garage Expansion</i>	661	0	7,675	1,164	83/ (105)	1. 21 (115) 2. 15 (21) 3. 57 (214)	1. C (F) 2. B (C) 3. E (F)	960,000 ³	9,935
<i>Three-Level Garage Expansion (Preferred)</i>	998	0	7,675	1,496	88 (117)	1. 21 (116) 2. 15 (22) 3. 57 (217)	1. C (F) 2. B (C) 3. E (F)	1,100,000 ³	11,605

¹ Key Intersections include: 1) Shoppers World Drive at Route 30, 2), Shoppers World Drive at Burr St Extension and 3) Burr Street Extension at Route 30.

² Logan Airport gateway roadways including Sumner and Callahan Tunnels and Massachusetts Turnpike (I-90).

³ Assumes 6.5% annual growth in LEX Framingham ridership, continued use of the overflow parking lots, and increase in bus service to meet demand. Future No-Build assumes parking capacity effectively reached in 2019. Two-Level Garage expansion would reach effective capacity in 2029. Three-Level Garage expansion would reach effective capacity in 2030.

⁴ Measured as tons per year of CO₂E (carbon dioxide equivalent)

1.10 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

Wetland Resources:

In developing a preferred concept for the garage expansion, avoidance and minimization of impact to natural resources, including wetlands, was examined thoroughly. The first step of this process was to update the field wetland delineation (see Figure 5). With that wetland information in hand, the construction plan was adjusted to avoid direct wetland impact and minimize wetland buffer zone impacts to the maximum extent practicable.

The net result of that effort was the complete avoidance of impact to Bordering Vegetated Wetlands (BVW) and minimization of work within the wetland buffer zone at the northeast corner of the garage structure to up to approximately 7,675 square feet of temporary, construction phase impact. The garage was originally sited as close to the western property boundary and Burr Street easement as possible in order to reduce wetland impacts while allowing enough room for foundation construction.

Soil erosion and sediment controls will be implemented prior to and in conjunction with proposed construction activities.

Stormwater Management:

The project is considered a redevelopment project as defined in 310 CMR 10.04 and therefore the stormwater management system will be designed to meet stormwater standards to the maximum extent practicable, while improving upon existing conditions. Conformance with the stormwater standards will be achieved in accordance with the Massachusetts Stormwater Handbook (Jan 2008).

The existing storm drainage facilities are comprised of an open and closed drainage system with specific Low Impact Development (LID) measures and Best Management Practices (BMPs) for controlling the stormwater discharges. LID/BMP's measures include the use of pervious pavement at selected locations, infiltration trenches and proprietary treatment unit. Existing stormwater basin and drainage outfalls will be retained and utilized as part of the stormwater management system.

Roof runoff will be directed to stormwater treatment units prior to discharging to the existing stormwater basin, while runoff from the interior levels of the garage will be directed to the sewer system. Stormwater pollutants will be minimized as roof parking will be only be used during peak operation and snow-melting machines will be utilized in place of de-icing chemicals. Areas outside the impervious footprint are maintained as lawn or other pervious surface.

During the construction period, to provide a level work area for a crane to operate fill may be temporarily placed in the 100' wetland buffer zone and a portion of the detention pond on the northeast side of the garage. The fill will be supported by a steel sheet-pile wall. It is anticipated that the temporary fill placed within the stormwater basin will not significantly affect the basin's ability to manage stormwater from the site. Since stormwater flows through the water quality unit prior to discharge to the stormwater basin, stormwater flowing through the basin and toward the adjacent BVW is anticipated to be relatively clean, with little turbidity. The basin would be

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restored to pre-construction condition after construction.

Building Shading Analysis:

The REI store to the north of the project site has an existing solar carport and additional arrays on the roof of their building. A Shade Study was completed to evaluate the impact of the shadows cast by the vertical expansion of the parking garage on the adjacent REI solar panels (Attachment F). The study determined that shadows from the proposed vertical expansion of the garage to seven levels would have no effect on the REI carport panels at any time of the year. The expanded garage would obstruct sun exposure to no more than 10% of REI's rooftop solar panels for two- to four-hours in the morning during November and December, a period of relatively low solar power generation.

The shade analysis also indicates that the existing parking garage casts shadows on the adjacent wetlands in the afternoon for most of the year, with the size and duration of these shadows varying by date. The proposed modifications will marginally increase the size of these shadows cast on the adjacent wetlands, most notably during the spring, fall, and winter seasons. The impacts during the summer months are shown to be relatively minor, with the shadows cast around the summer solstice extending only just over the wetlands delineation for up to 3 hours before sunset. Because the majority of the shadow impacts are during non-growing seasons, this is not anticipated to impact the health of this wetland.

Greenhouse Gas Emissions:

Massport has detailed their commitments to mitigate Project GHG emissions. Additional mitigation measures have not been quantified, primarily because the degree of accuracy or the reliability of the quantification method is uncertain.

Massport is committed to environmental stewardship and will encourage the continued evaluation of energy efficiency and renewable energy measures throughout the life of the Project.

Massport is committed to the following mitigation elements for the Project:

- Reduced lighting power densities
- A minimum of approximately 160 MWh/year in on-site solar PV generation

Massport has included in the design of the garage expansion all feasible GHG emissions mitigation in order to avoid, reduce, minimize, or mitigate damage to the environment.

1.11 PERMITTING STATUS

The following municipal, state and federal environmental permits and reviews are anticipated as part of this project:

- **Notice of Intent (NOI) for Project Construction** will be filed with the Framingham Conservation Commission due to the potential for temporary construction stage work in 100-foot buffer zone to bordering vegetated wetlands (BVW). The buffer zone area consists of garage landscaping and/or mowed lawn.

LOGAN EXPRESS FRAMINGHAM – GARAGE EXPANSION

- An application for a **State Building Permit** and **State Plumbing Permit** will be filed by the project contractor during the construction phase.

ATTACHMENT B

Figures

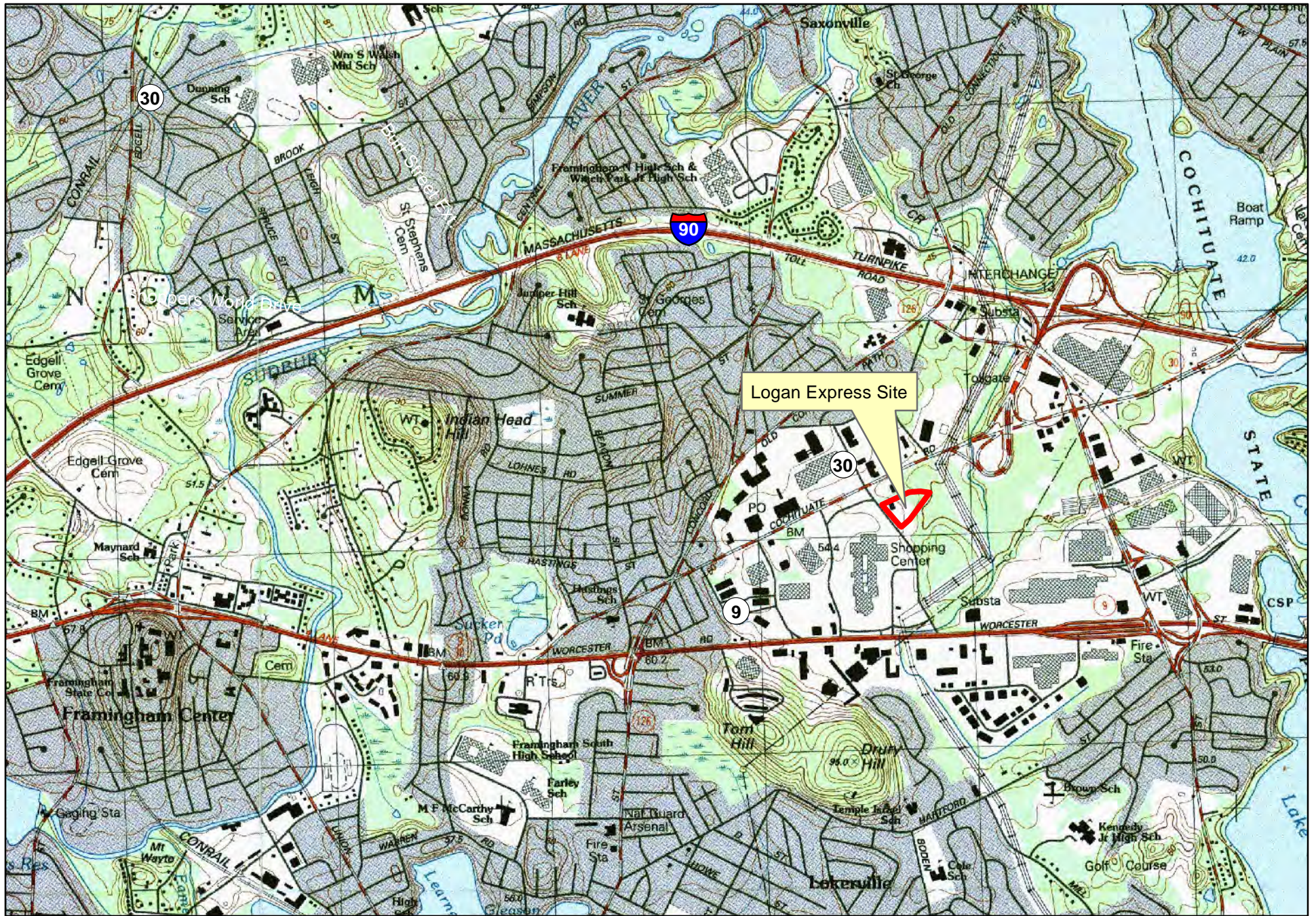
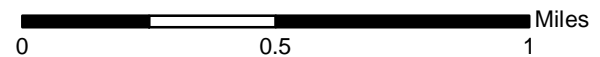


Figure 1: USGS Topographic Map (1:24,000)

Massport Logan Express Garage Expansion
 Framingham, MA

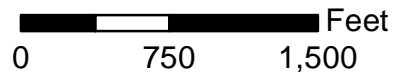


Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, (data current to October 2013).
 2015 Orthophotography.



Figure 2 - Project Site & Offsite Parking

Massport Logan Express Garage Expansion
Framingham, MA



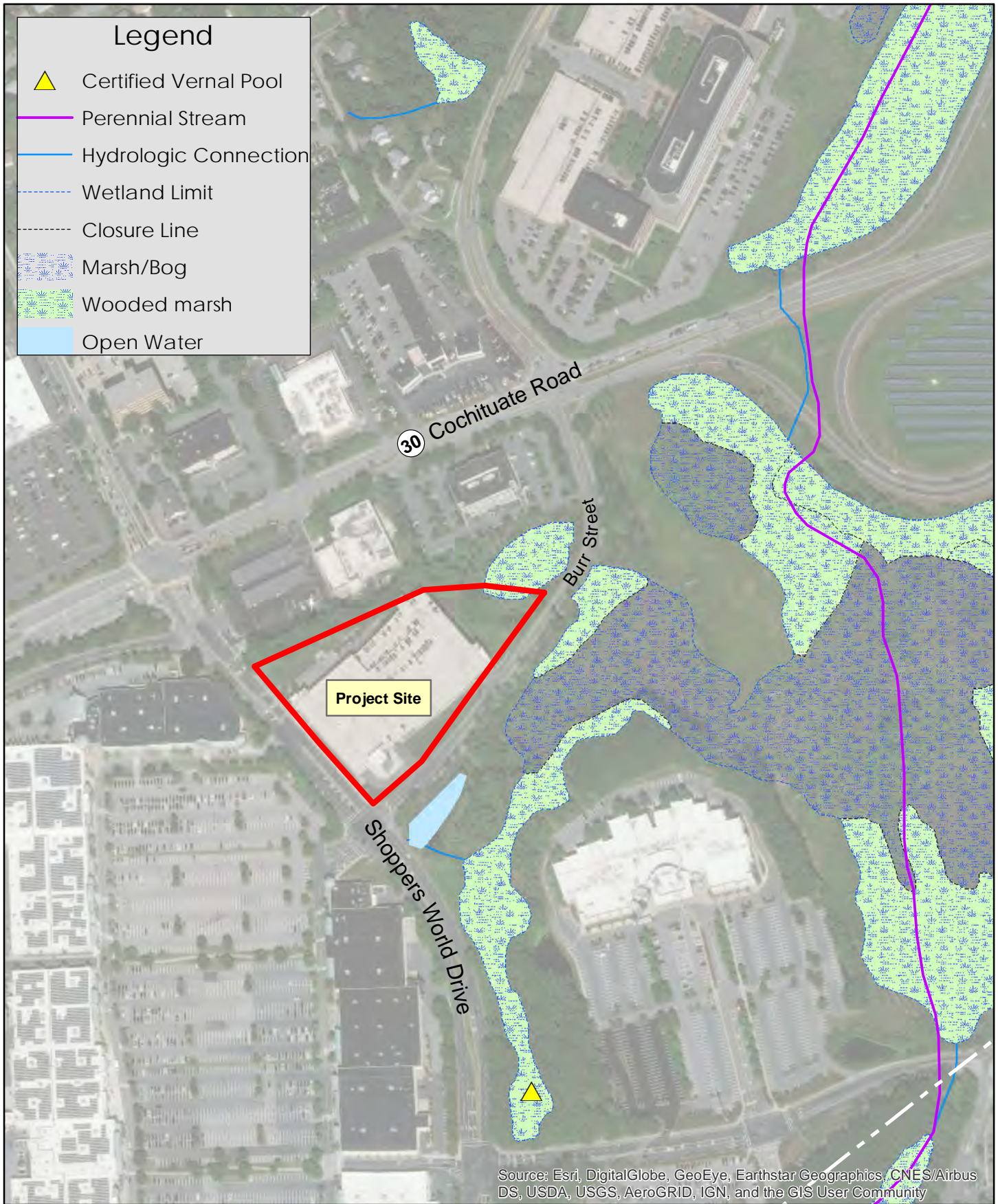


Figure 3 - DEP Wetlands

Massport Logan Express Garage Expansion
Framingham, MA

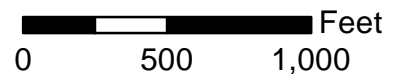


Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, (data current to October 2013).
2015 Orthophotography.



Figure 4 - FEMA Floodplains

Massport Logan Express Garage Expansion
Framingham, MA



Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, (data current to October 2013).
2015 Orthophotography.

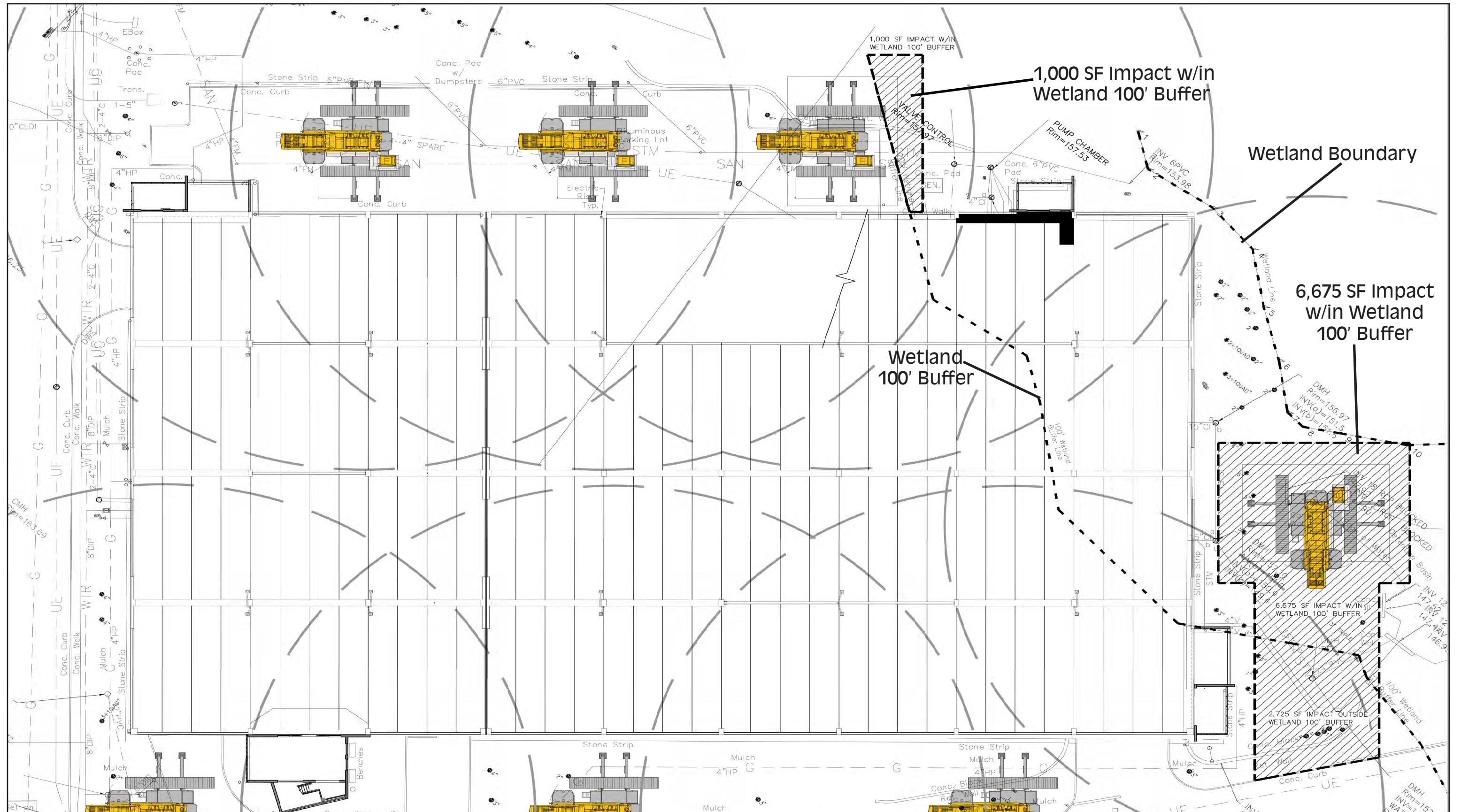


Figure 5: Potential Work Within Delineated WPA Wetlands 100-foot Buffer
 Massport Logan Express Garage Expansion
 Framingham, MA

ATTACHMENT C

Traffic Impact Analysis

**(Available Upon Request: Traffic Count Data, Crash Rate Worksheets,
Trip Generation Calculations, Intersection Capacity Analysis
Worksheets)**



**Traffic Impact and Access Study
Proposed Expansion of the
Framingham Logan Express
Parking Garage**

February 14, 2020

Prepared for:

Massachusetts Port Authority



Prepared by:

Stantec Consulting Services Inc.
Burlington, Massachusetts

**TRAFFIC IMPACT & ACCESS STUDY
 PROPOSED EXPANSION OF THE
 FRAMINGHAM LOGAN EXPRESS GARAGE
 FEBRUARY 14, 2020**

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1.0 INTRODUCTION

1.1 OVERVIEW

The Massachusetts Port Authority (Massport) is proposing improvements to the existing Logan Express parking garage and terminal facility (LEXF) in the City of Framingham that is located in close proximity to the Massachusetts Turnpike (I-90) at the corner of Burr Street and Shoppers World Drive (Figure 1). Massport completed improvements to this facility in the summer of 2015. Over the past several years, as passenger levels at Boston-Logan International Airport have continued to expand, ridership at Massport's Framingham Logan Express facility has likewise expanded.

Logan Express is a transit service offered by Massport, transporting passengers by bus between each of its five satellite locations in Peabody, Woburn, Framingham, Braintree and Boston (Back Bay), and Logan Airport. At each of the four suburban facilities, including Framingham, users are able to park their personal vehicles at relatively low cost and take the Logan Express bus directly to Logan Airport's four passenger terminals. Some users of the Logan Express bus service are also dropped off/picked up at the facility and do not use the parking facilities. The Logan Express system currently carries approximately 2 million annual passengers and is a component of Massport's overall trip reduction and high occupancy vehicle (HOV) strategy.

To meet this existing and projected demand, Massport is proposing to increase the parking capacity to provide 2,080 parking spaces at this facility. Construction of an expansion to the existing garage and integrated terminal building will add to Massport's HOV capacity for passengers and employees.

This study evaluates the impacts that the proposed expansion of the LEXF parking supply will have on traffic volumes in study area. To address potential traffic impacts of the proposed expansion, an extensive data collection effort was undertaken. Stantec coordinated with Massport staff to identify changes in the project area and project goals. New intersection traffic turning movement counts and automatic traffic recorder counts were performed in Framingham and Natick, where the intersections are likely to be affected by the LEXF expansion.

In addition to traffic related data, historical crash trends in the study area were identified for the most recent available four-year period of 2015-2018 and crash analyses were conducted using MassDOT crash rate calculation procedures.

Traffic estimates from several future development projects permitted/approved but not yet occupied in Framingham and Natick were obtained and added onto the background traffic growth projections to establish future year analysis projections to represent year 2029 Build and No-Build conditions.

Lastly, projections were made of year 2029 (Build) traffic volumes and operating conditions with the proposed expansion of the LEXF parking garage by 998 parking spaces and increased frequency of Logan Express bus service. Expansion of the LEXF can be accomplished without adversely affecting the



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local roadway network, while providing a significant reduction in annual trips between Framingham and Boston along a severely congested corridor.



1.2 PURPOSE AND NEED

The purpose of this project is to expand reliable and convenient access for HOV service to Boston Logan International Airport Logan for passengers and employees in the MetroWest/Framingham area. Currently, the Framingham Logan Express garage consists of 1,082 parking spaces, and existing demand can exceed that capacity during Logan Airport's peak travelling periods.

Massport's Ground Transportation Plan calls for an increase in HOV usage to Logan Airport to reduce congestion around Logan Airport and the regional highway system leading to the airport and to lower greenhouse gas (GHG) emissions. In order to satisfy these goals, Massport continues to heavily promote the use of its five Logan Express sites, which includes the Framingham Logan Express facility, through means including the proposed increase in parking capacity at the Framingham site. Since the construction of the Framingham Logan Express parking garage in 2015, parking demand has steadily increased, and demand now exceeds capacity at the new garage much of the time. Demand is such that Massport continues to use proximate overflow surface parking lots. As Logan Airport continues to grow to meet forecast regional demand, implementation of the Ground Transportation Plan, which includes the need for enhanced HOV services, will become all the more critical. Further expansion of the garage at the existing Framingham Logan Express site allows Massport to help meet the growing regional HOV demand and, as a result, lower GHG emissions.



2.0 EXISTING TRANSPORTATION CONDITIONS

2.1 PROJECT BACKGROUND

At the present time, the main Framingham Logan Express (LEXF) terminal building is served by a 1,082 parking space garage, integrated with the Logan Express bus terminal and constructed by Massport in 2015. Logan Express buses can stage simultaneously in one lane on the east side of the LEXF terminal on the ground level of the garage with a lane available for bypass and a similar setup for curbside passenger drop off/pick up on the west side. Buses flow in a clockwise direction, entering from Shoppers World Drive, stopping and discharging/embarking passengers and exit the facility onto Burr Street.

To meet growing customer demand for HOV service to Logan Airport, particularly during peak travel periods, Massport currently leases an additional 565 parking spaces from adjacent property owners, including 490 spaces at AMC Theatres, 75 spaces at Fran's Florist. During peak travel periods, up to 132 additional parking spaces can be accessed at the Shopper's World parking area. Thus, a total of 697 overflow parking spaces are available for Logan Express Framingham customers.

These overflow parking lots are located within a quarter mile walking distance of the existing LEXF terminal. Massport has indicated that the two overflow lots are used frequently. Figure 2 shows the full LEXF parking system.

The Logan Express primary overflow surface lot (Lot 4) is located on the south side of Flutie Pass (across the roadway from the AMC movie theatre) and 565 existing parking spaces are leased by Massport at this location (AMC Overflow Lot). This lot is also serviced by Logan Express buses.

The second overflow lot is located at the Shoppers World shopping complex. The parking spaces at this location are not leased by Massport. Rather, Massport pays on a per parking space basis only when these existing Shoppers World parking spaces are used by Logan Express customers. Use of spaces at Shoppers World is expected to end upon the opening of the new garage levels.

Once the proposed expansion of the existing garage is complete, Massport intends to continue to lease 565 existing parking spaces along the adjacent Flutie Pass for use on an as-needed basis during peak travel periods. Use of overflow parking at Shopper's World would be discontinued upon opening of the new garage levels.



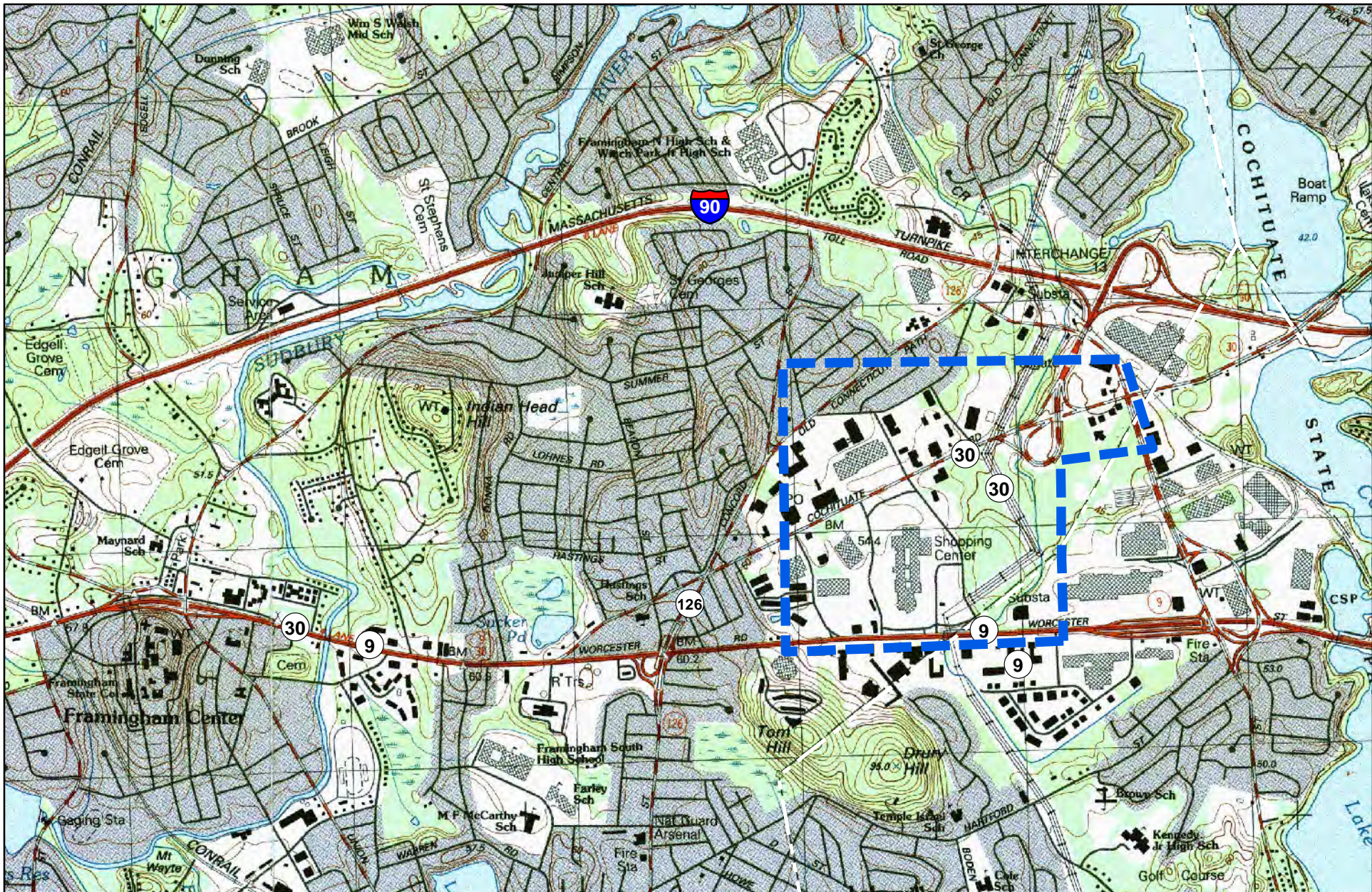


Figure 1 - Study Area Locus Map

Logan Express - Framingham
February 2020



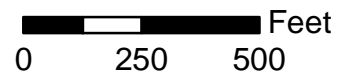
0 625 1,250 2,500 Feet





Figure 2 - Parking Systems

Logan Express - Framingham
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2.2 EXISTING ROADWAY CONDITIONS

2.2.1 Framingham Logan Express Access

The LEXF site is conveniently located close to three regionally significant east-west corridors – the Massachusetts Turnpike (Interstate 90), Cochituate Road (State Route 30), and Worcester Road (State Route 9). It is located just east and adjacent to the Shoppers World retail commercial area far from sensitive residential areas in the northeast quadrant of the intersection of Shoppers World Drive at Burr Street. Three driveways provide existing access/egress to the site. An entrance only driveway is provided via a four-legged unsignalized intersection on Shoppers World Drive approximately 300 feet north of its signalized intersection with Burr Street. The LEXF driveway on Shoppers World Drive accommodates entering traffic only. Shoppers World Drive is median divided and generally consists of two travel lanes in each direction with auxiliary lanes at intersections. A median opening with a left-turn access lane approximately 55 feet in length allows for southbound traffic on Shoppers World Drive to enter the site. This driveway serves as the Logan Express bus entrance, as well as the entrance for vehicles picking up and dropping off at the facility.

An exit-only driveway is located off Burr Street, approximately 130 feet east of Shoppers World Drive. The approach serves as a single wide lane for both right and left turning movements. This driveway serves exiting Logan Express buses and exiting vehicles picking up and dropping off at the facility.

A two-way driveway is located off Burr Street, approximately 410 feet east of Shoppers World Drive. The approach consists of a single shared lane for left and right turning exiting vehicles, and a lane for entering vehicles. This driveway serves vehicles entering and exiting the facility to park in the Logan Express facility's parking areas.

Entry into the AMC Overflow Lot is provided via two driveways off Flutie Pass. Entry to the Fran's Flowers Overflow Lot will also be off Flutie Pass, as Massport plans to implement changes to the lot and the existing entrance driveway to Fran's Flowers from Shoppers World Drive will be closed. Traffic exits the AMC and Fran's Flowers Overflow lots via the traffic signal at the four-way signalized intersection of Burr Street/AMC Theatre Driveway/AMC Overflow Lot.

Bus traffic enters the LEXF site via Shoppers World Drive and exits via the western Burr Street driveway.

2.2.2 Cochituate Road (Route 30)

Cochituate Road (State Route 30) is a generally northeast-southwest-oriented arterial roadway that traverses several eastern Massachusetts communities. While a state-numbered route, Cochituate Road is under the jurisdiction of the City of Framingham. Its posted speed limit is 30 miles per hour. Through the study area, Cochituate Road is median divided, has two through lanes in each direction, and is bounded mainly by commercial land uses. At critical signalized intersections, Cochituate Road widens to provide left and right turning lanes. Within the study area, its four intersections with Speen Street, Burr Street, Whittier Street/Shoppers World Drive, Shoppers World Way /Ring Road are all under traffic signal-control and all located in the City of Framingham.



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From east to west:

At Speen Street, the westbound Cochituate Road approach has three lanes including two through lanes and exclusive left turn lane. The southbound Speen Street approach to the intersection has four lanes striped to provide an exclusive left-turn lane, two through lanes and an exclusive right turn lane. The eastbound Cochituate Road approach has four lanes including exclusive left- and right turn lanes, a through lane and a shared through/right lane. The northbound Speen Street approach has four lanes including a double left turn lane, and two through lanes.

At Burr Street, the westbound Cochituate Road approach has three lanes including a right-turn only lane and two through lanes. Westbound left turns are not permitted from Cochituate Road to Burr Street. The southbound Burr Street approach to the intersection has two lanes striped - an exclusive left-turn lane and a shared left/through/right turn lane. The eastbound Cochituate Road approach has three lanes including an exclusive left-turn lane, a through lane, and a shared through/right lane. The northbound Burr Street approach has a shared through/left-turn lane and a channelized exclusive right-turn lane.

At Whittier Street and Shoppers World Drive, the westbound Cochituate Road approach consists of three lanes including an exclusive left-turn lane, a through lane, and a shared through/right lane. The existing southbound Whittier Street approach includes an exclusive left-turn lane, a shared through/left lane, a through lane and an exclusive right-turn lane. The eastbound Cochituate Road approach provides an exclusive left-turn lane, two through lanes and two exclusive right-turn lanes separated from the through movements by a channelization island. The northbound Shoppers World Drive approach is median-divided and provides a shared left-through lane, a through lane and an exclusive right-turn lane.

At Shoppers World Way and Ring Road, the westbound Cochituate Road approach consists of an exclusive left-turn lane, two through lanes and an exclusive right-turn lane. The southbound Shoppers World Way approach provides three approach lanes including an exclusive left-turn lane, a shared left/through lane, and an exclusive right-turn only lane separated by a channelization island. The eastbound Cochituate Road approach is similar to the westbound approach as it also provides exclusive left and right-turn lanes and two through lanes. The northbound approach has three lanes including two exclusive left-turn lanes and a shared through/right lane and is median divided.

2.2.3 Worcester Road (Route 9)

Worcester Road (State Route 9) is a generally east-west oriented arterial roadway that traverses most of the Commonwealth. Worcester Road is a significant east-west regional roadway between eastern and central Massachusetts. Worcester Road is under the jurisdiction of the MassDOT.



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Through the study area, Worcester Road is median divided, typically provides three through lanes in each direction, and has commercial land uses adjacent to it. Its posted speed limit is 40 miles per hour through the study area. Worcester Road has been widened at critical intersections to provide auxiliary lanes for heavy turning movements. Worcester Road also forms the southern boundary of a large commercial area in the City of Framingham and Town of Natick known as the 'Golden Triangle'. The other two boundaries of the Golden Triangle are Speen Street to the east and Cochituate Road/Concord Street/Old Connecticut Path to the north and west. Within the study area, Worcester Road has signalized intersections at Natick Mall Road, Shoppers World Drive, the Ring Road West Couplet, and Ring Road.

Again, from east to west:

At the intersection with Natick Mall Road and Dean Road, the westbound Worcester Road approach provides four lanes, including an exclusive left-turn lane, two through lanes, and one shared through-right turn lane. The southbound Natick Mall Road approach intersects Worcester road at a skew to the west to foster left turn movements out of the Natick Mall heading eastbound on Worcester Road. The southbound Natick Mall Road approach is median divided and provides two exclusive left turn lanes and a channelized right turn lane. The eastbound Worcester Road approach has four lanes including three through lanes and a channelized right turn lane. Eastbound left turns are not permitted and are geometrically constrained. The northbound Dean Road approach has three lanes, including two exclusive left-turn lanes and a channelized right-turn lane. Through traffic from Dean Road to Natick Mall Road is prohibited.

At its intersection with Shoppers World Drive, the westbound Worcester Road approach provides five lanes including an exclusive right-turn lane, three through lanes, and an exclusive left-turn lane. The southbound Shoppers World Drive approach intersects Worcester Road at a skew to the west to foster left turn movements out of Shoppers World heading eastbound on Worcester Road. The southbound Shoppers World Drive approach is median divided and provides an exclusive left-turn lane and a shared through left-turn lane. The eastbound Worcester Road approach has three lanes including two through lanes and a shared through/right lane. Eastbound left turns are not permitted and are geometrically constrained, as they are provided at the West Couplet intersection just upstream of this intersection. The northbound approach of the Michael's/La-Z-Boy plaza driveway has two lanes, including exclusive left- and right-turn lanes.

The Ring Road West Couplet intersects Worcester Road at an acute angle to foster right-turn lane movements westbound to Worcester Road and eastbound left-turn lane movements from Worcester Road to the Ring Road West Couplet and Shoppers World. The westbound Worcester Road approach has three through lanes (with left and right turns prohibited). The southbound Ring Road West Couplet has two right-turn lanes only (with left and through movements prohibited). Eastbound Worcester Road has a double left-turn lane and three through lanes. The signal operation permits pedestrian crossings of the east leg of the intersection.

At its intersection with the Ring Road and a private driveway to the south serving commercial developments (Verizon/Bed, Bath & Beyond), the westbound Worcester Road approach provides three through lanes, a double left-turn lane, and an exclusive right-turn lane. The southbound Shoppers World



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West Driveway approach is median divided and restricted to right turns out only in one signal-controlled right-turn lane. The eastbound Worcester Road approach has a double left-turn lane, two through lanes, and a shared through/right-turn lane. The northbound approach from a private commercial drive is also median-divided and includes a driveway wide enough for two lanes but is unmarked.

2.2.4 Shopper's World Drive

Shoppers World Drive provides a north-south connection between Worcester and Cochituate Roads, or State Routes 9 and 30 respectively. It has two through lanes in each direction, is median-divided and provides direct access to the LEXF facility and several Shoppers World adjacent land uses. Shoppers World Drive is privately-owned and maintained by Shoppers World.

