

# The Guide to Map Design



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## 01 introduction

*Map design is a synthesis of design and data; balancing information, context, color, readability and accuracy. A well designed map must encourage exploration while maintaining quick comprehension.*

Modern mapping tools unlock the traditional GIS “black box” and democratize map making for developers and designers. This allows product owners to build elegant, considered mapping experiences for their end users.

Tools like **Mapbox Studio** and **Mapbox GL JS**, allow for visual and experiential mapping customization. Maps can respond in real-time to user inputs, environments, needs, and other factors.

## Why design custom maps?

Maps visualize our current location, our destination, and everything in between. Depending on where you are going, how you're getting there, and what you are doing once you arrive; you need totally different view of the map. Since our mapping needs and experiences can be very unique, why should all maps look exactly the same?

Customizing your map allows you to curate the data, measure the experience, and match the context with your brand. Teams typically tend to customize their maps for one of the following reasons:

- To improve performance
- To focus the visual narrative
- To streamline map content for context
- To identify patterns in big data



## How to use this guide

Some people begin the mapping process by diving into the code, reading the API documentation, or exploring the interface. The designer approach? Question everything before you build anything. The key is starting with the right questions.

As you start this map design process, ask yourself and your team:

- Why do we need to customize this mapping experience?
- What is the purpose of this mapping experience?
- How, where, and why will our users interact with this mapping experience?

This guide will explain:

- What vector maps are, how they are built, and how they work.
- The four design elements you need to change to customize your map—color, typography, iconography, and texture.
- The basic design principles to adhere to as you design your map—contrast, hierarchy, density, and legibility.
- Best practices for designing maps for navigation, mobile, and data visualization.
- An overview of the Mapbox curated global data available for your mapping needs and how to leverage it.
- The features and benefits of each of the Mapbox-provided core map styles. These can act as templates for you to begin your custom map, choose wisely.

By the end of this guide, you'll have the strategy and design toolkit you need to begin designing the perfect branded map for your application.

**Let's get started!**

## 02 vector maps

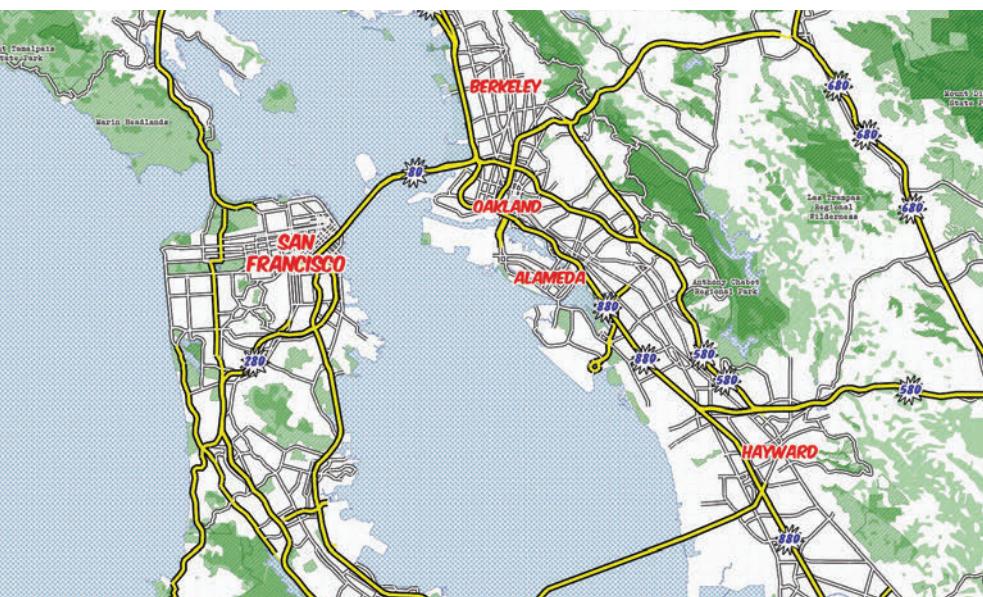
*Vector maps are an advanced approach to mapping where geospatial data is delivered to a device (mobile, web, auto, etc.) and then mathematically rendered in real-time.*

The underlying structure of a vector map is geospatial information; meaning planet data like coordinates, address, city or zip code. This data makes up the invisible fabric of our world in points, lines, and polygons. You can style the data, hide the data, add your own custom data, or even change the data on the fly. This map is also the baseline for all the interactions you will have in your application. Be that navigation information, search capabilities, or a mobile experience, this map can be used in every instance and is changeable at any time.

Vector maps consist of three working parts: **1) the renderer, 2) the vector tiles, and 3) the style rules.**

## The renderer

The engine that draws and redraws your maps is Mapbox GL. Mapbox GL uses the power of WebGL to combine vector data with style rules and draws that on the client in real time. For web browsers, the Javascript library Mapbox GL JS draws the map and allows for motion and interactivity to be incorporated with code. For maps in native applications such as Mapbox iOS and Android SDKs, Mapbox GL Native is the renderer for the job.



## The vector tiles

The vector tileset is a set of points, lines, and polygons that represent natural and manmade features across the globe. Vector tilesets describe the geometry of each feature, where they belong in the world, and other key properties. They do not include any inherent style properties. This data is optimized in vector tile format which renders the data lightweight and ready for delivery on mobile or web platforms.

## The style rules

The map style itself is written as rules which define its visual appearance using the [Mapbox GL Style Specification](#).

It specifies:

- What data to draw
- What order to draw the data in
- How to style the data when drawing it

Don't worry you don't have to touch a line of code if you don't want to.

The style editor in Mapbox Studio provides the user interface where you can define your map style. Behind the scenes, Studio creates the file containing all your specified rules in a JSON file called, `style.json`, and hosts the file along with your custom data, fonts, and images on Mapbox.com. Then your style is accessible via endpoint to add to your mobile or web app.



