Seeing the ‘Unseen’ at Emerson Green, Devens, MA and Beyond

Phase II


A Biometric Pilot-Study to Compare and Contrast the ‘Unconscious’ Human Responses to New Urbanist versus Conventional Subdivisions

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This report follows the first phase[1] of the Emerson Green development in Devens, MA (2016-17) which showed how biometric tools can be used to better understand the key features that make a design memorable and a better fit for human nature promoting healthy living, including predicting ease of neighborhood walkability.

The first phase used eye-tracking emulation software (3M’s Visual Attention Software, VAS) to track what catches people’s eye in a new housing development on Chance Street in Emerson Green and older existing buildings, both restored and unrestored, on the former Devens base. The report outlined how VAS can help set new metrics for evaluating residential development by showing:

- the ‘regions’ in a development that attract the eye at ‘first-glance’ or in ‘pre-attentive’ processing, which is before the conscious brain can come online;
- the ‘heat maps’ that glow brightest where people look, indicating where people likely look most in the first 3-to-5 seconds;
- the ‘visual sequence’ the eye is likely to follow taking in a scene, which is predictive of an area’s walkability; people tend not to walk in areas not seen ‘pre-attentively.’

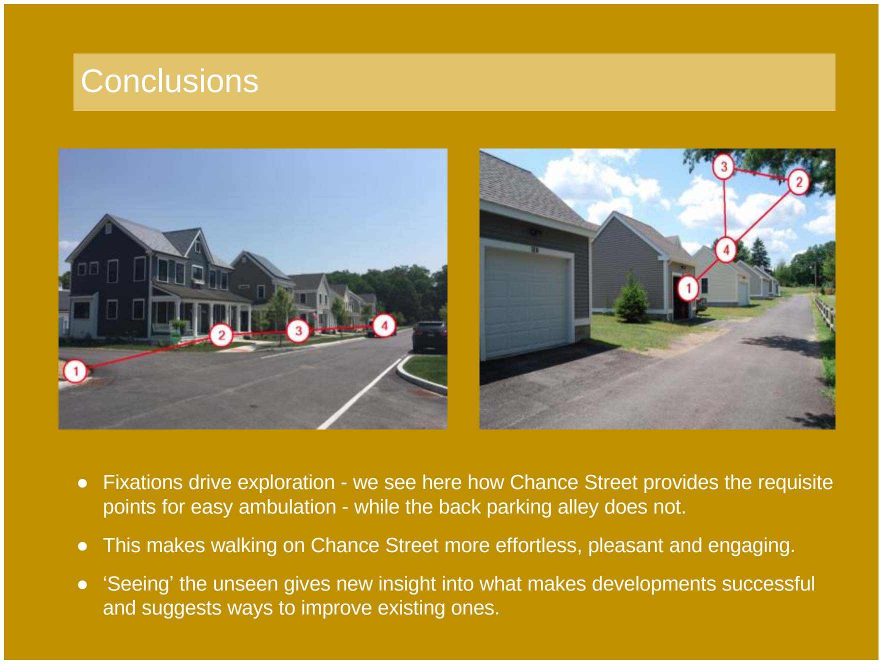
Further drawing specific conclusions about residential-subdivision design, (see Figure 1) the first phase report noted how:

- Housing designed with punched windows and porch columns perennially attract the eye and that linear arrangements of buildings down a street are important for enhancing walkability;
- People ignore blank facades and are less likely to look at blank elevations or move towards them;
- The cognitive science *mantra*, ‘Fixations drive exploration,’ is key for understanding how our unconscious eye movements direct conscious actions and behaviors. The study suggests that one reason many residential subdivisions do

[1] http://www.devensec.com/news/Eye_Tracking_Devens_1_11_18 report.pdf

not invite walkability is they do not provide the requisite *pre-attentive* fixation points for our brain to most easily move us forward.

Figure 1



Phase II

Building on this first study, Phase II of the Devens project seeks to compare a conventional subdivision with the Emerson Green innovative approach, to measure and evaluate walkability and the pedestrian experience as a gauge of a healthy public realm, and to further develop metrics and a new language for healthy place-making. (POD, sense of place). See Figure 2.