Within the study area, Shoppers World Drive has five signalized intersections, two of which intersect public roads (Cochituate and Worcester roads) and were described previously. The other three signalized intersections are with private roads on the Shoppers World site -- i.e., the Burr Street, Flutie Pass, and the West Couplet Ring Road/Shoppers World Drive split. Auxiliary turn lanes are provided at each of these intersections, as described below.

From north to south:

At its intersection with Burr Street, the westbound Burr Street approach provides two lanes including a shared through/left lane and a shared through/right lane. The southbound Shoppers World Drive approach provides four lanes, including two through lanes, as well as exclusive left and right-turn lanes. An unnamed eastbound Shoppers World driveway approaches this intersection in three lanes including a shared through/left lane, a through lane, and an exclusive right-turn lane. The northbound Shoppers World Drive approach has three approach lanes including an exclusive left-turn lane, a through lane, and a shared through/right-turn lane.

At its intersection with Flutie Pass, the westbound Flutie Pass approach provides three lanes, with two exclusive left turn lanes and an exclusive right turn lane. The southbound Shoppers World Drive approach provides four lanes, including two through lanes and two exclusive left turn lanes. An unnamed eastbound Shoppers World driveway approaches this intersection in three lanes including an exclusive left turn lane, a through lane, and a channelized right turn lane. The northbound Shoppers World Drive approach has three approach lanes including two through lanes and two exclusive right-turn lanes.

At its intersection with the Ring Road West Couplet, the southbound approach of the Shoppers World Drive has four lanes; two are exclusive right-turn lanes channelized by a median toward the Ring Road West Couplet (ultimately travelling westbound on Route 9) and two are southbound through lanes. The eastbound Ring Road West Couplet approach to the intersection is median divided and has three lanes comprised of an exclusive left-turn lane to an east-west Shoppers World distributor driveway, an exclusive left-turn lane to the Shoppers World Drive, and a shared left/right lane to Shoppers World Drive. The northbound Shoppers World Drive approach also has three lanes including an exclusive left-turn lane to the east-west Shoppers World distributor driveway, and two through lanes.



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2.2.5 Burr Street

Burr Street is undivided adjacent to the LEXF facility and has two lanes in each direction. At its intersection with the Shoppers World Drive, Burr Street is striped for one lane in each direction to the east of the LEXF facility exit driveway. Primarily commercial uses and open space/wetlands abut Burr Street.

2.2.6 Shopper's World Roadways

Shoppers World provides several internal driveways including Shoppers World Drive and the Ring Road that serve primarily adjacent retail/commercial users. These roadways located between Worcester Road (Route 9) Cochituate Road (Route 30) were constructed to minimize the need for Shoppers World users to make U-turns and left turns onto the regional highway system. The circular roads provide the same advantage for use of the LEXF facility.

2.3 EXISTING TRAFFIC VOLUMES

Traffic volume data was collected during October 2019. Two types of traffic counts were performed, automatic traffic recorder (ATR) counts and manual turning movement counts (TMC). Refer to Figure 3 for the locations where automatic and manual counts were performed.

2.3.1 Automatic Traffic Recorder Counts

Automatic traffic recorder counts were performed over a two-day period on October 16-17th 2019 on a Wednesday and Thursday at four driveways to obtain a two-day record of activity at the LEXF site. The four locations included:

- The LEXF entrance off Shoppers World Drive – serving entering buses and drop-off and pick ups;
- The LEXF exit to Burr Street – serving exiting buses and drop-off and pick ups;
- The LEXF entrance/exit to Burr Street – serving entering/exiting vehicles to parking areas; and

Additionally, automatic traffic recorder counts were performed at:

- Burr Street south of Cochituate Road (Route 30)
- Shoppers World Drive south of Burr Street
- Cochituate Road west of Burr Street
- AMC Overflow Lot south of Flutie Pass
- Fran's Flowers Overflow Lot east of Shoppers World Drive
- Flutie Pass east of AMC Overflow Lot
- Whittier Street north of Cochituate Road
- Ring Road south of Cochituate Road



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Rounded and seasonally adjusted average weekday traffic volumes are provided on Figure 4. According to MassDOT's seasonal factors data, traffic volumes collected during the month of October are historically approximately 6% higher than average annual conditions, and therefore, traffic volumes in this study were not adjusted, in order to present a conservative approach to the study.

2.3.2 Manual Turning Movement/Vehicle Classification Counts

Morning and afternoon peak hour turning movement counts were performed at 23 intersections between 6-9 AM and 4-6 PM on a typical weekday, which are the typical commuter peak hours and when roadways typically carry the highest volumes. All TMCs were conducted on Thursday October 17, 2019, with the exception of the intersection of Ring Road at Shoppers World Drive, which was conducted on Tuesday October 29, 2019, due to an issue with the counting apparatus. From the data collected, the typical morning commuter peak hour in the study area occurs from 8:00-9:00 AM, while the typical afternoon commuter peak hour occurs from 5:00-6:00 PM. Traffic volume counts include truck and automobile turning movements as well as pedestrians and bicycles. Manual count locations included:

- Burr Street at Cochituate Road (Route 30)
- Whittier Street and Shoppers World Drive at Cochituate Road (Route 30)
- Shoppers World Way at Cochituate Road (Route 30) at and Ring Road
- Ring Road at Ring Road (north)
- Ring Road at Shoppers Word Drive (north)
- Burr Street at Shoppers World Drive
- Shoppers World Drive at Flutie Pass
- Ring Road at Shoppers World Drive (south)
- Worcester Road (Route 9) at Shoppers World Drive
- Worcester Road (Route 9) at the Ring Road West Couplet
- Worcester Road (Route 9) at Ring Road (west)
- Ring Road at Ring Road (south)
- Ring Road at Shoppers World Interior Driveway
- Shoppers World Drive at Logan Express Driveway and Shopper's World Interior Driveway
- Burr Street at Logan Express West Driveway
- Speen Street at Cochituate Road (Route 30)
- Route 30 at TJX Driveway
- Speen Street at TJX Driveway
- Whittier Street at Colonial Shopping Center Overflow Lot
- Flutie Pass at AMC Lots
- Newbury Street at Old Connecticut Path
- Burr Street at Logan Express East Driveway
- Worcester Road (Route 9) at Natick Mall Road

Existing morning and afternoon peak hour turning movement volumes at the 23 intersections are summarized on Figures 5 and 6.



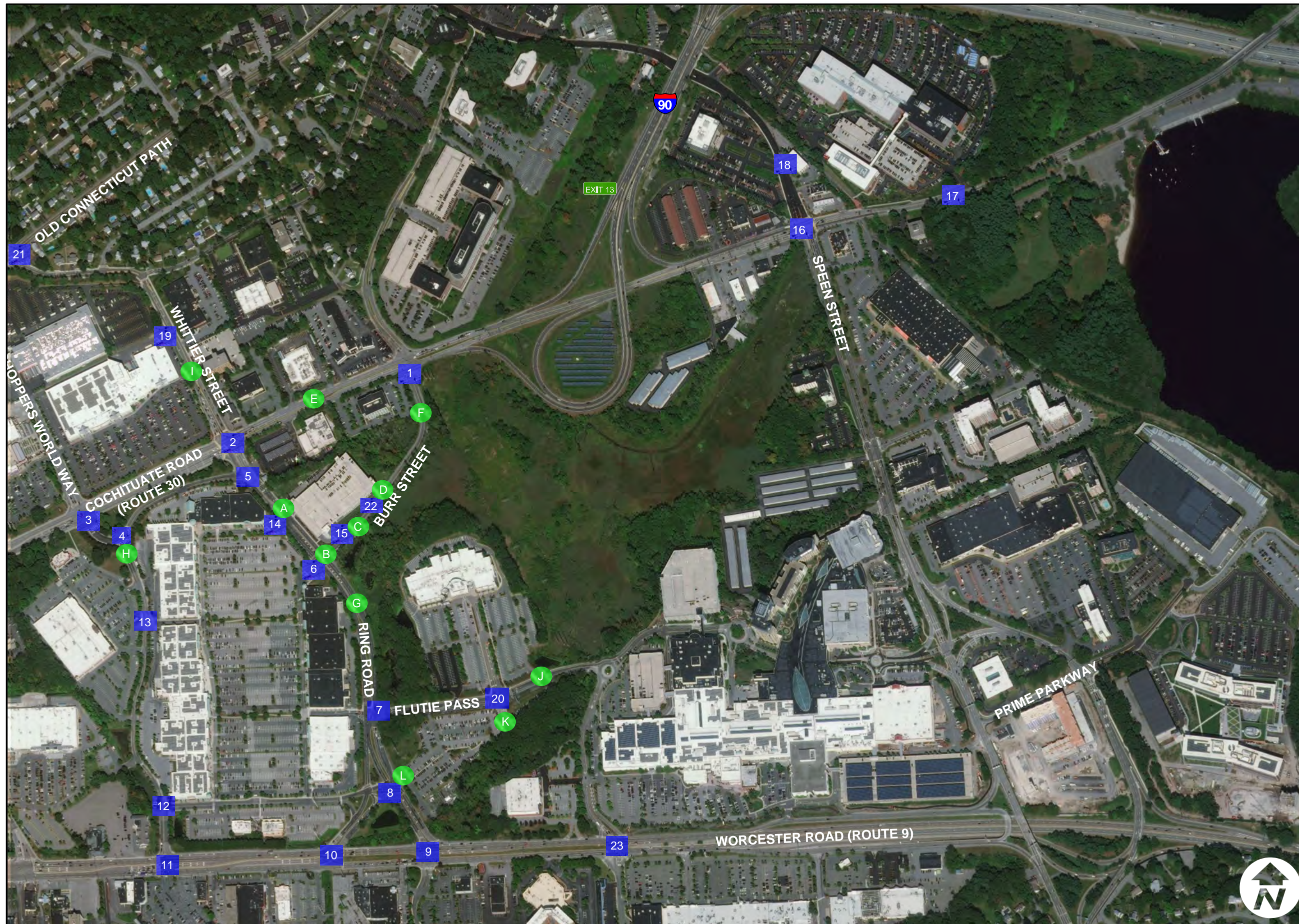
**Traffic Count Locations
Framingham Logan Express
Garage Expansion
(9/30/19)**

Turning Movement Counts (TMC)

1. Burr Street at Cochituate Road/Route 30
2. Whittier Street and Ring Road at Cochituate Road/Route 30
3. Shopper's World Way and Ring Road at Cochituate Road/Route 30
4. Ring Road at Ring Road (west)
5. Ring Road at Ring Road (east)
6. Burr Street at Ring Road
7. Ring Road at Flutie Pass
8. Ring Road at Ring Road (southeast)
9. Worcester Road/Route 9 at Ring Road (east)
10. Worcester Road/Route 9 at Ring Road (central)
11. Worcester Road/Route 9 at Ring Road (west)
12. Ring Road at Shopper's World Driveway (1)
13. Ring Road at Shopper's World Driveway (2)
14. Ring Road at Logan Express Driveway and Shopper's World Driveway
15. Burr Street at Logan Express Driveway
16. Speen Street at Cochituate Road (Route 30)
17. Route 30 at TJX Driveway
18. Speen Street at TJX Driveway
19. Whittier Street at Colonial Shopping Center Overflow Lot
20. Flutie Pass at Overflow Lot
21. Whittier Street at Old Connecticut Path
22. Burr Street at Logan Express Driveway
23. Worcester Road/Route 9 at Natick Mall Driveway

Automatic Traffic Recorder (ATR)

- A. Logan Express Entrance from Ring Road
- B. Logan Express Drop-Off
- C. Logan Express Exit on to Burr Street
- D. Logan Express Entrance/Exit on to Burr Street
- E. Cochituate Road (Route 30)
- F. Burr Street
- G. Ring Road (south of Burr Street)
- H. Ring Road (nrth of Kohl's Driveway)
- I. Whittier Street
- J. Flutie Pass
- K. Logan Express Overflow Lot Burr Street Entrance/Exit
- L. Logan Express Overflow Lot Ring Road Entrance/Exit



LEGEND # Turning Movement Counts (TMC) X Automatic Traffic Recorder (ATR)

Figure 3 - Traffic Count Locations
Logan Express - Framingham
February 2020

0 250 500 Feet





Figure 4



Schematic Diagram:
Not to Scale



2019 ADT Traffic Volumes
Logan Express – Framingham
November 2019

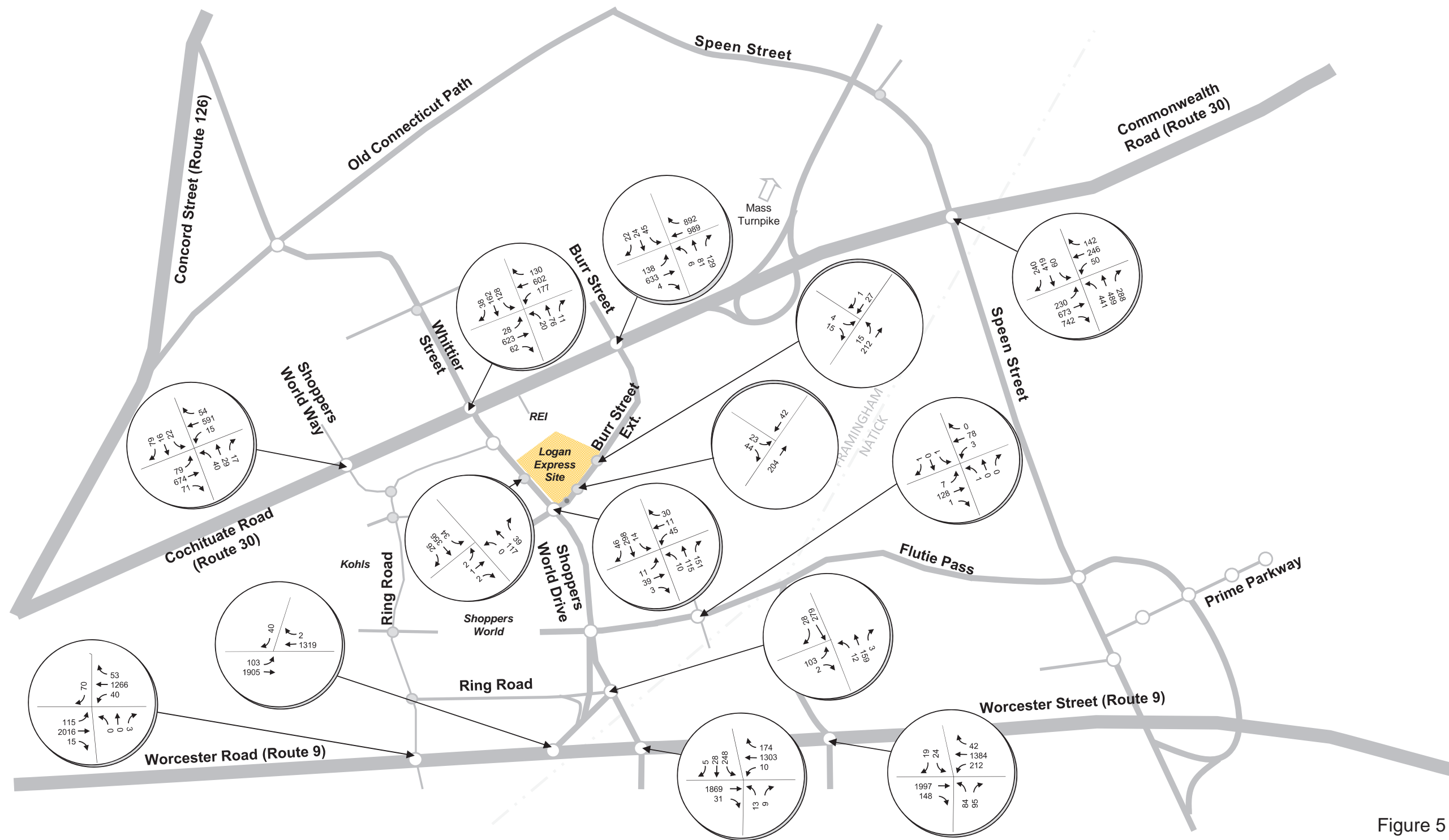


Figure 5



Schematic Diagram:
Not to Scale



2019 Existing AM Peak Hour Traffic Movement Volumes

Logan Express – Framingham
November 2019



Figure 6



Schematic Diagram:
Not to Scale



2019 Existing PM Peak Hour Traffic Movement Volumes

Logan Express – Framingham
November 2019

2.4 CRASH HISTORY

Stantec used data from the MassDOT Crash Data Portal to obtain study area crash data from 2015-2018, the latest four-year crash data period available in the Portal. Crash data includes only reported crashes with greater than \$1,000 in property damage. This particular study area presents substantial crash tabulation difficulties because much of the area is on private property and precise locations are more difficult to identify, as many of the driveways are unmarked or referenced by different names (e.g., Shoppers World Drive is sometimes referred to as the North-South Connector and Ring Road). The average statewide / (MassDOT District 3) crash rates are 0.78 / (0.89) crashes per million entering vehicles for signalized intersections and 0.57 / (0.61) crashes per million entering vehicles at unsignalized intersections. Table 1 summarizes LEXF study area crash data from 2015 to 2018. Details are contained in the Technical Appendix to this report.



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Table 1 - Study Area Crash Data Summary – 2015-2018

Intersection	Number of Crashes ¹		Number by Severity			Number by Crash Type ¹				Calculated Crash Rate ²
	Av./Year	4 Yr. Total	PDO ³	INJ ⁴	Not Reported	Angle	Rear End	Sideswipe	Other	2015-2018
Cochituate Road (Route 30) at Burr Street	7	28	15	12	1	11	11	4	2	0.52
Cochituate Road (Route 30) at Whittier and Shoppers World Drive	9.75	39	25	13	1	14	13	7	5	0.82 ⁵
Route 30 at Shoppers World Way and Ring Road	0.75	3	2	1	-	-	1	-	1	0.08
Shoppers World Drive at Burr Street	2	8	5	3	-	7	-	1	-	0.30
Shoppers World Drive at Worcester Road (Route 9) East	15.5	62	53	9	-	16	29	1 11	6	0.87 ⁵
Shoppers World Drive at Worcester Road (Route 9) West	13.5	54	37	10	7	16	8	15	15	0.93 ⁵
Worcester Street (Route 9) at Natick Mall Road	18.75	75	65	10	-	23	24	21	7	0.93 ⁵
Worcester Road (Route 9) at Ring Road West	6.25	25	16	9	-	8	5	7	5	0.37
Speen Street at Cochituate Road (Route 30)	15.75	63	50	11	2	23	20	14	6	0.91 ⁵
Shoppers World Drive at Flutie Pass	2.5	10	6	4	-	3	2	4	1	0.44

1. Reported crashes as summarized by the Massachusetts Department of Transportation from Registry of Motor Vehicles statistics. Data excludes unreported crashes with less than \$1,000 in damage.
2. Crash rate in accordance with Crash Rate calculation procedures
3. PDO – Accident involving Property Damage Only
4. INJ – Accident involving personal injuries.
5. Intersection exceeds average statewide or District 3 crash rate.



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Five of the study area signalized intersections exceeded statewide or District 3 crash rates for signalized intersections. In order of severity, they are:

- Worcester Road (Route 9) at Shopper's World Drive (west)
With 54 total reported crashes, this intersection has a relatively high occurrence of sideswipe and rear end collisions that contribute to the 0.93 crashes per million entering vehicles calculated for the four-year reporting period.
- Worcester Street (Route 9) at Natick Mall Road
With 75 total reported crashes, this intersection is the first signal on Route 9 westbound for over two miles, so sudden stops may contribute to the 0.93 crashes per million entering vehicles during the four-year reporting period.
- Speen Street at Cochituate Road (Route 30)
With 63 total reported crashes, this intersection also has a relatively high occurrence of angle and rear end collisions on Worcester Road (Route 9) that is contributing to its 0.91 crashes per million entering vehicles during the three-year reporting period.
- Cochituate Road (Route 30) at Whittier Street/Shopper's World Drive
With 39 total reported crashes, has an occurrence of angle and rear end crashes that contributes to the 0.82 crashes per million entering vehicles rate calculated for the four-year reporting period. Again, while exceeding the statewide crash rate, the calculated rate is lower than the District 3 average crash rate of 0.89 crashes per million entering vehicles.
- Worcester Road (Route 9) at Shopper's World Drive (east)
With 62 total reported crashes, this intersection has a relatively high occurrence of rear end collisions and 0.87 crashes per million entering vehicles rate calculated for the four-year reporting period. While exceeding the statewide crash rate, the calculated rate is lower than the District 3 average crash rate of 0.89 crashes per million entering vehicles.

The Massachusetts Department of Transportation – Highway Division (MassDOT) maintains a database of High Crash Locations in Massachusetts. The database uses crash information from the Massachusetts Registry of Motor Vehicles (RMV). Crash clusters are identified where the total number of "equivalent property damage only" (EPDO) crashes is within the top 5% in the region. EPDO is a methodology of weighting crashes by severity (fatal, injury or property damage only), so that the raw number of crashes is not the determining criteria. An examination of the database reveals that there are no crash clusters within the study area, based on year 2014-2016 crash data.



3.0 FUTURE TRAFFIC VOLUMES

Future traffic conditions within the study area were forecast to gain an understanding of the traffic impacts of the project on the adjacent transportation network. Traffic growth within the study area is a function of expected land development, economic activity, changes in demographics, and changes in travel patterns.

3.1 FUTURE NO-BUILD CONDITIONS

In order to evaluate traffic impacts associated with the proposed expansion of the proposed LEXF garage, future No-Build Condition traffic volumes were examined to provide a baseline condition for comparison. No-Build Condition vehicular traffic volumes are those that are expected to use the roadway network in the future, assuming the proposed expansion of the proposed LEXF garage does not occur. No-Build Condition traffic volumes will be projected for the year 2029 based on traffic volumes collected in 2019.

Future No-Build Condition traffic volume projections generally consist of background growth, and traffic generated from specific proposed development projects in the study area.

3.1.1 General Background Growth

Typically, general background growth is a function of population growth, future land development, increased economic activity, and changes in travel patterns. After consideration of the characteristics of the general land use in the region, and review of recent traffic impact studies for development projects in the surrounding area, it was determined that a background growth rate of 1% per year should be used to grow the existing traffic volumes. This background growth rate accounts for all background traffic growth, including external growth and growth due to unspecified developments in the area.

3.1.2 Specific Planned Development Projects

To assess Year 2029 traffic conditions in the area, future infrastructure and private development project information was obtained from the City of Framingham and the Town of Natick.

On the basis of the information obtained, Table 2 below summarizes a list of private land development projects and their associated projected morning and afternoon peak hour trip generation, which were in some cases calculated based on the information provided in permitting documents for their respective development project. A map of the study area with the locations of the approved background developments is provided in Figure 7. The anticipated trips generated for each of these developments were distributed on the study area roadways in order to estimate future traffic conditions. These projects have been approved and are expected to affect future traffic conditions in the vicinity of the LEXF site.



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**Table 2 - Study Area Approved Background Development Projects
 Projected AM/PM Peak Hour Trip Generation**

Development	Type	Size	AM Entering	AM Exiting	PM Entering	PM Exiting
236 Cochituate Road, Framingham	Medical Office	5,070 sf	12	4	5	14
TJX – 770 & 740 Cochituate Road, Framingham	Corporate Conference Center	54,000 sf	191	26	38	184
85 Worcester Road, Framingham	Marijuana Dispensary	5,700 sf	36	35	74	73
655 Cochituate Road, Framingham	Marijuana Dispensary	7,370 sf	43	34	80	81
Cloverleaf West Apartments 321 Speen Street, Natick	Residential	124 units	12	33	34	21

The resulting year 2029 Future No-Build peak hour traffic volumes were developed through the application of the one percent annual growth rate for a ten-year period to existing peak hour traffic volumes and the addition of traffic associated with specific area development projects. Figures 8 & 9 display the year 2029 Future No-Build traffic volumes for the morning and afternoon peak hours, respectively.



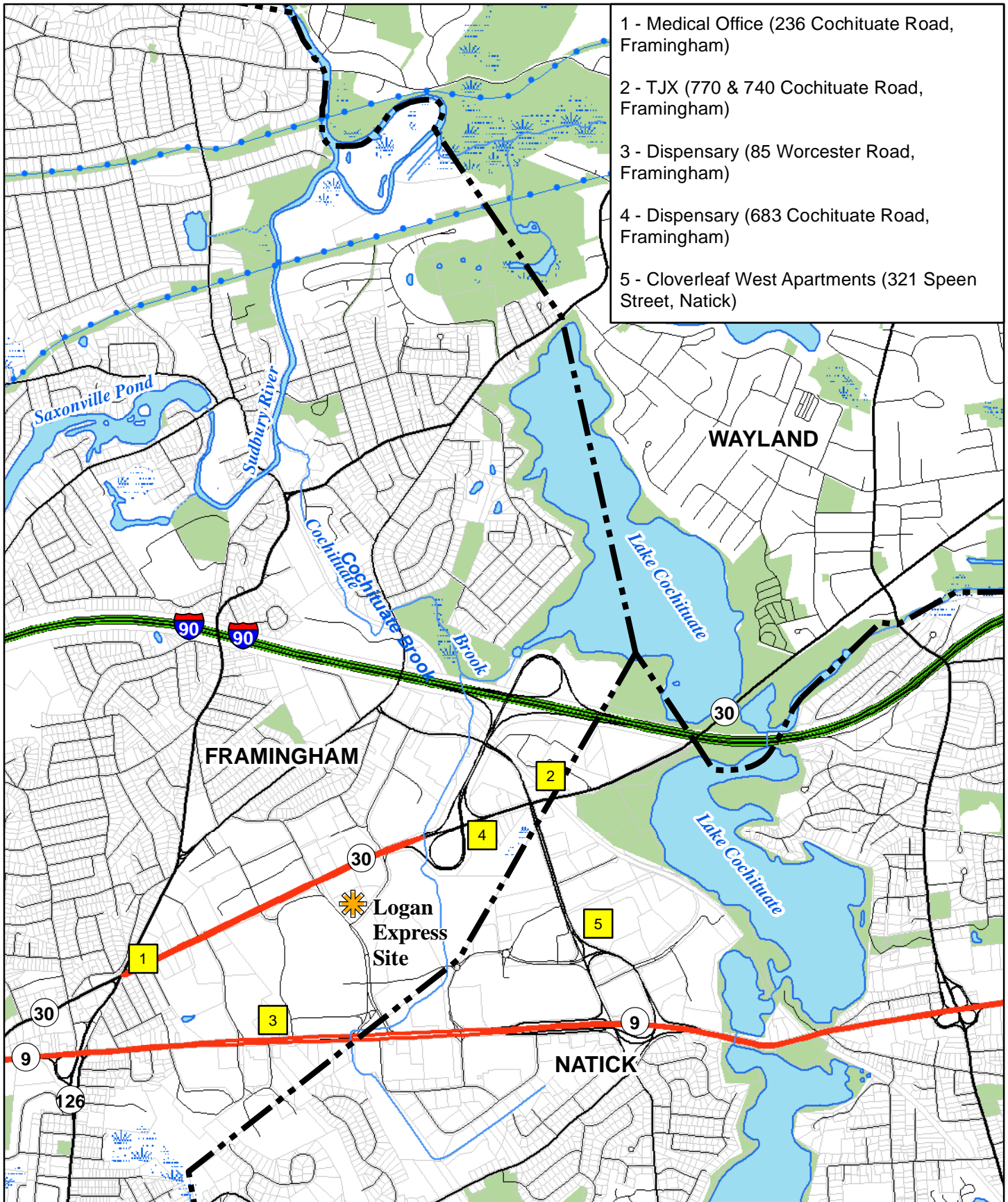


Figure 7 - Logan Express Study
Approved Developments Projects

Logan Express - Framingham

0 1,900 3,800 Feet





Figure 8



Schematic Diagram:
Not to Scale



2029 No-Build AM Peak Hour Traffic Movement Volumes

Logan Express – Framingham
November 2019

3.2 BUILD CONDITIONS

In order to evaluate the effect of the proposed LEXF garage expansion on traffic operations in the study area, vehicle trips associated with the proposed expansion are projected, distributed, and assigned to the adjacent roadway network. These incremental vehicle trips are added to the No-Build Condition traffic volumes to form the Build Condition traffic volume networks for the morning and afternoon peak hours.

3.2.1 Project Generated Traffic

The estimate of trips generated due to the expansion of the existing LEXF Garage is based upon 48-hour automatic traffic recorder count data obtained at driveways to the LEXF facility during the October 2019 count program. The use of the *ITE Trip Generation*¹ methodology, specifically Land Use Code 090 (Park and Ride Lot with Bus or Light Rail), to estimate trip generation is not assumed to be applicable, as the ITE methodology is associated with typical commuter park-ride lots for public transportation services that are typically used by daily commuters.

The custom trip generation used in this study is based upon the following:

- The total trip generation of the LEXF facility consists of two distinct components: trips associated with users of the permanent parking spaces at the facility and trips associated with Logan Express passengers being dropped off and picked up at the facility by the Logan Express Buses, personal automobiles, taxis and Transportation Network Company (TNC) vehicles.
- The trips associated with the users of the permanent parking spaces at the LEXF facility are generated at a different rate with a different independent variable than the trips associated with the pick-ups and drop offs.
- Using existing traffic volumes counted at the LEXF driveway to the permanent parking areas, peak hour and daily trip rates per parking space provided was developed.
- Similarly, using existing traffic volumes counted at the LEXF driveway to the drop off-area, existing daily and peak hour trips to the drop off areas were calculated.
- In order to calculate the trips associated with the proposed expansion of the LEXF facility the existing daily and peak hour trip rate per parking space was applied to the proposed 998 new parking spaces.
- Additionally, in order to account for pick ups and drop offs in the future, the existing daily and peak hour trips to the drop off areas were increased by 25 percent to reflect Massport's projections for growth of passenger traffic at Logan Airport and expected increase in frequency of Logan Express bus service, from two buses per hour per direction to three buses per hour per direction. The 25 percent growth rate is also reflective of the availability of some capacity in the current Logan Express service to accept additional passengers, as many of the buses are not currently fully occupied throughout the day.

Applying the two trip making scenarios of the expanded facility, on a typical weekday, the LEXF garage expansion is expected to add approximately **1,496** vehicle trips per day to the local roadway network, and

¹ Institute of Transportation Engineers, Trip Generation, 10th Edition, 2017.



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88 and 117 total trips during the morning and afternoon peak hours, respectively. Table 3 shows the details of the project trip generation.

Table 3 – Project Trip Generation

Trip Source	Weekday			Weekday AM			Weekday PM		
	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit
Parking (998 Additional Spaces)	961	500	461	70	35	35	96	47	49
Pick up/Drop off	535	294	241	18	10	8	21	11	10
Total New Trips	1,496	794	702	88	45	43	117	58	59

The existing traffic volume data collection program was completed with the existing Logan Express overflow parking lots in use. If the overflow lots are used in the future (after the proposed garage expansion is in operation), it is expected that these trips to the overflow lots are already captured in the baseline traffic volume data collection.

3.2.2 Trip Distribution and Assignment

The following forms the basis of the expected trip distribution pattern of the trips associated with the proposed expansion of the LEXF garage:

- Existing ground traffic count turning movements at the LEXF site;
- Results of the LEXF drop-off/pick-up and long term parking license plate surveys conducted as part of the 2014 traffic study (*Traffic Impact Access Study, Framingham Logan Express Parking Garage, January 2014*, prepared by Fay, Spofford & Thorndike), that evaluated the impacts of the construction of the current LEXF facility.

A comparison of these two trip distribution patterns indicates that the expected LEXF trip distribution patterns after construction and occupation of the proposed expansion is likely to be similar to the distribution patterns found during the 2014 study and confirmed by turning movements at the existing Logan Express driveways. Generally, traffic to and from the LEXF facility disperses relatively quickly, as approximately half the new trips are expected to travel to and from the north on the Shoppers World Drive and half to and from the Route 9 intersections. To summarize, the assumed trip distribution pattern based on the initial study in 2014, and confirmed by the current site driveway counts is as follows:

- Approximately **36%** to and from the east on Cochituate Road (southbound traffic via the Shoppers World Driveway and north eastbound traffic via Burr Street);
- **13%** to and from the north via Whittier Street;
- **31%** to and from the east on Route 9 via Shoppers World Driveway and
- **13%** to and from the west of Route 9 via Shoppers World Driveway and the West Couplet/Ring Road.



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- 7% to and from the west on Cochituate Road (southbound traffic via Shoppers World Driveway).

The trips expected to be generated by the proposed expansion, as detailed earlier in Table 3, were assigned to study area intersections using the trip distribution patterns outlined above. Year 2029 Build morning and afternoon peak hour traffic volumes, which consist of the addition of peak hour project generated traffic to the year 2029 No Build traffic volumes, are displayed in Figures 10 & 11, respectively.





Figure 10



Schematic Diagram:
 Not to Scale



2029 Build AM Peak Hour Traffic Movement Volumes

Logan Express – Framingham
 November 2019



Figure 11



Schematic Diagram:
Not to Scale



2029 Build PM Peak Hour Traffic Movement Volumes

Logan Express – Framingham
November 2019

4.0 TRAFFIC IMPACT ANALYSIS

4.1 CAPACITY ANALYSIS

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within a study area. To assess quality of flow, capacity analyses were conducted for study area intersections for the Existing, Future No-Build, and Future Build Conditions. The capacity analyses provide a standardized indication of the ability of the intersections to accommodate traffic demands placed upon it.

4.1.1 Level of Service Criteria

A primary result of capacity analyses is the assignment of Level of Service (LOS) to traffic facilities under various traffic flow conditions. Analyses were conducted using methods defined in the *Highway Capacity Manual, 6th Edition* (TRB, 2016) which provides methodologies for signalized and unsignalized intersections. The Level of Service is conceptually defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists.

A Level of Service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. In doing so, Level of Service provides an index to quality of traffic flow.

Six Levels of Service are defined for each type of facility. They are given letter designations, from A to F, with LOS A representing the best operating conditions and LOS F representing the worst. Since the Level of Service of a traffic facility is a function of traffic flows placed upon it, an intersection may operate at a wide range of Levels of Service, depending on the time of day, day of week, or period of year.

The average delay per vehicle approaching an intersection is used to quantify the Level of Service at a particular intersection. This is discussed briefly below, and LOS designations are defined in *Tables 4 & 5*. Average delay measures the mean stopped delay experienced by vehicles entering an intersection during the design period. Average delay is measured for each individual turning movement that must yield the right of way, and for the intersection as a whole (including through vehicles that experience no delay).

Table 4 – Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (Seconds/Vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F	>50

Source: Highway Capacity Manual, 6th Edition, TRB



Table 5 – Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (Seconds/Vehicle)
A	≤10
B	>10 – 20
C	>20 – 35
D	>35 – 55
E	>55 – 80
F	≥80

Source: Highway Capacity Manual, 6th Edition, TRB

4.2 OPERATING CONDITIONS

The Synchro traffic analysis software package (Version 10) was employed to evaluate operating conditions at the study intersections. This software uses methodology based on the Highway Capacity Manual (HCM) 6th Edition to conduct the analyses and is widely accepted for use by public agencies.

Under the HCM, the overall LOS for a STOP controlled intersection is not defined. Instead of the overall LOS, it is customary to instead report the LOS of the minor movements (i.e. side street or left turn) at the intersection. Since the methodology does not provide a means of reporting the overall LOS of a STOP controlled intersection, it is therefore important to note that even though the LOS for the minor movement is reported, it is not wholly representative of the overall performance of the intersection. In this report, LOS of the study intersections is reported on *Tables 6, 7, and 8*. Intersection capacity analyses were evaluated for 2019 Existing, 2029 No-Build, and 2029 Build Conditions. Capacity Analysis worksheets can be found in *Appendix D*.



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**Table 6 - Existing Level of Service and Delay¹
2019 AM (PM) Peak Hour (1 hour)**

Intersection	Average Total Delay (seconds/vehicle)	Volume to Capacity Ratio (v/c)	Level-of Service (LOS)
Signalized			
Shoppers World Way/Cochituate Road (Route 30) /Ring Road	14 (27)	0.59 (0.88)	B (C)
Whittier St/Shoppers World Drive/Cochituate Road (Route 30)	19(89)	0.75 (1.00+)	B (F)
Burr Street/ Cochituate Road (Route 30)	37 (161)	1.00+ (1.00+)	D (F)
Shoppers World Drive/Burr Street	13 (19)	0.54 (0.69)	B (B)
Shoppers World Drive/Flutie Pass	12 (19)	0.18 (0.55)	B (A)
Worcester Road (Route 9)/Shoppers World Drive/Michael's Driveway	12 (19)	0.71 (0.90)	B (B)
Shoppers World Drive/Ring Road West Couplet	12 (16)	0.32 (0.45)	B (B)
Worcester Road (Route 9)/Ring Road West Couplet	3 (5)	0.39 (0.51)	A (A)
Worcester Road (Route 9)/West Driveway/Bed Bath Drive	20 (24)	0.82 (0.84)	C (C)
Speen Street at Cochituate Road (Rte. 30)	36(64)	0.89 (1.00+)	D (E)
Worcester Road (Route 9)/Natick Mall Road	33(55)	1.00+ (1.00+)	C (E)
Unsignalized			
Shoppers World Drive /FLE Driveway ²	EB 12 (EB 18)	0.02 (0.17)	B (C)
Burr Street/FLE West Driveway ²	SB 10 (SB 11)	0.12 (0.15)	A (B)
Burr Street/FLE East Driveway ²	EB 9(EB 10)	0.04 (0.08)	A (B)

¹ Reported results from Synchro 10 analysis. Levels of Service are from A-F, where A is the best and F the worst. Seconds of delay rounded to nearest second during the highest 15-minute period of the AM or PM peak hours and represents total control delay per motorist including acceleration, deceleration, and stop delays. V/C (volume to capacity) is for the worst individual traffic movement in the intersection.

