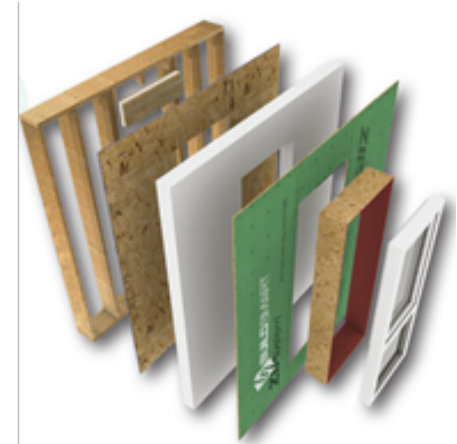


Profitability of panelized Passive House construction explained

Paul Grahovac, LEED AP
Vice President, Business Development
General Counsel
Risk Manager
Field Support



Paul Grahovac, LEED AP
Director, New Business Development
General Counsel
Risk Manager
Codes, Standards, & Field Support



Paul Grahovac, LEED AP

International Code Council

Air Barrier Association of America

-- Technical, Flashing, and Whole-Building Testing Committees

National Concrete Masonry Association's Air Barrier Task Force

ASTM Committees on building performance / vapor permeability / window installation

RCI Industry Advisory Council -- Waterproofing

National Institute of Building Sciences Councils:

-- Building Enclosure Technology and Environmental Council

-- Council on Finance, Insurance and Real Estate

Passive House Alliance

Passive House Institute Builders Training

- Not a presentation **about** the paper.
- A presentation **of** the paper.
- Powerful promotional tool.
- Points are too important not to go over carefully.

Learning Objectives

1. Explain the Tenant Utility Allowance on Affordable Housing projects, its negative impacts on net income, and how to reduce or eliminate it with Passive House design and construction.
2. Explain the financial benefit of paying tenant utilities on Market Rate projects.
3. Explain the financial benefits of accelerated construction.
4. Explain how to avoid NIMBY by locating multifamily projects near railroad tracks and crossings and taking advantage of the extraordinary soundproofing provided by Passive House construction.

Profitability of panelized passive house construction explained

Paul Grahovac, Vice President Business Development, Build SMART, LLC

1 Introduction

1.1 The As-Built Project

The Whitehall is a 49-unit three-story apartment building in Spring City, PA near Philadelphia. At the 2017 New Gravity Housing Conference of the Philadelphia area US Green Building Council (Delaware Valley), the Whitehall project developer, architect, Passive House consultant and the external wall-panel vendor gave a presentation called “The Whitehall” which disclosed the “Final Drywall Blower Door Test” result below Passive House Institute US maximum level allowable. The building was tested at shell completion, post-MEP penetrations, and final. In all three instances a single blower-door unit with a single fan was used to test the entire building at once, and in each instance, the result was lower than the maximum allowed for Passive House. There was no leak-chasing to achieve any of the results.

2 Methods

2.1 The Project Panelized Wall Assembly Design

- The exterior walls were provided by prefabricated 2x6” Passive House certified stud-wall panels featuring:
- Oriented Strand Board (OSB) sheathing (within-panel seams, panel-to-panel connections, and panel-to-floor / panel-to-top plate connections sealed with Silyl-Terminated Polymer (STP) joint and seam filler),
- 3.5” Expanded Polystyrene (EPS) rigid foam insulation laminated to the OSB,
- OSB (with OSB manufacturer-laminated water-resistive barrier) laminated to outer face of the EPS,
- Rough openings lined with fluid-applied STP flashing, and
- Passive House certified windows factory installed and air-tightened using STP sealant.

The complete plans and specifications are available online.

3 Results

3.1 Developer Satisfaction

At the environmental conference in Philadelphia (Delaware Valley Green Building Council 2017 New Gravity Housing Conference), the Whitehall non-profit developer provided slides relating to increased net income and fees on their project stating:

- “Passive House Makes us Money!!”
- “Passive House lets you borrow/leverage more money to build more housing”
[Increase from \$800,000 to \$1,100,000]
- “Higher net fees mean we can house more people”
[Increase from \$1,000,000 to \$1,300,000]

The reason for these financial benefits was a reduction in the tenant utility allowance based on the modeled Passive House energy savings. (The tenant utility allowance is an amount by which the rental charge must be reduced, so that the rent plus the utilities are less than the maximum allowable rent.)