Figure 2

PHASE II STUDY PROTOCOL

● Photo Inventory

To study conventional subdivisions for Phase II, we photographed conventional housing developments[2] in Ayer, MA, on Snake Hill Road, built since 2000, and ones of more recent vintage, built within the last five years, on Butterfly Lane, in Lunenburg, MA.

In Devens, we also photographed older Officer housing on Walnut, Auman, Bates and Vicksburg Square buildings on Buena Vista Street and more recently built net-zero energy residences on Bates Street (Index 1 lists locations and Map 1 displays the location of all photographs).

For comparative purposes, we also photographed a historic downtown and business center, in Ayer, MA, and a recently built one at Devens, The Devens Common.

● Eye-tracking Emulation Software

We ran the 158 images collected from Devens and surrounding towns through 3M's VAS (Visual Attention Software) (See Appendix 1). VAS emulates eye tracking, a biometric tool that maps the path the human eye takes looking at something. Eye tracking records fixations, or resting points, and saccades, (the rapid movements between them), and can give insight into what features of an image immediately attract attention. Traditional eye-tracking studies use a lab set-up requiring 30 or more test-takers per study and can be costly and time-consuming to complete. For these Devens studies, we selected the web-based 3M product which provides useful results and is efficient and cost-effective to run (Auffrey and Hildebrandt 2017; Cottrell 2016).

Because humans are such a visual species, where "fully half of the sensory information going to the brain is visual," (Kandel, Eric, p. 238) understanding where we look without conscious awareness – at 'first-glance' – as 3M notes (3M.com/VAS), turns out to be supremely important for determining our subsequent behaviors. This is because neurons that carry the information from our eye go directly to our brainstem, our ancient 'reptilian' brain, at the ready to 'fight, flight or freeze' depending on information received. This 'bottom-up' processing, which happens first and faster than the 'top-down' thinking from the higher human cortical regions, makes VAS and eye-tracking so relevant as a predictive metric for gauging human behavior in the built environment.

VAS's algorithm, based on 30 years of eye-tracking research, predicts responses to visual stimuli within the first 3 to 5 seconds, during *pre-attentive processing,* assessing study images for five "visual elements" known to attract attention; these are, "edges," "faces", color "intensity," "red/green color contrast" and "blue/yellow color contrast" (3M, 2017).

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[2] We define "conventional developments" as post-war housing developments that are car-centric, prioritizing drivers over pedestrians.

FINDINGS

- The Phase II VAS study reveals that conventional subdivisions, such as in Lunenburg and Ayer, make people focus 'pre-attentively' on the horizon and distant view; (See Figure 4)
- Pedestrian-centric design, on the other hand, as in Emerson Green, create edge conditions *with requisite fixation* points for pedestrians to focus on *at their side* to enable walking forward most effortlessly. (See Figure 3)

The VAS results for Emerson Green's Chance Street, show the 'regions' that grab human attention first and most (in red outline) – and how they tend to be at the street edge *not* straight out front:

Figure 3

Chance Street edge conditions grab attention.

Whereas, VAS indicates how in conventional developments, like Snake Hill Road, Ayer, or Butterfly Lane, Lunenburg, people relentlessly look, or 'fixate', straight ahead. They simply cannot help themselves, the brain directing this behavior without conscious awareness. (See Figure 4) The houses are simply set too far back from the street to get the brain's initial attention.

Figure 4

Of the 10 streets studied in Phase II, only the Vicksburg Square buildings on Buena Vista Street, by the Rogers Field in Devens, created similar red-outlined edge conditions, or implicitly drew the eye to buildings, off road. Significantly, of all streets, except Chance, we found Buena Vista the easiest to walk down, despite the fact its buildings stood empty and unrenovated. (See Figure 5) The proximity of the buildings to the street, with their symmetrical arrangements of punched windows, immediately drew the eye to the facades.

Figure 5

- The VAS Phase II study additionally reveals a key reason conventional development hampers walkability is because they fragment *unconscious visual sequencing* making it hard for people to know where to intuitively move; (See Figure 6). Walking bipedally, a demanding activity for the brain, is best done with *automaticity*, without the brain having to consciously think about it and most likely happens when layouts provide sequential arrangements of fixations.