² Worst unsignalized intersection approach is reported.



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From Table 6, none of the Study Area intersections operate worse than LOS D during the morning peak hour. However, during the afternoon peak hour, two Cochituate Road intersections – with Burr Street and Whittier Street/Shoppers World Drive -- operate with congestion at LOS F, while the intersections of Cochituate Road at Speen Street and Worcester Road at Natick Mall Road operate at LOS E, and all other intersections remain above LOS D in the afternoon peak hour.

During both the morning and afternoon peak hours, the unsignalized driveway intersections of the LEXF site driveway with Shoppers World Drive and Burr Street operate at LOS A-C. Similarly, the signalized intersection of the Burr Street and Shoppers World Drive is operating at LOS B.

**Table 7 - Projected No Build Level of Service and Delay¹
2029 AM (PM) Peak Hour (1 hour)**

Intersection	Average Total Delay (seconds/vehicle)	Volume to Capacity Ratio (v/c)	Level-of-Service (LOS)
Signalized			
Shoppers World Way/Cochituate Road (Route 30) /Ring Road	16 (30)	0.64 (0.98)	B (C)
Whittier St/Shoppers World Drive/Cochituate Road (Route 30)	20 (110)	0.81 (1.00+)	B (F)
Burr Street/ Cochituate Road (Route 30)	55 (208)	1.00+ (1.00+)	E (F)
Shoppers World Drive/Burr Street	13 (19)	0.57 (0.73)	B (B)
Shoppers World Drive/Flutie Pass	12 (20)	0.20 (0.58)	B (B)
Worcester Road (Route 9)/Shoppers World Drive/Michael's Driveway	14 (22)	0.75 (0.98)	B (C)
Shoppers World Drive/Ring Road West Couplet	13 (16)	0.36 (0.48)	B (B)
Worcester Road (Route 9)/Ring Road West Couplet	4 (6)	0.44 (0.58)	A (A)
Worcester Road (Route 9)/West Driveway/Bed Bath Drive	24 (31)	0.92 (0.97)	C (C)
Speen Street at Cochituate Road (Rte. 30)	49(112)	1.00+(1.00+)	D (F)
Worcester Road (Route 9)/Natick Mall Road	56(89)	1.00+(1.00+)	E (F)
Unsignalized			
Shoppers World Drive /FLE Driveway ²	EB 12 (EB 20)	0.02 (0.20)	B (C)
Burr Street/FLE West Driveway ²	SB 10 (SB 12)	0.13 (0.18)	B (B)
Burr Street/FLE East Driveway ²	EB 9 (EB 11)	0.05 (0.09)	A (B)

¹ Reported results from Synchro 10 analysis. Levels of Service from A-F, where A is the best and F the worst. Seconds of delay rounded to nearest second during the highest 15-minute period of the AM or PM peak hours and represents total control delay per motorist including acceleration, deceleration, and stop delays. V/C (volume to capacity) is for the worst individual traffic movement in the intersection.

² FLE – Framingham Logan Express. Worst unsignalized intersection approach is reported



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As depicted on Table 7, traffic operational levels of service by the year 2029 at the intersections studied are expected to be very similar to the year 2019 existing levels of service identified on Table 6 previously.

Table 7 results indicate nearly the same levels of service and delays are expected during the year 2029 No-Build when compared to year 2019 existing conditions, for the intersections between Route 9 and Route 30, with some expected minor increases in delays and volume to capacity ratios. Slightly larger increases in delay and volume to capacity ratios are expected to be found at the study intersections along Route 9 and Route 30 due to background development projects by others along those roadways.

**Table 8 - Projected Build Level of Service and Delay¹
2029 AM (PM) Peak Hour (1 hour)**

Intersection	Average Total Delay (seconds/vehicle)	Volume to Capacity Ratio (v/c)	Level-of-Service (LOS)
Signalized			
Shoppers World Way/Cochituate Road (Route 30) /Ring Road	16 (30)	0.64 (0.98)	B (C)
Whittier St/Shoppers World Drive/Cochituate Road (Route 30)	21 (116)	0.85 (1.00+)	C (F)
Burr Street/ Cochituate Road (Route 30)	57 (217)	1.00+ (1.00+)	E (F)
Shoppers World Drive/Burr Street	15 (22)	0.64 (0.76)	B (C)
Shoppers World Drive/Flutie Pass	12 (20)	0.20 (0.58)	B (B)
Worcester Road (Route 9)/Shoppers World Drive/Michael's Driveway	14 (23)	0.76 (1.00+)	B (C)
Shoppers World Drive/Ring Road West Couplet	13 (16)	0.37 (0.50)	B (B)
Worcester Road (Route 9)/Ring Road West Couplet	4 (6)	0.44 (0.59)	A (A)
Worcester Road (Route 9)/West Driveway/Bed Bath Drive	24 (32)	0.92 (0.98)	C (C)
Speen Street at Cochituate Road (Rte. 30)	49 (113)	1.00+(1.00+)	D (F)
Worcester Road (Route 9)/Natick Mall Road	57(91)	1.00+(1.00+)	E (F)
Unsignalized			
Shoppers World Drive /FLE Driveway ²	EB 12 (EB 22)	0.02 (0.23)	B (C)
Burr Street/FLE West Driveway ²	SB 11 (SB 13)	0.17 (0.25)	B (B)
Burr Street/FLE East Driveway ²	EB 10 (EB 13)	0.13 (0.23)	B (B)

¹ Reported results from Synchro 10 analysis. Levels of Service from A-F, where A is the best and F the worst. Seconds of delay rounded to nearest second during the highest 15-minute period of the AM or PM peak hours and represents total control delay per motorist including acceleration, deceleration, and stop delays. V/C (volume to capacity) is for the worst individual traffic movement in the intersection.

² FLE – Framingham Logan Express. Worst unsignalized intersection approach is reported



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Under 2029 Build conditions shown on Table 8, the assumed trip distribution pattern is expected to dissipate the impact of the garage to fewer than 60 peak hour trips through all of the intersections analyzed except t - the signalized intersection of Burr Street at Shoppers World Drive and the two unsignalized LEXF site driveway intersections on Burr Street.

At Study Area intersections, trips are expected to increase due to the proposed expansion of the LEXF facility (including increases to the parking capacity and increases in passenger pick up/drop off), but their projected levels of service are not expected to vary greatly when compared to the 2029 No-Build scenario. At most of the intersections, the expected increase in delay, if any at all, is 1 or 2 seconds, when compared to the No-Build condition. In some instances, even though the increase in delay was just one second, the increase in delay crossed the threshold into a different level of service letter grade. At the intersection of Cochituate Road/Whittier Street, the expected increase in delay is 6 seconds during the afternoon peak period. At the intersection of Cochituate Road/Burr Street the expected increase in delay is 9 seconds during the afternoon peak period. These anticipated increases in delay are typically considered to be small and the change to the experience of an individual driver is not expected to be notable. As such, it is not anticipated that improvements to the roadway or traffic signal timings at the study area intersections are needed as a result of the Project.



5.0 CONCLUSION

Using standard traffic engineering practices, this Traffic Impact Study has:

- Reviewed existing traffic and roadway conditions in the vicinity of the proposed project site, including an extensive data collection program
- Determined background traffic growth for the study area between 2019 and 2029, due to specific background development projects and due to general background growth
- Estimated and distributed the additional traffic that is expected to be generated by the proposed Logan Express Garage Expansion
- Presented an evaluation of traffic impacts due to the implementation of the proposed expansion

This study shows that:

- On a daily basis, the proposed expansion of the garage is expected to add approximately 1,496 vehicle trips to the surrounding road network. During the morning peak hour, approximately 88 vehicle trips (45 in and 43 out) are expected to be added, while during the afternoon peak hour, approximately 117 (58 in and 59 out) vehicle trips are expected to be added
- From a traffic operations perspective, the differences between the year 2029 No-Build and Build local traffic operations are relatively minor. At most of the intersections, the expected increase in delay, if any at all, is 1 or 2 seconds, when compared to the No-Build condition. At the intersection of Cochituate Road/Whittier Street, the expected increase in delay is 6 seconds during the afternoon peak period. At the intersection of Cochituate Road/Burr Street the expected increase in delay is 9 seconds during the afternoon peak period. These anticipated increases in delay are typically considered to be small and the change to the experience of an individual driver is not expected to be notable.

This study indicates that the roadways and intersections can accommodate the construction of the proposed expansion. It is not anticipated that improvements to the roadway or traffic signal timings at the study area intersections are needed as a result of the Project.



ATTACHMENT D
2014 MEPA Certificate



The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Deval L. Patrick
GOVERNOR

Richard K. Sullivan Jr.
SECRETARY

Tel: (617) 626-1000
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<http://www.mass.gov/envir>

February 28, 2014

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME : Logan Express Parking Garage
PROJECT MUNICIPALITY : Framingham
PROJECT WATERSHED : Concord River
EEA NUMBER : 15144
PROJECT PROPONENT : Massachusetts Port Authority
DATE NOTICED IN MONITOR : January 22, 2014

Pursuant to the Massachusetts Environmental Policy Act (MEPA) (M.G. L. c. 30, ss. 61-62I) and Section 11.06 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project **does not require** the preparation of an Environmental Impact Report (EIR).

Project Description

As described in the Environmental Notification Form (ENF) and supplemental information provided during the review period, the project consists of the construction of a five-story parking garage with 1,500 parking spaces and a bus terminal for passenger operations related to the Massachusetts Port Authority's (Massport) Logan Express bus service. The Logan Express is a critical component of Massport's High Occupancy Vehicle (HOV) strategy for air passenger and employee access to Logan Airport. If sufficient funding is not available for a five-story garage, the garage will be built with four levels and 1,100 parking spaces. The garage will include an 8,000-square foot (sf) bus terminal on the ground floor. While further expansion is not proposed at this time, the garage structure will be built so that it could accommodate vertical expansion to seven-levels in the future.

The garage will consolidate 874 existing parking spaces currently owned or leased by Massport, and add an additional 626 spaces to accommodate peak usage and future needs. The existing spaces are currently spread over four sites in the area, including: the project site, which

includes Massport's bus terminal and 374 parking spaces, at the corner of Shopper's World Drive and Burr Street Extension; 150 leased spaces at the Kohl's Department Store off West Drive; 300 spaces leased for ten months per year north of Ring Road at the Shopper's World shopping center; and 50 spaces leased at the AMC theater overflow parking lot off Flutie Pass. When the parking lot at the bus terminal site is full, customers are directed to one of the off-site lots to park. Logan Express users who park at the off-site lots are either picked up by a Logan Express bus or must walk or take a shuttle bus to the bus terminal. Under some operating conditions, valet parking service based at the bus terminal is used. During the construction period, Massport will lease 500 spaces and install a temporary terminal facility at the Mathworks property (EEA #15019) on Prime Parkway in Natick, approximately 1.5 miles from the project site.

The project site includes the 4.63-acre Massport-owned terminal site, as well as an additional area of 0.42 acres that includes a Shopper's World right-of-way and Burr Street Extension easement. The terminal site includes an existing 2,305 square-sf bus terminal building and 374 parking spaces. Approximately 3.25 acres of the site (including 0.10 acres within the easement area) is covered by impervious material. The northeastern part of the site includes an intermittent stream and associated Bordering Vegetated Wetland (BVW). The site is bordered by commercial uses to the north, the Shopper's World shopping center to the west and south, and wetlands and undeveloped land to the east.

An ENF was filed in 2001 proposing the construction of a 1,081 space parking garage at the site. A Certificate issued on February 23, 2001 determined that no further MEPA review was required. However, the project was not constructed and a new ENF was filed due to the lapse of time.

Permitting and Jurisdiction

The project is undergoing MEPA review and requires preparation of an Environmental Notification Form (ENF) pursuant to 301 CMR 11.03(6)(b)(15) because it is being undertaken by a State Agency and involves the construction of 300 or more new parking spaces at a single location. The project requires a State Building permit from the Department of Public Safety and a permit from the Massachusetts Plumbing Board.

It requires an Order of Conditions from the Framingham Conservation Commission (and, if a local Order is appealed, a Superseding Order of Conditions (SOC) from MassDEP). The project may require authorization from the U.S. Army Corps of Engineers (ACOE) under the Massachusetts General Permit. The project may also require a National Pollutant Discharge Elimination System (NPDES) Stormwater Permit for Construction Activities from the U.S. Environmental Protection Agency (EPA).

Because the Proponent, Massport, is a State Agency, MEPA jurisdiction is broad in scope and extends to all aspects of the project that may cause Damage to the Environment, as defined in the MEPA regulations.

Review of the ENF

The ENF provides a description of the project, a discussion of alternatives to the proposed project, preliminary project plans, a Traffic Impact and Access Study (TIAS), and identifies measures to avoid, minimize and mitigate project impacts. The ENF noted that the No Build alternative does not meet the project purpose of enhancing and expanding the traffic reduction benefits of the Logan Express service to this area. The ENF also described alternative garage layouts that were considered. The proposed layout of garage ramps in the east-west orientation was determined to yield the safest pedestrian passage within the garage and to optimize the number of parking spaces by allowing parking on the ramps. While the ENF does not propose any discharges of groundwater into the sanitary sewer system, Massport is reminded that such discharges are prohibited by the Massachusetts Water Resources Authority (MWRA).

Wetlands

A portion of the project is located within the BVW located in the northeast part of the site. The ENF identified a direct impact of 600 sf to BVW. However, in correspondence dated February 10, 2014, Massport indicated that minor design changes made since the filing of the ENF have reduced the BVW impact to approximately 50 sf. The project is proposing to mitigate for the BVW impact by creating a wetland replacement area of approximately 1,200 sf adjacent to the intermittent stream. The proposed BVW replacement is located in an area with hydric soils buried under a layer of fill, which will be removed prior to planting with native wetlands plant species.

Approximately 3.25 acres of the site is covered by impervious surface and the majority of the remainder includes the intermittent stream and associated BVW. The project will reduce total impervious cover by approximately 0.10 acres, adding lawn area and landscaping around the garage where some impervious parking spaces are now located. Porous pavement will be installed outside of the garage footprint in an area to be used for valet parking and employee parking.

The project will meet MassDEP Stormwater Management standards as a redevelopment project. Stormwater facilities include the use of infiltration trenches for surface runoff, and treatment of garage roof runoff in a proprietary treatment unit prior to discharge into an existing stormwater basin to achieve an 80 percent reduction in total suspended solids. Any stormwater runoff from the internal levels of the parking garage will be discharged into the town sanitary sewer. The project will implement stormwater management controls during construction. The project will be required to prepare and adhere to a Stormwater Pollution Prevention Plan (SWPP) as part of its NPDES permit.

Construction and Operations

According to the ENF, Massport requires its capital construction contractors to recycle construction and demolition debris (C & D) generated by the projects. Massport has determined that 98 percent of the C&D materials have been recycled as a result of this policy. I encourage the Proponent to continue to implement this effective policy for the current project, including the

debris generated by the demolition of the existing bus terminal and removal of the asphalt parking lot. Demolition activities must comply with both Solid Waste and Air Pollution Control regulations. In particular, the Proponent must notify MassDEP prior to demolition and may need to file an asbestos removal notification form with MassDEP prior to initiating work, if applicable. Both construction and operations of the project must also comply with the relevant air quality regulations. The ENF notes that Massport's Sustainable Design Standards and Guidelines requires that all heavy construction equipment used for its projects be equipped with diesel particulate filters or diesel oxidation catalysts in accordance with MassDEP's Clean Air Construction Initiative.

The Town of Framingham and Framingham Planning Board expressed concern about the lack of a garage ventilation system to remove bus exhaust from the passenger loading area. Massport provided additional information regarding this issue on February 24, 2014. According to Massport, the facility is being designed as an open parking garage that does not require an exhaust system per the State Building Code. The indoor portion of the bus terminal, including passenger ticketing and waiting areas, will include a heating, ventilation, and cooling (HVAC) system that will not draw vehicle exhaust from the garage into the interior areas.

Traffic

The TIAS evaluated traffic conditions within a study area encompassing the project site and surrounding roadways, including Speen Street to the east, Route 9 to the south, the roadways servicing Shopper's World to the west, and Route 30 and Whittier Street to the north. According to the TIAS, actual traffic count data were used as the basis of the trip generation estimates rather than trip generation report rates established by the Institute of Transportation Engineers (ITE). The ITE trip generation rates apply to typical commuter Park-Ride lots associated with public transportation services, which were not considered by Massport to be applicable to the ridership characteristics of the Logan Express, which carries both employees and airline passengers throughout the day. The TIAS also relied on Massport's usage data for both bus passengers and parking facilities. Turning Movement Counts (TMC) were collected at 26 locations and traffic volume data was collected by Automatic Traffic Recorders (ATR) at 11 additional locations. The TIAS study area included the location of the temporary Logan Express facility at the Mathworks site so that traffic operations in the vicinity of the temporary facility could be assessed during the construction period. The TIAS used a background traffic growth rate provided by the Central Transportation Planning Staff (CTPS) as well as traffic estimates from permitted but not yet occupied projects in Framingham and Natick to project future traffic conditions (2020) with and without the project. The traffic data was also used to evaluate the existing and future Level-of-Service (LOS) at 14 intersections in the study area.

According to the ENF, the existing Logan Express facility generates 2,562 average daily trips (adt). The project is expected to generate an additional 954 adt, including 60 trips during the morning peak hour and 80 trips during the evening peak hour. However, the bus service is expected to eliminate approximately 900 vehicle trips per day to Logan Airport, including 50 fewer trips during the morning peak hour and 70 fewer trips during the evening peak hour. Approximately 60 percent of the trips to and from the site are associated with the drop-off/pick-

up of Logan Express passengers and bus service, while the remaining 40 percent of trips are associated with long-term parking at the site.

The TIAS compared LOS at the study area intersections under existing conditions and 2020 No-Build and Build conditions. The analysis concluded that there will be no change in the LOS under 2020 Build or No-Build conditions compared to existing conditions. However, the analysis for three signalized intersections in the vicinity of the temporary facility concluded that one of the intersections (Specn Street East at Superior Drive) would degrade from LOD D under 2015 No-Build conditions to LOS E while the temporary Logan Express facility is in use. The ENF proposes to mitigate impacts to traffic operations during the use of the temporary facility by adding a second stop sign at the westbound approach to the intersection of Prime Parkway and a FedEx driveway due to the unusual angle at which the FedEx driveway enters the intersection.

The purpose of the project is to reduce or shorten vehicle trips by passengers and employees of Logan Airport. The project itself serves as a Transportation Demand Management (TDM) measure allowing employees of Logan Airport to drive a relatively short distance to the Logan Express facility and share the bus ride to Logan Airport. With respect to other typical TDM measures, Massport has indicated that the facility will include bicycle racks and priority parking spaces for clean vehicles. As recommended by the Town of Framingham, I encourage Massport to also add electric vehicle (EV) charging stations.

Greenhouse Gas Emissions (GHG)

I commend Massport for expanding and improving its HOV programs such Logan Express, which reduce traffic congestion, improve air quality, and reduce GHG emissions. The project will also benefit air quality by eliminating extra trips associated with the re-direction of cars from the terminal site to satellite parking lots. In addition, Massport has committed to provide clean vehicle priority parking locations and bicycle racks at the parking garage. While the project by its nature reduces mobile-source GHG emissions, I encourage Massport to voluntarily undertake significant measures to reduce GHG emissions associated with the garage. The garage may be suitable for the installation of roof-top solar photovoltaic (PV) system, and I encourage Massport to consider the feasibility of adding solar PV in connection with any decision on expansion of the facility to seven levels. The ENF identified the following measures that will be implemented:

- Use of warm-mix asphalt;
- Installation of low-flow plumbing fixtures; and,
- Use of LED lighting.

Additional measures that should be considered by Massport include:

- Vehicle charging station;
- Improvement of building envelope (i.e., higher R-value insulation);
- Reuse roof runoff for landscaping and other non-potable uses;
- Install lower U-value windows to improve envelope performance;

- Incorporate window glazing to balance and optimize daylighting, heat loss and solar heat gain performance;
- Reduced lighting power density;
- Installation of high-efficiency HVAC systems;
- Use of energy efficient appliances (i.e., Energy Star);

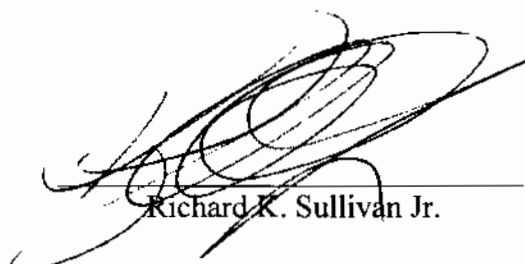
The ENF also includes an analysis of the potential shade cast by the garage onto the solar PV installation on the adjacent REI property. While the proposed five story garage will not affect the REI solar PV facility, future expansion to seven stories may cast shadows that reduce its generating capacity. Massport should coordinate with REI regarding any future expansion of the garage that could impact the solar installation.

Conclusion

The ENF has sufficiently defined the nature and general elements of the project for the purposes of MEPA review and demonstrated that the project’s environmental impacts will be avoided, minimized and/or mitigated to the extent practicable. Based on the information in the ENF and after consultation with State Agencies, I find that no further MEPA review is required at this time. Remaining issues can be addressed through the local, state and federal permitting and review processes.

February 28, 2014

Date



Richard K. Sullivan Jr.

Comments received:

- 02/04/2014 Massachusetts Department of Transportation (MassDOT)
- 02/10/2014 Massachusetts Port Authority (Massport)
- 02/20/2014 Massachusetts Water Resources Authority (MWRA)
- 02/21/2014 Framingham Town Manager
- 02/21/2014 Framingham Planning Board
- 02/24/2014 Massachusetts Port Authority (Massport)

RKS/AJS/ajs

ATTACHMENT E

Massachusetts Historical Commission Concurrence



November 7, 2013

Ms. Brona Simon, State Historic Preservation Officer
MASSACHUSETTS HISTORICAL COMMISSION
220 Morrissey Boulevard
Boston, MA 02125

Subject: State Historic Review
Framingham Logan Express Parking Garage
Framingham, Massachusetts
Massachusetts Port Authority Project No. L1319-D1

Dear Ms. Simon:

The Massachusetts Port Authority (Massport) is proposing improvements to the existing Logan Express parking facility in Framingham at 1 Worcester Road (on the corner of Shoppers World Drive and Burr Street - see Figure 1). Massport's four Logan Express facilities provide travelers with secure parking and bus service to all terminals at Logan Airport.

The Logan Express facility in Framingham currently consists of a one-story concrete masonry unit bus terminal and adjacent 374-space surface parking lot, constructed in 1996. This parking facility is within the highly developed Massachusetts Turnpike (I-90)/Route 30/Route 9 corridor in the Framingham/Natick area. Adjacent land uses include the Shoppers World Plaza, REI store, the AMC Premium Cinema, Liberty Mutual office building, Home Goods/Target stores and numerous other retail, restaurant, and commercial buildings and associated parking lots.

Due to consistently high demand for this bus service, Massport is seeking to consolidate and increase the amount of parking available at its Framingham location. Massport is proposing to construct a five-level, 1,500-space parking garage within the existing property, essentially replacing the existing surface parking lot. The existing 1996 terminal building will be demolished and replaced in its entirety within the new garage structure.

Massport previously filed an Environmental Notification Form (ENF) under the Massachusetts Environmental Policy Act (MEPA) on January 16, 2001 for a 1,081 space garage (surface and garage parking). The Secretary of Environmental Affairs issued a Certificate on the ENF February 23, 2001 which determined that the preparation of an EIR was not required. This project was not constructed at that time. Due to the length of time that has elapsed since the issuance of the MEPA Certificate in 2001, the filing of a new ENF is required and will be filed shortly. An ENF is required for this project because the proposed parking garage exceeds the MEPA review threshold for the construction of 300 or more new parking spaces at a single location.

There were no historic sites on or surrounding the proposed project site when the 2001 ENF was filed. A review of the current MACRIS database also found there to be no identified historic sites. MPA respectfully requests your concurrence that the existing building and site at the Logan Express terminal in Framingham are not listed or eligible for listing on the National Register of Historic Places, and the

RECEIVED

DEC 02 13

F.S.&T.

FAY, SPOFFORD &
THORNDIKE
5 Burlington Woods
Burlington, MA 01803
Toll Free: 800.835.8666
Main: 781.221.1000
Fax: 781.229.1115
www.fstinc.com

RECEIVED

NOV 08 2013

MASS. HIST. COMM

RC55071

Ms. Brona Simon
MPA Project No. L1319-D1

November 7, 2013
Page 2

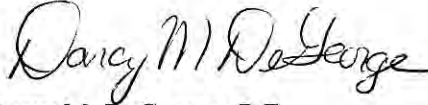
proposed action does not constitute an Adverse Effect under M.G.L. Chapter 9, Sections 26-27C, as amended by Chapter 254 of the Acts of 1988 [950 CMR 71.04(2)].

After signing and dating this letter, I ask that you return the original to the project engineer at the below address:

Darcy DeGeorge, P.E., Project Manager
Fay, Spofford & Thorndike
5 Burlington Woods
Burlington, MA 01803

If you have any questions regarding the proposed project, please feel free to contact me at 781-221-1283 or via email at ddegeorge@fstinc.com.

Sincerely,



Darcy M. DeGeorge, P.E.
Project Manager

Enclosures

cc: Darcy DeGeorge, P.E., FST
S. Dalzell, Massport
D. Doane, Massport

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant historic or archaeological resources.



Brandee Loughlin
Preservation Planner
Massachusetts Historical Commission

11/26/13
Date

RC-55071

ATTACHMENT F

**Greenhouse Gas Emissions Analysis, Epsilon Associates
Analysis Worksheets**

Logan Express Garage Solar Modeling



February 10, 2020
File: 179410001

Stantec Inc
65 Network Drive, 2nd Floor Burlington MA 01803

Attention: Katie Raymond, PE, LEED AP
3 Mill & Main Place, Suite 250
Maynard, MA 01754

Dear Katie,

Reference: Solar Modeling at Framingham Logan Express Parking Garage

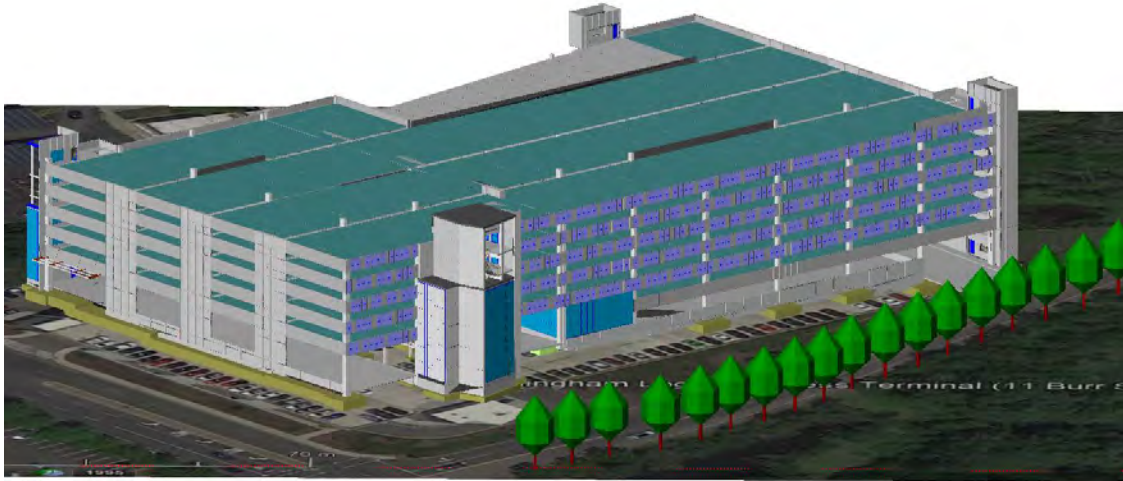
The solar modelling to the parking garage has been performed using PVsyst v.6.8.6 on Feb 4 & 5th, 2020 using Metonorm data. The values were then revised using NREL Data on Feb 8th, 2020. Building PV orientation was at an Azimuth of S41°E with two outputs generated. Option 1 was all PV modules were at 90° Tilt and Option 2 with five rows of modules at various tilts (90°, 75°, 65°, 55°, 45°) from vertical. Both simulations were run with the following results:

Item	Option 1 (90° Only)	Option 2 (90°, 75°, 65°, 55°, 45°)
Specific Production (kWh/kWp/Year)	968.00	1,114.00
Average Performance Ratio (%)	81.74%	75.43%
Near Shadings Losses (%)	4.34%	10.93%
Electrical Shadings Loss (%)	0.23%	2.37%
Soiling Loss (%)	2.42%	2.43%
Energy Injected to Grid (MWh) (For first year – Solar typical depreciates at a rate of 0.4%/yr.)	163.53	190.00

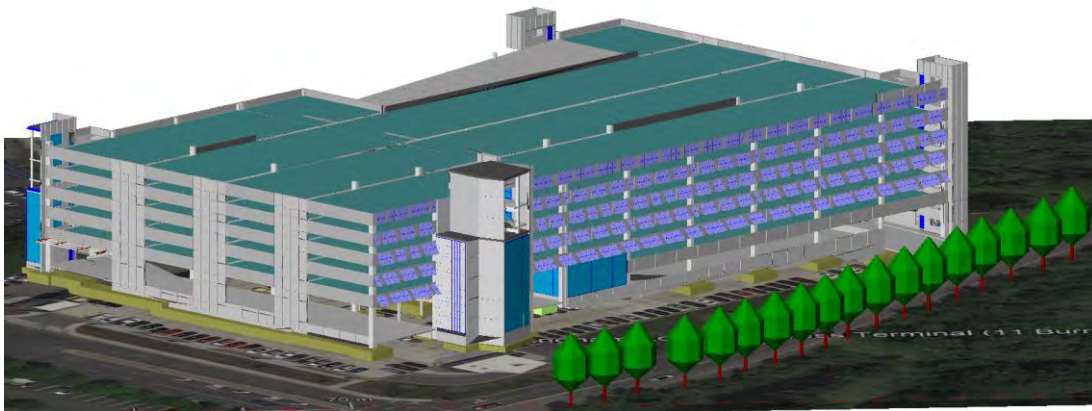
Due to limitations in the PVSyst software, the Option 2 ended up with a slightly higher DC value of 1.64kW; however, this would be negligible as it amounts to roughly 4 additional modules.

Even though the shading losses on Option 2 were higher, this variant was able to collect a higher amount of the available irradiance than Option 1 was.

Option 1: Vertical Tilt (90°)



Option 2: Various Tilt (90°, 75°, 65°, 55°, 45°)



Please see the attached PVsyst reports following this memo for full parameters on how these scenarios were modelled.