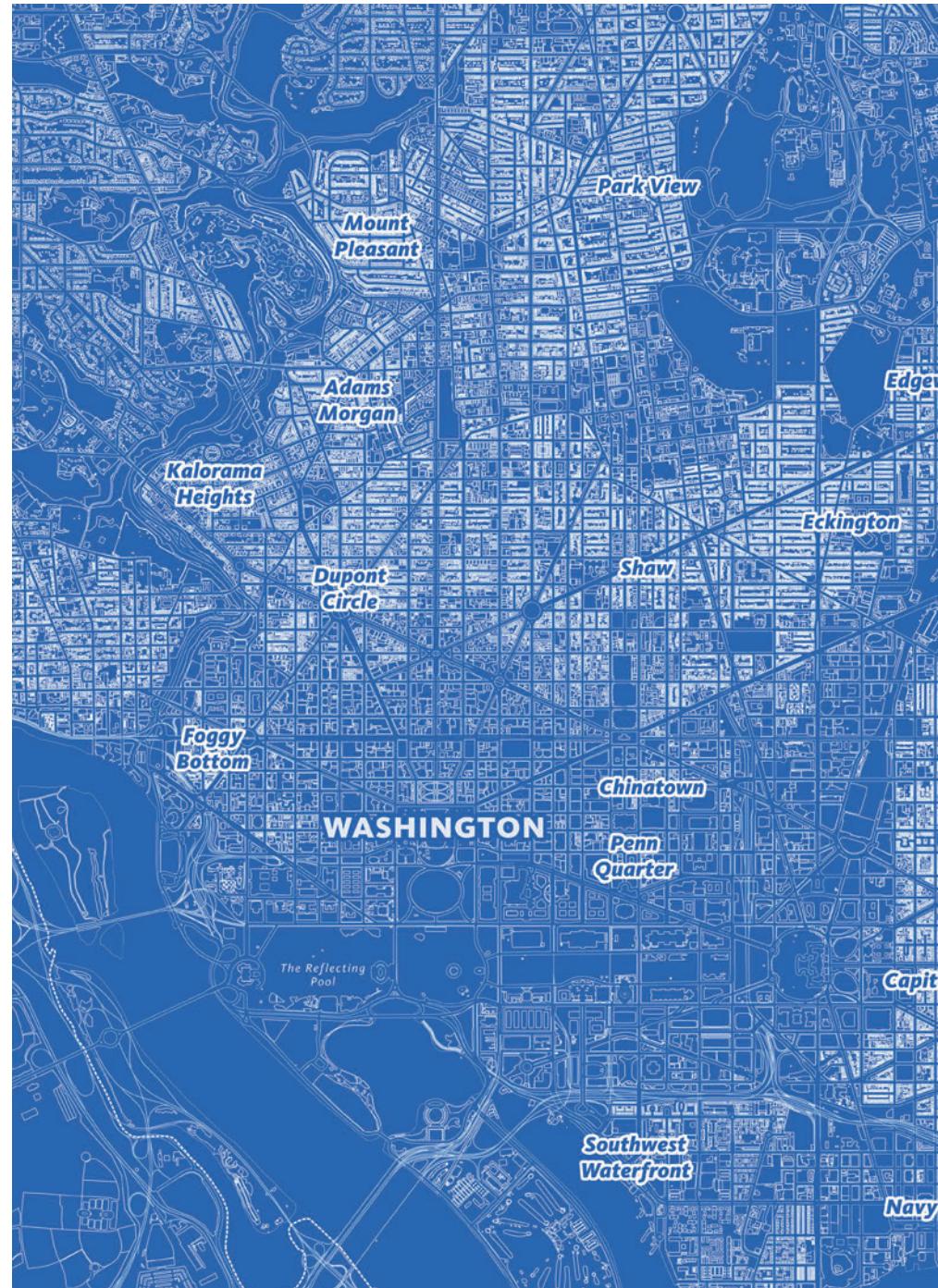
```
{
  version: 8,
  name: "whaami",
  + metadata: {},
  - center: [
    -122.40041294788173,
    37.7667664679347
  ],
  zoom: 11.247547497362104,
  bearing: 0,
  pitch: 0,
  - sources: {
    - composite: {
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      type: "vector"
    },
    - mapbox://mslee.3rd3tnlg: {
      url: "mapbox://mslee.3rd3tnlg",
      type: "vector"
    }
  },
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  glyphs: "mapbox://fonts/mslee/{fontstack}/{range}.pbf",
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      type: "background",
      - layout: {
        visibility: "visible"
      }
    }
  ]
}
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## 03 map design

*Map design begins with the problem you're solving. As you craft your vision, the solution is reached beyond the dance of designing and building and sometimes starting over.*

In this section, we'll cover four key design elements you should identify and customize to fit your product. While you have complete control over your map style—in fact, any feature can be customized—make updates sparingly. Much of the sizing and hierarchy for labels and road networks have been carefully curated by the Mapbox cartography team for you. We recommend you start customizing your map by changing: color, typography, iconography, and texture.

Armed with those design decisions, adhere to these four key design principles that will ensure your map is well designed: contrast, hierarchy, density, and legibility. These principles are not to be applied in isolation, they're complementary. Collectively, they help cartographers and map designers create maps that successfully communicate geographic information.



## Design elements

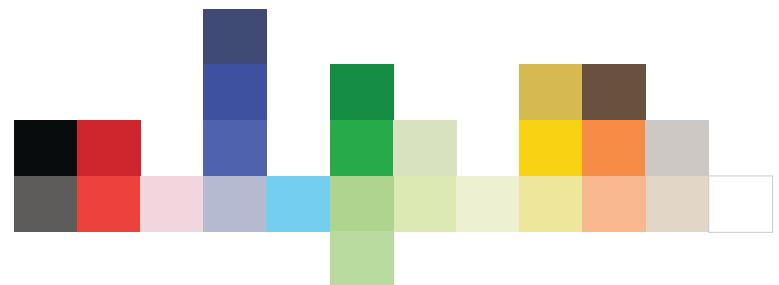
Consider the following elements to be the customizable parts of your map. You can typically find these elements outlined in your style guide. Look for the fonts, colors, imagery, patterns, tone, etc. specific to your brand to help you make decisions about your map's customization.