3.2 Energy Modeling

Passive House energy modeling and consulting for the project was performed by Certified Passive House Consultant Tim McDonald RA, CPHC, LEED AP. The Excel file containing the Passive House Planning Package modeling was provided to Paul Grahovac (author of this paper) who in turn provided it to Certified Passive House Consultant Skylar Swinford, energy and enclosure consultant at Energy Systems Consultants, who modeled The Whitehall project as if it were built to Passive House performance standards in Kansas City, and, alternatively, built merely to code standards there. Mr. Swinford estimated the code air changes per hour at 7.0ACH50 based on his field experience.

The Kansas City modeling showed that the HVAC kilowatt hours (kWh) for the code case to be 617,760 kWh with the Passive House case at 41,098 kWh.

3.3 Passive House panelized construction cost

The company providing the exterior wall panels for Whitehall estimated that the additional cost of Passive House construction versus stick-building to code at approximately \$292,297 which includes these costs:

- wall panels and windows,
- slab and footing insulation,
- energy heel truss,
- additional attic insulation,
- exterior insulation panels for energy heel truss, and
- OSB ceiling lid for long-term durable ceiling air barrier performance.

This was estimated to be an approximately 3.76% increase in overall construction costs.

4 Discussion

4.1 *Calculations*

The wall-panel company interviewed three high-energy performance multifamily real estate developers who said they paid or planned to pay their tenants' utilities. One of them indicated they determined their rental

charge by adding the market value of the space to an amount the tenant would pay for utilities if they lived in energy-inefficient premises rather than the energy-efficient structure.

The calculations below compare the net income of hypothetical owner A (who stick-builds to code and does not pay tenant utilities) to hypothetical owner B who builds to [Passive House](#), pays tenant utilities, and determines their rental charge by adding the market value of the space to an amount the tenant would pay for utilities if they lived in energy-inefficient premises rather than the energy-efficient structure.

Table 1 *A Revenue Comparison of Passive House vs. Code Construction for a Kansas City Market-Rate Multifamily Project*

Code-compliant building cost: \$7,783,196 Passive House building cost: \$8,075,493
 Cost difference (investment): \$292,297 Percent cost increase: 3.76%

49-unit apartment building: Annual Revenue

	Builds to code	Builds to Passive House & pays tenant power bill	HVAC electricity <u>use</u> common areas	HVAC electricity use living units	Tenant rent	Tenant total cost	Owner net revenue	Passive House net revenue increase
Apt. Bldng. Owner A	x		113,250 kWh \$12,344	299,685 kWh \$32,666	\$588,000	\$620,666	\$575,656	0.00
Apt. Bldng. Owner B		x	9,513kWh \$1,037	25,225 kWh \$2,750	\$620,666	\$620,666	\$616,879	\$41,223

Assumes all-electric Heating, Ventilation, and Air Conditioning (HVAC). kWh cost is KCK average \$0.109/kWh.

Total conditioned area: 41,259sqft. Common area: 11,325sqft.

Table 2 49-unit apartment building: Passive House Annual Net Cash Flow

Moving from left to right, each case assumes the previous case is adopted.

Case→	Base case. See previous chart.	HVAC capital expense savings \$120,000	Fixed windows ¹ \$34,250	Construction loan interest decrease \$42,400	Contractor overhead ² \$161,510	Rents start sooner \$103,646	<u>20 year</u> window replacement avoided ³ \$456,500 Present Value \$208,340
Net annual cash flow	\$27,190	\$32,951	\$34,596	\$36,631	\$44,385	\$49,361	\$59,363
Years to Payback	10.75	8.80	8.44	7.97	6.59	5.92	4.92

¹ Operable windows in bedrooms retained. Fixed windows lower maintenance costs and reduce falling risks.

² Owner captures in contract negotiations or bidding process.

³ State affordable housing manuals and most experts maintain windows should be replaced every 20 years.

Passive House certified windows are of exceptional quality, have a 20-year warranty, and are expected to last the life of the building.

4.2 Table 2 Background Information

Table 2 shows the increased income after consideration of the additional revenue from energy savings and the additional cost of the mortgage payment attributable to the additional cost of the Passive House energy efficient construction. The “Net annual cash flow” attributable to Passive House construction and energy savings was calculated using an Excel spreadsheet created by a bank multifamily housing lending manager. Various construction cost savings amounts are used to reduce the construction cost in the calculation.