Regards,

Daniel Kraemer CTech
Project Manager: Controls, Power - Ontario

Phone: 519 585 7433
Fax: 519 579 6733
dan.kraemer@stantec.com

Attachment: ana_Framington_Garage_PVsyst_90deg_EnergyModelResults_08.02.2020.pdf,
ana_Framington_Garage_PVsyst_VariousTilt_EnergyModelResults_08.02.2020.pdf
c. Jeff Cohen



Grid-Connected System: Simulation parameters

Project : Framington_Garage

Geographical Site Lokerville Country **United States**

Situation Latitude 42.30° N Longitude -71.39° W

Time defined as Legal Time Time zone UT-5 Altitude 50 m

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.26	0.29	0.24	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.27

Meteo data: Lokerville NREL NSRDB Typ. Met. Year PSMv3_1998 to 2016 - TMY

Simulation variant : Vertical Variant_NREL

Simulation date 08/02/20 15h39
Simulation for the 1st year of operation

Simulation parameters System type **SE Facade**

Collector Plane Orientation Tilt 90° Azimuth -41°

Models used Transposition Perez Diffuse Imported

Horizon Average Height 0.8°

Near Shadings According to strings Electrical effect 80 %

User's needs : Unlimited load (grid)

PV Arrays Characteristics (2 kinds of array defined)

PV module Si-mono Model **JKM 410M-72HL-V**
Custom parameters definition Manufacturer Jinkosolar

Sub-array "Sub-array #1"

Number of PV modules	In series	13 modules	In parallel	8 strings
Total number of PV modules	Nb. modules	104	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	42.6 kWp	At operating cond.	43.8 kWp (20°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp	81 A

Sub-array "Sub-array #2"

Number of PV modules	In series	14 modules	In parallel	22 strings
Total number of PV modules	Nb. modules	308	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	126 kWp	At operating cond.	130 kWp (20°C)
Array operating characteristics (50°C)	U mpp	585 V	I mpp	222 A

Total Arrays global power	Nominal (STC)	169 kWp	Total	412 modules
	Module area	829 m²	Cell area	748 m²

Inverter

Custom parameters definition Model **Sunny Tripower33-US-10 (480 VAC)**
Manufacturer SMA

Characteristics Operating Voltage 300-800 V Unit Nom. Power 33.3 kWac

Sub-array "Sub-array #1" Nb. of inverters 2 units Total Power 67 kWac
Pnom ratio 0.64

Sub-array "Sub-array #2" Nb. of inverters 3 units Total Power 100 kWac
Pnom ratio 1.26

Total Nb. of inverters 5 Total Power 167 kWac

PV Array loss factors



65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Simulation parameters

Array Soiling Losses

Average loss Fraction 2.4 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
3.1%	1.4%	3.1%	1.5%	3.1%	1.5%	3.1%	3.1%	3.0%	1.6%	3.0%	1.6%

Thermal Loss factor

Uc (const) 26.0 W/m²K

Uv (wind) 1.2 W/m²K / m/s

Wiring Ohmic Loss

Array#1 99 mOhm

Loss Fraction 1.5 % at STC

Array#2 39 mOhm

Loss Fraction 1.5 % at STC

Global

Loss Fraction 1.5 % at STC

LID - Light Induced Degradation

Loss Fraction 1.4 %

Module Quality Loss

Loss Fraction -0.8 %

Module Mismatch Losses

Loss Fraction 1.0 % at MPP

Strings Mismatch loss

Loss Fraction 0.10 %

Module average degradation

Year no 1

Loss factor 0.4 %/year

Mismatch due to degradation

Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

Incidence effect (IAM): User defined profile

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.995	0.982	0.933	0.879	0.765	0.545	0.000

Spectral correction

FirstSolar model

Coefficient Set	C0	C1	C2	C3	C4	C5
Monocrystalline Si	0.85914	-0.02088	-0.0058853	0.12029	0.026814	-0.001781

System loss factors

AC wire loss inverter to transfo

Inverter voltage 480 Vac tri

Wires: 3x95.0 mm² 69 m

Loss Fraction 1.0 % at STC

External transformer

Iron loss (24H connexion) 168 W

Loss Fraction 0.1 % at STC

Resistive/Inductive losses 13.7 mOhm

Loss Fraction 1.0 % at STC

Unavailability of the system

3.0 days, 3 periods

Time fraction 0.8 %

Auxiliaries loss

constant (fans) 130 W

... from Power thresh. 0.0 kW

Night auxiliaries consumption 130 W



65 Network Drive 2nd Floor, Burlington MA 01803-2767

By: Daniel Kraemer

Grid-Connected System: Horizon definition

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
 Simulation for the 1st year of operation

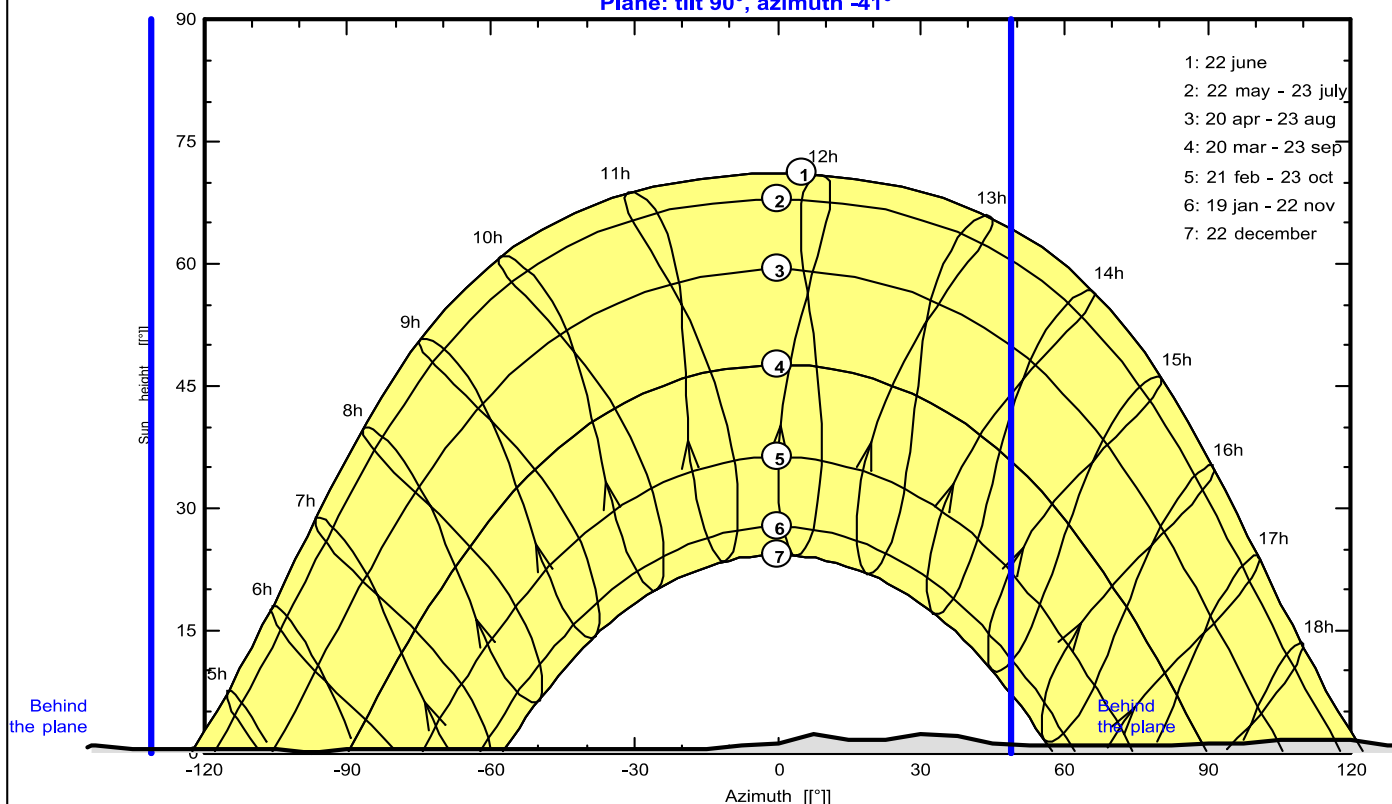
Main system parameters	System type	SE Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
PV Field Orientation	tilt	90° azimuth -41°
PV modules	Model	JKM 410M-72HL-V Pnom 410 Wp
PV Array	Nb. of modules	412 Pnom total 169 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0 Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Horizon	Average Height	0.8°	Diffuse Factor	0.99
	Albedo Factor	100 %	Albedo Fraction	0.97

Height [°]	0.4	0.4	0.0	0.4	0.8	0.4	0.4	0.0	0.4	0.4
Azimuth [°]	-180	-165	-158	-150	-143	-135	-105	-98	-90	-15
Height [°]	0.8	1.1	2.3	1.5	1.5	2.3	1.9	1.1	0.8	0.8
Azimuth [°]	-8	0	8	15	23	30	38	45	53	83
Height [°]	1.1	1.1	1.5	1.5	0.8	1.1	0.8	0.8	0.4	0.4
Azimuth [°]	90	98	105	120	128	135	143	150	158	180

Horizon from PVGIS website API, Lat=42°18'15', Long=-71°23'35', Alt=53m

Plane: tilt 90°, azimuth -41°





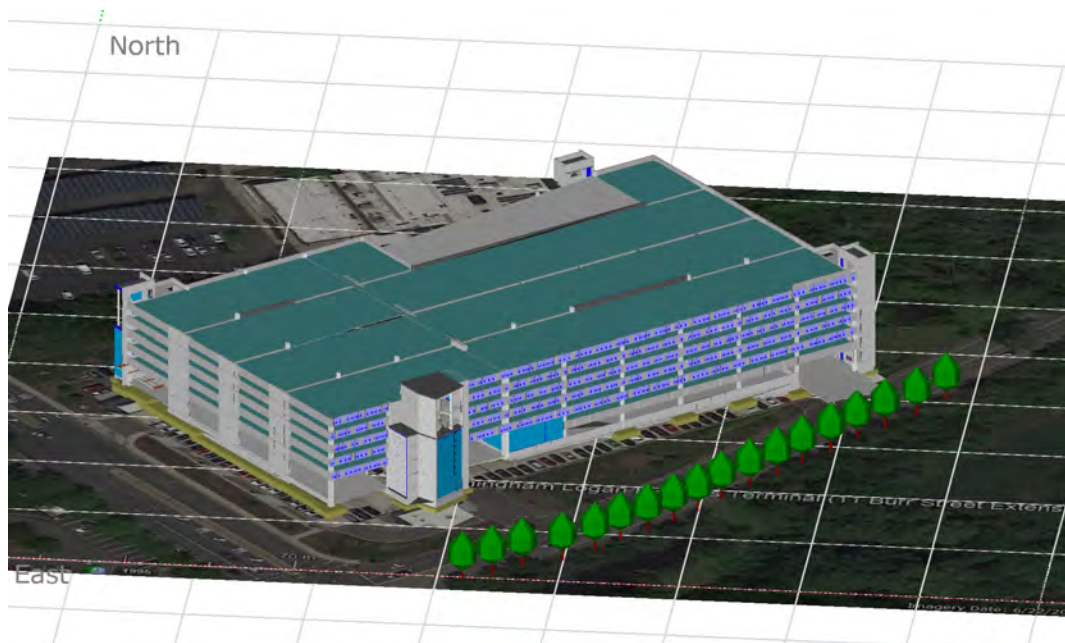
65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Near shading definition

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

Main system parameters	System type	SE Facade	
Horizon	Average Height	0.8°	
Near Shadings	According to strings		Electrical effect 80 %
PV Field Orientation	tilt	90°	azimuth -41°
PV modules	Model	JKM 410M-72HL-V	Pnom 410 Wp
PV Array	Nb. of modules	412	Pnom total 169 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)		Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 167 kW ac
User's needs	Unlimited load (grid)		

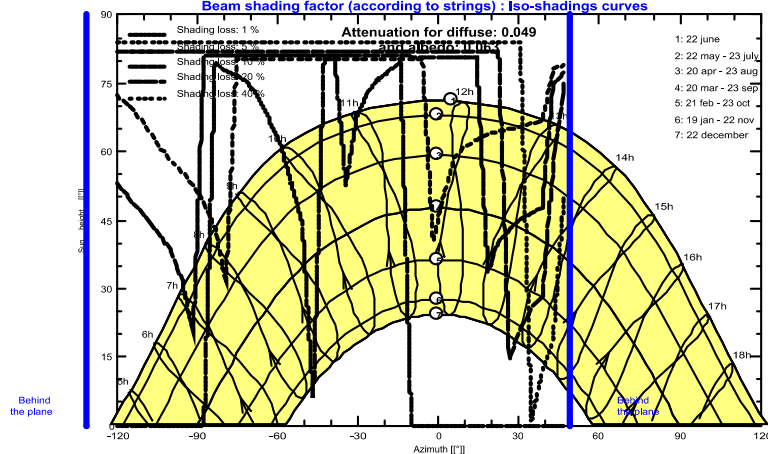
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Framington_Garage

Beam shading factor (according to strings) : Iso-shadings curves





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

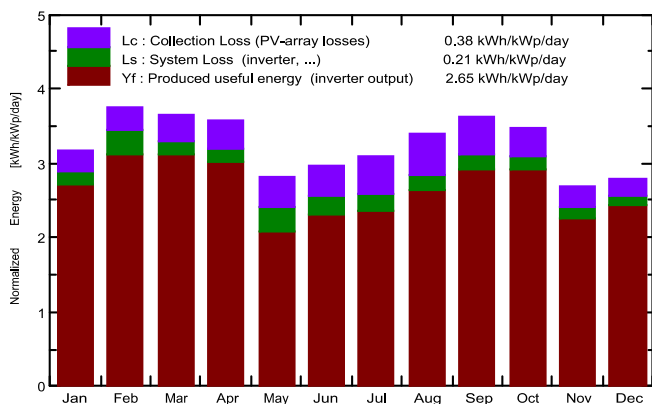
Grid-Connected System: Main results

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

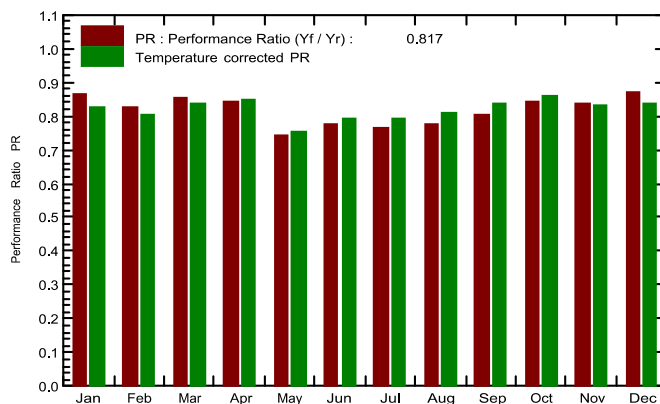
Main system parameters	System type	SE Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
PV Field Orientation	tilt	90° azimuth -41°
PV modules	Model	JKM 410M-72HL-V Pnom 410 Wp
PV Array	Nb. of modules	412 Pnom total 169 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0 Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Main simulation results
System Production **Produced Energy 163534 kWh/year** Specific prod. 968 kWh/kWp/year
Performance Ratio PR **81.74 %**

Normalized productions (per installed kWp): Nominal power 169 kWp



Performance Ratio PR and Weather corrected PR



Vertical Variant_NREL
Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray kWh	E_Grid kWh	PR
January	60.9	21.92	-3.95	97.9	88.9	15097	14274	0.863
February	83.8	28.96	-1.63	105.4	97.4	16265	14701	0.826
March	122.8	44.18	1.01	113.2	103.2	17278	16313	0.853
April	155.7	52.88	7.67	107.0	98.1	16241	15252	0.844
May	166.5	69.85	13.77	87.0	77.5	12668	10923	0.743
June	177.0	74.06	17.85	89.0	80.1	12932	11670	0.776
July	191.5	75.26	21.37	95.7	85.0	13520	12367	0.765
August	172.2	63.93	21.01	105.0	94.1	14909	13791	0.777
September	134.3	43.50	17.09	109.0	99.3	15836	14816	0.805
October	95.3	33.33	11.29	107.9	100.4	16257	15304	0.839
November	58.1	22.66	5.47	80.8	73.2	12193	11427	0.838
December	51.0	20.04	-2.60	86.3	79.0	13445	12696	0.871
Year	1469.0	550.58	9.08	1184.3	1076.3	176642	163534	0.817

Legends: GlobHor Horizontal global irradiation
DiffHor Horizontal diffuse irradiation
T_Amb T amb.
GlobInc Global incident in coll. plane
GlobEff Effective Global, corr. for IAM and shadings
EArray Effective energy at the output of the array
E_Grid Energy injected into grid
PR Performance Ratio



65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Special graphs

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

Main system parameters

Horizon

System type **SE Facade**
Average Height 0.8°

Near Shadings

According to strings

Electrical effect 80 %

PV Field Orientation

tilt 90°

azimuth -41°

PV modules

Model JKM 410M-72HL-V

Pnom 410 Wp

PV Array

Nb. of modules 412

Pnom total **169 kWp**

Inverter

Sunny Tripower33-US-10 (480 VAC)

Pnom 33.3 kW ac

Inverter pack

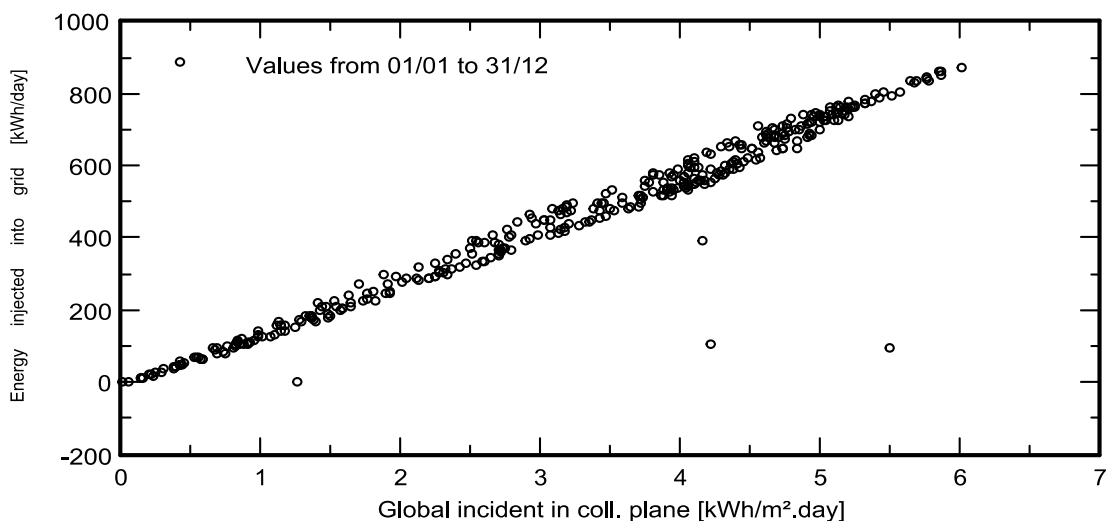
Nb. of units 5.0

Pnom total **167 kW ac**

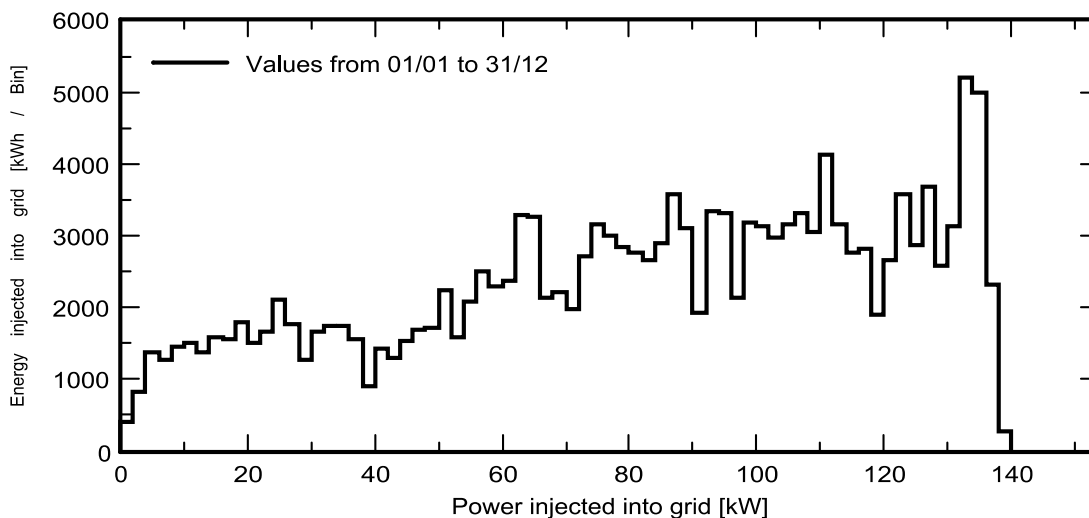
User's needs

Unlimited load (grid)

Daily Input/Output diagram



System Output Power Distribution





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Loss diagram

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

Main system parameters

Horizon

System type **SE Facade**
Average Height 0.8°

Near Shadings

According to strings

Electrical effect 80 %
azimuth -41°

PV Field Orientation

tilt 90°

PV modules

Model JKM 410M-72HL-V

Pnom 410 Wp

PV Array

Nb. of modules 412

Pnom total **169 kWp**

Inverter

Sunny Tripower33-US-10 (480 VAC)

Pnom 33.3 kW ac

Inverter pack

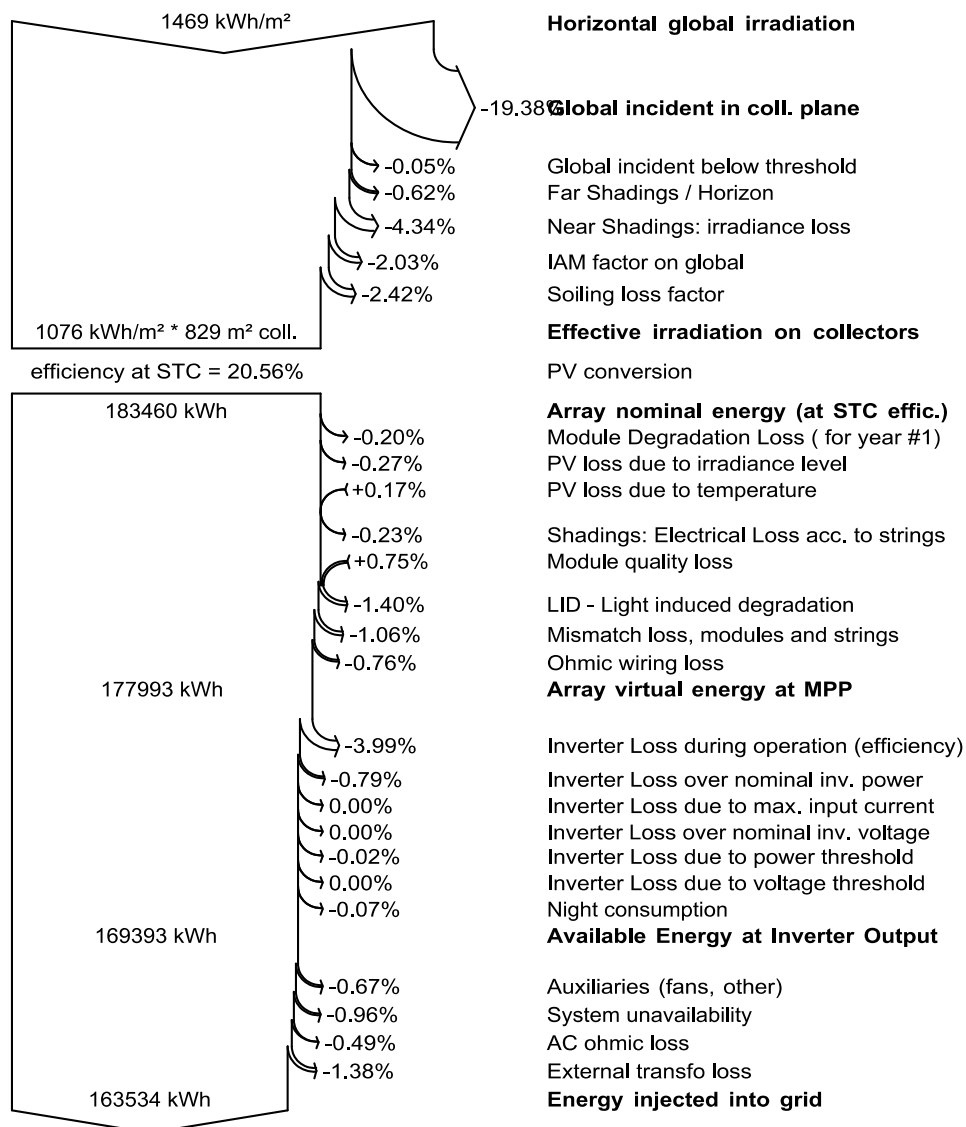
Nb. of units 5.0

Pnom total **167 kW ac**

User's needs

Unlimited load (grid)

Loss diagram over the whole year





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: P50 - P90 evaluation

Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

Main system parameters	System type	SE Facade	
Horizon	Average Height	0.8°	
Near Shadings	According to strings		Electrical effect 80 %
PV Field Orientation	tilt	90°	azimuth -41°
PV modules	Model	JKM 410M-72HL-V	Pnom 410 Wp
PV Array	Nb. of modules	412	Pnom total 169 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)		Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 167 kW ac
User's needs	Unlimited load (grid)		

Evaluation of the Production probability forecast

The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices:

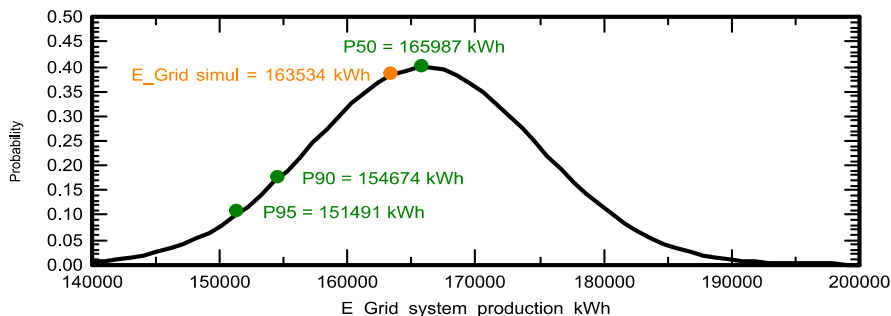
Meteo data source		NREL NSRDB Typ. Met. Year PSMv3_1998 to 2016
Meteo data	Kind	Monthly averages TMY Multi-year average
Specified Deviation	Climate change	1.5 %
Year-to-year variability	Variance	5.0 %

The probability distribution variance is also depending on some system parameters uncertainties

Specified Deviation	PV module modelling/parameters	1.0 %	
	Inverter efficiency uncertainty	0.5 %	
	Soiling and mismatch uncertainties	1.0 %	
	Degradation uncertainty	1.0 %	
Global variability (meteo + system)	Variance	5.3 %	(quadratic sum)

Annual production probability	Variability	8822 kWh
	P50	165987 kWh
	P90	154674 kWh
	P95	151491 kWh

Probability distribution





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: CO2 Balance

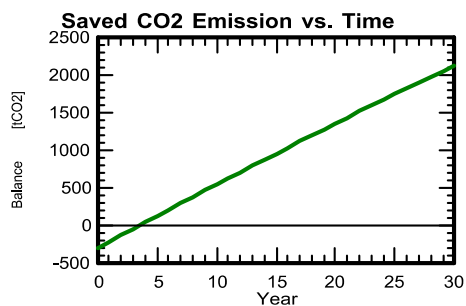
Project : Framington_Garage
Simulation variant : Vertical Variant_NREL
Simulation for the 1st year of operation

Main system parameters	System type	SE Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
PV Field Orientation	tilt 90°	azimuth -41°
PV modules	Model JKM 410M-72HL-V	Pnom 410 Wp
PV Array	Nb. of modules 412	Pnom total 169 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units 5.0	Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Produced Emissions	Total: 303.82 tCO2	
	Source: Detailed calculation from table below	
Replaced Emissions	Total: 2590.4 tCO2	
	System production: 163.53 MWh/yr	Lifetime: 30 years
		Annual Degradation: 0.4 %
	Grid Lifecycle Emissions: 528 gCO2/kWh	
	Source: IEA List	Country: United States
CO2 Emission Balance	Total: 2141.8 tCO2	

System Lifecycle Emissions Details:

Item	Modules	Supports
LCE	1713 kgCO2/kWp	3.52 kgCO2/kg
Quantity	169 kWp	4120 kg
Subtotal [kgCO2]	289313	14510





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Simulation parameters

Project : Framington_Garage

Geographical Site Lokerville Country **United States**

Situation Latitude 42.30° N Longitude -71.39° W

Time defined as Legal Time Time zone UT-5 Altitude 50 m

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.26	0.29	0.24	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.27

Meteo data: Lokerville NREL NSRDB Typ. Met. Year PSMv3_1998 to 2016 - TMY

Simulation variant : Various Tilts Variant_NREL

Simulation date 08/02/20 15h41
Simulation for the 1st year of operation

Simulation parameters	System type	Building Facade	
5 orientations	tilts/azimuths	90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°	
Sheds configuration	Nb. of sheds	412	Identical arrays
	Sheds spacing	0.56 m	Collector width 2.03 m
Shading limit angle	Limit profile angle	74.6°	Ground cov. Ratio (GCR) 362.7 %
Models used	Transposition	Perez	Diffuse Imported
Horizon	Average Height	0.8°	
Near Shadings	According to strings	Electrical effect	80 %
User's needs :	Unlimited load (grid)		

PV Arrays Characteristics (4 kinds of array defined)

PV module	Si-mono	Model	JKM 410M-72HL-V	
Custom parameters definition		Manufacturer	Jinkosolar	
Sub-array "Level 7 & 6"	Mixed orient.	#1/2: 7/6 strings	Tilt/Azimuth	90°/-41°, 75°/-41°
Number of PV modules	In series	13 modules	In parallel	13 strings
Total number of PV modules	Nb. modules	169	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	69.3 kWp	At operating cond.	71.1 kWp (20°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp	131 A
Sub-array "Level 5"	Mixed orient.	#3	Tilt/Azimuth	65°/-41°
Number of PV modules	In series	13 modules	In parallel	6 strings
Total number of PV modules	Nb. modules	78	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	32.0 kWp	At operating cond.	32.8 kWp (20°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp	60 A
Sub-array "Level 4"	Mixed orient.	#4	Tilt/Azimuth	55°/-41°
Number of PV modules	In series	13 modules	In parallel	6 strings
Total number of PV modules	Nb. modules	78	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	32.0 kWp	At operating cond.	32.8 kWp (20°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp	60 A
Sub-array "Level 3"	Mixed orient.	#5	Tilt/Azimuth	45°/-41°
Number of PV modules	In series	13 modules	In parallel	7 strings
Total number of PV modules	Nb. modules	91	Unit Nom. Power	410 Wp
Array global power	Nominal (STC)	37.3 kWp	At operating cond.	38.3 kWp (20°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp	70 A



Grid-Connected System: Simulation parameters

Total Arrays global power	Nominal (STC) 171 kWp	Total 416 modules
	Module area 837 m²	Cell area 755 m²
Inverter	Model Sunny Tripower33-US-10 (480 VAC)	
Custom parameters definition	Manufacturer SMA	
Characteristics	Operating Voltage 300-800 V	Unit Nom. Power 33.3 kWac
Sub-array "Level 7 & 6"	Nb. of inverters 2 units	Total Power 67 kWac
		Pnom ratio 1.04
Sub-array "Level 5"	Nb. of inverters 1 units	Total Power 33 kWac
		Pnom ratio 0.96
Sub-array "Level 4"	Nb. of inverters 1 units	Total Power 33 kWac
		Pnom ratio 0.96
Sub-array "Level 3"	Nb. of inverters 1 units	Total Power 33 kWac
		Pnom ratio 1.12
Total	Nb. of inverters 5	Total Power 167 kWac

PV Array loss factors

Array Soiling Losses

Average loss Fraction **2.4 %**

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
3.1%	1.4%	3.1%	1.5%	3.1%	1.5%	3.1%	3.1%	3.0%	1.6%	3.0%	1.6%

Thermal Loss factor

Uc (const) **26.0 W/m²K**

Uv (wind) **1.2 W/m²K / m/s**

Wiring Ohmic Loss

Array#1 **61 mOhm**

Loss Fraction **1.5 % at STC**

Array#2 **133 mOhm**

Loss Fraction **1.5 % at STC**

Array#3 **133 mOhm**

Loss Fraction **1.5 % at STC**

Array#4 **114 mOhm**

Loss Fraction **1.5 % at STC**

Global

Loss Fraction **1.5 % at STC**

LID - Light Induced Degradation

Loss Fraction **1.4 %**

Module Quality Loss

Loss Fraction **-0.8 %**

Module Mismatch Losses

Loss Fraction **1.0 % at MPP**

Strings Mismatch loss

Loss Fraction **0.10 %**

Module average degradation

Year no **1**

Loss factor **0.4 %/year**

Mismatch due to degradation

Imp RMS dispersion **0.4 %/year**

Vmp RMS dispersion **0.4 %/year**

Incidence effect (IAM): User defined profile

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.995	0.982	0.933	0.879	0.765	0.545	0.000

Spectral correction

FirstSolar model

Coefficient Set	C0	C1	C2	C3	C4	C5
Monocrystalline Si	0.85914	-0.02088	-0.0058853	0.12029	0.026814	-0.001781

System loss factors

AC wire loss inverter to transfo

Inverter voltage **480 Vac tri**

Wires: **3x95.0 mm² 69 m**

Loss Fraction **1.0 % at STC**

External transformer

Iron loss (24H connexion) **170 W**

Loss Fraction **0.1 % at STC**

Resistive/Inductive losses **13.6 mOhm**

Loss Fraction **1.0 % at STC**

Unavailability of the system

3.0 days, 3 periods

Time fraction **0.8 %**

Auxiliaries loss

constant (fans) **130 W**

... from Power thresh. **0.0 kW**

Night auxiliaries consumption **130 W**



65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Horizon definition

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
Simulation for the 1st year of operation

Main system parameters

Horizon

System type **Building Facade**
Average Height 0.8°

Near Shadings

5 orientations

PV modules

PV Array

Inverter

Inverter pack

User's needs

According to strings

Tilt/Azimuth 90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°

Model JKM 410M-72HL-V

Nb. of modules 416

Sunny Tripower33-US-10 (480 VAC)

Nb. of units 5.0

Unlimited load (grid)

Electrical effect 80 %

Pnom 410 Wp

Pnom total **171 kWp**

Pnom 33.3 kW ac

Pnom total **167 kW ac**

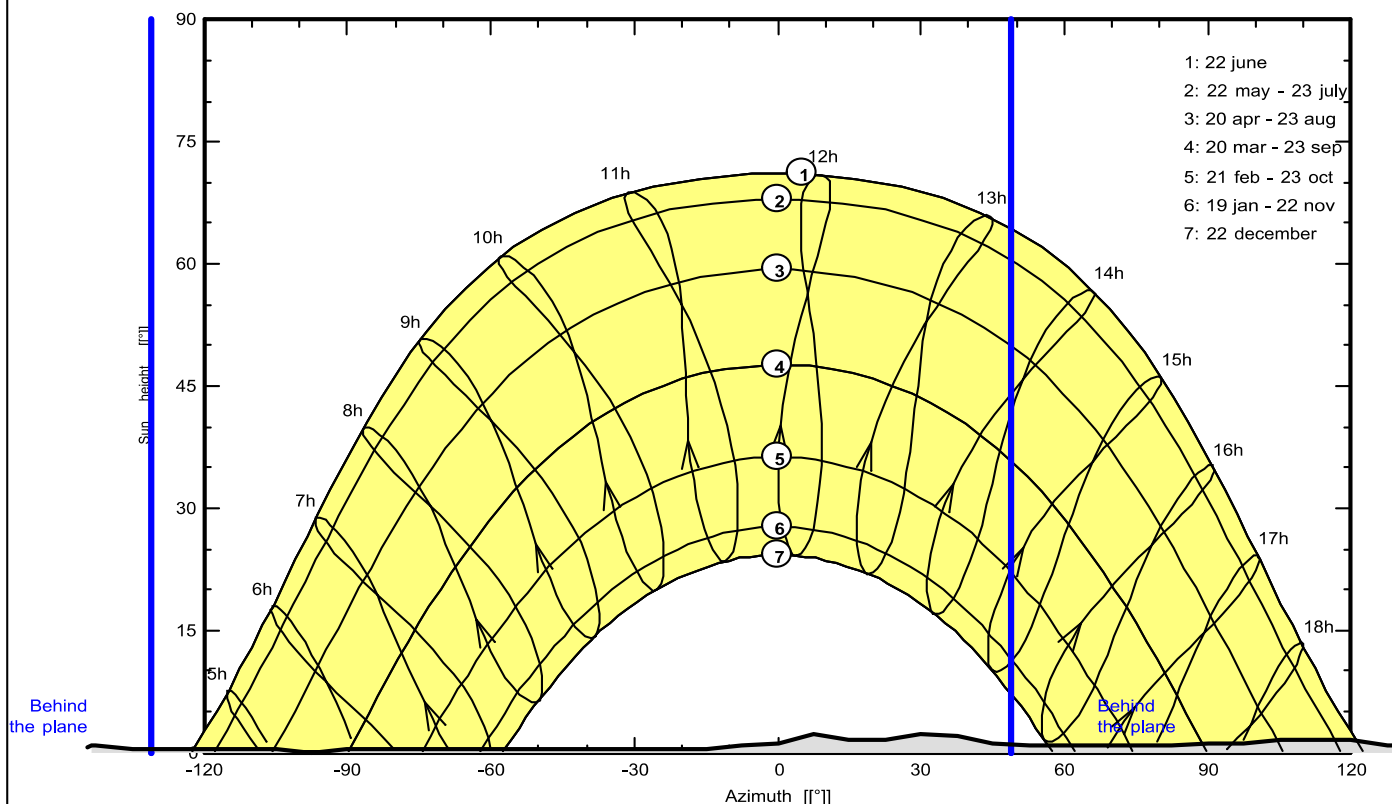
Horizon

Average Height 0.8°
Albedo Factor 100 %

Diffuse Factor 1.00
Albedo Fraction 0.97

Height [°]	0.4	0.4	0.0	0.4	0.8	0.4	0.4	0.0	0.4	0.4
Azimuth [°]	-180	-165	-158	-150	-143	-135	-105	-98	-90	-15
Height [°]	0.8	1.1	2.3	1.5	1.5	2.3	1.9	1.1	0.8	0.8
Azimuth [°]	-8	0	8	15	23	30	38	45	53	83
Height [°]	1.1	1.1	1.5	1.5	0.8	1.1	0.8	0.8	0.4	0.4
Azimuth [°]	90	98	105	120	128	135	143	150	158	180

Horizon from PVGIS website API, Lat=42°18'15", Long=-71°23'35', Alt=53m





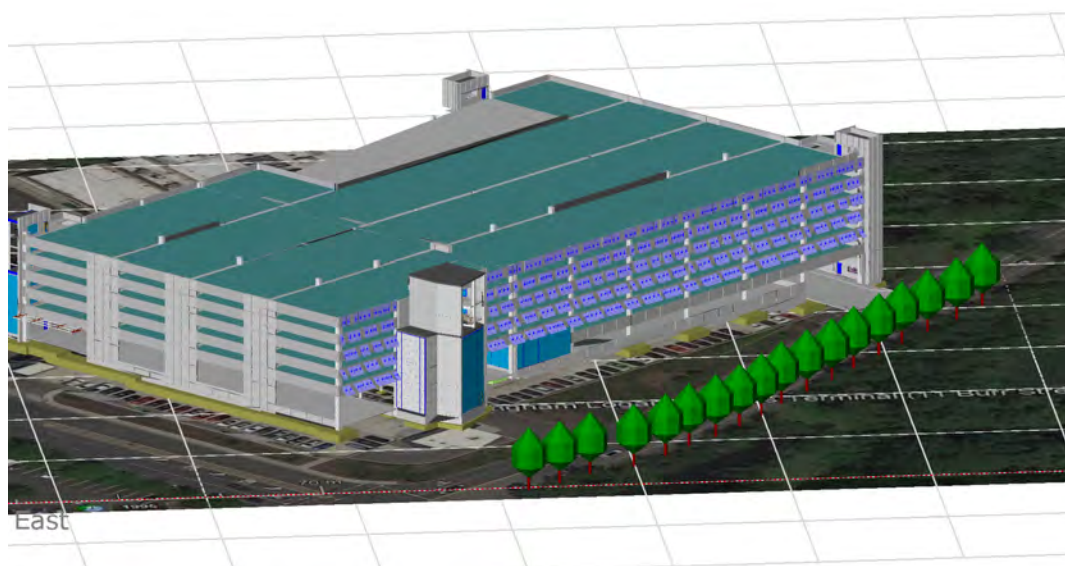
65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Near shading definition

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
Simulation for the 1st year of operation

Main system parameters	System type	Building Facade	
Horizon	Average Height	0.8°	
Near Shadings	According to strings	Electrical effect	80 %
5 orientations	Tilt/Azimuth	90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°	
PV modules	Model	JKM 410M-72HL-V	Pnom 410 Wp
PV Array	Nb. of modules	416	Pnom total 171 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)		Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 167 kW ac
User's needs	Unlimited load (grid)		

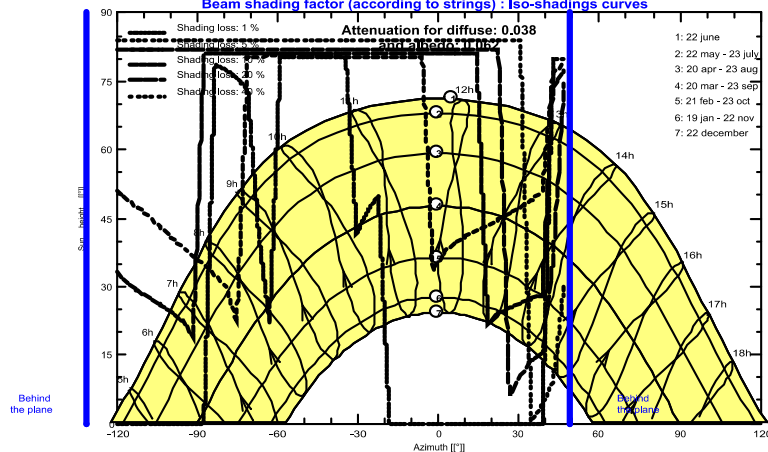
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Framington_Garage