Typically, you want your map to match your brand or to complement your brand's user interface. Let's review each design element in detail to see the impact it has on your map style.

## Number of colors

Use color conservatively. The eye can only process so much at a time, so a limited color palette is best. Depending on the complexity of your map design, between 10-12 colors is pretty standard for a full-body color palette. Also consider a significant portion of the population has limited color vision, so style accordingly.

Both Mapbox Streets and Mapbox Outdoors use around a dozen unique colors, but a variety of shades and tints.

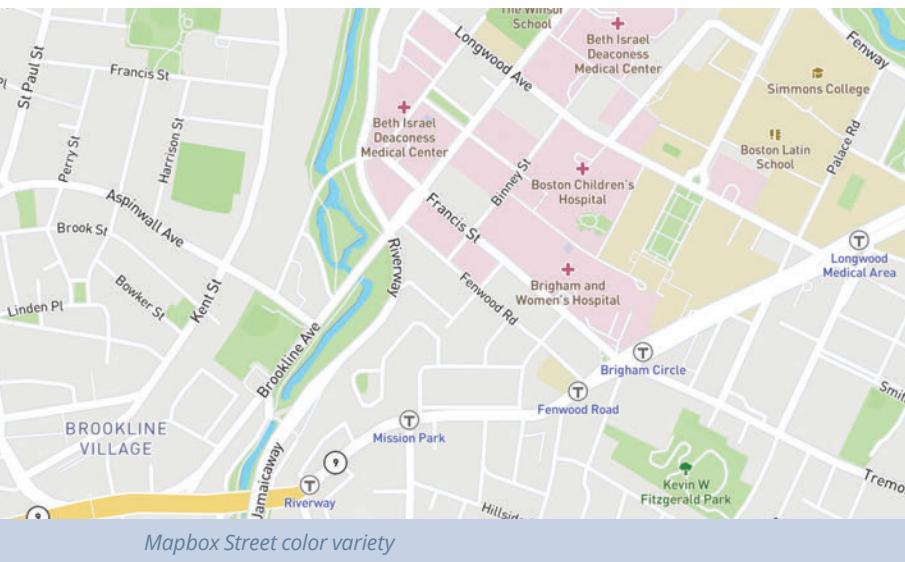


Many conceptually similar features share the same hue value, to reinforce their meaning and create a more cohesive map.

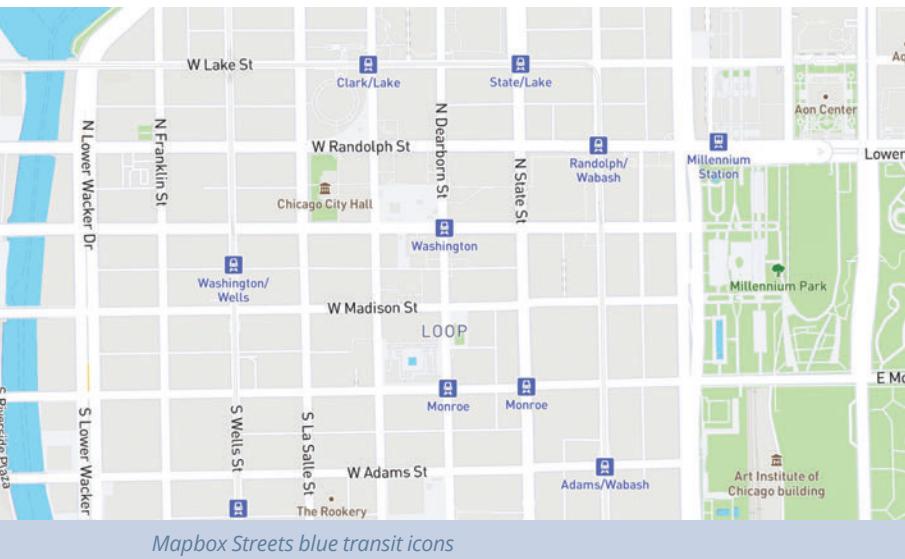
## Color

Color is used in design to attract attention, group similar elements, show meaning, and enhance aesthetics. We typically begin the design process with a color palette for each map, comprised of a cohesive group of primary and accent colors. This is an iterative process.

Colors will most likely grow and morph once you start designing and seeing what works together on your map. Just make sure your final map and palette are consistent and work harmoniously together. Below are a few things to consider as you define the color palette for your custom map.



Limiting your colors will also help with visual harmony. For example, many features related to navigation and transportation share the same blue hue: rail labels, highway shields, ferry routes, and even road casings for this purpose.

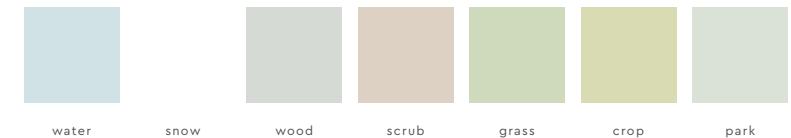


## Color consistency

Make subtle adjustments to your color palette while maintaining visual harmony. Achieve this by matching saturation and lightness across the different hues in your color palette.

The LA Terrain map color palette is very earthy and muted; each hue has the same color dominance and tone or about of lightness/brightness.

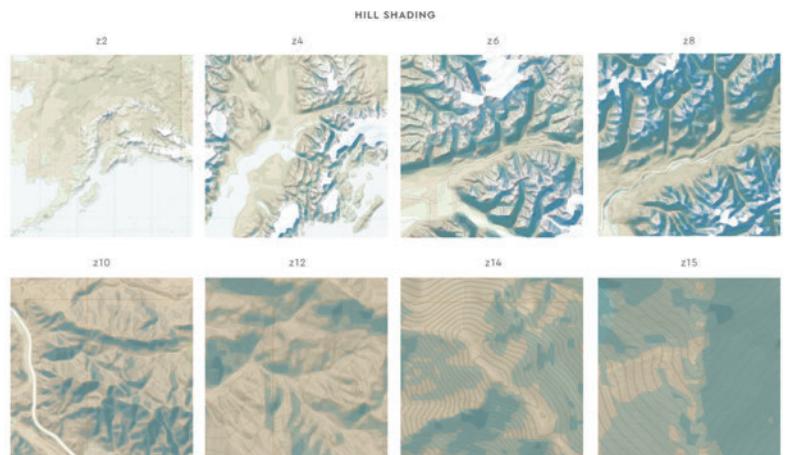
WATER & LANDCOVER & LAND USE