HVAC first-cost savings

“Some developers even report a negative cost premium for passive building since the high-performance enclosure allows for the reduction in mechanical system size and equipment, thereby reducing both first costs and operational expenses for the life of the building.”⁵ For this 49-unit case study example, the first-cost savings have been estimated at 30% after accounting both for the reduction in heating and cooling equipment cost and the addition of energy recovery ventilation cost. Our thanks for this go to Barry Dicker of Decent Energy, Inc.

Speed Matters

Bruce Anderson, the owner of Insulated Concrete Form company Polycrete USA, who is also an accountant, wrote a guest editorial entitled “Speed Matters” in a leading ICF publication. Anderson, Bruce, “Speed Matters,” ICF Builder Magazine, November/December [2016](#).⁶ In that piece, Anderson explains that accelerated construction reduces construction loan interest, brings in rent sooner, reduces overhead, and increases profits.

Applying that to the Whitehall case study, we assume a projected ten-month construction schedule based on conventional stick-building rather than use of prefabricated panels.

Based on the reduction in field wall assembly construction hours, we have calculated a two-month reduction in the construction schedule from ten months to eight months. The National Association of Home Builders reports prefabrication acceleration of 2.5 homes to 1 which proportion corresponds to a two-month reduction in a ten-month schedule.⁷

Speed -- construction loan

The interest on the construction loan of \$8,075,493 is calculated to be \$212,000. With a ten-month duration, the monthly interest is \$21,200. Ten months is reduced to eight months, so project cost is reduced by \$42,400.

Speed -- sooner rents

The estimated annual revenue after paying HVAC utilities is 634,553 which yields a monthly revenue of \$52,879. The project cost is accordingly reduced by the amount of two months' rent which is \$105,78.

Steve Bliss is the Founding Editor of BuildingAdvisor.com, and he was Editorial Director of The Journal of Light Construction for 16 years. In a BuildingAdvisor.com article, he addressed contractor accounting. Bliss, Steve, "Pricing the Job: Mark-up, Overhead & Profit," BuildingAdvisor.com. Bliss explained that "10 and 10" for 10% overhead and 10% profit is sometimes referenced in the industry and has been borne out by a National Association of Home Builders study.⁸

Speed – reduced overhead

Starting with \$8,075,493 in contractor revenue, a 10% overhead of \$807,549 is calculated. Dividing this by 10 months yields a monthly overhead of \$80,755. Two months overhead saved is \$161,510, so the project cost is reduced by that amount. (We depart from the financial concepts provided by the Anderson and Bliss articles here by not including a project cost reduction of \$161,510 corresponding to profit that would be a windfall to the contractor, so that we present a worst-case scenario where the owner is not able to negotiate the profit away from the contractor.)

Window replacement avoidance.

The original formulations of the fluid-applied window rough opening flashing, joint and seam filler, and window installation sealant used in the panel prefabrication and installation were developed by Tatley-Grund Building Repair Specialists, Inc. of Seattle, Washington. Company President Stacey Grund has evaluated the Passive House Certified windows used in the wall panels and opined that because of their high quality, buildings using them will be able to save \$456,500 by avoiding the customary 20-year window replacement that is also typically referenced in the architectural manuals of State Affordable Housing agencies. After present-value adjustment, the project cost is reduced by \$208,159.

Tenant Amenities

Passive House tenants enjoy a 50% reduction in urban noise exposure⁹, and their living space is continuously infused with abundant, fresh, virtually allergen-free air.¹⁰

Passive House Defeats NIMBY

<https://en.wikipedia.org/wiki/NIMBY>

It's the Noise Thing

Passive House + Train-Street Crossing Horn = Dishwasher

Passive House + Train-Track Noise = Refrigerator Hum

Passive House reduces decibels by 50% -- logarithmic – nonlinear -- so 500% ??

<https://www.treehugger.com/green-architecture/another-reason-love-passive-house-its-really-quiet.html>

Minimum train horn decibel is 96 and maximum is 110, so average is 103.

[file:///C:/Users/paul.grahovac/Downloads/FRA%20Train%20Horn%20and%20Quiet%20Zone%20Fact%20Sheet%20\(3\).pdf](file:///C:/Users/paul.grahovac/Downloads/FRA%20Train%20Horn%20and%20Quiet%20Zone%20Fact%20Sheet%20(3).pdf)

A dishwasher is 50 decibels.