Beam shading factor (according to strings) : Iso-shadings curves





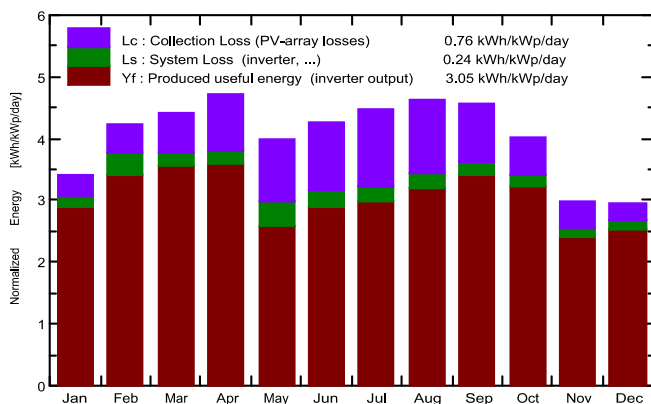
Grid-Connected System: Main results

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
 Simulation for the 1st year of operation

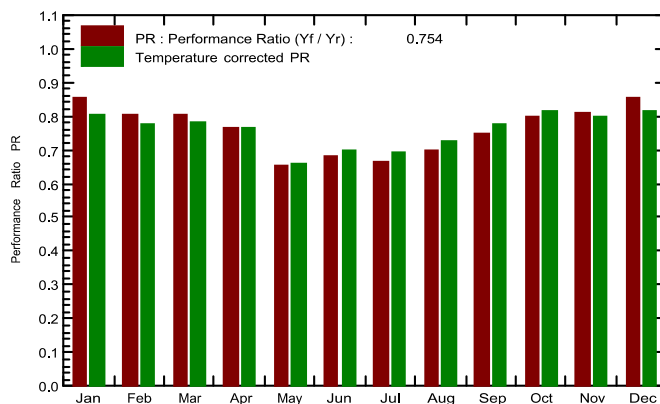
Main system parameters	System type	Building Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
5 orientations	Tilt/Azimuth	90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°
PV modules	Model	JKM 410M-72HL-V Pnom 410 Wp
PV Array	Nb. of modules	416 Pnom total 171 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0 Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Main simulation results
 System Production **Produced Energy 189996 kWh/year** Specific prod. 1114 kWh/kWp/year
 Performance Ratio PR **75.43 %**

Normalized productions (per installed kWp): Nominal power 171 kWp



Performance Ratio PR and Weather corrected PR



**Various Tilts Variant_NREL
Balances and main results**

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	EArray	PR	PRTemp
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	kWh	kWh	kWh		
January	60.9	21.92	-3.95	105.4	93.2	16188	15294	16188	0.851	0.805
February	83.8	28.96	-1.63	118.4	105.9	17963	16213	17963	0.803	0.773
March	122.8	44.18	1.01	137.1	119.2	19896	18809	19896	0.804	0.783
April	155.7	52.88	7.67	141.0	121.6	19477	18358	19477	0.763	0.765
May	166.5	69.85	13.77	123.6	100.4	15790	13732	15790	0.651	0.659
June	177.0	74.06	17.85	127.6	105.1	16231	14796	16231	0.680	0.697
July	191.5	75.26	21.37	138.3	111.5	17007	15730	17007	0.667	0.692
August	172.2	63.93	21.01	143.0	119.0	18181	16944	18181	0.695	0.725
September	134.3	43.50	17.09	136.6	118.5	18537	17400	18537	0.747	0.775
October	95.3	33.33	11.29	124.9	112.0	18079	17035	18079	0.800	0.812
November	58.1	22.66	5.47	89.2	78.4	13163	12335	13163	0.810	0.796
December	51.0	20.04	-2.60	91.7	81.9	14154	13350	14154	0.853	0.813
Year	1469.0	550.58	9.08	1476.9	1266.7	204666	189996	204666	0.754	0.755

Legends: GlobHor Horizontal global irradiation
 DiffHor Horizontal diffuse irradiation
 T_Amb T amb.
 GlobInc Global incident in coll. plane
 GlobEff Effective Global, corr. for IAM and shadings
 EArray Effective energy at the output of the array
 E_Grid Energy injected into grid
 EArray Effective energy at the output of the array
 PR Performance Ratio
 PRTemp Weather corrected PR



65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: Special graphs

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
Simulation for the 1st year of operation

Main system parameters

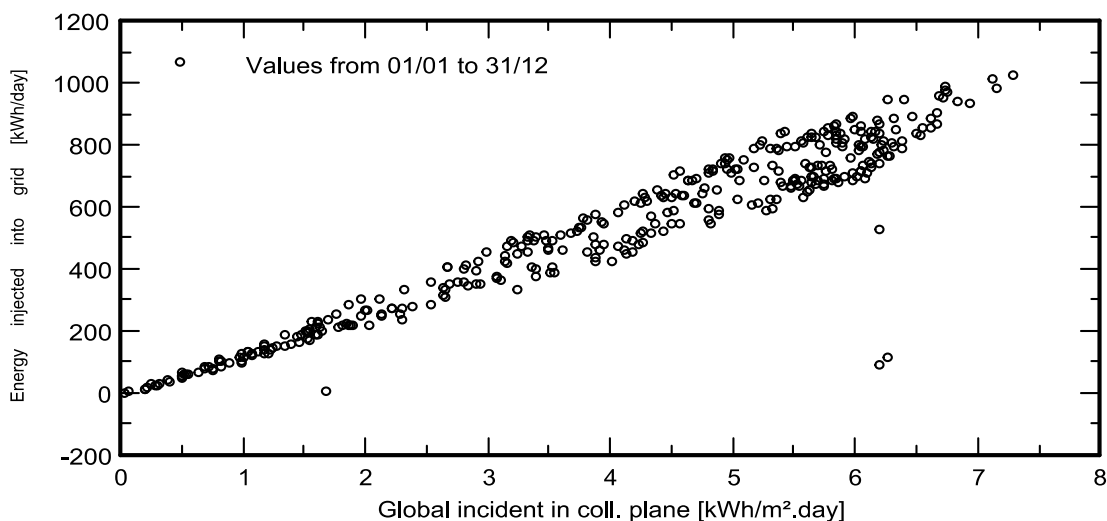
Horizon

System type **Building Facade**
Average Height 0.8°

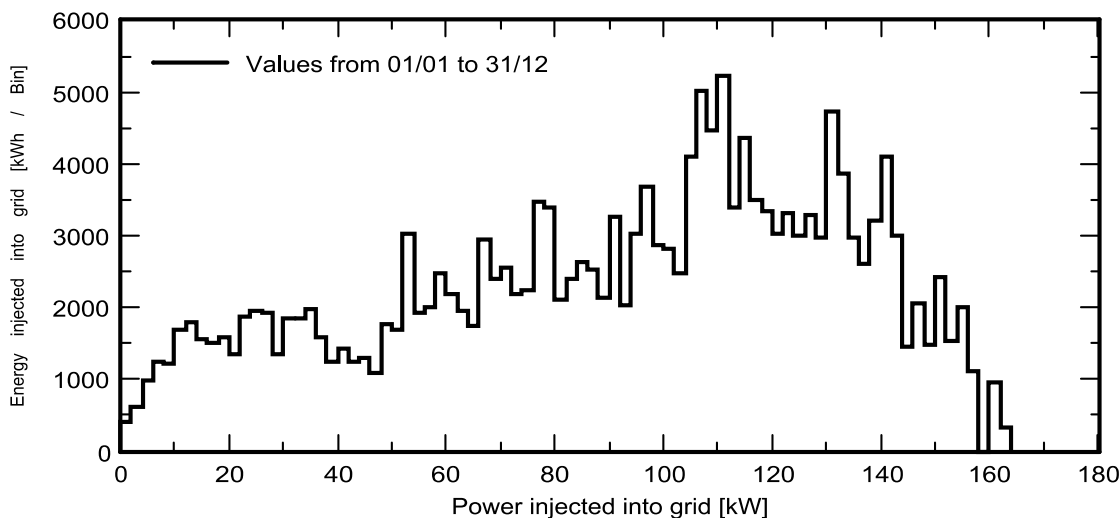
Near Shadings

According to strings
Electrical effect 80 %
Tilt/Azimuth 90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°
PV modules Model JKM 410M-72HL-V Pnom 410 Wp
PV Array Nb. of modules 416 Pnom total **171 kWp**
Inverter Sunny Tripower33-US-10 (480 VAC) Pnom 33.3 kW ac
Inverter pack Nb. of units 5.0 Pnom total **167 kW ac**
User's needs Unlimited load (grid)

Daily Input/Output diagram



System Output Power Distribution



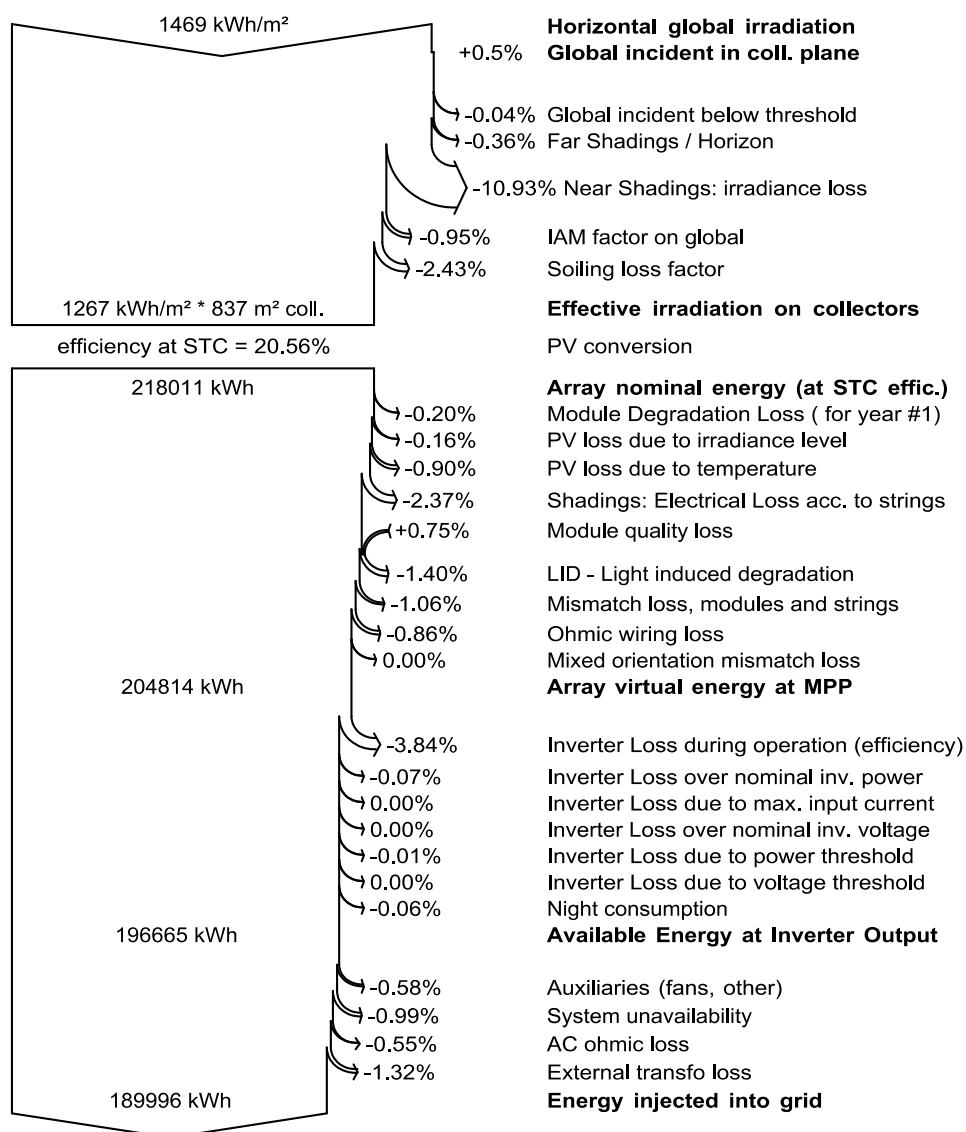


Grid-Connected System: Loss diagram

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
 Simulation for the 1st year of operation

Main system parameters	System type	Building Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
5 orientations	Tilt/Azimuth	90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°
PV modules	Model	JKM 410M-72HL-V Pnom 410 Wp
PV Array	Nb. of modules	416 Pnom total 171 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0 Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Loss diagram over the whole year





65 Network Drive 2nd Floor, Burlington MA 01803-2767
By: Daniel Kraemer

Grid-Connected System: P50 - P90 evaluation

Project : Framington_Garage
Simulation variant : Various Tilts Variant_NREL
Simulation for the 1st year of operation

Main system parameters	System type	Building Facade
Horizon	Average Height	0.8°
Near Shadings	According to strings	Electrical effect 80 %
5 orientations	Tilt/Azimuth	90°/-41°, 75°/-41°, 65°/-41°, 55°/-41°, 45°/-41°
PV modules	Model	JKM 410M-72HL-V Pnom 410 Wp
PV Array	Nb. of modules	416 Pnom total 171 kWp
Inverter	Sunny Tripower33-US-10 (480 VAC)	Pnom 33.3 kW ac
Inverter pack	Nb. of units	5.0 Pnom total 167 kW ac
User's needs	Unlimited load (grid)	

Evaluation of the Production probability forecast

The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices:

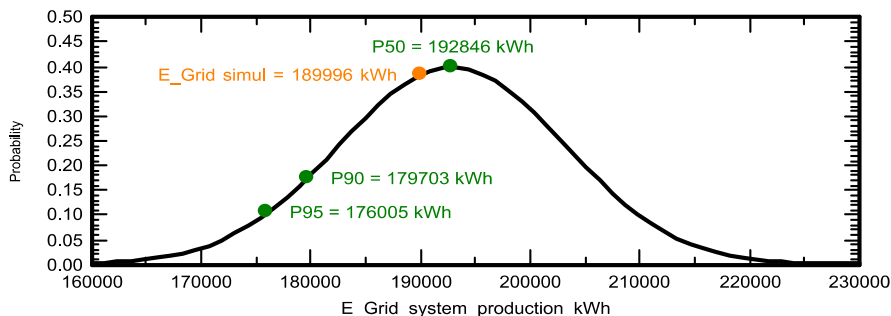
Meteo data source	NREL NSRDB Typ. Met. Year PSMv3_1998 to 2016		
Meteo data	Kind	Monthly averages	TMY Multi-year average
Specified Deviation	Climate change	1.5 %	
Year-to-year variability	Variance	5.0 %	

The probability distribution variance is also depending on some system parameters uncertainties

Specified Deviation	PV module modelling/parameters	1.0 %	
	Inverter efficiency uncertainty	0.5 %	
	Soiling and mismatch uncertainties	1.0 %	
	Degradation uncertainty	1.0 %	
Global variability (meteo + system)	Variance	5.3 %	(quadratic sum)

Annual production probability	Variability	10250 kWh
	P50	192846 kWh
	P90	179703 kWh
	P95	176005 kWh

Probability distribution



Logan Express Garage Lighting Analysis



Stantec Inc
65 Network Drive, 2nd Floor
Burlington MA 01803

February 4, 2020
File: 179410001

Attention: Katie Raymond, PE, LEED AP
3 Mill & Main Place, Suite 250
Maynard, MA 01754

Dear Katie,

Reference: Greenhouse Gas Study for Proposed Lighting at Framingham Logan Express Parking Garage

The greenhouse gas impact of the proposed lighting for the three new levels of the parking garage has been calculated. The calculated lighting loads, power density and energy consumed are compared to the maximum allowable by the energy code. The energy code referenced is the Massachusetts Energy Code (International Energy Conservation Code 2018, Table C405.3.2(2)).

Proposed Lighting uses 29 kilowatts less than required by energy code.

Proposed Lighting is 66.5% below energy code requirements.

Energy usage is 75% below allowable energy code since garage luminaires are equipped with motion sensors and ambient light sensors to dim when no occupancy is detected for 10 minutes and turn off when daylight is sufficient.

783.9 kWh are saved per day over allowable energy code which equates to 286.1 MWh annually.

Attached is the associated calculation.

Regards,

Dan Hallahan

Daniel Hallahan, PE, LC, LEED AP

Phone: 617 792 3431
Email: daniel.hallahan@stantec.com

Attachment: Greenhouse Gas Study for Proposed Lighting on the 3 New Levels
c. Jeff Cohen
hd \\us1552-f01\shared_projects\179410517\documents\letters\greenhouse_gas_lighting_letter.docx

**Framingham Garage Expansion
Greenhouse Gas Study for Proposed Lighting on the 3 New Levels**

Calculated By: Dan Hallahan
Checked by: DJS
Date: 2/4/2020

LIGHTING POWER

Lighting Watts - Forth Level Proposed (Reference As-built DWG EG107)
-110 Type V Fixtures @ 33-Watts Each = 3630-Watts

Lighting Watts - Fifth Level Proposed (Reference As-built DWG EG107)
-110 Type V Fixtures @ 33-Watts Each = 3630-Watts

Lighting Watts - Sixth Level Proposed (Reference As-built DWG EG107)
-104 Type V Fixtures @ 33-Watts Each = 3432-Watts
-30 Type CD Fixtures @ 122-Watts Each = 3660-Watts
-6 Type VD Fixtures @ 50-Watts Each = 300-Watts
Sixth Level Total: 7392 -Watts

Total Lighting Wattage Proposed for the forth, fifth and sixth levels is 14652 Watts

LIGHTING POWER DENSITY

Garage Parking Levels Measure 240' x 434' = 104160 SqFt per floor
With 3 new floors, the total new square footage is 312480 SqFt

Proposed Lighting Power Density = $14652W/312480 \text{ SqFt} = 0.047 \text{ W/SqFt}$
Per Massachusetts Energy Code (IECC 2018, Table C405.3.2(2)), Lighting Power Density allowed is 0.14 W/SqFt

Lighting Wattage Allowed is $0.14 \text{ W/SqFt} \times 312480 \text{ SqFt} = 43747\text{-Watts}$
Proposed Lighting uses 29095 Watts lower than required by energy code.
Proposed Lighting is 66.5% below energy code requirements.

LIGHTING ENERGY

Type V luminaires are equipped with motion sensors and ambient light sensors to dim when no occupancy is detected for 10 minutes and turn off when daylight is sufficient.

25% of Type V luminaires will be 'off' for 10 hours per day because of daylight at perimeter
25% of Type V luminaires will be 'off' for 5 hours per day because of daylight near perimeter (2nd row in)
50% of Type V luminaires will be 'off' for 0 hours per day because of daylight - interior
When powered, 50% of the time, the V luminaires will be dimming to 40% power.
So, Each V luminaire will operate an average of 20.25 hours per day.
With dimming, that is reduced to the equivalent full power of 14.175 hours per day per V fixture

Type CD luminaires are designed for portal lighting to counter the cave effect from entering the garage from bright sunlight to relatively dark interior and will operate only during daytime - 12 hours per day.

Type VD luminaires are equipt with motion sensors to dim when no occupancy is detected for 10 minutes & operate 24 hours per day.
50% of the time, the VD luminaires will be dimming to 40% power.
With dimming, that is reduced to the equivalent full power of 16.8 hours per day per VD fixture

Power from all type V luminaires is 10.7kW, which operates for an average equivalent of 20.25 hours per day consuming 216.7 kWh per day.
Power from all type CD luminaires is 3.7kW, which operates for an average equivalent of 12 hours per day consuming 44.4 kWh per day.
Power from all type VD luminaires is 0.3kW, which operates for an average equivalent of 16.8 hours per day consuming 5 kWh per day.

Total energy usage for the three new levels: 266.1 kWh per day
Total energy usage allowed by energy code without controls is: 1050 kWh per day
Energy usage is 75% below allowable energy code.

783.9 kWh are saved per day over allowable energy code or 62.4 gallons of gasoline saved per day for the three new interior levels.
783.9 kWh per day is 286.1 MWh annually which equates to 223 Tons of Carbon Dioxide Equivalent, or 2.7 tanker trucks worth of gasoline saved per year.

In addition to the energy savings on the new floors, on the existing 3rd floor, 30 Type CD luminaires will be removed.
These luminaires have been used for transitional lighting from bright roof level to relatively dark interior.

Third floor power savings: 30 Type CD Fixtures are being removed from the 3rd level @ 122-Watts Each = -3660-Watts
Power from these type CD luminaires is 3.7kW, which operates for an average equivalent of 12 hours per day consuming 44.4 kWh per day.

So, in addition to the 783.9 kWh saved on the new floors, 44.4 kWh will be saved on the third floor for a total of 828.3 kWh saved per day or 302 MWh annually.

\\US1552-F01\Shared_Projects\179410840\design\electrical\GHG_Lighting_Study\[GHG lighting study.xlsx]GHG Sheet

GHG Mobile Source Analysis

Massport Framingham Park & Ride Garage Expansion

Trip Distance (One way)	22.30	miles	via Google Maps
Trip Distance (Round trip)	44.80	miles	via Google Maps
EXISTING/FUTURE NO BUILD			
Trips to Logan	450,000	trips	saved annually
Average I-90 Private Vehicle Speed	75	mph	
MOVES 2029 CO2E Emission Factor	-241.46	g/VMT	60/40 Passenger Car/Passenger Truck
VMT	20,160,000	VMT/yr	
CO2E emissions (Annually)	-4,867,732,800	g/yr	
CO2E emissions (Annually)	-5,366	tpy	
Trips to Logan	14,196	trips	annually
Average I-90 Private Vehicle Speed	65	mph	
MOVES 2029 CO2E Emission Factor	1,456.96	g/VMT	Intercity Buses
VMT	635,981	VMT/yr	
CO2E emissions (Annually)	926,598,586	g/yr	
CO2E emissions (Annually)	1,021	tpy	
TOTAL NET CO2E (Annually)	-4,344	tpy	
FUTURE BUILD (2 added garage levels)			
Trips to Logan	960,000	trips	saved annually
Average I-90 Private Vehicle Speed	75	mph	
MOVES 2029 CO2E Emission Factor	-241.46	g/VMT	60/40 Passenger Car/Passenger Truck
VMT	43,008,000	VMT/yr	
CO2E emissions (Annually)	-10,384,496,640	g/yr	
CO2E emissions (Annually)	-11,447	tpy	
Trips to Logan	21,008	trips	annually
Average I-90 Private Vehicle Speed	65	mph	
MOVES 2029 CO2E Emission Factor	1,456.96	g/VMT	Intercity Buses
VMT	941,158	VMT/yr	
CO2E emissions (Annually)	1,371,230,142	g/yr	
CO2E emissions (Annually)	1,512	tpy	
TOTAL NET CO2E (Annually)	-9,935	tpy	
FUTURE BUILD (2 level)-NO BUILD Difference	-5,591	tpy	
FUTURE BUILD (3 added garage levels)			
Trips to Logan	1,100,000	trips	saved annually
Average I-90 Private Vehicle Speed	75	mph	
MOVES 2029 CO2E Emission Factor	-241.46	g/VMT	60/40 Passenger Car/Passenger Truck
VMT	49,280,000	VMT/yr	
CO2E emissions (Annually)	-11,898,902,400	g/yr	
CO2E emissions (Annually)	-13,116	tpy	
Trips to Logan	21,008	trips	annually
Average I-90 Private Vehicle Speed	65	mph	
MOVES 2029 CO2E Emission Factor	1,456.96	g/VMT	Intercity Buses
VMT	941,158	VMT/yr	
CO2E emissions (Annually)	1,371,230,142	g/yr	
CO2E emissions (Annually)	1,512	tpy	
TOTAL NET CO2E (Annually)	-11,605	tpy	
FUTURE BUILD (3 level)-NO BUILD Difference	-7,260	tpy	

Massport Framingham Park & Ride Garage Expansion

Regional Mesoscale Emissions Analysis - Roadway Emissions

Link Data

Link Number	Roadway Segment	Link Distance (miles)	Estimated Average Speed (mph)	Weekday AM Peak Hour Volume			Weekday PM Peak Hour Volume		
				2019 Existing	2029 No Build	2029 Build	2019 Existing	2029 No Build	2029 Build
1	Worcester Rd, W of Ring Rd.	0.18	50	3,482	3,897	3,911	3,830	4,319	4,337
2	84 Worcester Plaza	0.06	10	58	64	64	287	316	316
3	Ring Rd, N of Worcester	0.12	25	238	270	270	713	799	799
4	Worcester Rd, Ring Rd to Shoppers World Dr	0.17	50	3,367	3,763	3,777	3,586	4,038	4,056
5	Shoppers World Dr., Worcester to Ring Rd (West)	0.08	25	145	169	183	247	287	305
6	Worcester Rd, Shoppers World Dr to Mercer Rd	0.10	50	3,221	3,593	3,593	3,343	3,756	3,756
7	Mercer Rd	0.10	30	91	100	100	205	226	226
8	Shoppers World Dr., Worcester to Ring Rd (East)	0.08	25	455	503	536	972	1,073	1,116
9	Shoppers World Dr, N of Ring Rd	0.09	25	569	634	681	1,039	1,158	1,219
10	Worcester Rd, Mercer to Dean/Mall Rd	0.20	50	3,632	4,046	4,079	4,142	4,639	4,682
11	Dean Rd	0.15	30	539	595	595	854	944	944
12	Mall Rd	0.08	25	85	94	94	491	543	543
13	Worcester Rd, Dean/Mall to Speen	0.43	50	3,754	4,182	4,215	4,417	4,943	4,985
14	Cochituate Rd, W of Shoppers World Way	0.17	40	1,534	1,735	1,741	1,843	2,093	2,103
15	Shoppers World Way N of Cochituate	0.10	25	279	310	310	646	723	723
16	Shoppers World Way S of Cochituate	0.10	25	188	212	212	540	604	604
17	Cochituate Rd, Shoppers World Way to Whittier St	0.17	40	1,373	1,560	1,567	1,627	1,864	1,874
18	Whittier St	0.13	25	562	624	638	883	1,181	1,140
19	Shoppers World Dr, Cochituate to GARAGE ENTRY	0.10	25	523	583	624	1,082	1,206	1,259
20	Cochituate Rd, Shoppers World Drive to Burr St	0.21	40	1,684	1,903	1,922	2,155	2,438	2,463
21	Burr St, N of Cochituate	0.08	25	1,202	1,327	1,327	953	1,053	1,053
22	Cochituate Rd, E of Burr	0.17	40	2,688	3,011	3,050	3,023	3,396	3,447
23	Commonwealth Rd, W of Speen	0.21	40	2,572	2,940	2,950	2,877	3,386	3,401
24	Speen St, N of Commonwealth	0.10	30	1,580	1,788	1,788	1,515	1,742	1,742
25	Speen St, S of Commonwealth	0.14	30	2,429	2,805	2,810	2,566	2,979	2,987
26	Commonwealth Rd, E of Speen	0.17	40	1,459	1,733	1,738	1,576	1,905	1,912
27	Burr St Ext, Rte 30 to N ENTRY	0.16	25	244	269	288	585	645	670
28	GARAGE Burr St Ext N ENTRY	0.02	10	35	39	110	43	47	139
29	Burr St Ext, N Entry to S Entry	0.06	25	269	297	361	610	674	757
30	GARAGE Burr St Ext S EXIT	0.02	10	67	74	92	68	75	98
31	Burr St Ext, S Entry to Shoppers World Dr	0.03	25	290	320	391	640	706	798
32	Shoppers World Dr, S of Burr St Ext	0.15	25	622	692	739	1,243	1,384	1,446
33	Shoppers World Entry opposite Burr St Ext	0.05	10	120	132	132	439	485	485
34	Shoppers World Dr, Burr St Ext to Garage Entry	0.06	25	514	572	562	984	1,099	1,150
35	GARAGE Shoppers World Dr ENTRY	0.02	10	74	82	99	66	72	96
36	Shoppers World Entry opposite Garage Entry	0.05	10	31	34	34	158	174	174
37	Flutie Pass, W of AMC	0.13	25	216	238	238	717	791	791
38	AMC	0.10	10	9	10	10	86	95	95
39	Flutie Pass Park & Ride	0.10	10	5	5	5	12	13	13
40	Flutie Pass, E of AMC	0.13	25	210	231	231	675	745	745

Massport Framingham Park & Ride Garage Expansion

Regional Mesoscale Emissions Analysis - Roadway Emissions

Link Data

Link Number	Roadway Segment	Link Distance (miles)	Estimated Average Speed (mph)	K-factor	Average Daily Traffic (ADT)			Average Hourly Traffic Volumes		
					2019 Existing	2029 No Build	2029 Build	2019 Existing	2029 No Build	2029 Build
1	Worcester Rd, W of Ring Rd.	0.18	50	10.0%	38,300	43,190	43,370	1,596	1,800	1,807
2	84 Worcester Plaza	0.06	10	10.0%	2,870	3,160	3,160	120	132	132
3	Ring Rd, N of Worcester	0.12	25	10.0%	7,130	7,990	7,990	297	333	333
4	Worcester Rd, Ring Rd to Shoppers World Dr	0.17	50	10.0%	35,860	40,380	40,560	1,494	1,683	1,690
5	Shoppers World Dr., Worcester to Ring Rd (West)	0.08	25	10.0%	2,470	2,870	3,050	103	120	127
6	Worcester Rd, Shoppers World Dr to Mercer Rd	0.10	50	10.0%	33,430	37,560	37,560	1,393	1,565	1,565
7	Mercer Rd	0.10	30	10.0%	2,050	2,260	2,260	85	94	94
8	Shoppers World Dr., Worcester to Ring Rd (East)	0.08	25	10.0%	9,720	10,730	11,160	405	447	465
9	Shoppers World Dr, N of Ring Rd	0.09	25	10.0%	10,390	11,580	12,190	433	483	508
10	Worcester Rd, Mercer to Dean/Mall Rd	0.20	50	10.0%	41,420	46,390	46,820	1,726	1,933	1,951
11	Dean Rd	0.15	30	10.0%	8,540	9,440	9,440	356	393	393
12	Mall Rd	0.08	25	10.0%	4,910	5,430	5,430	205	226	226
13	Worcester Rd, Dean/Mall to Speen	0.43	50	10.0%	44,170	49,430	49,850	1,840	2,060	2,077
14	Cochituate Rd, W of Shoppers World Way	0.17	40	10.0%	18,430	20,930	21,030	768	872	876
15	Shoppers World Way N of Cochituate	0.10	25	10.0%	6,460	7,230	7,230	269	301	301
16	Shoppers World Way S of Cochituate	0.10	25	10.0%	5,400	6,040	6,040	225	252	252
17	Cochituate Rd, Shoppers World Way to Whittier St	0.17	40	10.0%	16,270	18,640	18,740	678	777	781
18	Whittier St	0.13	25	10.0%	8,830	11,810	11,400	368	492	475
19	Shoppers World Dr, Cochituate to GARAGE ENTRY	0.10	25	10.0%	10,820	12,060	12,590	451	503	525
20	Cochituate Rd, Shoppers World Drive to Burr St	0.21	40	10.0%	21,550	24,380	24,630	898	1,016	1,026
21	Burr St, N of Cochituate	0.08	25	10.0%	12,020	13,270	13,270	501	553	553
22	Cochituate Rd, E of Burr	0.17	40	10.0%	30,230	33,960	34,470	1,260	1,415	1,436
23	Commonwealth Rd, W of Speen	0.21	40	10.0%	28,770	33,860	34,010	1,199	1,411	1,417
24	Speen St, N of Commonwealth	0.10	30	10.0%	15,800	17,880	17,880	658	745	745
25	Speen St, S of Commonwealth	0.14	30	10.0%	25,660	29,790	29,870	1,069	1,241	1,245
26	Commonwealth Rd, E of Speen	0.17	40	10.0%	15,760	19,050	19,120	657	794	797
27	Burr St Ext, Rte 30 to N ENTRY	0.16	25	10.0%	5,850	6,450	6,700	244	269	279
28	GARAGE Burr St Ext N ENTRY	0.02	10	10.0%	430	470	1,390	18	20	58
29	Burr St Ext, N Entry to S Entry	0.06	25	10.0%	6,100	6,740	7,570	254	281	315
30	GARAGE Burr St Ext S EXIT	0.02	10	10.0%	680	750	980	28	31	41
31	Burr St Ext, S Entry to Shoppers World Dr	0.03	25	10.0%	6,400	7,060	7,980	267	294	333
32	Shoppers World Dr, S of Burr St Ext	0.15	25	10.0%	12,430	13,840	14,460	518	577	603
33	Shoppers World Entry opposite Burr St Ext	0.05	10	10.0%	4,390	4,850	4,850	183	202	202
34	Shoppers World Dr, Burr St Ext to Garage Entry	0.06	25	10.0%	9,840	10,990	11,500	410	458	479
35	GARAGE Shoppers World Dr ENTRY	0.02	10	10.0%	740	820	990	31	34	41
36	Shoppers World Entry opposite Garage Entry	0.05	10	10.0%	1,580	1,740	1,740	66	73	73
37	Flutie Pass, W of AMC	0.13	25	10.0%	7,170	7,910	7,910	299	330	330
38	AMC	0.10	10	10.0%	860	950	950	36	40	40
39	Flutie Pass Park & Ride	0.10	10	10.0%	120	130	130	5	5	5
40	Flutie Pass, E of AMC	0.13	25	10.0%	6,750	7,450	7,450	281	310	310

Massport Framingham Park & Ride Garage Expansion

Daily VMT

SUM		
88,454	100,199	101,127

Link Number	Roadway Segment	Link Distance (miles)	Average Daily Traffic (ADT) Volumes			Daily VMT		
			2019 Existing	2029 No Build	2029 Build	2019 Existing	2029 No Build	2029 Build
1	Worcester Rd, W of Ring Rd.	0.18	38,300	43,190	43,370	6,894	7,774	7,807
2	84 Worcester Plaza	0.06	2,870	3,160	3,160	172	190	190
3	Ring Rd, N of Worcester	0.12	7,130	7,990	7,990	856	959	959
4	Worcester Rd, Ring Rd to Shoppers World Dr	0.17	35,860	40,380	40,560	6,096	6,865	6,895
5	Shoppers World Dr., Worcester to Ring Rd (West)	0.08	2,470	2,870	3,050	198	230	244
6	Worcester Rd, Shoppers World Dr to Mercer Rd	0.10	33,430	37,560	37,560	3,343	3,756	3,756
7	Mercer Rd	0.10	2,050	2,260	2,260	205	226	226
8	Shoppers World Dr., Worcester to Ring Rd (East)	0.08	9,720	10,730	11,160	778	858	893
9	Shoppers World Dr, N of Ring Rd	0.09	10,390	11,580	12,190	935	1,042	1,097
10	Worcester Rd, Mercer to Dean/Mall Rd	0.20	41,420	46,390	46,820	8,284	9,278	9,364
11	Dean Rd	0.15	8,540	9,440	9,440	1,281	1,416	1,416
12	Mall Rd	0.08	4,910	5,430	5,430	393	434	434
13	Worcester Rd, Dean/Mall to Speen	0.43	44,170	49,430	49,850	18,993	21,255	21,436
14	Cochituate Rd, W of Shoppers World Way	0.17	18,430	20,930	21,030	3,133	3,558	3,575
15	Shoppers World Way N of Cochituate	0.10	6,460	7,230	7,230	646	723	723
16	Shoppers World Way S of Cochituate	0.10	5,400	6,040	6,040	540	604	604
17	Cochituate Rd, Shoppers World Way to Whittier St	0.17	16,270	18,640	18,740	2,766	3,169	3,186
18	Whittier St	0.13	8,830	11,810	11,400	1,148	1,535	1,482
19	Shoppers World Dr, Cochituate to GARAGE ENTRY	0.10	10,820	12,060	12,590	1,082	1,206	1,259
20	Cochituate Rd, Shoppers World Drive to Burr St	0.21	21,550	24,380	24,630	4,526	5,120	5,172
21	Burr St, N of Cochituate	0.08	12,020	13,270	13,270	962	1,062	1,062
22	Cochituate Rd, E of Burr	0.17	30,230	33,960	34,470	5,139	5,773	5,860
23	Commonwealth Rd, W of Speen	0.21	28,770	33,860	34,010	6,042	7,111	7,142
24	Speen St, N of Commonwealth	0.10	15,800	17,880	17,880	1,580	1,788	1,788
25	Speen St, S of Commonwealth	0.14	25,660	29,790	29,870	3,592	4,171	4,182
26	Commonwealth Rd, E of Speen	0.17	15,760	19,050	19,120	2,679	3,239	3,250
27	Burr St Ext, Rte 30 to N ENTRY	0.16	5,850	6,450	6,700	936	1,032	1,072
28	GARAGE Burr St Ext N ENTRY	0.02	430	470	1,390	9	9	28
29	Burr St Ext, N Entry to S Entry	0.06	6,100	6,740	7,570	366	404	454
30	GARAGE Burr St Ext S EXIT	0.02	680	750	980	14	15	20
31	Burr St Ext, S Entry to Shoppers World Dr	0.03	6,400	7,060	7,980	192	212	239
32	Shoppers World Dr, S of Burr St Ext	0.15	12,430	13,840	14,460	1,865	2,076	2,169
33	Shoppers World Entry opposite Burr St Ext	0.05	4,390	4,850	4,850	220	243	243
34	Shoppers World Dr, Burr St Ext to Garage Entry	0.06	9,840	10,990	11,500	590	659	690
35	GARAGE Shoppers World Dr ENTRY	0.02	740	820	990	15	16	20
36	Shoppers World Entry opposite Garage Entry	0.05	1,580	1,740	1,740	79	87	87
37	Flutie Pass, W of AMC	0.13	7,170	7,910	7,910	932	1,028	1,028
38	AMC	0.10	860	950	950	86	95	95
39	Flutie Pass Park & Ride	0.10	120	130	130	12	13	13
40	Flutie Pass, E of AMC	0.13	6,750	7,450	7,450	878	969	969

Massport Framingham Park & Ride Garage Expansion

	2019 Existing			2019 Existing		
	Weekday AM Peak			Weekday PM Peak		
Intersections (Signalized and Unsignalized)	LOS	Delay (Sec)	Traffic Volume	LOS	Delay (Sec)	Traffic Volume
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	C	32.5	4005	E	55.1	4952
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	D	37.1	2963	F	161.6	3346
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	B	18.6	2057	F	88.8	2920
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	B	14.4	1687	C	26.5	2333
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	B	12.5	773	B	18.5	1653
70: North-South Connector & Shoppers World driveway/Flutie Pass	B	11.5	719	B	19.1	1594
80: West Couplet & North-South Connector	B	12.3	586	B	16.2	1129
90: Michael's driveway/North-South Connector & Worcester Rd. (Route 9)	B	12.1	3690	B	18.6	4380
100: Worcester Rd. (Route 9) & West Couplet	A	3.0	3369	A	5.1	3597
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	C	20.2	3578	C	24.0	4217
160: Speen St. & Cochituate Rd. (Route 30)	D	36.3	3990	E	63.7	4267
170: Cochituate Rd. (Route 30) & TJX	F	155.3	1542	C	21.4	1587
200: Park & Ride/Cinema & Flutie Pass	A	7.7	220	A	8.2	745
7: Old Connecticut Path & Newbury Street		8.6	1249		201.0	1663
14: Burr St. Ext.		1.4	274		1.0	619
40: Ring Rd.		6.7	232		7.6	630
120: Ring Rd. & Ring Rd		2.6	268		5.2	792
130: Ring Rd. & Shoppers World driveway		2.3	156		3.6	587
140: Shoppers World driveway/Logan Express north driveway & North-South Connector		0.7	577		1.2	1156
150: Burr St. Ext. & Logan Express south driveway		2.4	313		1.5	659
180: Speen St.		10.5	1924		137.9	1548
195: Driveway/Overflow & Whittier St		0.5	476		2.7	915

LOS is HCM value for signalized intersections and ICU value for unsignalized intersections.