Saturation represents the level of intensity in the color or the dominance of the color. As you decrease the saturation, the hue becomes less vibrant and the color less dominating. At 0 saturation all hues become a colorless gray.

ROAD & RAIL SYMBOLS


Cali Terrain employees the Mapbox Terrain DEM layer which provides more highshades to show visual depth and drama in the terrain. When designing this style, I started with a deep desert brown but used a vibrant blue in various shades as a complement. While brown is a blended color that doesn't have a direct opposite on the color wheel, the hints of orange in my brown made blue the complementary color. These colors blended smoothly, and in some cases, enhanced the green in hilly terrain.





## Typography

Typography is one of the most important design elements of your map and can make or break the readability of your map. Labels, which represent most of the text you find in maps, are often only one to three words long and are displayed at very small sizes. With this constraint, fonts with taller x-heights, open counters, and no serifs usually work best on maps.

Your brand's font may or may not work for your map style needs. In that case, choose a font directly from Mapbox Studio that works for your brand. Consider the font's quality, readability, and personality.

## Quality

High quality fonts offer a variety of styles: *Italics*, *Caps*, *Caps Italic*, and *Small Caps*; weights: *Ultra Light* to *Ultra Black* and everything in between; and widths: *Condensed*, *Narrow*, *Normal*, *Mono*, and *Expanded*, just to name a few. You can leverage this variety to easily differentiate between labels and show hierarchy in your map styles.

## Mapbox primary font

DIN Offc Pro Regular

**Washington, DC**

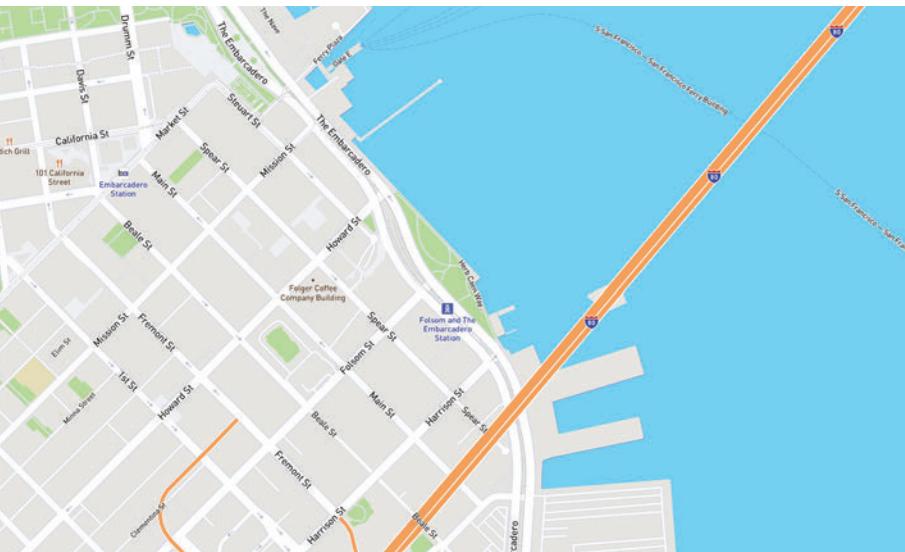
DIN Offc Pro Italic

*Washington, DC*

DIN Offc Pro Medium

**Washington, DC**

DIN Offc Pro Bold

**Washington, DC**

Mapbox Streets, by Mapbox cartography team