<https://www.sears.com/articles/appliances/dishwashers/what-is-decibel-range-for-a-dishwasher.html>

Freight train 45mph at 15 meters or 50 feet 80 decibels.

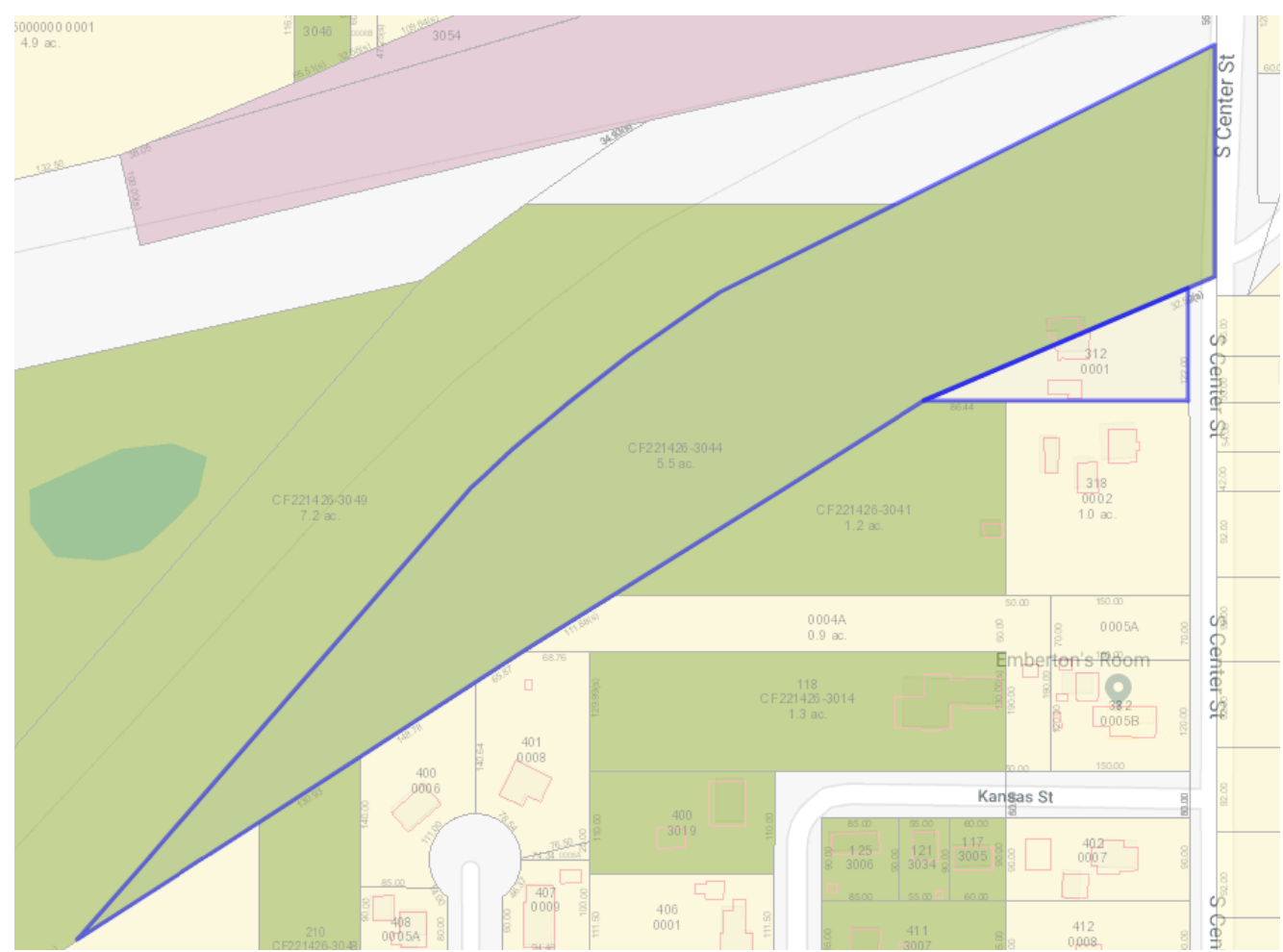
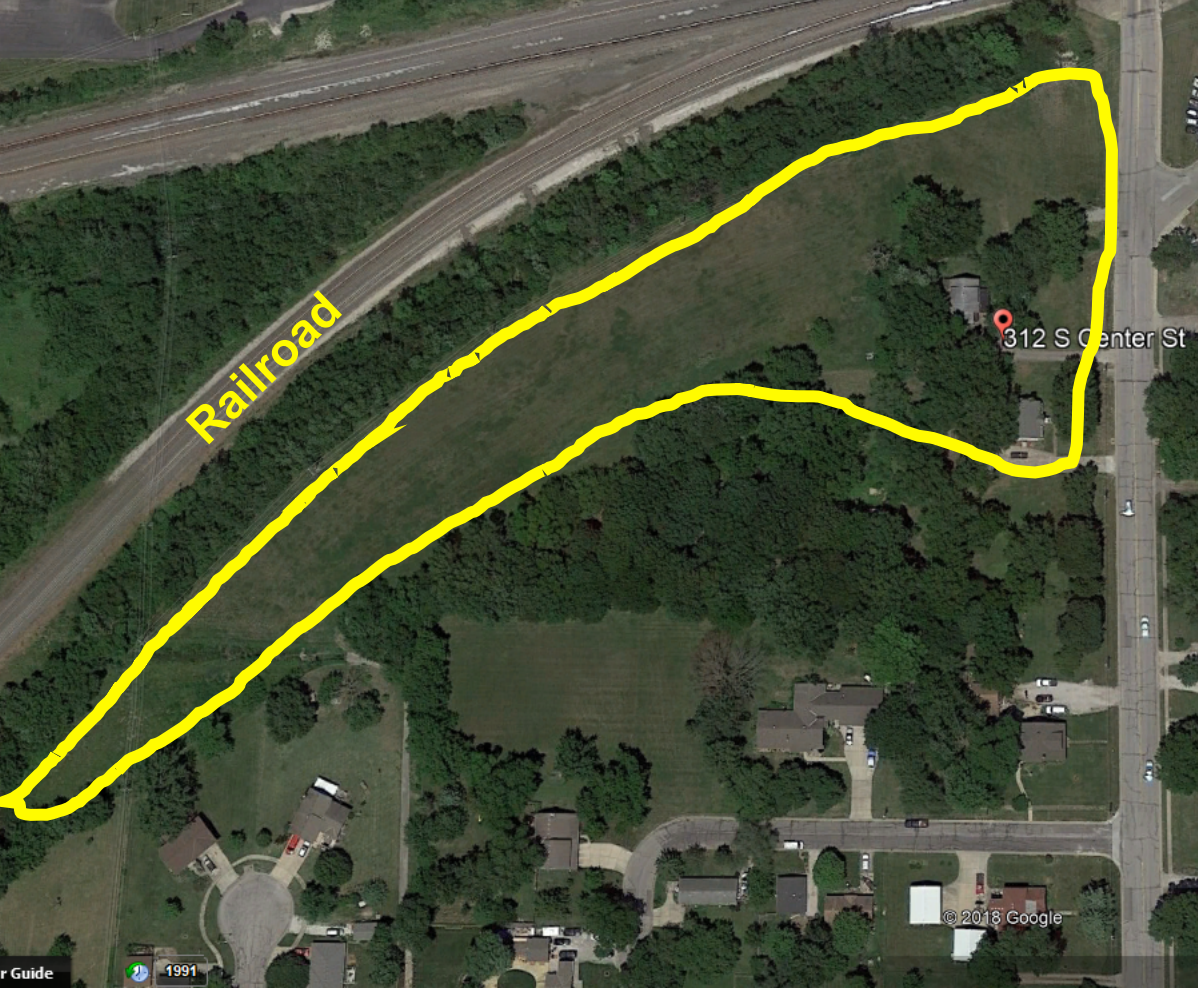
<https://www.chem.purdue.edu/chemsafety/Training/PPETrain/dblevels.htm>