Color Code:

Red = Signalized intersections at LOS D or worse.

Green = Top 3 signalized intersections based on volume.

Dark Blue = Volume increase >20%

Light Blue = Volume increase > 10%

Yellow = New intersection to be constructed.

Yellow = Unsignalized intersection with delay > 180s. Capped at 180s

Purple/Orange = mitigated delay times decreased/increased

Massport Framingham Park & Ride Garage Expansion

	2029 No-Build			2029 No-Build		
	Weekday AM Peak			Weekday PM Peak		
Intersections (Signalized and Unsignalized)	LOS	Delay (Sec)	Traffic Volume	LOS	Delay (Sec)	Traffic Volume
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	E	55.5	4459	F	88.6	5535
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	E	55.2	3314	F	207.8	3754
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	B	20.0	2317	F	110.4	3299
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	B	16.3	1905	C	30.4	2644
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	B	12.9	859	B	19.1	1837
70: North-South Connector & Shoppers World driveway/Flutie Pass	B	11.6	800	B	19.7	1771
80: West Couplet & North-South Connector	B	13.2	652	B	15.9	1257
90: Michael's driveway/North-South Connector & Worcester Rd. (Route 9)	B	13.5	4111	C	21.6	4901
100: Worcester Rd. (Route 9) & West Couplet	A	3.6	3761	A	5.7	4046
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	C	23.9	4000	C	31.0	4745
160: Speen St. & Cochituate Rd. (Route 30)	D	48.6	4633	F	112.4	5008
170: Cochituate Rd. (Route 30) & TJX	F	317.8	1822	D	38.2	1897
200: Park & Ride/Cinema & Flutie Pass	A	7.7	242	A	8.3	823
7: Old Connecticut Path & Newbury Street		16.8	1379		325.7	1837
14: Burr St. Ext.		1.5	302		1.0	684
40: Ring Rd.		6.8	260		7.9	704
120: Ring Rd. & Ring Rd		2.6	300		6.1	886
130: Ring Rd. & Shoppers World driveway		2.4	177		3.8	658
140: Shoppers World driveway/Logan Express north driveway & North-South Connector		0.7	641		1.3	1284
150: Burr St. Ext. & Logan Express south driveway		2.5	346		1.6	728
180: Speen St.		95.6	2247		306.6	1820
195: Driveway/Overflow & Whittier St		0.5	525		3.5	1009

LOS is HCM value for signalized intersections and ICU value for unsignalized intersections.

Color Code:

Red = Signalized intersections at LOS D or worse.

Green = Top 3 signalized intersections based on volume.

Dark Blue = Volume increase >20%

Light Blue = Volume increase > 10%

Yellow = New intersection to be constructed.

Yellow = Unsignalized intersection with delay > 180s. Capped at 180s

Purple/Orange = mitigated delay times decreased/increased

Massport Framingham Park & Ride Garage Expansion

	2029 Build				2029 Build			
	Weekday AM Peak				Weekday PM Peak			
	LOS	Delay (Sec)	Traffic Volume	No-Build to Build Volume % Change	LOS	Delay (Sec)	Traffic Volume	No-Build to Build Volume % Change
Intersections (Signalized and Unsignalized)								
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	E	57.1	4486	1%	F	90.7	5571	1%
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	E	57.1	3347	1%	F	217.3	3796	1%
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	C	20.9	2353	2%	F	116.4	3343	1%
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	B	16.3	1912	0%	C	30.3	2651	0%
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	B	15.3	923	7%	C	21.5	1922	5%
70: North-South Connector & Shoppers World driveway/Flutie Pass	B	11.5	839	5%	B	19.5	1824	3%
80: West Couplet & North-South Connector	B	12.6	692	6%	B	15.6	1310	4%
90: Michael's driveway/North-South Connector & Worcester Rd. (Route 9)	B	13.8	4138	1%	C	22.8	4938	1%
100: Worcester Rd. (Route 9) & West Couplet	A	3.8	3773	0%	A	5.9	4062	0%
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	C	24.0	4012	0%	C	31.5	4762	0%
160: Speen St. & Cochituate Rd. (Route 30)	D	48.9	4642	0%	F	112.6	5019	0%
170: Cochituate Rd. (Route 30) & TJX	F	321.6	1826	0%	D	38.8	1903	0%
200: Park & Ride/Cinema & Flutie Pass	A	7.7	242	0%	A	8.3	824	0%
7: Old Connecticut Path & Newbury Street		19.1	1390	1%		348.8	1852	1%
14: Burr St. Ext.		3.0	367	22%		2.5	769	12%
40: Ring Rd.		6.8	260	0%		7.9	704	0%
120: Ring Rd. & Ring Rd		2.6	300	0%		6.1	886	0%
130: Ring Rd. & Shoppers World driveway		2.4	177	0%		3.8	658	0%
140: Shoppers World driveway/Logan Express north driveway & North-South Connector		0.7	683	7%		1.4	1342	5%
150: Burr St. Ext. & Logan Express south driveway		2.6	409	18%		2.0	811	11%
180: Speen St.		95.6	2247	0%		306.6	1820	0%
195: Driveway/Overflow & Whittier St		0.5	535	2%		3.6	1025	2%

LOS is HCM value for signalized intersections and ICU value for unsignalized intersections.

Color Code:

Red = Signalized intersections at LOS D or worse.

Green = Top 3 signalized intersections based on volume.

Dark Blue = Volume increase >20%

Light Blue = Volume increase > 10%

Yellow = New intersection to be constructed.

Yellow = Unsignalized intersection with delay > 180s. Capped at 180s

Purple/Orange = mitigated delay times decreased/increased

Massport Framingham Park & Ride Garage Expansion 2019 Existing

K Factor	10%	factors peak hour vehicle volumes to daily volumes
Peak hr delay to daily Factor (8hr/day)	33%	Factors peak hour delay to daily delay
Daily delay to annual Factor (7 days/wk, 52 wk/yr)	100%	factors peak daily delay to annual delay

Intersection	Average Peak Delay time (s)	Traffic Volume (adt)	Idle MOVES VOC (g/hr)	VOC (lb/day)	VOC (tpy)	Idle MOVES NOX (g/hr)	NOX (lb/day)	NOX (tpy)	Idle MOVES CO2 (g/hr)	CO2 (lb/day)	CO2 (tpy)
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	44.99	49520	1.0810637	0.49	0.09	0.9861954	0.45	0.082	3260.7058	1483.09	269.922
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	103.13	33460	1.081	0.76	0.14	0.986	0.69	0.126	3260.706	2296.84	418.025
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	59.79	29200	1.081	0.39	0.07	0.986	0.35	0.064	3260.706	1162.01	211.485
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	21.42	23330	1.081	0.11	0.02	0.986	0.10	0.018	3260.706	332.66	60.545
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	16.59	16530	1.081	0.06	0.01	0.986	0.06	0.010	3260.706	182.51	33.218
70: North-South Connector & Shoppers World driveway/Flutie P	16.74	15940	1.081	0.06	0.01	0.986	0.05	0.010	3260.706	177.58	32.320
80: West Couplet & North-South Connector	14.87	11290	1.081	0.04	0.01	0.986	0.03	0.006	3260.706	111.73	20.334
90: Michael's driveway/North-South Connector & Worcester Rd.	15.63	43800	1.081	0.15	0.03	0.986	0.14	0.025	3260.706	455.62	82.922
100: Worcester Rd. (Route 9) & West Couplet	4.08	35970	1.081	0.03	0.01	0.986	0.03	0.005	3260.706	97.79	17.798
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	22.26	42170	1.081	0.21	0.04	0.986	0.19	0.034	3260.706	624.70	113.695
160: Speen St. & Cochituate Rd. (Route 30)	50.46	42670	1.081	0.48	0.09	0.986	0.43	0.079	3260.706	1433.15	260.833
170: Cochituate Rd. (Route 30) & TJX	87.39	15870	1.081	0.31	0.06	0.986	0.28	0.051	3260.706	923.10	168.004
200: Park & Ride/Cinema & Flutie Pass	8.09	7450	1.081	0.01	0.00	0.986	0.01	0.002	3260.706	40.10	7.298
7: Old Connecticut Path & Newbury Street	118.48	16630	1.081	0.43	0.08	0.986	0.40	0.072	3260.706	1311.44	238.683
14: Burr St. Ext.	1.12	6190	1.081	0.00	0.00	0.986	0.00	0.000	3260.706	4.63	0.842
40: Ring Rd.	7.36	6300	1.081	0.01	0.00	0.986	0.01	0.002	3260.706	30.85	5.615
120: Ring Rd. & Ring Rd	4.54	7920	1.081	0.01	0.00	0.986	0.01	0.001	3260.706	23.95	4.358
130: Ring Rd. & Shoppers World driveway	3.33	5870	1.081	0.00	0.00	0.986	0.00	0.001	3260.706	13.00	2.366
140: Shoppers World driveway/Logan Express north driveway &	1.03	11560	1.081	0.00	0.00	0.986	0.00	0.000	3260.706	7.95	1.447
150: Burr St. Ext. & Logan Express south driveway	1.79	6590	1.081	0.00	0.00	0.986	0.00	0.000	3260.706	7.85	1.429
180: Speen St.	67.30	19240	1.081	0.29	0.05	0.986	0.26	0.047	3260.706	861.90	156.865
195: Driveway/Overflow & Whittier St	1.95	9150	1.081	0.00	0.00	0.986	0.00	0.001	3260.706	11.86	2.158
Totals	hrs	1612.85883		3.84	0.70		3.51	0.64		11594.30	2110.16

Massport Framingham Park & Ride Garage Expansion 2029 No-Build

K Factor	10%	factors peak hour vehicle volumes to daily volumes
Peak hr delay to daily Factor (8hr/day)	33%	Factors peak hour delay to daily delay
Daily delay to annual Factor (7 days/wk, 52 wk/yr)	100%	factors peak daily delay to annual delay

Intersection	Average Peak Delay time (s)	Traffic Volume (adt)	Idle MOVES VOC (g/hr)	VOC (lb/day)	VOC (tpy)	Idle MOVES NOX (g/hr)	NOX (lb/day)	NOX (tpy)	Idle MOVES CO2 (g/hr)	CO2 (lb/day)	CO2 (tpy)
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	73.83	55350	0.7461037	0.62	0.11	0.341557	0.28	0.052	2366.0783	1973.80	359.232
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	136.25	37540	0.746	0.78	0.14	0.342	0.36	0.065	2366.078	2470.43	449.618
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	73.10	32990	0.746	0.37	0.07	0.342	0.17	0.031	2366.078	1164.83	211.999
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	24.50	26440	0.746	0.10	0.02	0.342	0.05	0.008	2366.078	312.81	56.932
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	17.12	18370	0.746	0.05	0.01	0.342	0.02	0.004	2366.078	151.94	27.653
70: North-South Connector & Shoppers World driveway/Flutie P	17.18	17710	0.746	0.05	0.01	0.342	0.02	0.004	2366.078	146.95	26.745
80: West Couplet & North-South Connector	14.98	12570	0.746	0.03	0.01	0.342	0.01	0.002	2366.078	90.93	16.550
90: Michael's driveway/North-South Connector & Worcester Rd.	17.91	49010	0.746	0.13	0.02	0.342	0.06	0.011	2366.078	423.84	77.139
100: Worcester Rd. (Route 9) & West Couplet	4.69	40460	0.746	0.03	0.01	0.342	0.01	0.002	2366.078	91.62	16.675
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	27.75	47450	0.746	0.20	0.04	0.342	0.09	0.017	2366.078	636.03	115.758
160: Speen St. & Cochituate Rd. (Route 30)	81.74	50080	0.746	0.62	0.11	0.342	0.29	0.052	2366.078	1977.17	359.846
170: Cochituate Rd. (Route 30) & TJX	175.18	18970	0.746	0.51	0.09	0.342	0.23	0.042	2366.078	1605.08	292.124
200: Park & Ride/Cinema & Flutie Pass	8.16	8230	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	32.45	5.906
7: Old Connecticut Path & Newbury Street	193.25	18370	0.746	0.54	0.10	0.342	0.25	0.045	2366.078	1714.59	312.056
14: Burr St. Ext.	1.15	6840	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	3.81	0.693
40: Ring Rd.	7.60	7040	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	25.85	4.705
120: Ring Rd. & Ring Rd	5.21	8860	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	22.32	4.061
130: Ring Rd. & Shoppers World driveway	3.50	6580	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	11.13	2.026
140: Shoppers World driveway/Logan Express north driveway &	1.10	12840	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	6.82	1.242
150: Burr St. Ext. & Logan Express south driveway	1.89	7280	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	6.65	1.209
180: Speen St.	190.02	22470	0.746	0.65	0.12	0.342	0.30	0.054	2366.078	2062.30	375.339
195: Driveway/Overflow & Whittier St	2.47	10090	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	12.05	2.194
Totals	hrs	2864.73373		4.71	0.86		2.16	0.39		14943.42	2719.70

Massport Framingham Park & Ride Garage Expansion 2029 Build

K Factor 10% factors peak hour vehicle volumes to daily volumes
 Peak hr delay to daily Factor (8hr/day) 33% Factors peak hour delay to daily delay
 Daily delay to annual Factor (7 days/wk, 52 wk/yr) 100% factors peak daily delay to annual delay

Intersection	Average Peak Delay time (s)	Traffic Volume (adt)	Idle MOVES VOC (g/hr)	VOC (lb/day)	VOC (tpy)	Idle MOVES NOX (g/hr)	NOX (lb/day)	NOX (tpy)	Idle MOVES CO2 (g/hr)	CO2 (lb/day)	CO2 (tpy)
1: Dean Road/Natick Mall Road & Worcester Rd. (Route 9)	75.71	55710	0.7461037	0.64	0.12	0.341557	0.29	0.054	2366.0783	2037.24	370.778
10: Burr St. Ext./Burr St. & Cochituate Rd. (Route 30)	142.23	37960	0.746	0.82	0.15	0.342	0.38	0.069	2366.078	2607.80	474.620
20: North-South Connector/Whittier St. & Cochituate Rd. (Route 30)	76.95	33430	0.746	0.39	0.07	0.342	0.18	0.033	2366.078	1242.46	226.128
30: Ring Rd./Shoppers World Way & Cochituate Rd. (Route 30)	24.43	26510	0.746	0.10	0.02	0.342	0.05	0.008	2366.078	312.85	56.939
60: Shoppers World driveway/Burr St. Ext. & North-South Connector	19.49	19220	0.746	0.06	0.01	0.342	0.03	0.005	2366.078	180.92	32.927
70: North-South Connector & Shoppers World driveway/Flutie P	16.98	18240	0.746	0.05	0.01	0.342	0.02	0.004	2366.078	149.59	27.225
80: West Couplet & North-South Connector	14.56	13100	0.746	0.03	0.01	0.342	0.01	0.002	2366.078	92.14	16.770
90: Michael's driveway/North-South Connector & Worcester Rd.	18.70	49380	0.746	0.14	0.03	0.342	0.06	0.012	2366.078	445.92	81.157
100: Worcester Rd. (Route 9) & West Couplet	4.89	40620	0.746	0.03	0.01	0.342	0.01	0.003	2366.078	95.91	17.456
110: Bed Bath driveway/Ring Rd. & Worcester Rd. (Route 9)	28.07	47620	0.746	0.20	0.04	0.342	0.09	0.017	2366.078	645.63	117.504
160: Speen St. & Cochituate Rd. (Route 30)	81.99	50190	0.746	0.63	0.11	0.342	0.29	0.052	2366.078	1987.63	361.748
170: Cochituate Rd. (Route 30) & TJX	177.28	19030	0.746	0.51	0.09	0.342	0.24	0.043	2366.078	1629.45	296.560
200: Park & Ride/Cinema & Flutie Pass	8.16	8240	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	32.49	5.913
7: Old Connecticut Path & Newbury Street	207.44	18520	0.746	0.59	0.11	0.342	0.27	0.049	2366.078	1855.58	337.715
14: Burr St. Ext.	2.66	7690	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	9.89	1.799
40: Ring Rd.	7.60	7040	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	25.85	4.705
120: Ring Rd. & Ring Rd	5.21	8860	0.746	0.01	0.00	0.342	0.00	0.001	2366.078	22.32	4.061
130: Ring Rd. & Shoppers World driveway	3.50	6580	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	11.13	2.026
140: Shoppers World driveway/Logan Express north driveway &	1.16	13420	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	7.54	1.373
150: Burr St. Ext. & Logan Express south driveway	2.20	8110	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	8.62	1.569
180: Speen St.	190.02	22470	0.746	0.65	0.12	0.342	0.30	0.054	2366.078	2062.30	375.339
195: Driveway/Overflow & Whittier St	2.54	10250	0.746	0.00	0.00	0.342	0.00	0.000	2366.078	12.56	2.286
Totals	hrs	2966.79915		4.88	0.89		2.23	0.41		15475.82	2816.60

Mesoscale Emissions Summary

Massport Framingham Park & Ride Garage Expansion

Roads

	CO2 lbs/day	CO2 tons/yr
2019 Existing	68,137	12,435
2029 No-Build	56,781	10,363
delta from 2019 Existing	-11,356	-2,072
2029 Build	57,342	10,465
delta from 2029 No-Build	561	102

Intersections

	CO2 lbs/day	CO2 tons/yr
2019 Existing	11,563	2,110
2029 No-Build	14,902	2,720
delta from 2019 Existing	3,340	610
2029 Build	15,433	2,817
delta from 2029 No-Build	531	97

Total

	Pollutant	CO2 lbs/day	CO2 tons/yr
2019 Existing		79,699	14,545
2029 No-Build		71,683	13,082
delta from 2019 Existing		-8,016	-1,463
2029 Build		72,775	13,282
delta from 2029 No-Build		1,092	199

Minor differences in sums are due to rounding of individual values.

Pound per day to tons per year is based on an 100% factor to account for peak daily to annual data.

GHG Summary

Massport Framingham Park & Ride Garage Expansion

	units	2019 Existing	2029 No-Build	2029 Build
Daily VMT	veh-miles/day	88,454	100,199	101,127
Net Change	veh-miles/day	-	11,745	928
Net Delay	veh-hrs/day	1,613	2,865	2,967
Net Change	veh-hrs/day	-	1,252	102
Roadway CO ₂ e	tpy	12,435	10,363	10,465
Intersection CO ₂ e	tpy	2,110	2,720	2,817
Other CO ₂ e	tpy	-4,344	-4,344	-11,605
Total CO ₂ e	tpy	10,201	8,738	1,677
Net CO ₂ e Change	tpy	-	-1,463	-7,062

Massport Framingham Park & Ride Garage Expansion

		Case 1
	units	2024 Build minus 2024 No-Build
Daily VMT	veh-miles/day	928.2
Net Change	veh-miles/day	-
Net Delay	veh-hrs/day	102.1
Net Change	veh-hrs/day	-
Roadway CO ₂ e	tpy	102
Intersection CO ₂ e	tpy	97
Other CO ₂ e	tpy	-7261
Net CO ₂ e Emissions	tpy	-7062
Net CO ₂ e Change	tpy	-
Percent Change		-

ATTACHMENT G

Logan Express Parking Garage Shade Study

FRAMINGHAM LOGAN EXPRESS PARKING GARAGE MODIFICATIONS SHADE STUDY



January 22, 2020

Prepared by:





PROJECT: Framingham Logan Express Parking Garage

JOB NO: 179410840

SUBJECT: Shade Study

SHEET NO: 2 of 18

Evaluation of Shadows Cast by Proposed Parking Garage Modifications

DATE: 1/22/2020

BY: RAM

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EXECUTIVE SUMMARY

A shade study was performed by Stantec to evaluate the impacts of the shadows cast by the proposed parking garage modifications at Framingham Logan Express. In particular, the study focused on the impacts of the shadows on the adjacent lot of land, which is owned by Recreational Equipment Incorporated (REI) and contains solar photovoltaic (PV) panels in the parking lot and on the building's roof. The objective of the study was to determine if the proposed parking garage modifications would negatively impact the panels' sun exposure, and if so, at what dates and times of the year. The study also evaluated shadow impacts to the adjacent wetlands.

A three-dimensional model of the site was created in AutoCAD, Revit, and 3ds Max to evaluate the impacts of the proposed condition of the parking garage shadows. Two major assumptions were made during modeling that may affect the results of the analysis. Firstly, because the extents of the project survey are contained to the Logan Express site, the ground elevation of the REI site was approximated using GIS data. Secondly, because construction drawings of the REI building were not available, the height of the building and roof elevations were approximated using Google Earth. Since the impact of the parking garage shadow is highly dependent upon the elevation of the REI rooftop panels and the ground elevation of the carport solar panels, the results presented may vary from real-world conditions.

The solar analysis indicates that the proposed modifications to the parking garage will not negatively impact the sun exposure of the solar panels during the spring, summer, and fall seasons. On the winter solstice, it can be seen that the parking garage shadow slightly obstructs sun exposure of some of the REI building's rooftop panels.

Further analysis indicates that the obstruction would begin around the middle of November and end around the end of January. The extent of the obstruction varies with time. During the middle of November and end of January, only one or two panels are obstructed for less than 3 hours after sunrise. The worst-case scenario occurs on the winter solstice, which is when the sun appears at its lowest altitude above the horizon. Around this date, up to 10% of the rooftop panels are obstructed for a maximum of 4 hours after sunrise. It should be noted that during the winter months, the sun shines at a much lower angle to the horizon and is therefore much weaker than during the other seasons. In addition, the obstructions only occur during the first few hours after sunrise, when the intensity of the sun is lowest. Therefore, the amount of energy lost by the PV panels' decreased sun exposure due to the parking garage modifications will be minimal.

The solar analysis also indicates that the existing parking garage currently casts shadows on the adjacent wetlands in the afternoon for most of the year, with the size and duration of these shadows varying by date. The proposed modifications will marginally increase the size of these shadows cast on the adjacent wetlands, most notably during the spring, fall, and winter seasons. The impacts during the summer months are shown to be relatively minor, with the shadows cast around the summer solstice extending only just beyond the wetlands delineation for up to 3 hours before sunset. Because the shadow impacts are only for a portion of the day and generally occur during non-growing seasons, this is not anticipated to impact the overall health of this wetland.

SHADE STUDY—EVALUATION OF SHADOWS CAST BY PROPOSED PARKING GARAGE MODIFICATIONS

1.1. INTRODUCTION

A shade study was performed by Stantec to evaluate the impacts of the shadows cast by the proposed parking garage modifications at Framingham Logan Express. In particular, the study focused on the impacts of the shadows on the adjacent lot of land, which is owned by Recreational Equipment Incorporated (REI) and contains solar photovoltaic (PV) panels in the parking lot and on the building's roof. The objective of the study was to determine if the proposed parking garage modifications would negatively impact the panels' sun exposure, and if so, at what dates and times of the year. The study also evaluated shadow impacts to the adjacent wetlands.



FIGURE 1. Aerial View of Project Site

1.2. MODELING

A three-dimensional model of the site was created in AutoCAD and Revit. The model contains the existing and proposed parking garage structures, surrounding terrain, including the adjacent wetlands, the REI building with rooftop solar panels, and the REI parking lot with the carport solar panels, and the trees between the Logan Express site and the REI parking lot (see Figure 2). The model was imported into 3ds Max to apply materials and perform the daylight simulations.

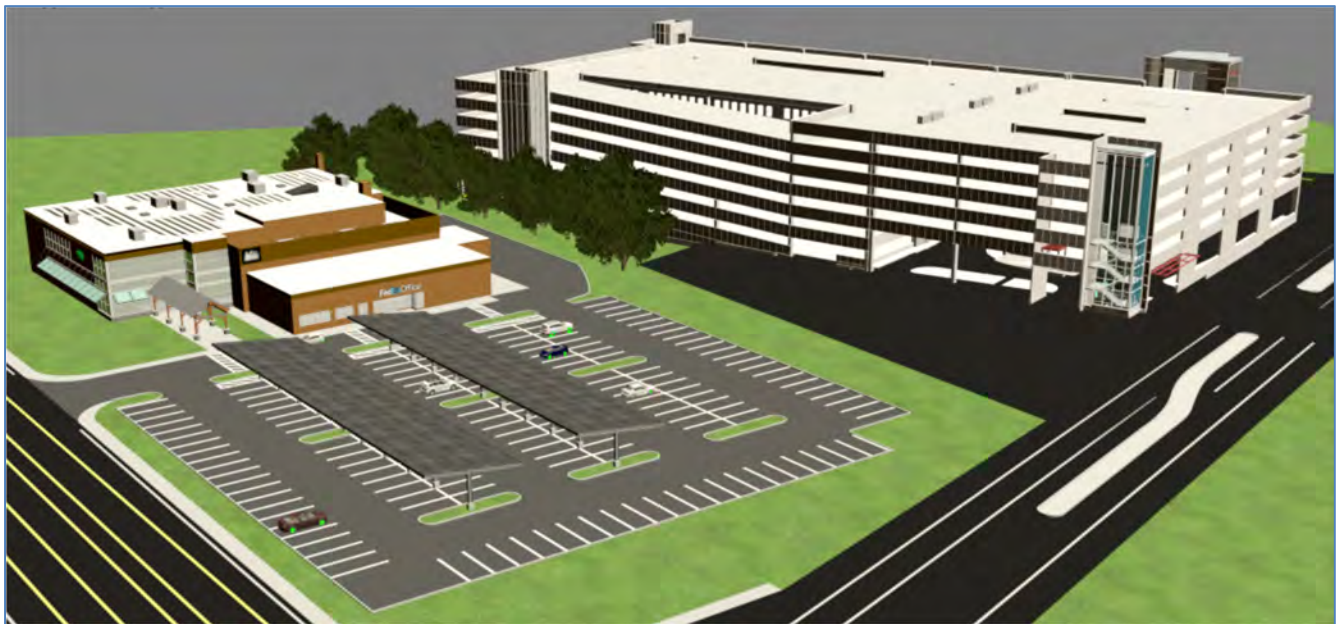


FIGURE 2. Image of 3D Model

1.2.1. ASSUMPTIONS

Two major assumptions were made during modeling that may affect the results of the analysis. Firstly, because the extents of the project survey are contained to the Logan Express site, the ground elevation of the REI site was approximated using GIS data. Secondly, because construction drawings of the REI building were not available, the height of the building and roof elevations were approximated using Google Earth. Since the impact of the parking garage shadow is highly dependent upon the elevation of the REI rooftop panels and the ground elevation of the carport solar panels, the results presented may vary from real-world conditions.

1.3. DAYLIGHT SIMULATION

The daylight simulation was created using the daylight system feature of Autodesk 3ds Max. This feature allows the user to set the location, date, and time to accurately position the sun. For this analysis, the location was set to the nearby city of Worcester, Massachusetts. Four dates were evaluated:

- **March 19, 2020** – Spring Equinox
- **June 20, 2020** – Summer Solstice
- **September 22, 2020** – Fall Equinox
- **December 21, 2020** – Winter Solstice

At the following times:

- 2.0 hours after sunrise
- Solar Noon (SN)
- 2.0 hours before sunset

These dates and times represent the solar extremes throughout the year and day, respectively. Shadow locations between these dates and times can be approximated through interpolation.

To further determine the duration of impacts to the REI roof panels, the following dates were also evaluated at 2 hours after sunrise, 3 hours after sunrise, and 4 hours after sunrise:

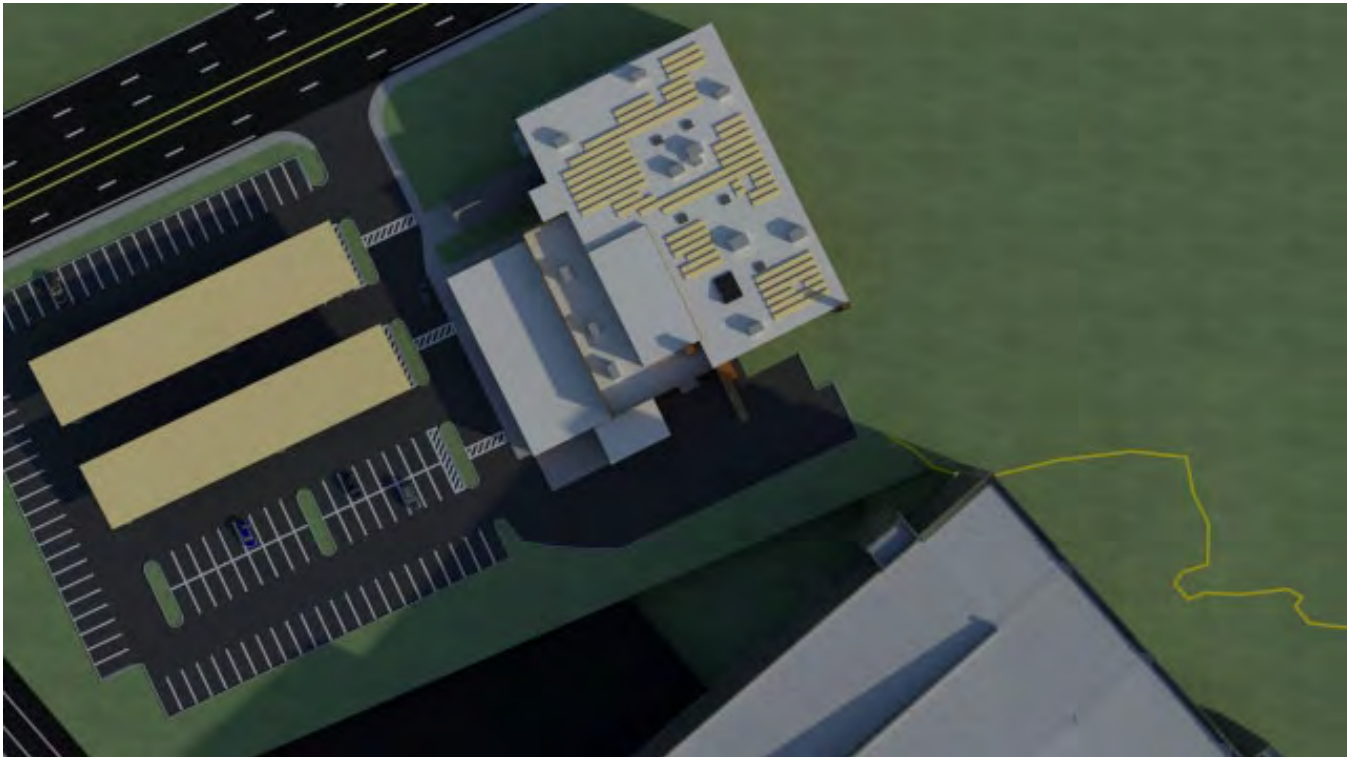
- November 15, 2020
- November 30, 2020
- January 15, 2020
- January 31, 2020

1.4. ANALYSIS RESULTS

1.4.1. PROPOSED PARKING GARAGE MODIFICATIONS SHADE ANALYSIS RESULTS

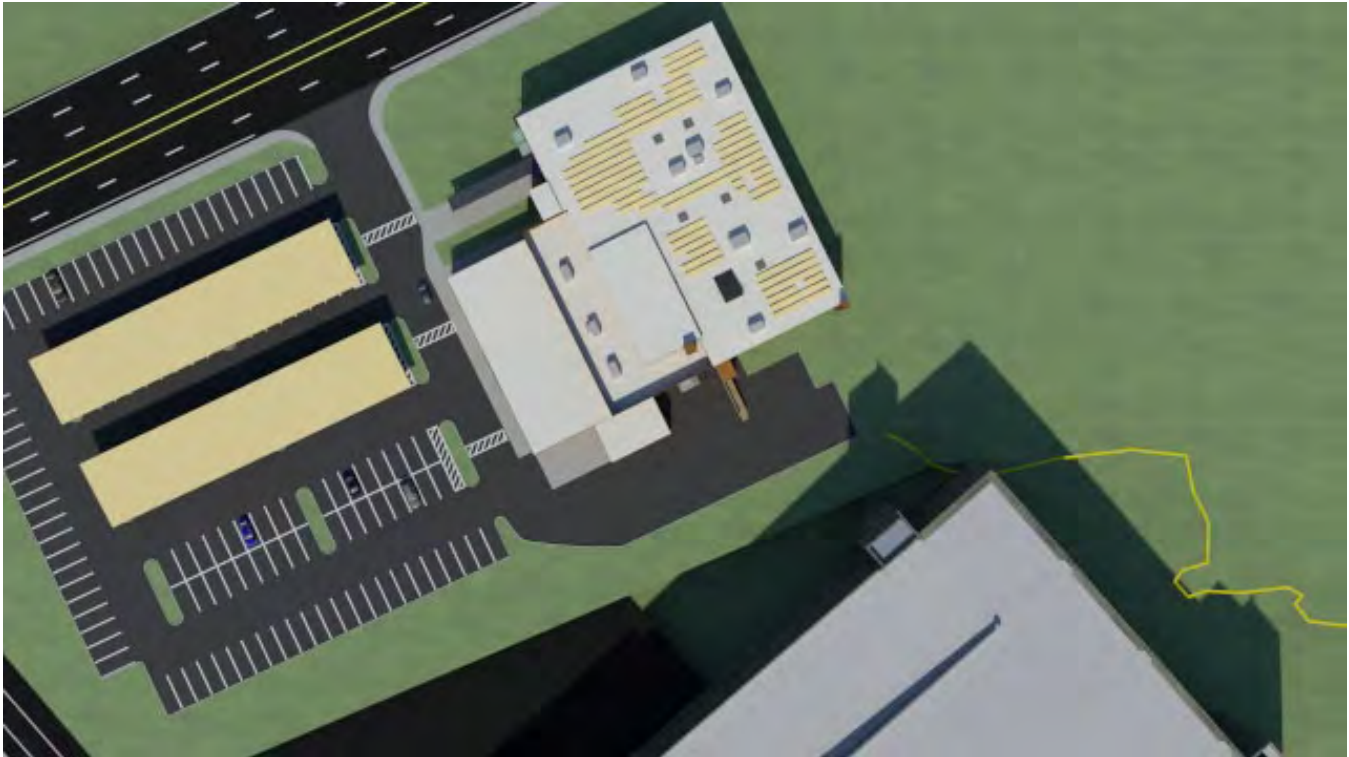
The solar analysis indicates that the proposed modifications to the parking garage will not negatively impact the sun exposure of the solar panels during the spring, summer, and fall seasons. On the winter solstice, it can be seen that the parking garage shadow slightly obstructs sun exposure of some of the REI building's rooftop panels (approximately 10% of the rooftop panels).