The primary font for Mapbox maps is *Din Office Pro* for map styles used in the Medium, Italic, Regular, and Bold variety. We use *Arial Unicode MS* as our fallback font to make sure your map has complete language. *Arial Unicode MS* is mapped to the standard Universal Character Set which supports a wide range of global languages.<sup>1</sup> Most professional fonts do not come with characters to support all languages. Establishing a unicode fallback font is necessary to ensure global coverage.

## Minimalist meets Superfamily

Klevit Offc Pro Light

**Washington, DC**

Klevit Offc Pro Light Italic

*Washington, DC*

Klevit Offc Pro Italic

*Washington, DC*

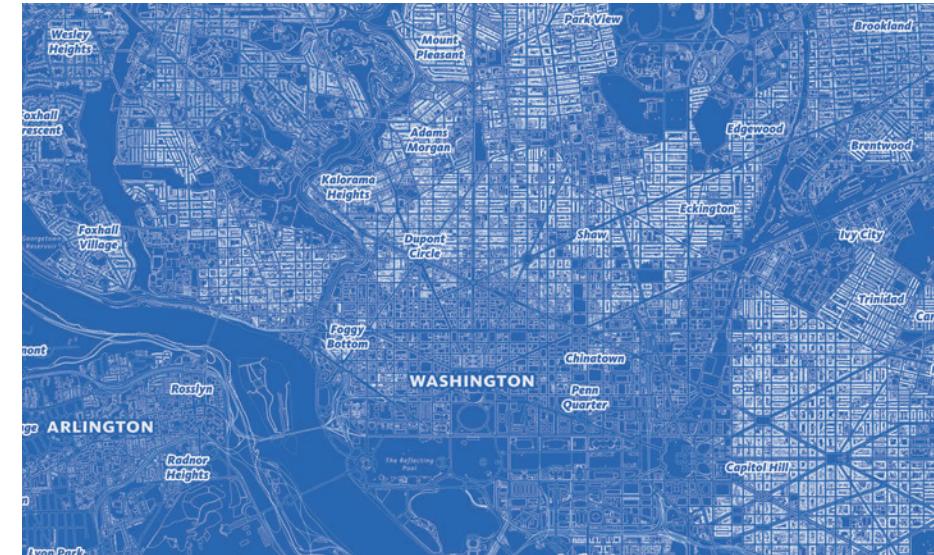
Klevit Offc Pro Bold

**Washington, DC**

Klevit Offc Pro Black

**Washington, DC**

Klevit Offc Pro Black Italic

**Washington, DC**

Blueprint, by Amy Lee Walton

The Blueprint design is driven three variations of blue and one superfamily typeface, *FF Klevit*.<sup>2</sup> This font combines sans-serif form with the structure and proportions of a traditional serif. This superfamily spans 9 weights including small caps, true italics, and figure sets; all the elements for creating a sophisticated typographic system.

## Readability

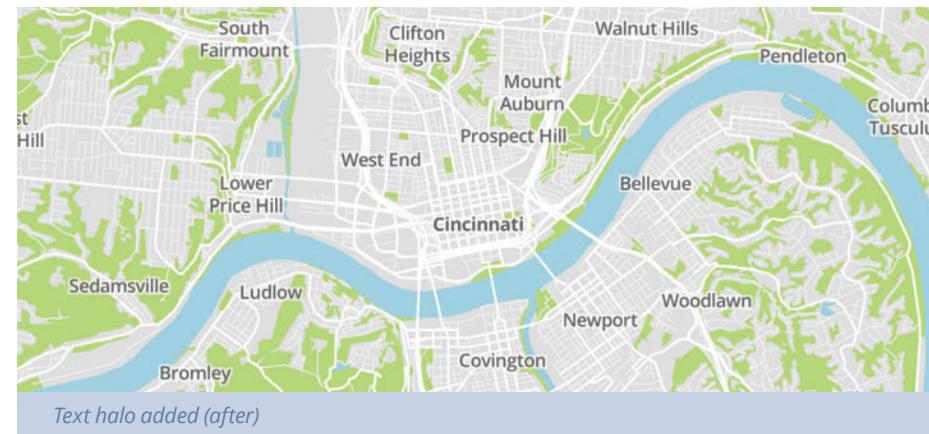
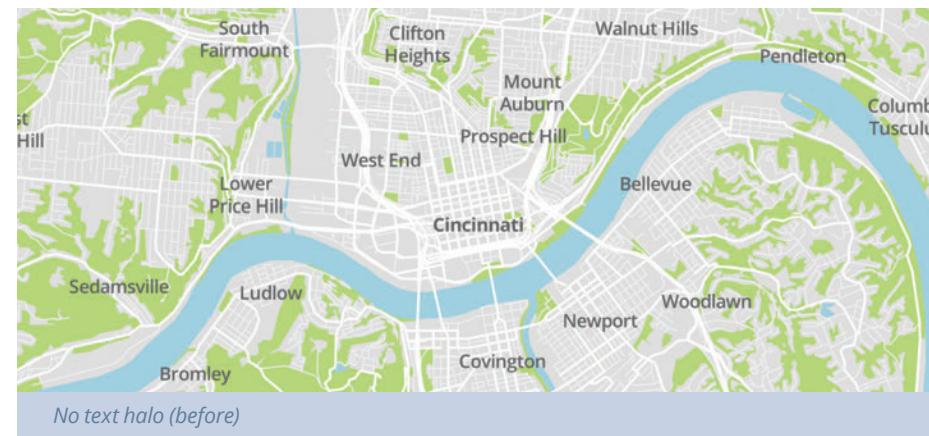
Readability is about arranging words in a way that allows the readers' eye to access the content easily and intelligibly. This skill takes time to hone, but here are a few stellar ways to greatly enhance the readability of your maps:

- 1. Diversity of label classifications.** Design distinction into the classifications and properties available in your label data. For example, place labels offer classifications of cities, towns, villages, neighborhoods, and more. Create a system of treatment to distinguish this diversity.
- 2. Diversity of label colors.** This can be subtly enforced by altering the saturation or value of the same hue as shown in the Color section. This works particularly for styling points of interest (POIs) to give distinction to categories of points, like cafes or schools having distinct colors. But keep it moderate.