The Phase II study also suggests that typical design characteristics of walkable neighborhoods, with buildings closer to street, parking in back, sidewalks and other multi-modal accommodations, consistently connect buildings, streets and the pedestrian's point of view, while conventional subdivisions don't – their buildings' front doors, set far back from the street, lead to expansive lawns and driveways rather than sidewalks and streets, and are inadvertently blind to pedestrian orientation needs; VAS *heat maps* show this disconnect between the street and residence, (Figure 7), as a large black band, severing the viewer from the building, deconstructing how the pedestrian sense of disconnection happens.

The Phase II study also underscores findings from Phase I, that punched windows symmetrically arranged on a symmetrical façade grab the eye, aiding in finding a front door; which likely reduces the anxiety people experience when they cannot do so! (Figure 8) The study also indicates that the inclusion of sidewalks and placement of buildings closer to the street, combined with the architectural style of the building contributes to walkability (providing requisite fixation points that promote it.)

Figure 6

Chance Street visual sequencing implies effortless walkability;

Snake Hill Road visual sequencing, often tracking skyward, does not; the same skyward move happens at Butterfly Lane, below left, and Walnut street, at right.

Figure 6 underscores why it is easier to walk in a development with a layout implicitly, or *unconsciously*, telling the brain where to go. Figure 7 further reveals how our brain actively visually connects - or not - to its surroundings, with buildings closer in, not surprisingly, more likely to get attention.

Figure 7

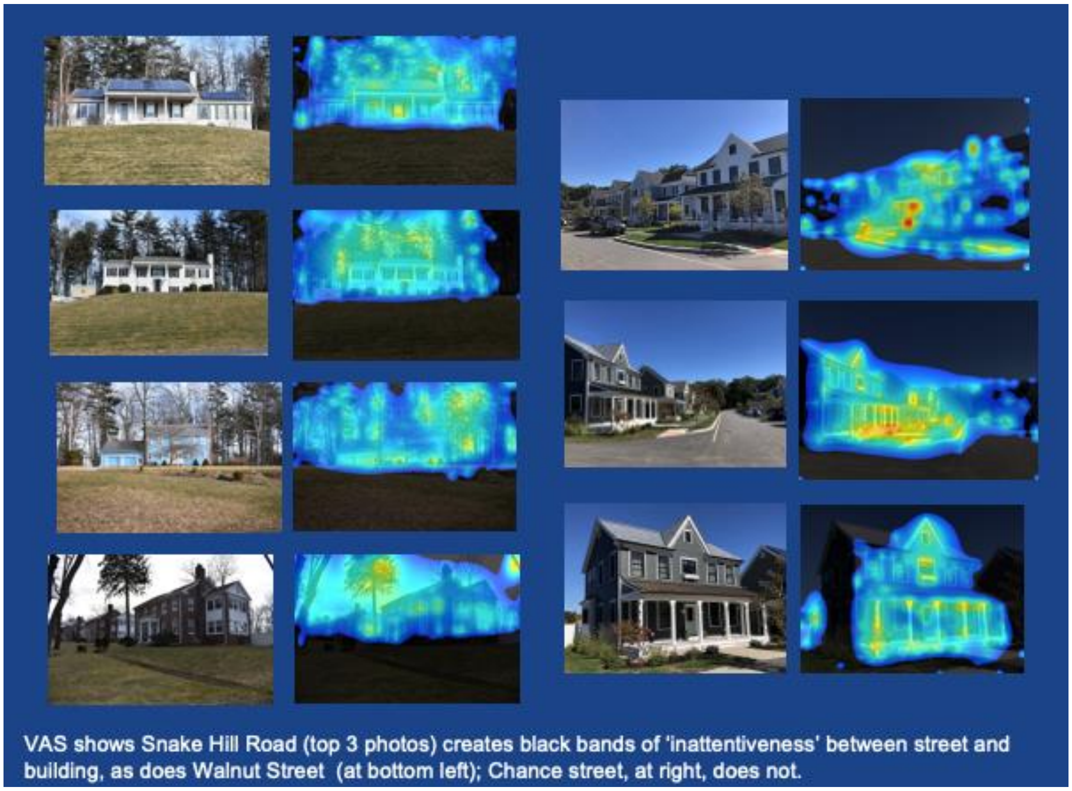
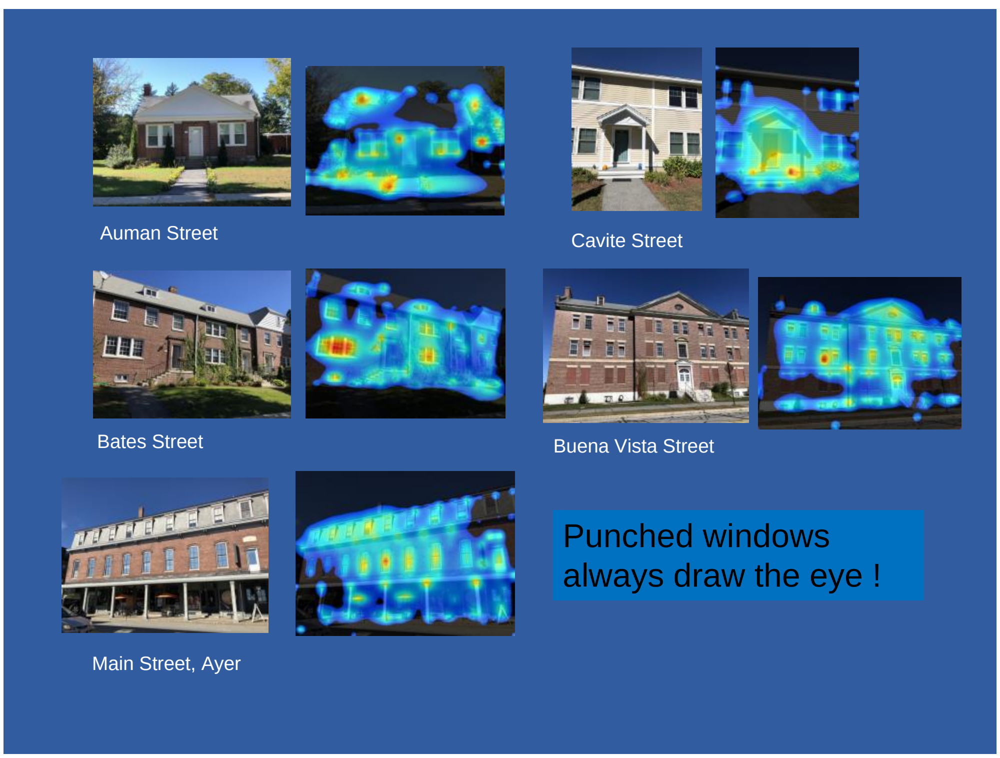