The renderings below display an aerial view of the site with the proposed parking garage modifications and the sun positioned according to the noted dates and times. The yellow line indicates the delineation of the adjacent wetlands.



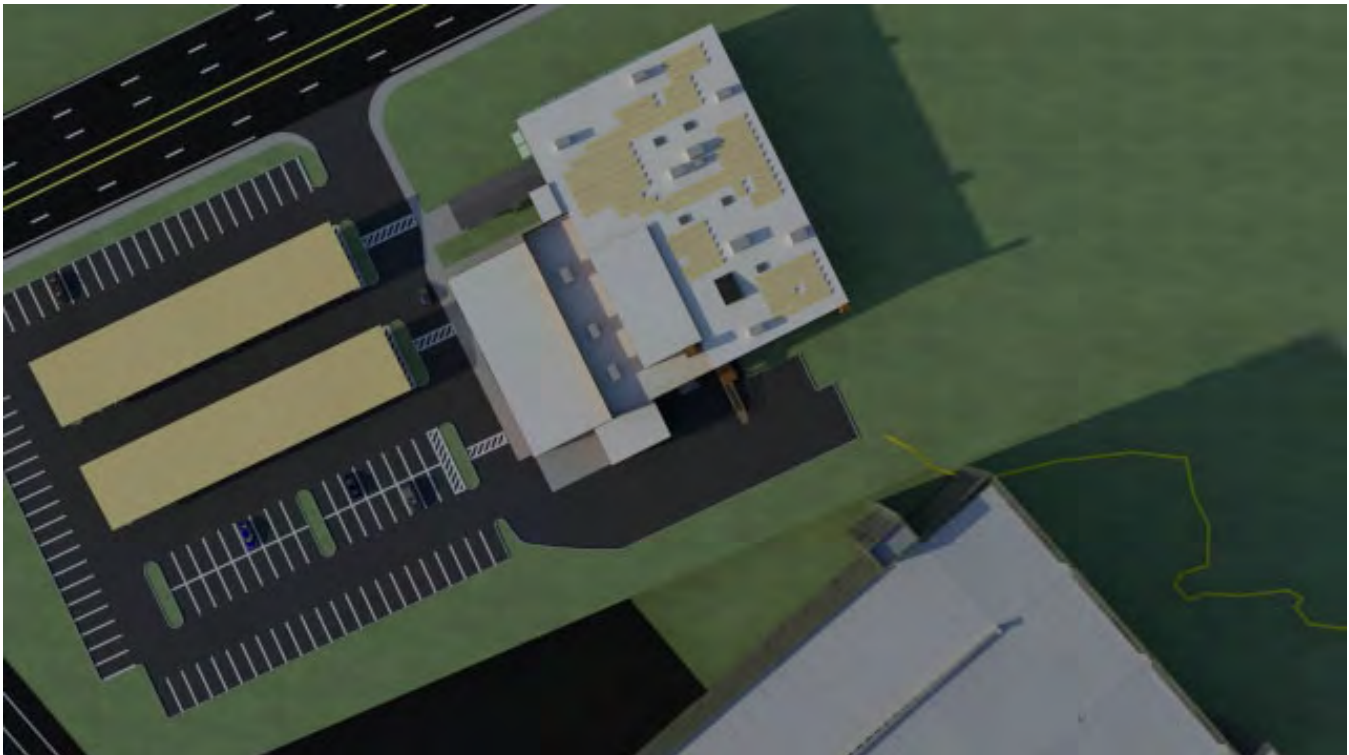
Date: March 19, 2020 (Spring Equinox) **Time:** 8:51 A.M. (2 hours after sunrise)

Impact Analysis: No impacts



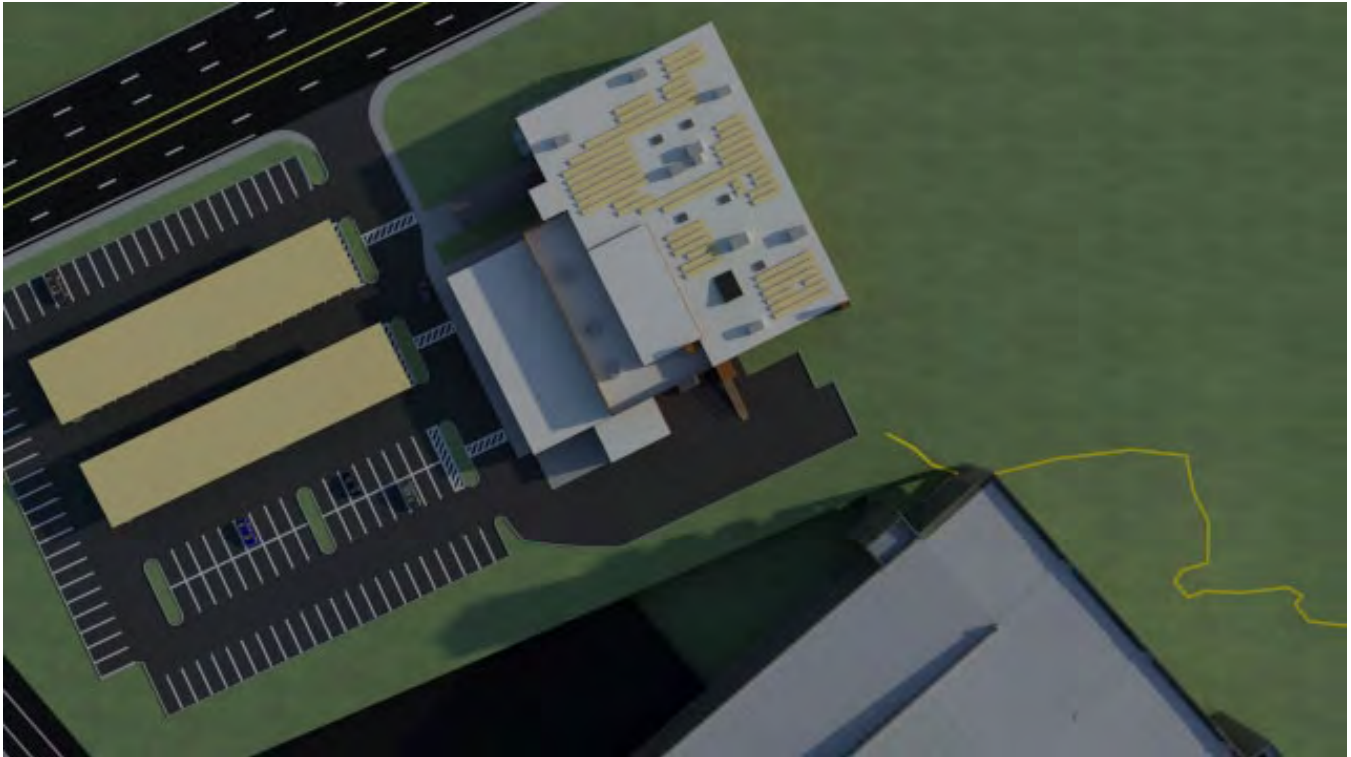
Date: March 19, 2020 (Spring Equinox) **Time:** 12:54 P.M. (solar noon)

Impact Analysis: Minor shade impacts to wetlands



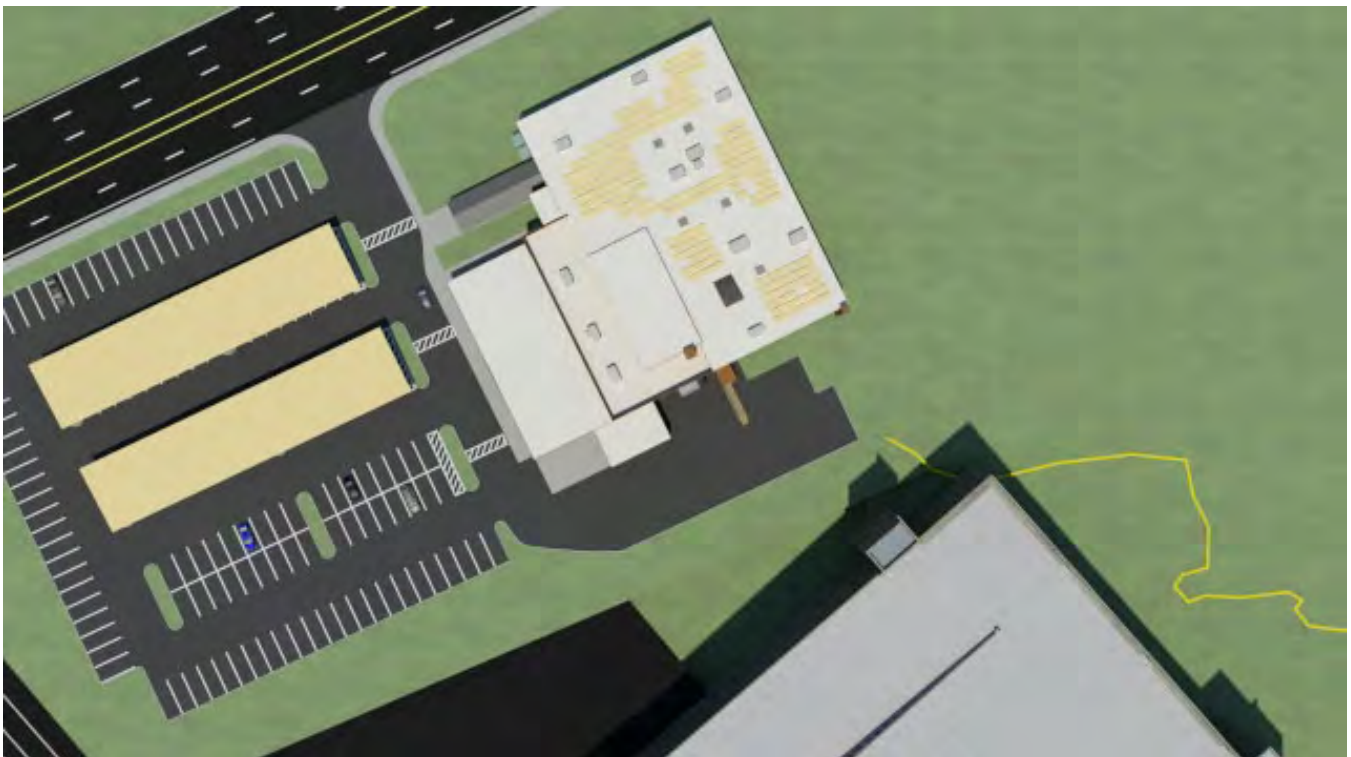
Date: March 19, 2020 (Spring Equinox) **Time:** 4:58 P.M. (2 hours before sunset)

Impact Analysis: Moderate shade impact to wetlands



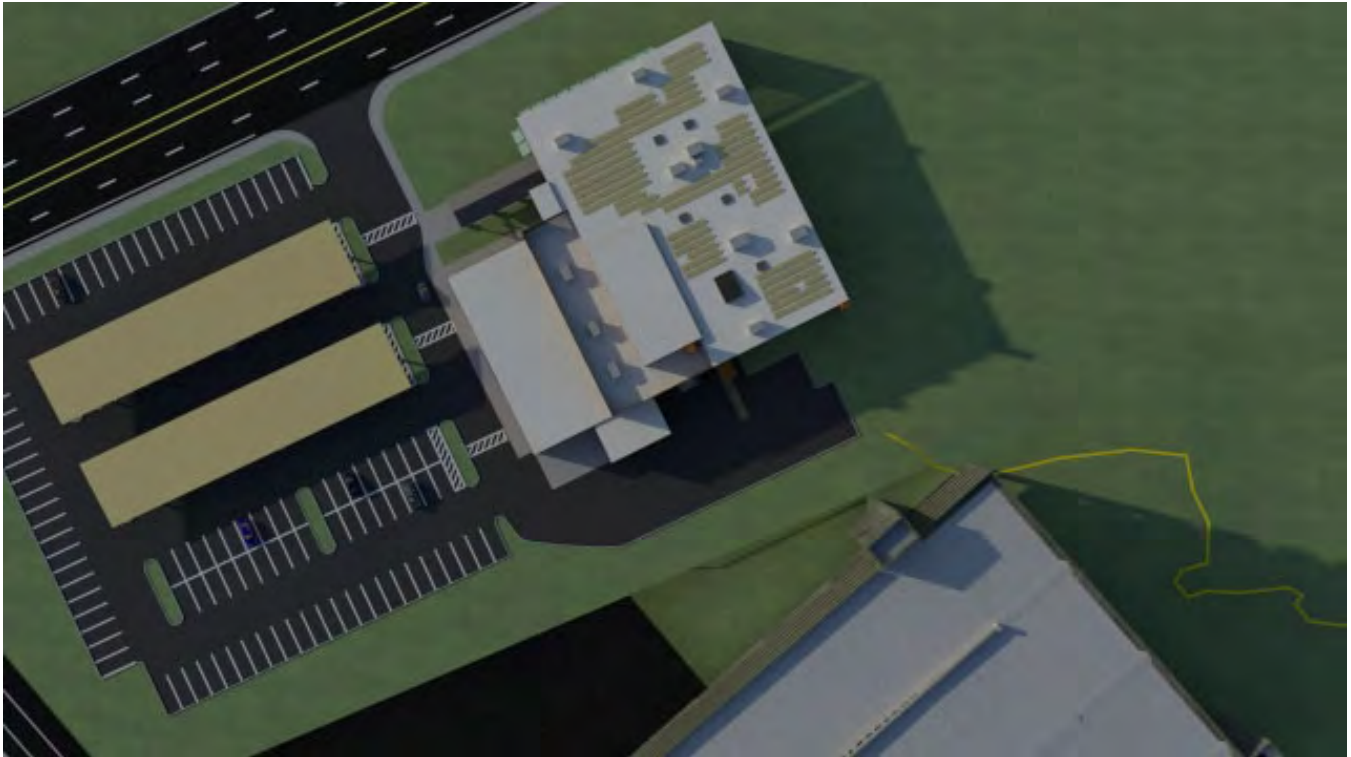
Date: June 20, 2020 (Summer Solstice) **Time:** 7:10 A.M. (2 hours before sunrise)

Impact Analysis: No impacts



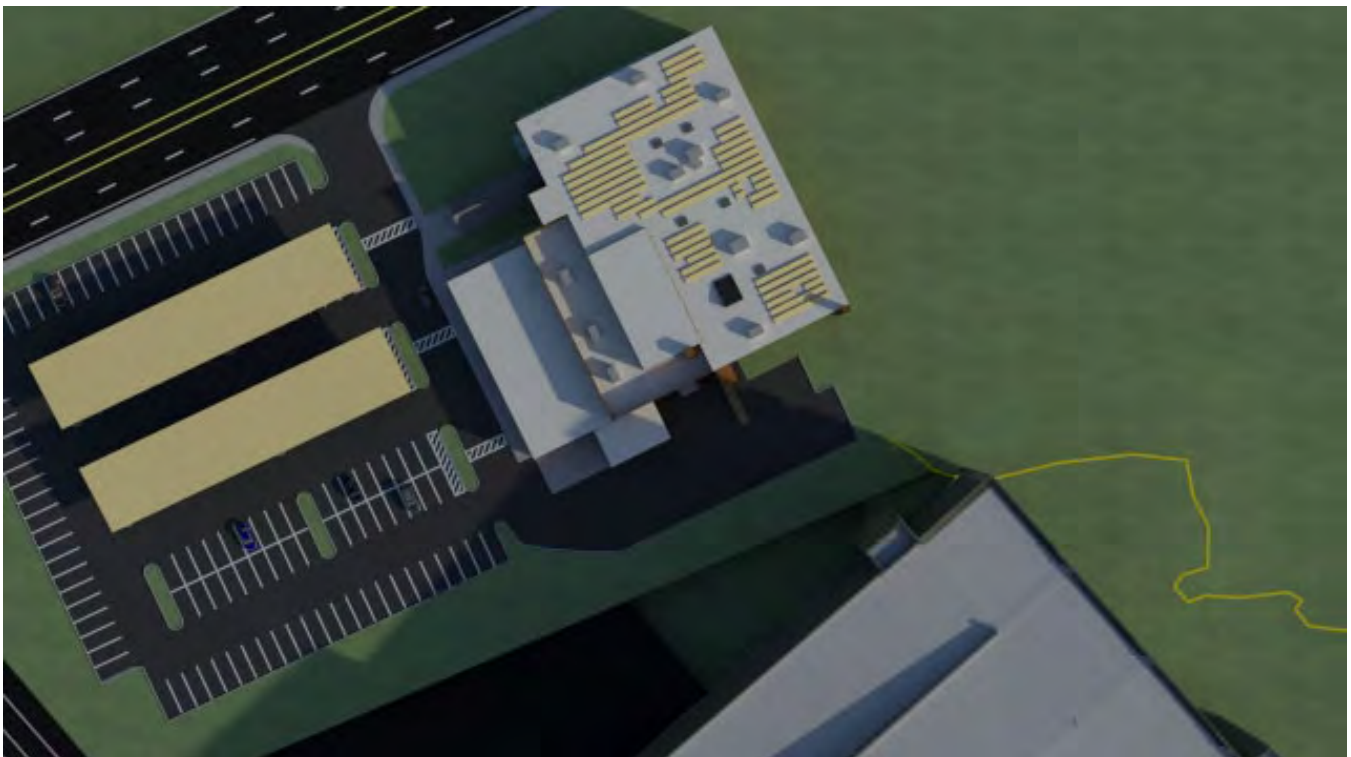
Date: June 20, 2020 (Summer Solstice) **Time:** 12:48 P.M. (solar noon)

Impact Analysis: No impacts



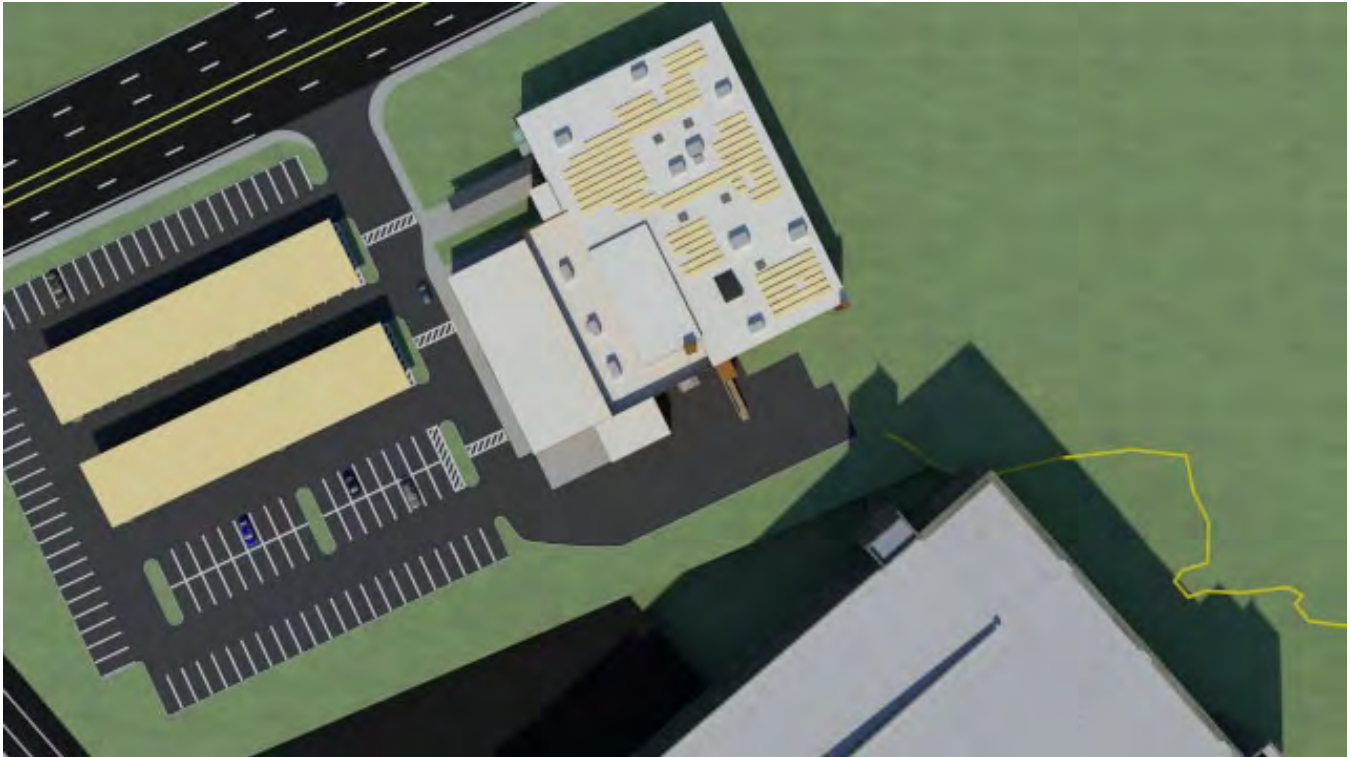
Date: June 20, 2020 (Summer Solstice) **Time:** 6:27 P.M. (2 hours before sunset)

Impact Analysis: Minor shade impacts to wetlands



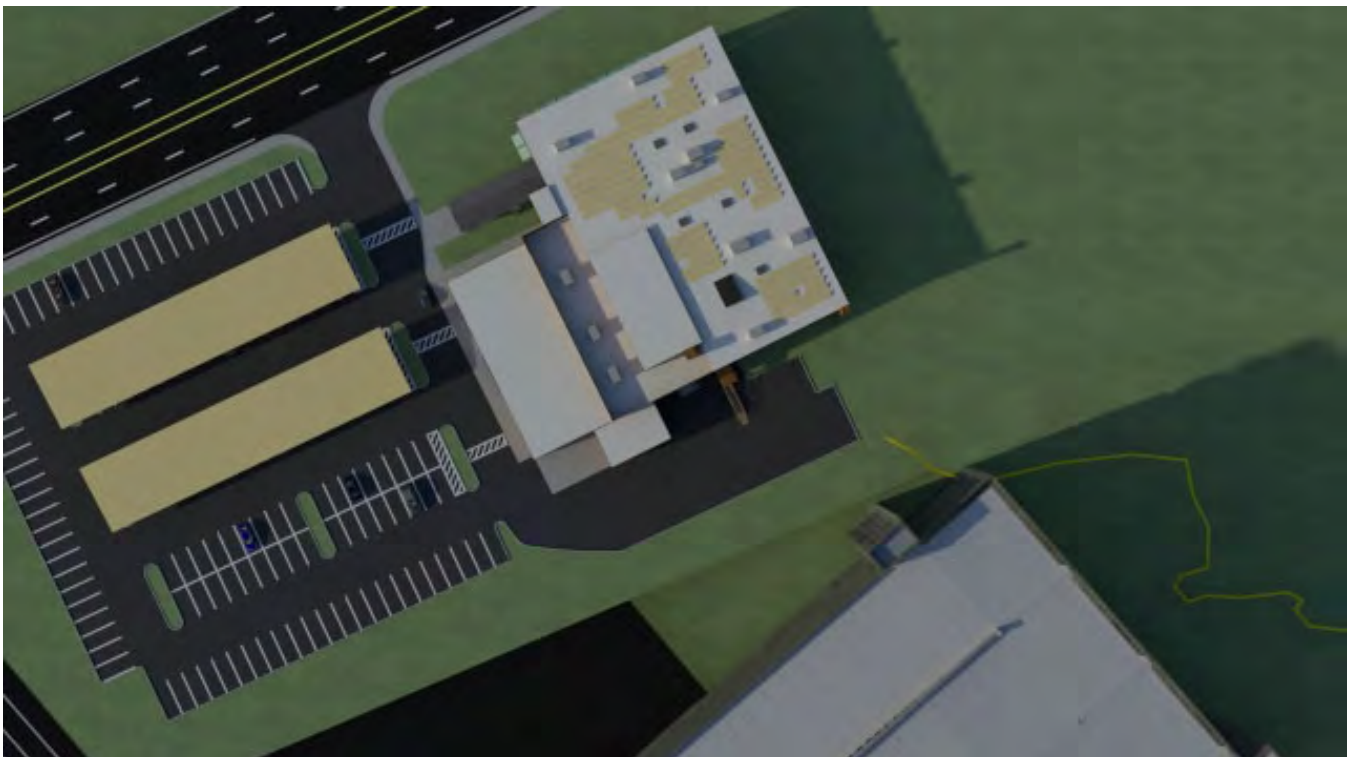
Date: September 22, 2020 (Fall Equinox) **Time:** 8:35 A.M. (2 hours before sunrise)

Impact Analysis: No impacts



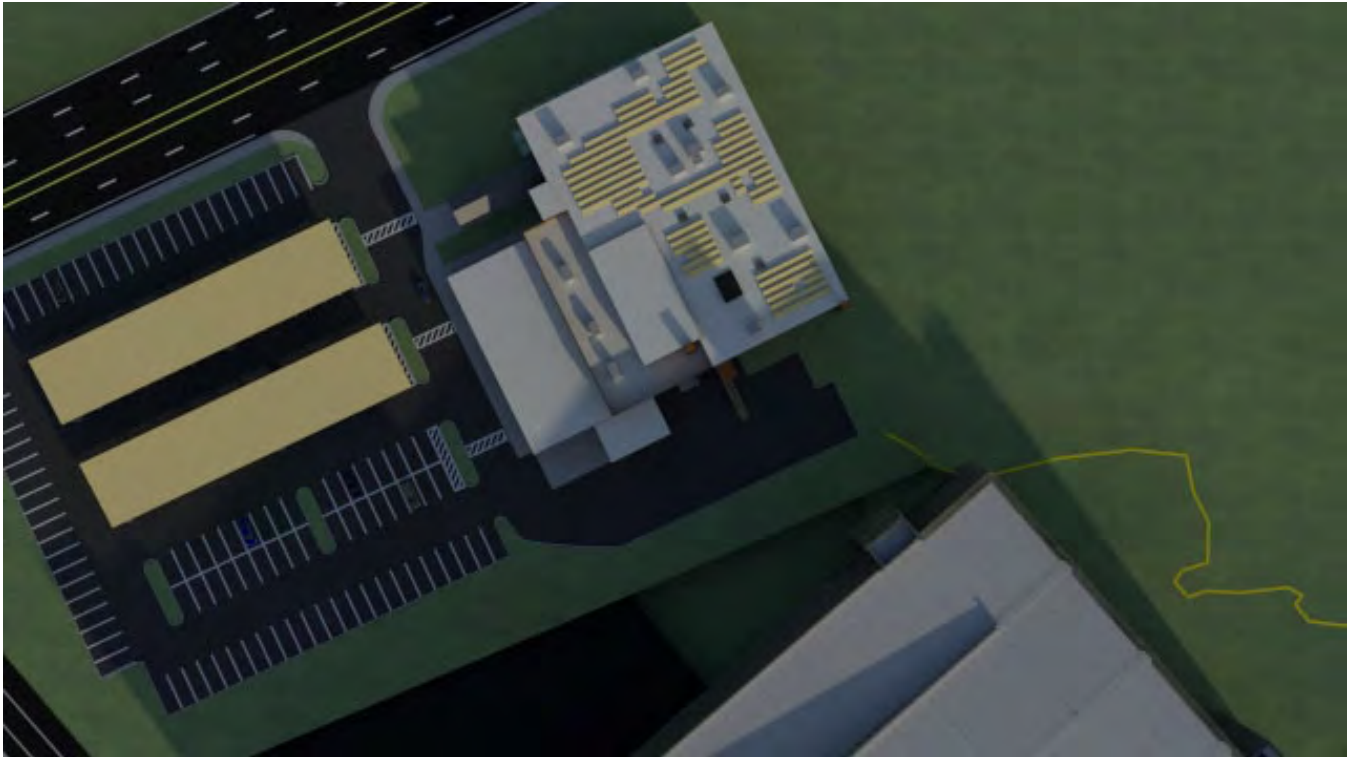
Date: September 22, 2020 (Fall Equinox) **Time:** 12:39 P.M. (solar noon)

Impact Analysis: Minor shade impacts to wetlands



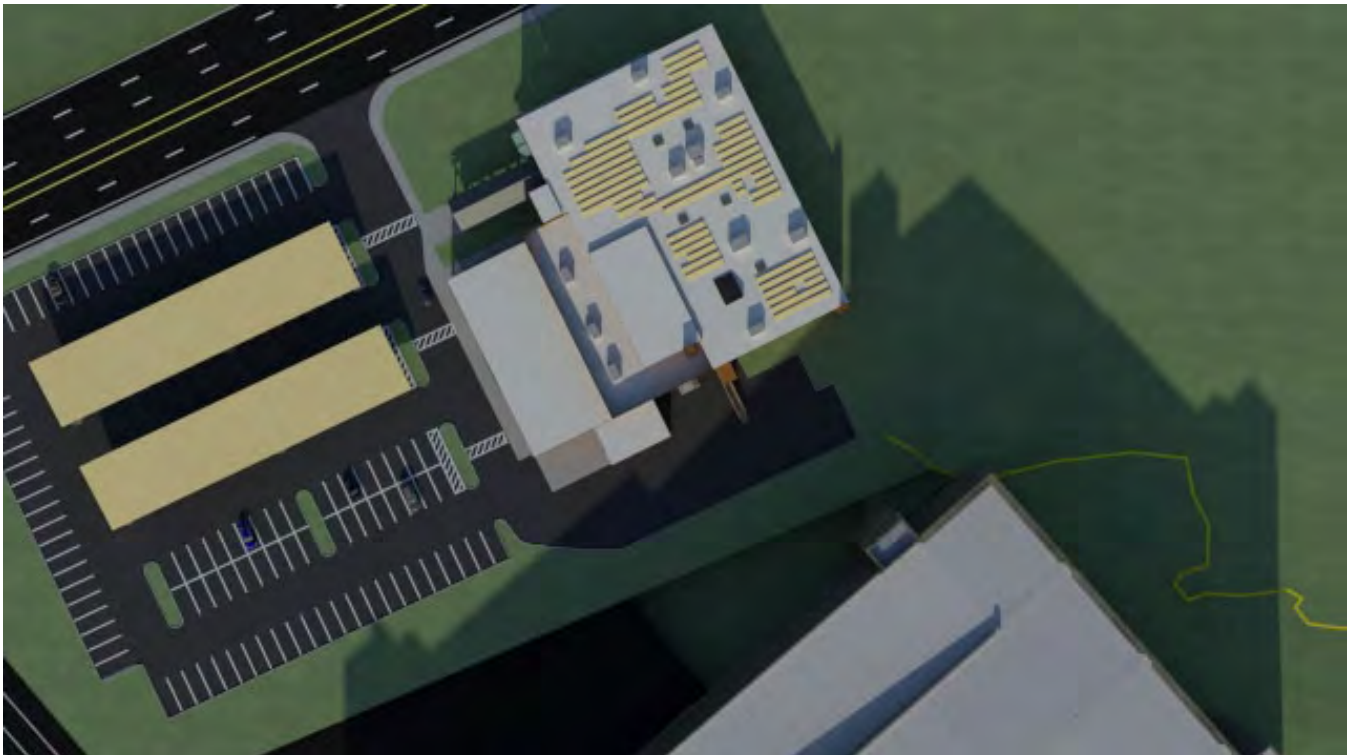
Date: September 22, 2020 (Fall Equinox) **Time:** 4:43 P.M. (2 hours before sunset)

Impact Analysis: Moderate shade impact to wetlands



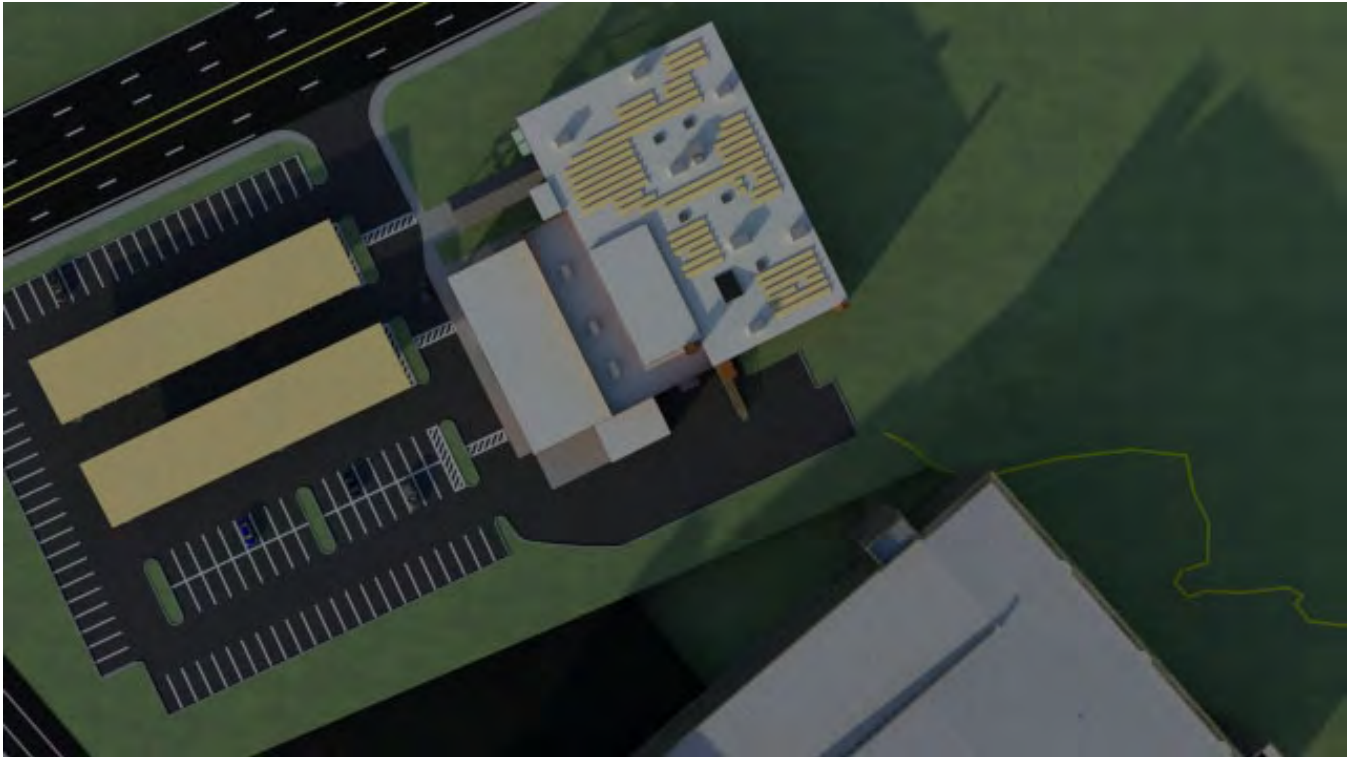
Date: December 21, 2020 (Winter Solstice) **Time:** 9:12 A.M. (2 hours after sunrise)

Impact Analysis: Minor impacts to REI roof panels (worst-case date/time), minor impacts to wetlands



Date: December 21, 2020 (Winter Solstice) **Time:** 11:45 A.M. (solar noon)