Refrigerator hum = 40 decibels.

<http://www.washingtonpost.com/wp-dyn/content/article/2009/03/09/AR2009030902133.html?noredirect=on>



- 6 acres
- City open to apartment building
- www.reecenichols.com/gardner
- 312 S. Center St., Gardner



When a train horn blows adjacent to a Passive House apartment building, the occupant noise level is the same as a dishwasher. The train & track sound is the level of a refrigerator's hum.


Search

19400 Montrose St, Edgerton, KS 66021 Search

ex: 1600 Pennsylvania Ave, 20500

Get Directions History

19400 Montrose St

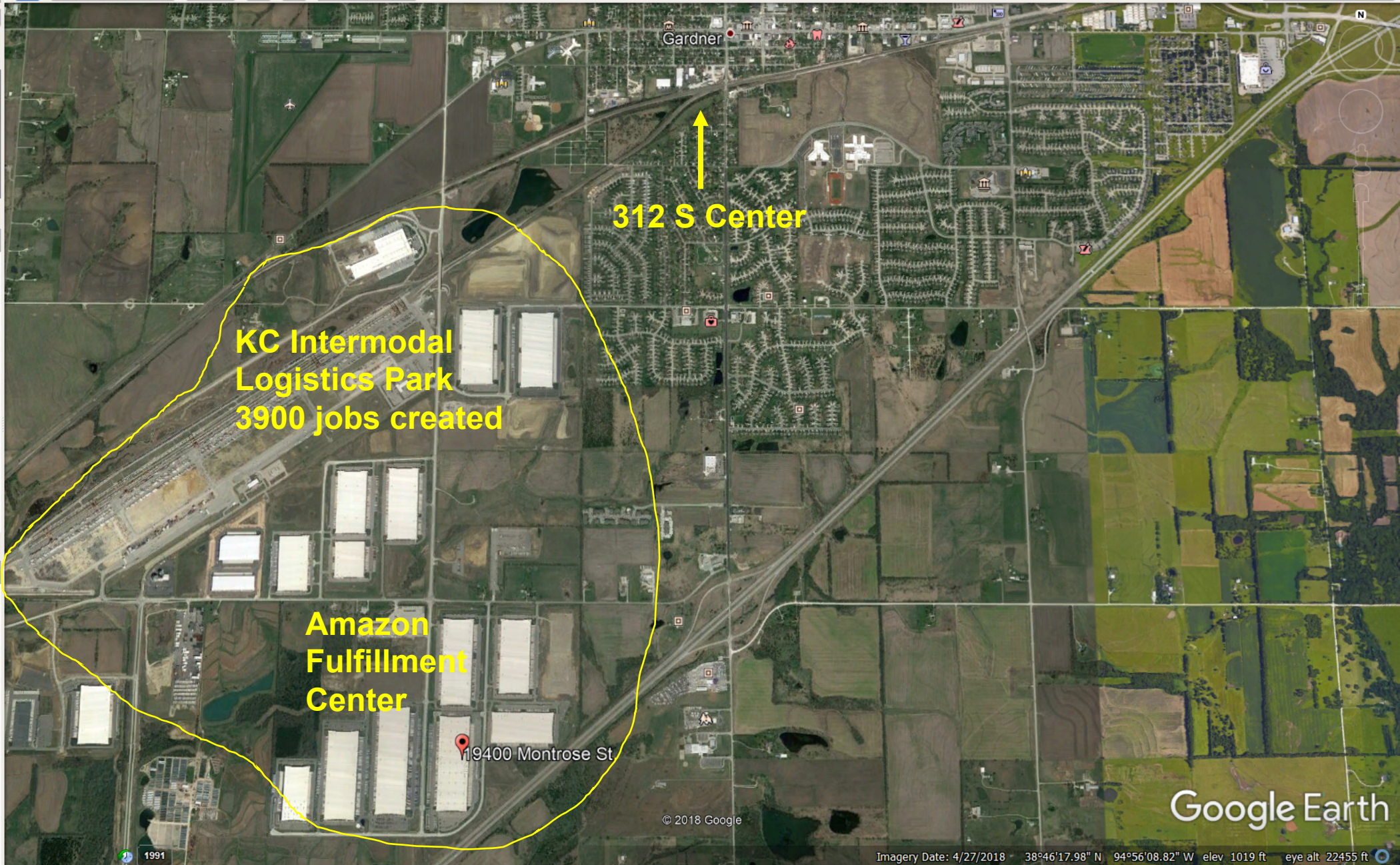


Places

- My Places
- Sightseeing Tour
 - Make sure 3D Buildings layer is checked
- Temporary Places

Layers

- Primary Database
- Borders and Labels
- Places
- Photos
- Roads
- 3D Buildings
- Ocean
- Weather
- Gallery
- Global Awareness
- More
- Terrain



312 S Center

KC Intermodal Logistics Park
3900 jobs created

Amazon Fulfillment Center

19400 Montrose St

Gardner

Sign in