Figure 8



In Figure 8, we again note how rarely punched windows show up as black on VAS images. Heat maps show them as yellow and orange dots indicating strong eye appeal. Helping to create an organized experience, these fixations matter, implicitly indicating in traditional and vernacular architecture, for instance, where a front door is likely to be. (See how the buildings on Chance Street, Bates Street and downtown Ayer all do this.)

Quantitative Analysis

To explore how the findings held across the neighborhood studied, we ran a quantitative analysis tabulating first fixations and strongest Regions of Interest (ROIs), or areas that show up in red outlines in VAS, indicating a 70-96% chance of drawing a person's attention in the first 3-5 seconds. We limited the sample of photos to those which included a building comprising at least 10% of the image. For red regions, we counted the single feature most predominately featured. See Appendix 2 for the results of the first-fixation analysis and Appendix 3, for red region analysis results.

For the fixation points, we found:

- Punched windows (on building) and plant/trees (not on building) tended to be viewed first, with architectural elements and contrasting landscaping contributing to walkability;

- Elements on Buildings tended to be viewed first in Vicksburg Square, Bates Street, Net-Zero Energy Condos, Chance, Rear of Elm Street Multi-family housing in Devens, downtown Ayer streets [> 50%];

- Elements *not on buildings* tended to viewed first in Auman, Street Service Roads/ Rear of homes, Bates, Cavite Street 13-unit multi-family housing (women's shelter), Walnut Street in Devens and Snake and Butterfly Streets in Ayer [<50%];

- The Devens Common had a distribution of "first viewed" features relating to both buildings and other elements.

For the Red Regions, we found:

- Elements on buildings tended to be the main attribute in the red regions of Vicksburg Square, Cavite and Chance streets;

- Elements *not on building* tended to be the main attribute in the red regions of Auman, Auman Street Service Roads/Rear of homes, Devens Common and Walnut Street in Devens and Main, Snake, and Butterfly Streets in Ayer;

- Cavite Street 13-unit multi-family housing (women's shelter) had the same distribution of features related to both buildings and other elements in red region.