Impact Analysis: Moderate shade impact to wetlands

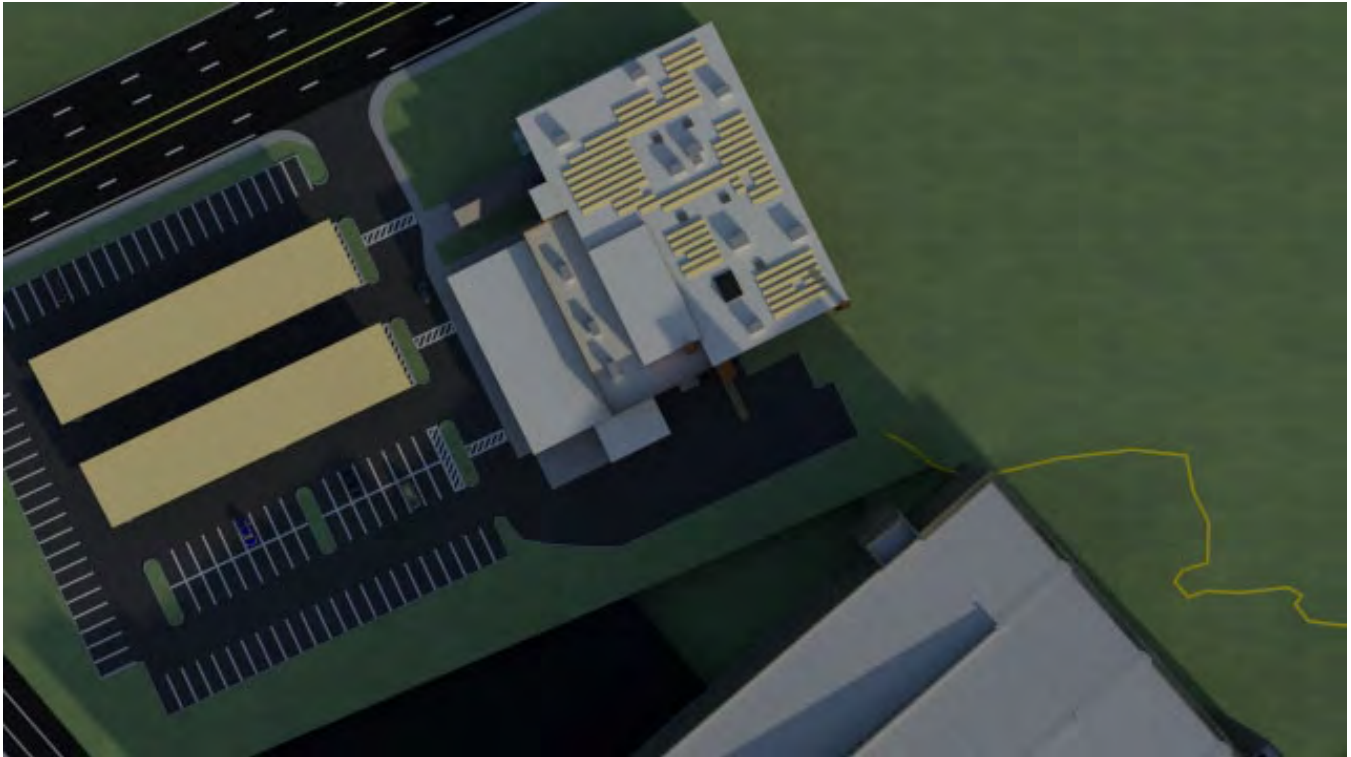


Date: December 21, 2020 (Winter Solstice) **Time:** 2:18 P.M. (2 hours before sunset)

Impact Analysis: Heavy shade impact to wetlands (worst-case date/time)

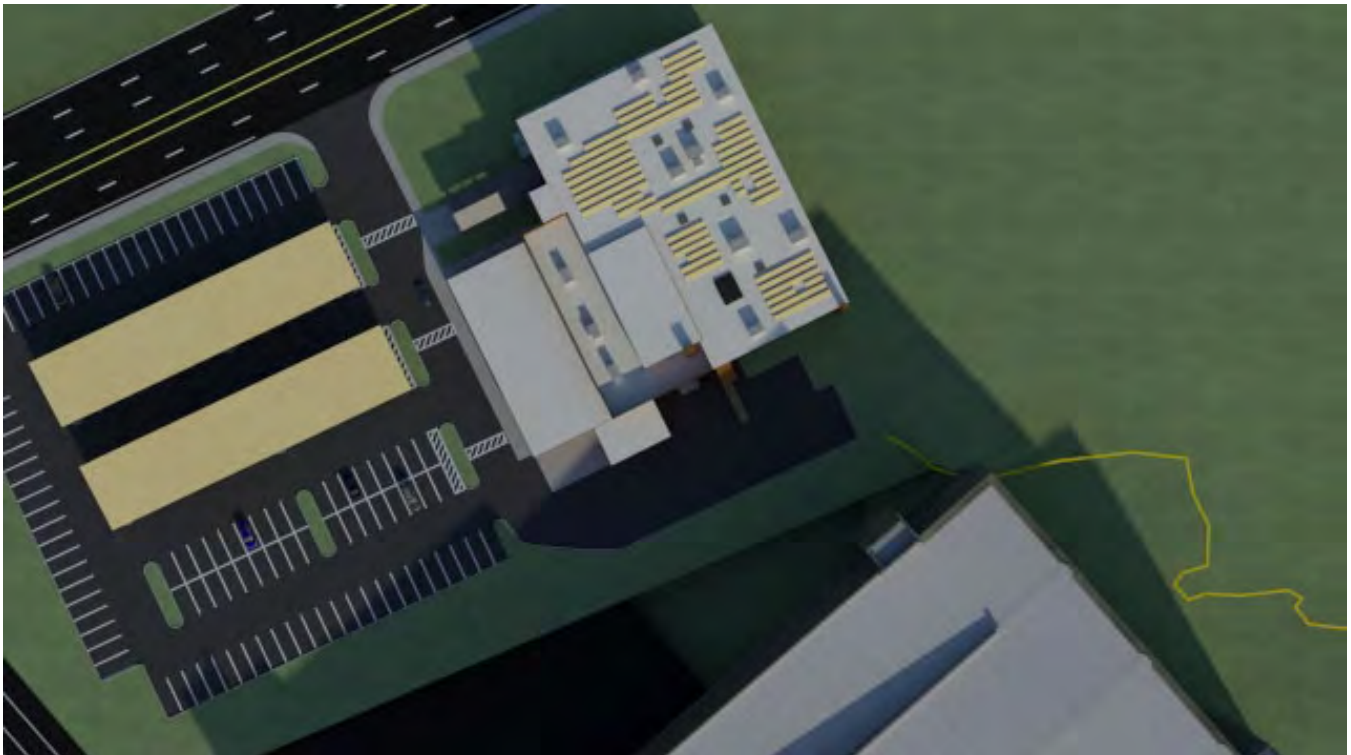
1.4.2. FURTHER EVALUATION OF SHADE IMPACTS TO REI ROOFTOP PANELS

Further analysis indicates that the minor impacts to the REI rooftop panels would begin around the middle of November and end around the end of January. The extent of the obstruction varies with time. During the middle of November and end of January, only one or two panels are obstructed for less than 3 hours after sunrise. The worst-case scenario occurs on the winter solstice, which is when the sun appears at its lowest altitude above the horizon. Around this date, up to 10% of the rooftop panels are obstructed for a maximum of 4 hours after sunrise. It should be noted that during the winter months, the sun shines at a much lower angle to the horizon and is therefore much weaker than during the other seasons. In addition, the obstructions only occur during the first few hours after sunrise, when the intensity of the sun is lowest. Therefore, the amount of energy lost by the PV panels' decreased sun exposure due to the parking garage modifications will be minimal.



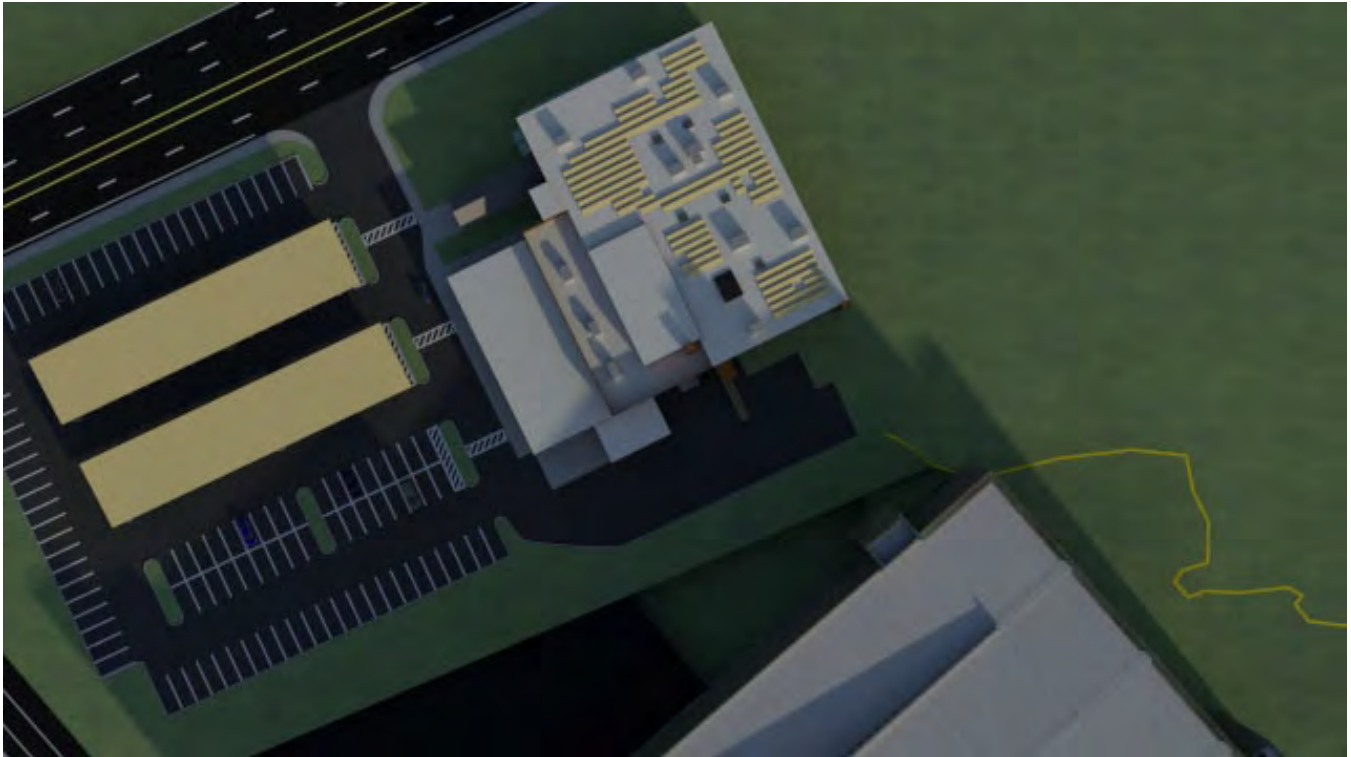
Date: November 15, 2020 (Approximate start of impacts) **Time:** 8:38 A.M. (2 hours after sunrise)

Impact Analysis: Extremely minor impacts to REI rooftop panels



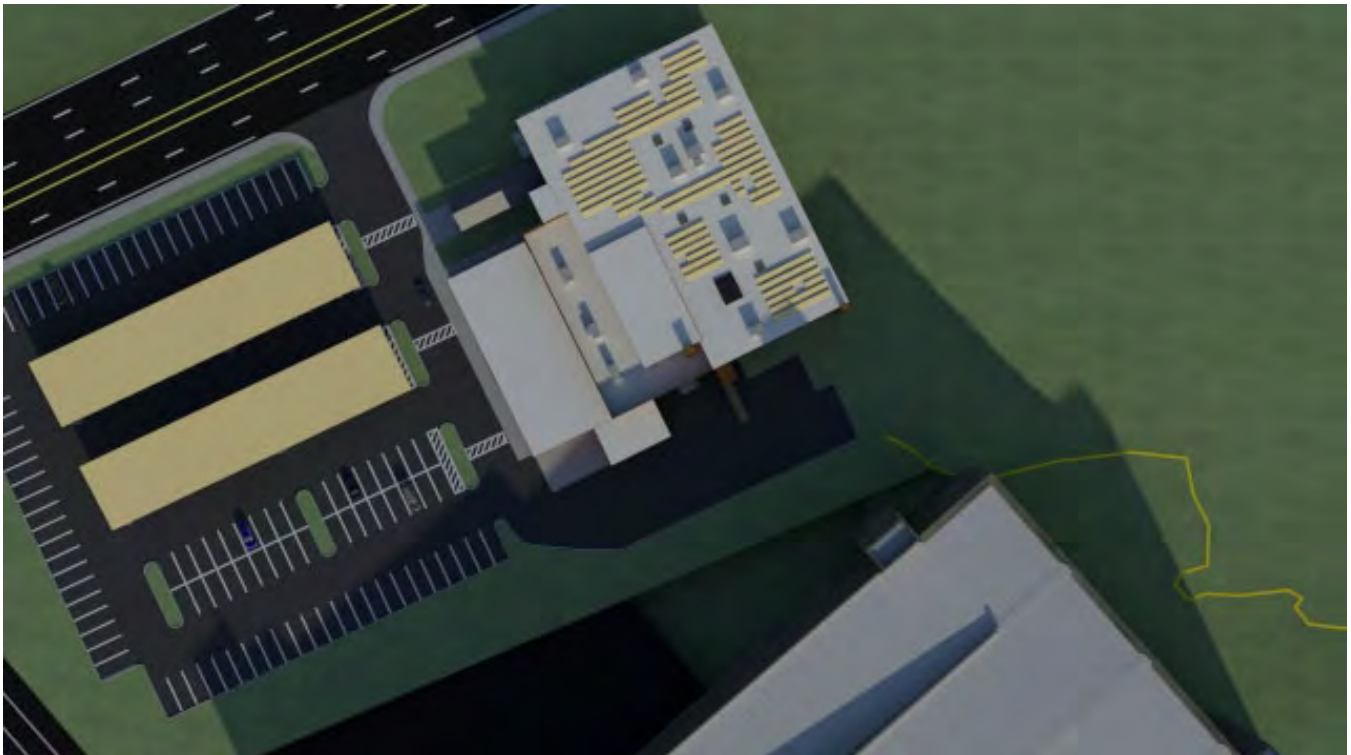
Date: November 15, 2020 (Approximate start of impacts) **Time:** 9:38 A.M. (3 hours after sunrise)

Impact Analysis: No impacts to REI rooftop panels



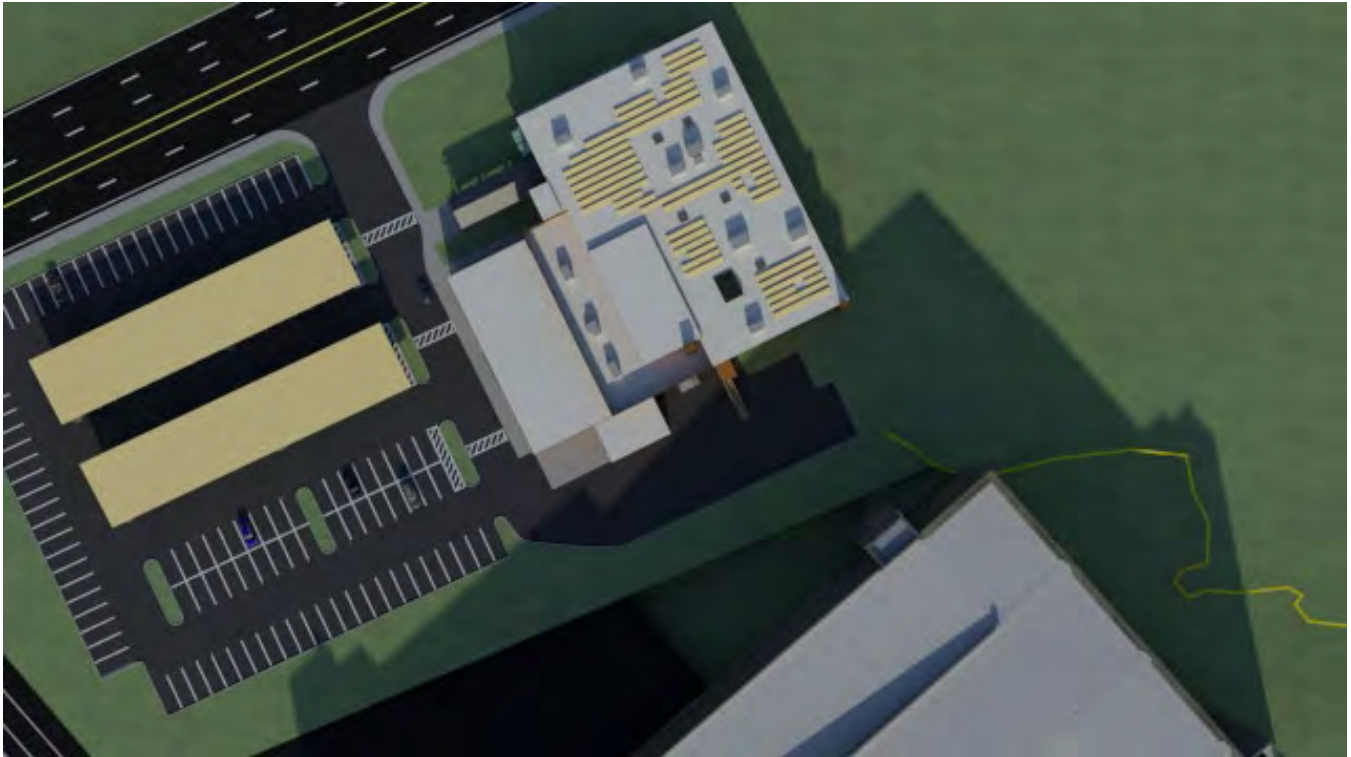
Date: November 30, 2020 **Time:** 8:55 A.M. (2 hours after sunrise)

Impact Analysis: Minor impacts to REI rooftop panels



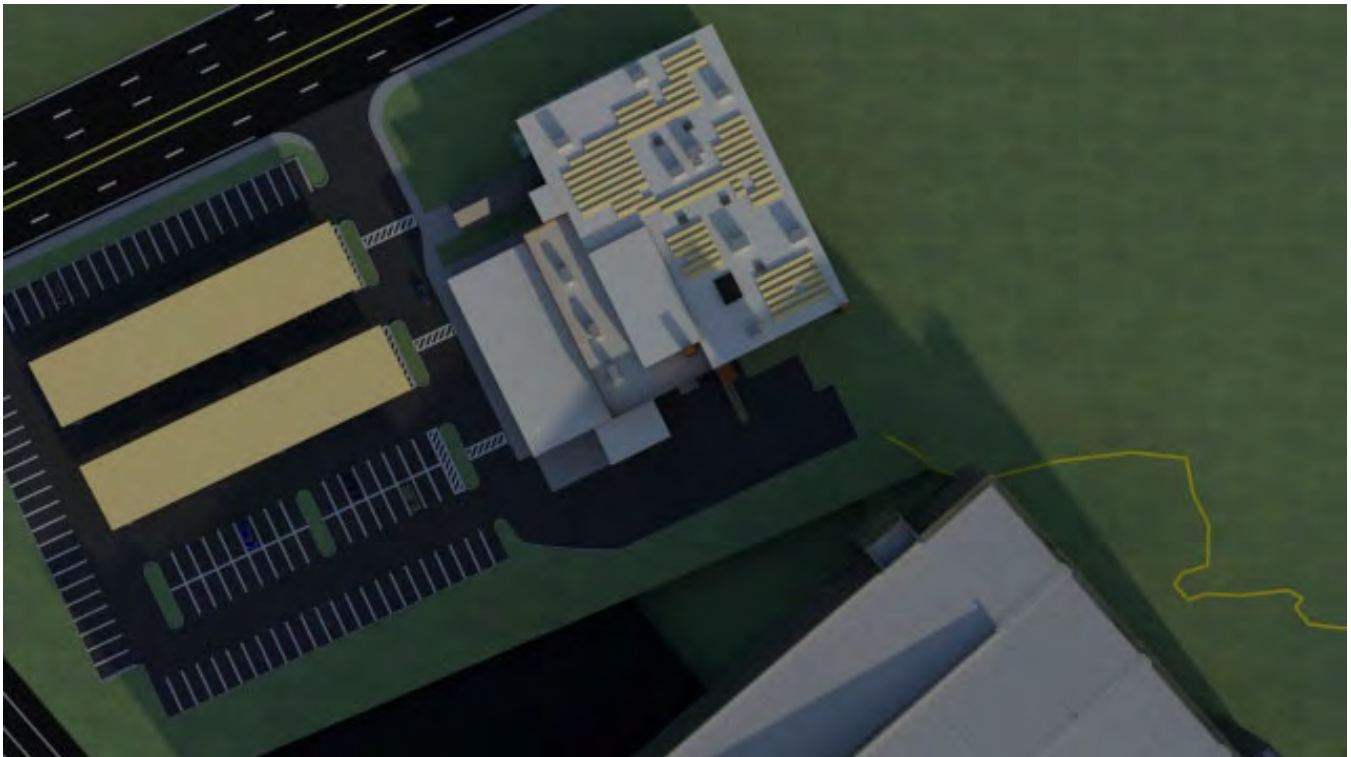
Date: November 30, 2020 **Time:** 9:55 A.M. (3 hours after sunrise)

Impact Analysis: Extremely minor impacts to REI rooftop panels



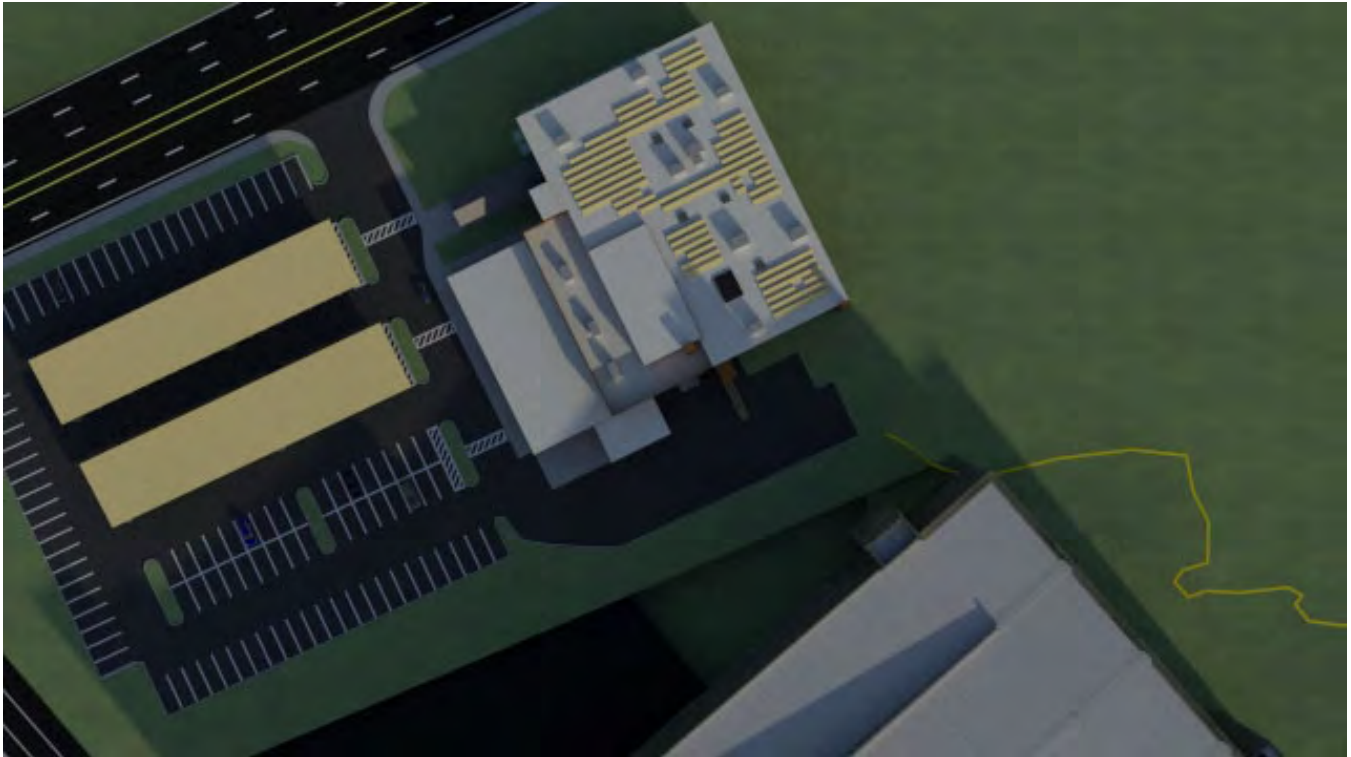
Date: November 30, 2020 **Time:** 10:55 A.M. (4 hours after sunrise)

Impact Analysis: No impacts to REI rooftop panels



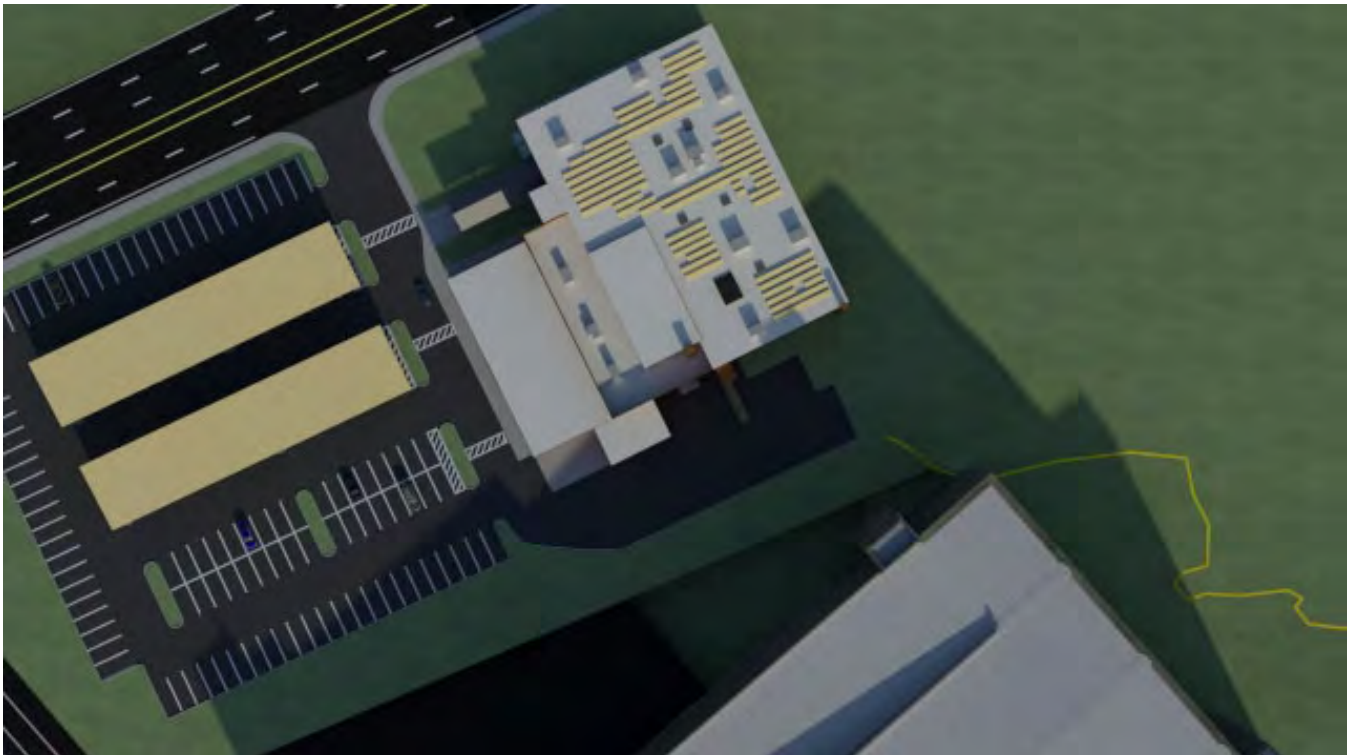
Date: December 21, 2020 (Winter Solstice) **Time:** 9:12 A.M. (2 hours after sunrise)

Impact Analysis: Minor impacts to REI roof panels (worst-case date/time)



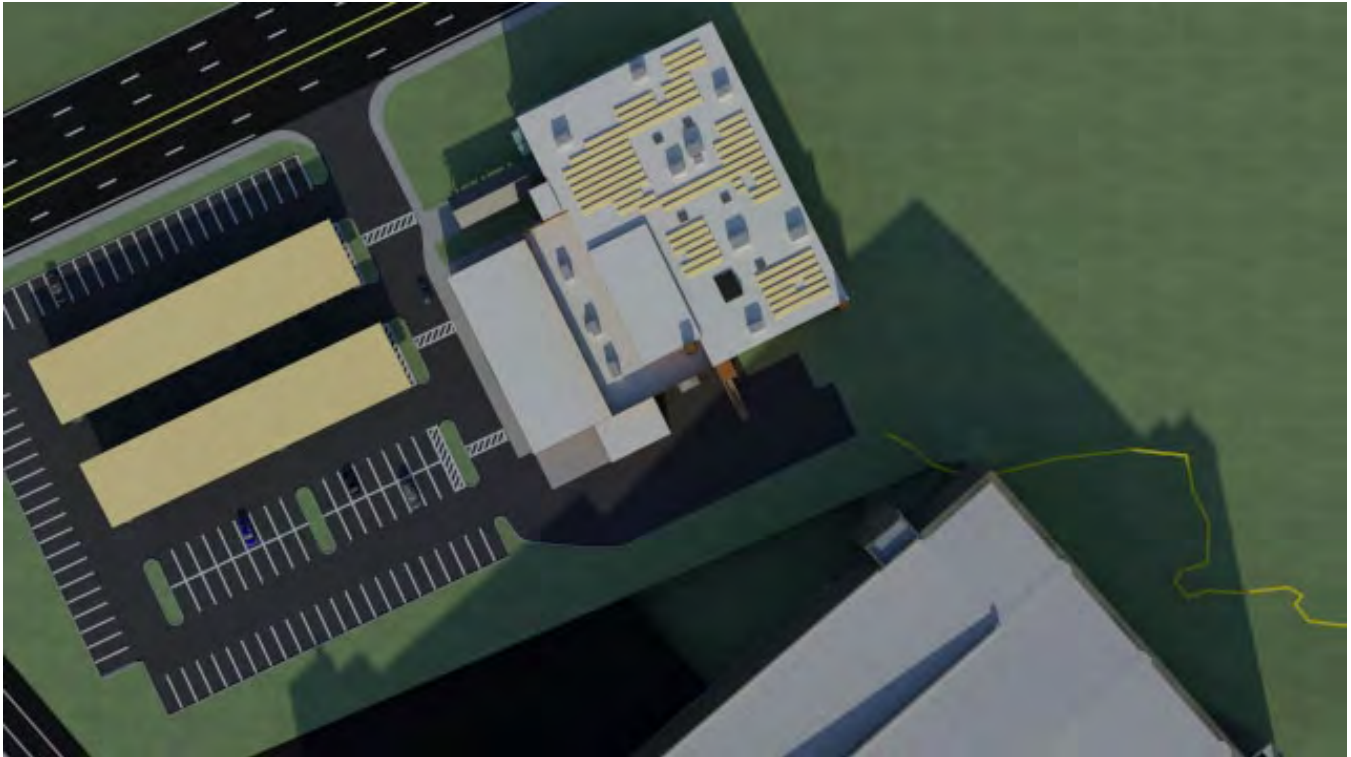
Date: January 15, 2020 **Time:** 9:13 A.M. (2 hours after sunrise)

Impact Analysis: Extremely minor impacts to REI rooftop panels



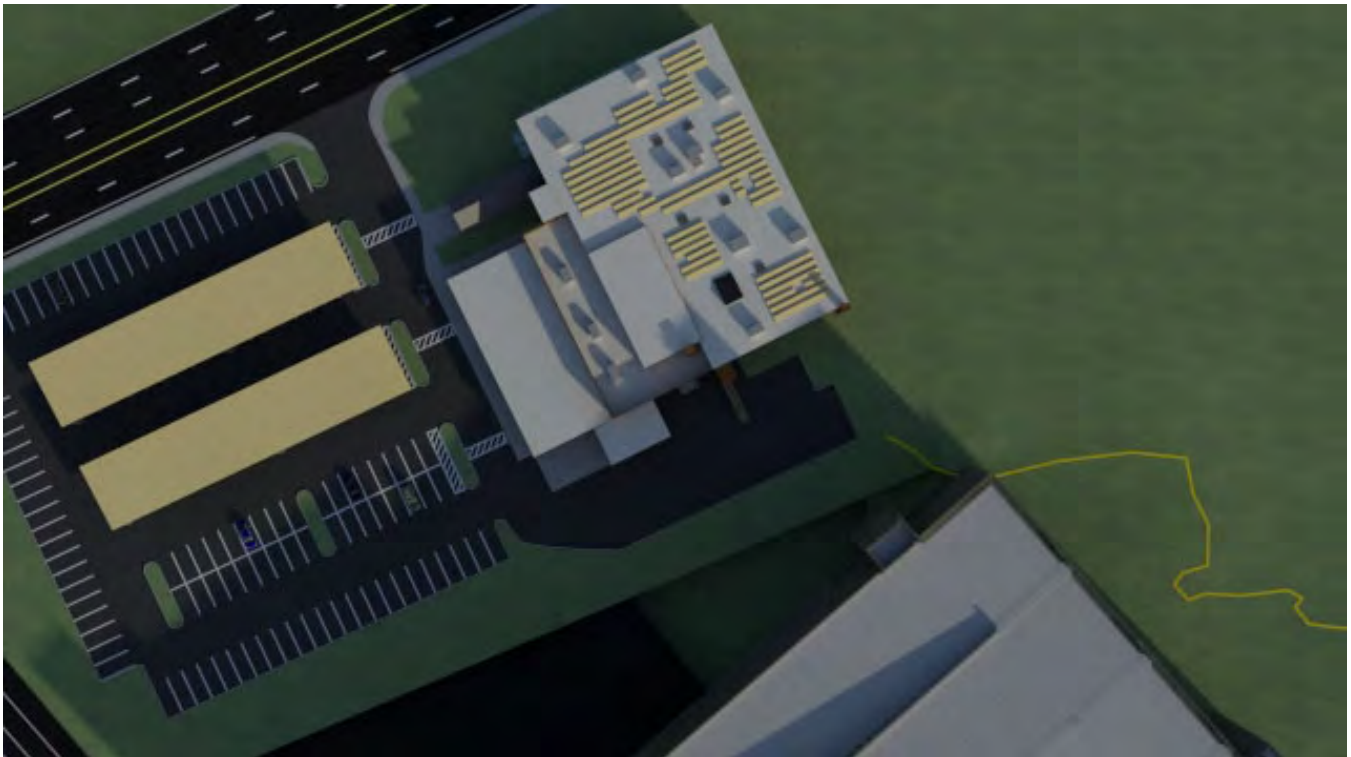
Date: January 15, 2020 **Time:** 10:13 A.M. (3 hours after sunrise)

Impact Analysis: Extremely minor impacts to REI rooftop panels



Date: January 15, 2020 **Time:** 11:13 A.M. (4 hours after sunrise)

Impact Analysis: No impacts to REI rooftop panels



Date: January 31, 2020 **Time:** 9:02 A.M. (2 hours after sunrise)

Impact Analysis: No impacts to REI rooftop panels

**ATTACHMENT H
ENF DISTRIBUTION LIST**

Agency	Contact
Executive Office of Energy and Environmental Affairs	MEPA Office 100 Cambridge Street, Suite 900 Boston, MA 02114
State Senator Karen Spilka	Honorable Karen Spilka Massachusetts State House 24 Beacon Street, Room 332 Boston, MA 02133
State Representative Carmine Gentile	Honorable Carmine Gentile Massachusetts State House 24 Beacon Street, Room 167 Boston, MA 02133
State Representative Maria Robinson	Honorable Maria Robinson Massachusetts State House 24 Beacon Street, Room 22 Boston, MA 02133
State Representative Jack Lewis	Honorable Jack Lewis Massachusetts State House 24 Beacon Street, Room 43 Boston, MA 02133
Department of Environmental Protection Boston Office	Commissioner's Office One Winter Street Boston, MA 024108
Department of Environmental Protection Northeast Regional Office	Attn: MEPA Coordinator 205 Lowell Street Wilmington, MA 01887
Massachusetts Department of Transportation (MassDOT) Highway Division	Public / Private Development Unit 10 Park Plaza, Suite 4150 Boston, MA 02116
Massachusetts Department of Transportation District 3 Office	Attn: MEPA Coordinator 403 Belmont Street Worcester, MA 01604
Massachusetts Historical Commission (MCH)	The MA Archives Building 220 Morrissey Boulevard Boston, MA 02125
Metropolitan Area Planning Council (MAPC)	60 Temple Place, 6 th Floor Boston, MA 02111
Massachusetts Water Resources Authority (MWRA)	Massachusetts Water Resources Authority Charlestown Navy Yard, 100 First Avenue Boston, MA 02129
Department of Energy Resources	Department of Energy Resources Attn: MEPA Coordinator 100 Cambridge Street, 10 th Floor Boston, MA 02114

Framingham Mayor Yvonne Spicer	Honorable Yvonne Spicer Framingham City Hall 150 Concord Street Framingham, MA 01702
Framingham Planning Department	150 Concord Street, Room B2 Framingham, MA 01702
Framingham Select Board	150 Concord Street Framingham, MA 01702
Framingham Conservation Committee	150 Concord Street, Room 213 Framingham, MA 01702
Framingham Health Department	150 Concord Street Framingham, MA 01702
Framingham City Clerk	150 Concord Street, Room 105 Framingham, MA 01702
Natick Town Administrator	Town of Natick c/o Melissa Malone, Town Administrator Natick Town Hall, 2 nd Floor 13 East Central Street Natick, MA 01760
REI Senior Corporate Counsel	Wilma Wallace, Vice President, General Counsel and Corporate Secretary REI Corporation 6750 South 228 th Street Kent WA 98032
R.W. Holmes Realty Co. Inc.	R.W Holmes Realty Co. Inc. 321 Commonwealth Road, Suite 202 Wayland, MA,