- 3. Control the spacing.** Letter spacing (often called tracking) adjusts the spacing between all the letters in a piece of text. This can help to make your labels look more open and inviting. Tiny type is made more readable by opening the letter spacing a bit. As with everything, exercise caution: tracking is often wildly overdone. Also monitor your label width; this determines how many letters fit on one row before a line-break occurs. Be especially mindful of this. Something to be mindful of when working with Bold, Black or just more heavy typefaces.

## Text halos

Text halos bring your labels to the foreground visually and help prevent background elements, such as roads, waterways, etc., from diluting the comprehension of your labels. The specific treatment here will vary from design to design but you want to pull your labels to the foreground without making the halos obvious.

Take a look at the before and after below showing a small halo effect. Notice how much easier it is to read the text after applying a small touch of halo.



## Personality

The personality of a typeface speaks to the voice and energy it exudes. The most popular styles of type are sans-serif, serif, and script. Sans-serif fonts work best on web and mobile because of the lower DPI (dots per inch) on screens. Three main types of sans-serif fonts: humanist, transitional and geometric.

Humanist sans-serif typefaces mimic handwriting and evoke a feeling of warmth and personality. Transitional sans-serif typefaces have strong strokes and are more upright and uniform. They typically have an unassuming, authoritarian and modern personality. Geometric sans-serif typefaces use geometric shapes to form the backbones of the letters, which creates a strict, objective, and universal feel.

Details of a typeface—such as contrast, proportions and angles—can alter a type's emotional characteristics. Here are a few questions to ask of the typeface you're considering:

- What's the purpose and mood of this font?
- Is it serif or sans-serif?
- Does it blend into the background or stand out?
- Does it feel classic or more creative or edgy?