In sum, the tabulations confirm how buildings on Chance and Vicksburg Square generally featured architecture that attracts the eye, while the eye is not drawn to houses on Snake Hill and Butterfly Lane, along with some other Devens' neighborhoods where housing is set back from the street and where there are no sidewalks.

DISCUSSION

Biometric tools such as 3M's VAS, (Visual Attention Software) help us understand how people take in their surroundings, revealing hidden human brain architecture and visual biases, which turn out to be surprisingly useful in assessing actual built-architecture including the differences between conventional and new urbanist subdivisions.

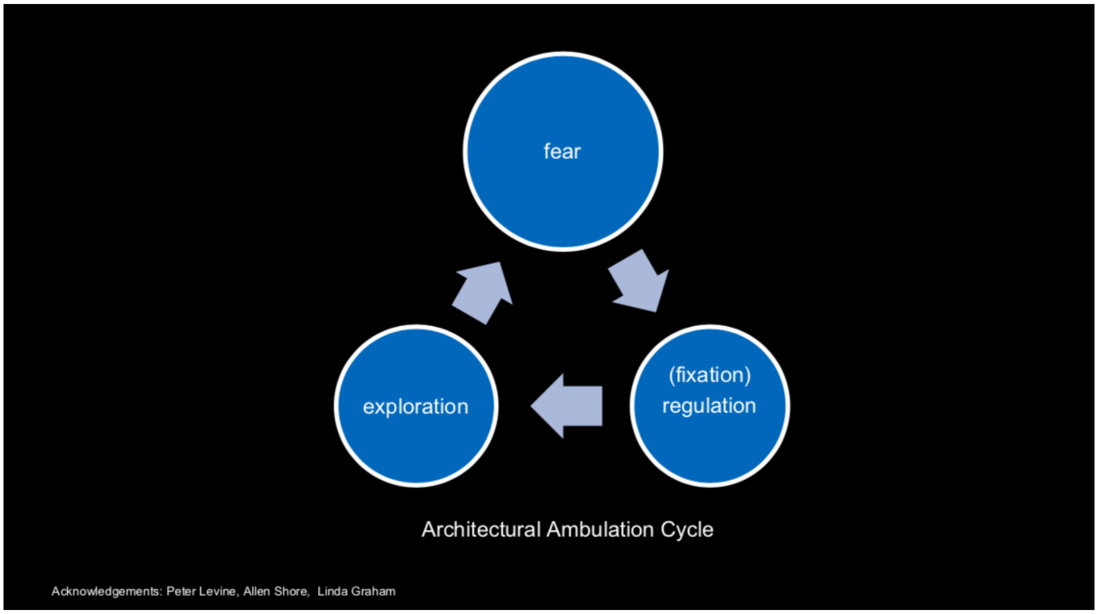
The Devens Phase II study indicates that the layout of conventional subdivisions, such as those in Lunenburg and Ayer, while obviously taking in the desires of individual homeowners, are designed collectively, from *the driver's perspective*, designed to provide an uninterrupted view of the road straight-ahead. The layout of houses far from the street, makes it easy on the driver, but difficult for the pedestrian walking in the neighborhood to fixate on or *even find* any buildings *pre-attentively*. This makes walking onerous, and lessens the likelihood that people will even think of doing so. Essentially, what we appear to observe in both Phase I and II of this study, is the impact of the near universal application of *The American Association of State Highway and Transportation Officials Highway Manual* in suburbs, which prioritizing the needs of the driver, gives little thought to pedestrian experience, walkability or human health overall. Treating walking as an 'externality', we see in this study, promotes a fracturing of the public realm, a disconnected sense of place, at the end of the day, eroding both individual and community well-being.

First fixations matter. Interestingly, in the most walkable districts, including new-urbanist Chance Street, and Vicksburg Square along Buena Vista Street, *first fixations* tend to be on building facades themselves; this rarely happens in the conventional developments, where they tend to be on road, sky, or edge conditions. On Chance Street, we also observed how the fixation sequence within five seconds connects neighboring buildings making the neighborhood appear obviously, inherently connected.
The study also suggests that the endemic 'placeless-ness' in many conventional suburban communities happens because of *black bands of inattentiveness* (Figure 7) surrounding the pedestrian in such environments. VAS indicates it takes extra work to make a connection between the street, building and person in these places – too much from the brain's perspective, so people do not.

And, as in the Phase I study, we also saw that visual sequencing forecasts walkability and coherent experience of place. Gaze path matters and appears to connect to *ease of orientation* in a place and the ease of moving yourself forward there. Whether in Butterfly Lane or Snake Hill Road, anecdotally we experienced a sense of *disorientation* when visiting these conventional subdivisions and the VAS visual sequencing, starting up in the air or a tree, suggests why. Conversely, we experienced a sense of coherence in areas with the most straightforward gaze path, with VAS focused on houses, front porches, symmetrical arrangements of punched windows and doorways, as we also found in the Chance Street development Phase I study.

While VAS reveals hidden brain architecture, it also reflects essential mechanisms from neuroscience regulating our nervous system. The straight-forward visual sequencing we consistently find in the walkable districts leads us to posit *the Architectural Ambulation Cycle* (see Figure 9) where our fear-based brain is quickly soothed or regulated. Because the brain does not receive the regulating *pre-attentive* fixations in conventional subdivisions – and never will – people cannot feel comfortable walking there the way they can in neighborhoods that provide the requisite *pre-attentive* fixations (Levine 1997).

Figure 9



The quantitative findings also reinforce that neighborhoods like Chance Street, Cavite, Vicksburg Square, with their punched windows, high quality edges, and other features tend to draw the first fixation and most red regions on their buildings. In contrast the conventional subdivisions on Snake Hill Road and Butterfly Lane, cannot draw the eye and create the fixations required for effortless walking.

- **Implications for Urban Planning**

A key implication of these studies is that by revealing our *pre-attentive* habits we understand ourselves better and can build and plan better places, literally forecasting how we will unconsciously respond to and take in a new development. We also see that VAS and biometric tools like it can serve as a useful tool for quickly showing people something critical and often overlooked: how our ancient brain architecture and *pre-attentive* habits set parameters for our modern built environments.

The Phase II study also highlights how human walking needs and automobile driving needs are different, opposing, and in certain ways *irreconcilable*. The driver want a view straight ahead without distractions at the edges to be able to move straight forward quickly; the walker favors edge conditions that draw the eye on a rhythmic regular basis, like on Chance Street.

CONCLUSION

Biometric tools, such as VAS, are useful for helping us better understand the human experience in new and existing communities. They can help us quickly grasp the difference between conventional, traditional, and new urbanist developments and 'see' how the experience of each is framed in seconds. Biometric studies provide a new language, where words like *fixations* and *pre-attentive processing* enter the urban planners' lexicon to promote better place-making and enable more accurate assessments of existing or planned communities. They aide in creating safe and healthy spaces, designed for people, acknowledging the hidden needs we all carry and appropriate ways of responding to them.

There is also the opportunity for further research to elaborate these ideas. External stimuli contribute to our internal organization and subsequent behaviors; it is important to honor that. Or, to put in other words, borrowing from Steve Jobs, the broader our understanding of the *unconscious* human experience, the better design we will have.