- Does this match the mood of my product or app?

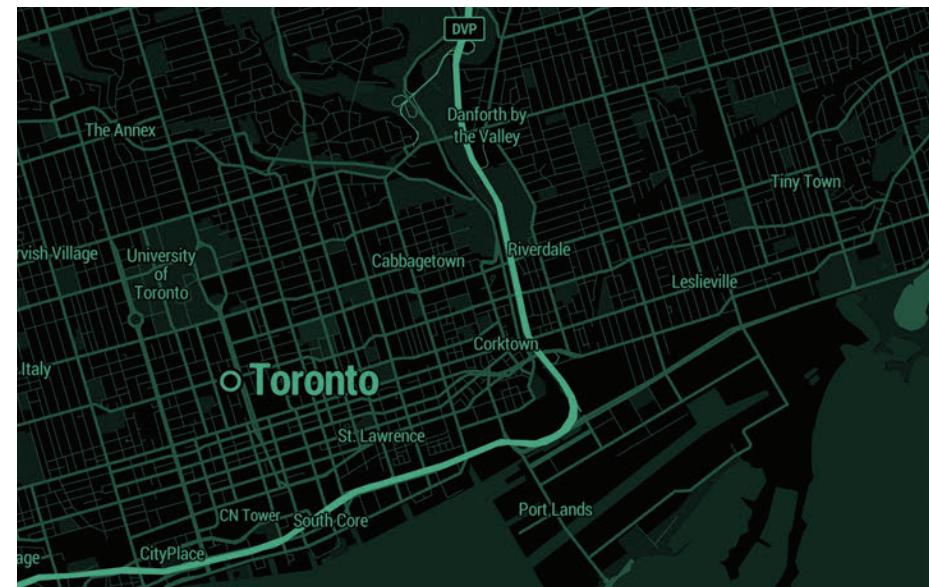
Let's unpack the personality of some Mapbox designer map styles.

## Modern yet approachable

Roboto Condensed

Roboto Bold Condensed

**Washington, DC**    **Washington, DC**



Decimal, by Tristen Brown

**Decimal** uses simple dark colors with a splash of vibrant details. The fonts used are *Roboto Condensed* and *Roboto Bold Condensed*. Google describes Roboto as “modern, yet approachable” and “emotional”. Condensed fonts grab your attention due to their slender, high-reaching vertical real estate. This font pairs very nicely with such an extreme color palette and feel overly technical with the terminal, computer whiz theme.

## The modern classic

Roboto Mono Thin  
Washington, DC

Roboto Mono Light  
Washington, DC

Roboto Mono Regular  
Washington, DC

Roboto Mono Italic  
*Washington, DC*

Roboto Mono Medium  
**Washington, DC**

Old Standard TT Italic  
*Washington, DC*



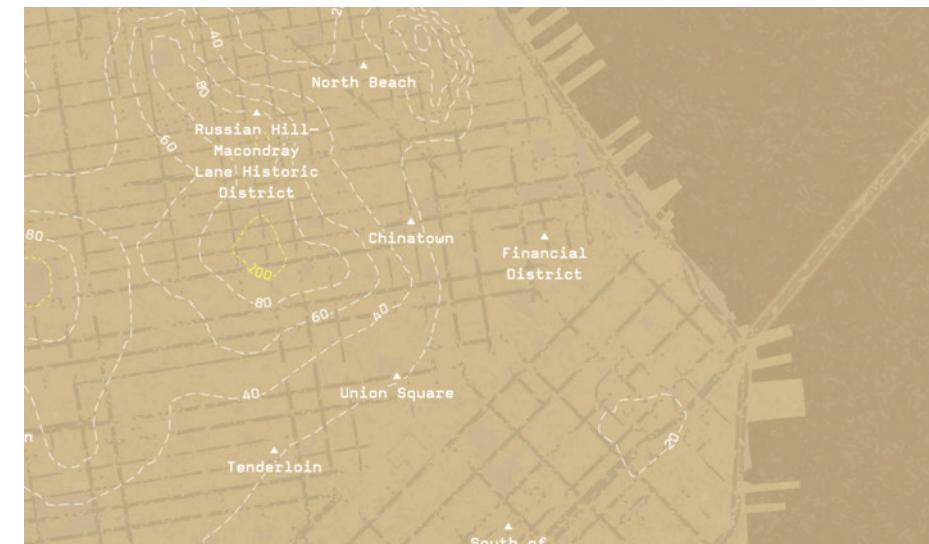
*North Star, by Nat Slaughter*

**North Star** uses *Roboto Mono* in a variety of weights and styles. While “modern, yet approachable” the monospace format has letters and characters occupy the same amount of horizontal space similar to the lettering that would come from an old- fashioned typewriter. North Star pairs this font with gentle touches of *Old Standard TT*. Another modern, yet classicist style font but with serif evoking an older, classic feeling of the late 19th century. This combination promotes the old modern mix of this map style.

## Nostalgic grunge

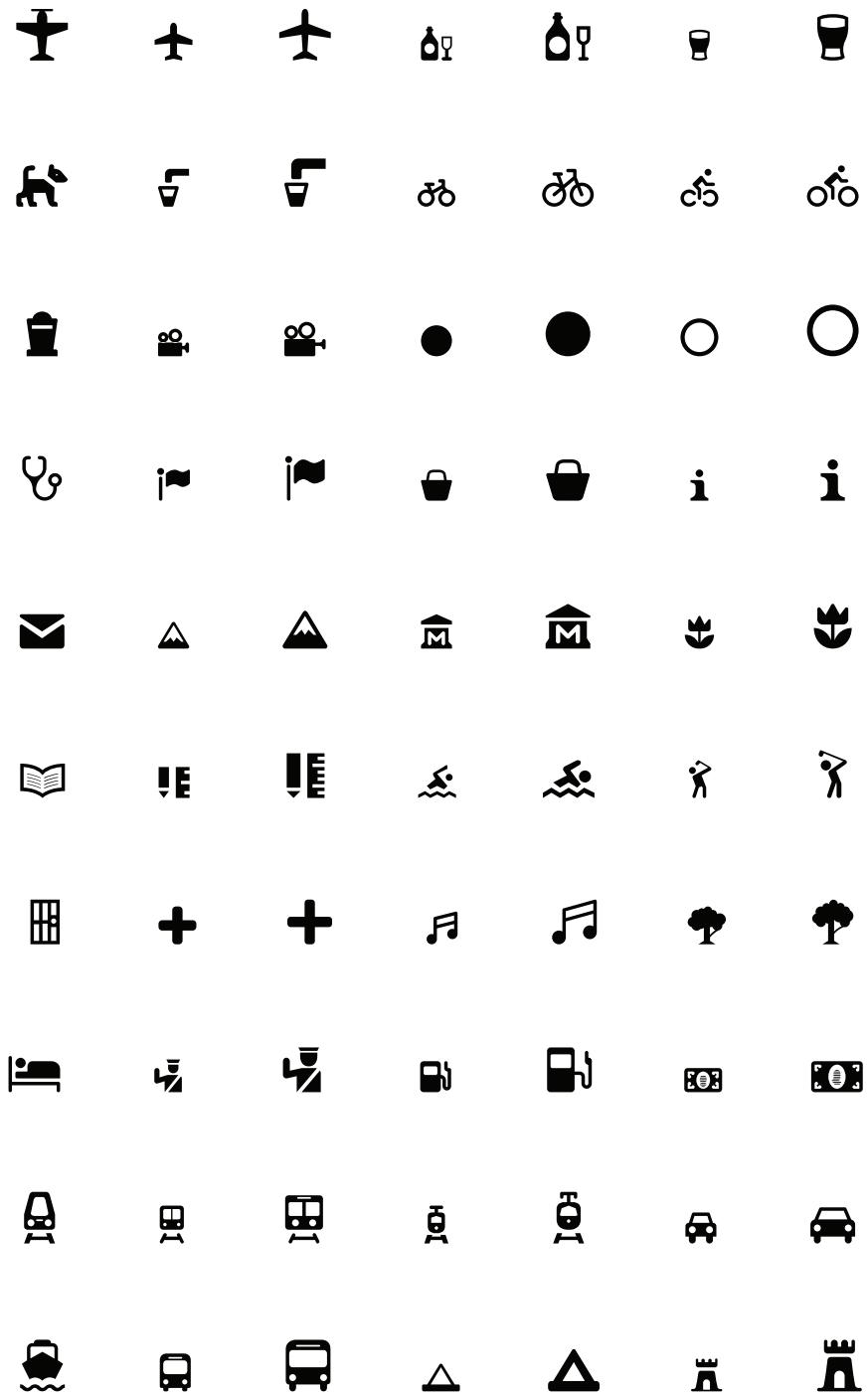
Magda Clean Mono Offc Pro Bold  
**Washington, DC**

Magda Clean Mono Offc Pro Black  
**Washington, DC**



*Desert Planet, by Saman Bemel-Benrud*

**Desert Planet** uses *Magda Clean Mono Offc Pro Bold* and *Magda Clean Mono Offc Pro Black*, both available in Mapbox Studio. Another monospace, this font has a boxy typewriter look giving it a throwback appeal. There is also a grungy, edginess to the wide letters and the letter spacing added to these labels. This font has tons of personality and adds a strong narrative to this deserted, almost dystopian map style.