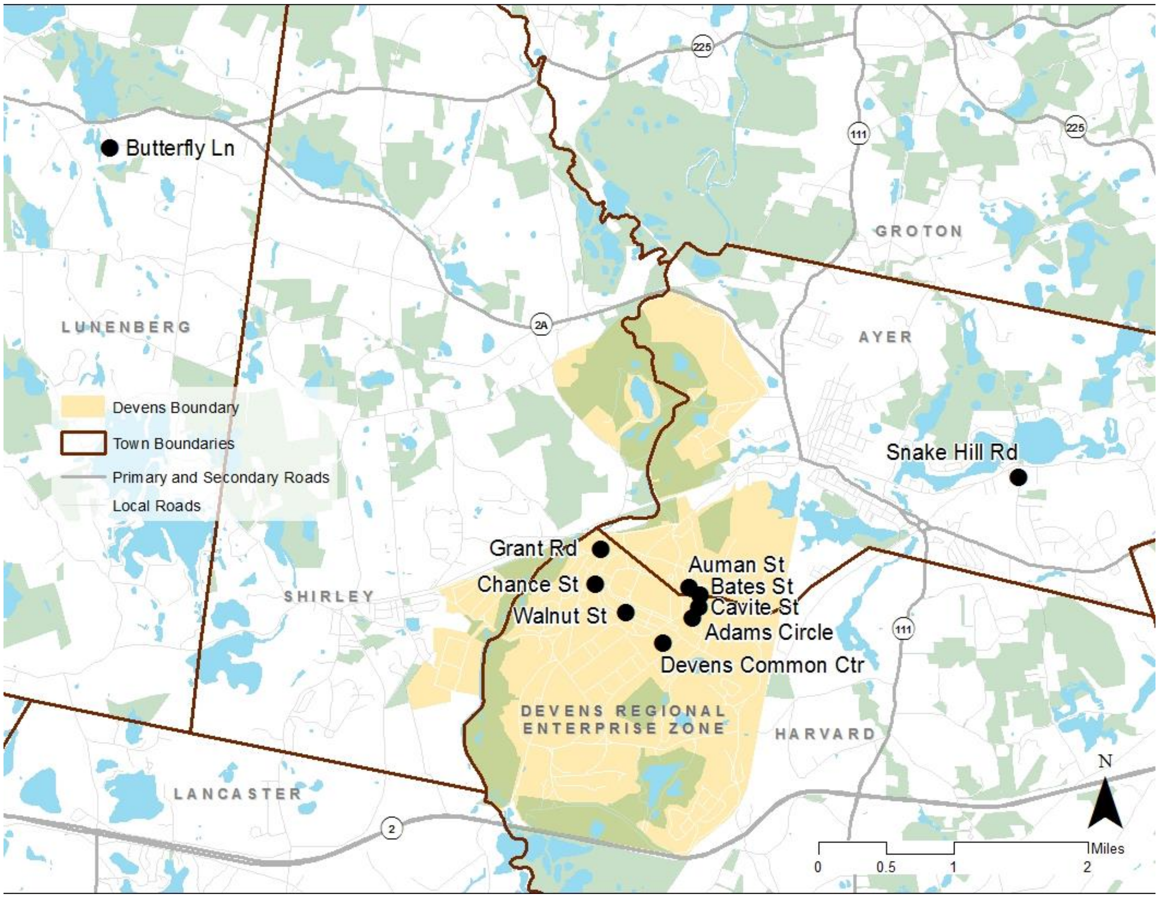
Phase II location list:

- Emerson Green, Devens, MA (Housing Subdivision)
    - Chance Street (https://goo.gl/maps/hATNnjnBBMk)
- Historic Officer Housing and Barracks, Devens, MA
    - Walnut Street (https://goo.gl/maps/btPMYkXNFRC2)
    - Bates Street (https://goo.gl/maps/YYtcsvnYCH92)
    - Auman Street (https://goo.gl/maps/wZk6GzdSW3u)
    - Grant Road (https://goo.gl/maps/PVnSZSxhZFR2)
    - Buena Vista Street (https://goo.gl/maps/UjC1dULk62f69pPX8)
- Transformation Inc, (Sustainable Housing Complex) Devens, MA
    - Cavite Street (https://goo.gl/maps/uqiHzaZ6taJ2)
    - Adams Circle (https://goo.gl/maps/QhKkmN55mTB2)
- Ayer, MA Housing Subdivision
    - Snake Hill Road (https://goo.gl/maps/SsmHcLxnSREYtCQ5A)
- Lunenberg, MA Housing Subdivision
    - Butterfly Lane (https://goo.gl/maps/wCeBnhysjNr)

List of all images in Devens Phase II VAS analysis:

https://app.box.com/file/352683032515

Map 1



Butterfly Ln
LUNENBERG
GROTON
AYER
Devens Boundary
Town Boundaries
Primary and Secondary Roads
Local Roads
Snake Hill Rd
Grant Rd
Auman St
Chance St
Bates St
Cavite St
Walnut St
Adams Circle
Devens Common Ctr
SHIRLEY
DEVENS REGIONAL
ENTERPRISE ZONE
HARVARD
LANCASTER
N
Miles
0
0.5
1
2
225
111
2A
2

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