## Iconography

Map icons typically indicate points of interest or POIs. They can represent any type of location or business; from libraries to cafes to parks to museums to bus stops. The icons you use in your map should reinforce your brand and strengthen your map's brand recognition and readability.

Successful map icons must be widely recognizable even across cultures, as simple as possible, and legible at sizes as small as 11px. Creating your own custom map icons for each project is rather time-consuming, so Mapbox has created a collection of pixel-aligned point of interest icons made by cartographers for cartography. This collection of icons is called **Maki**.

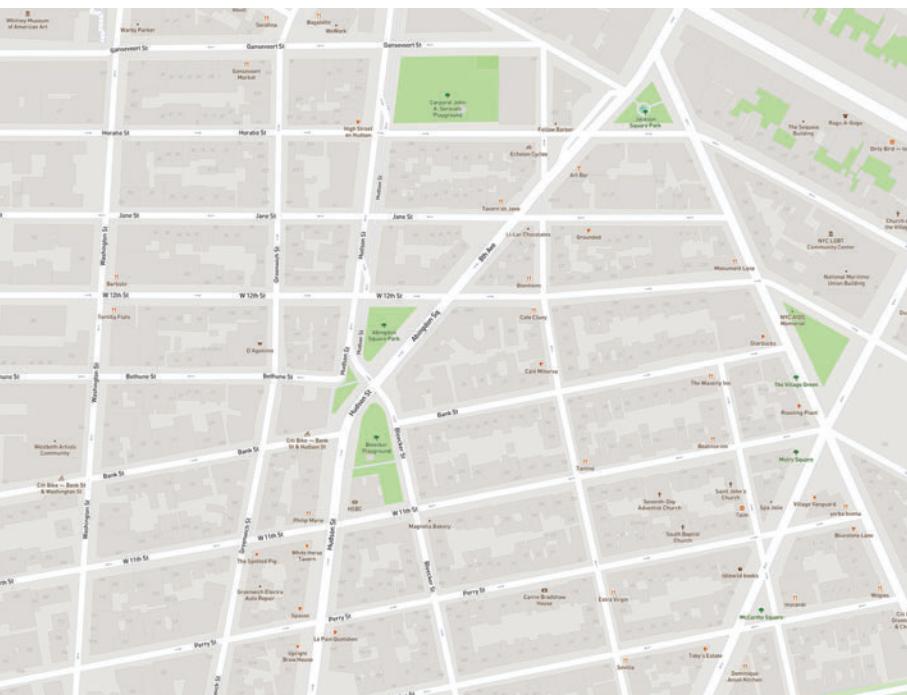
**Maki** aims to be the most high quality, consistent, and comprehensive point of interest icon set possible. Maki icons are designed simply and work seamlessly with Mapbox Studio. The [Maki icon editor](#) allows you to customize the style of your icons. You can add and remove your icons, categorize and style them in groups, and download them for your map styles.

## Mapbox Streets icons

In Mapbox Streets icons are grouped and styled based on categories, i.e. restaurants are orange, transit is blue. Groupings help the viewer to recognize like POIs faster and navigate the map easier.



Maki icons used in Mapbox Streets map style



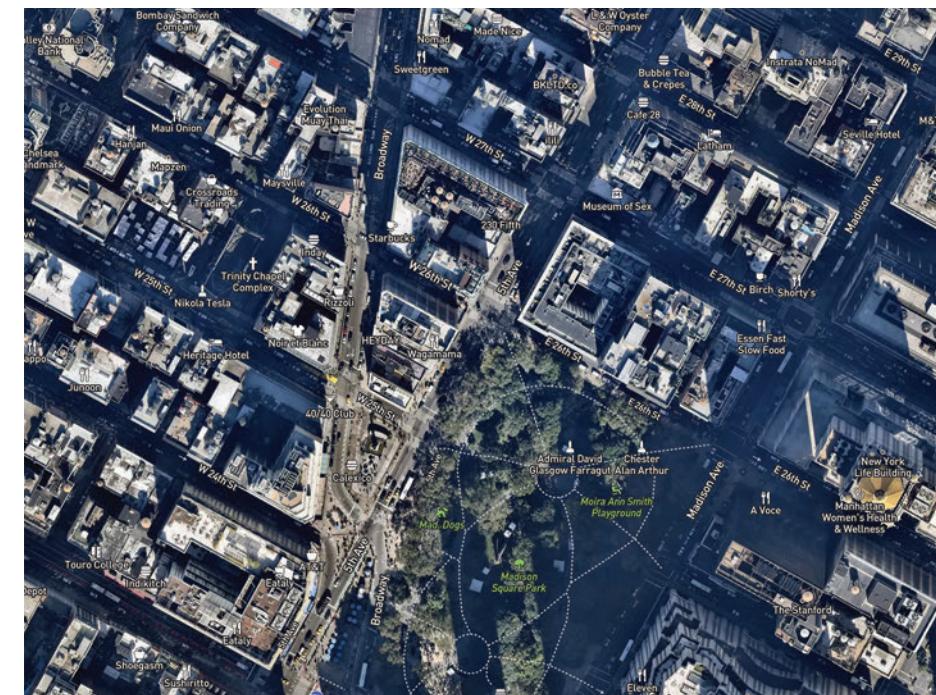
Styled and categorized icons each with a light stroke to pull them slightly from the background in the Mapbox Streets map style

## Mapbox Satellite Streets icons

Mapbox Satellite Streets however deals with a satellite imagery layer, and this requires a different treatment of the icons to ensure they are legible over varying terrain and urban landscapes.



Maki icons used in Mapbox Satellite Streets map style



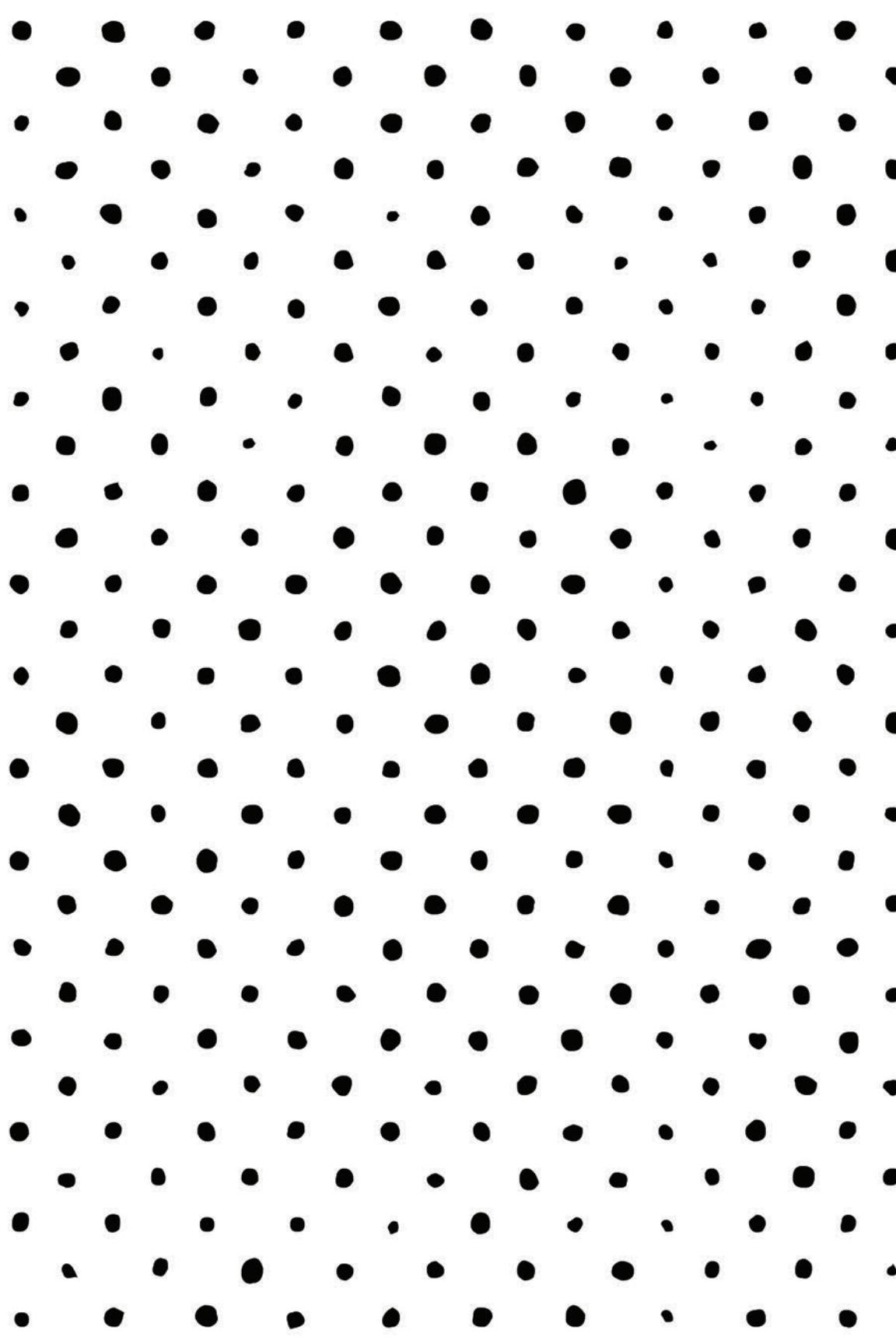
Simple white icons with a dark gray stroke that blends with varying terrain for Mapbox Satellite Streets map style

## Texture

Texture is an added bonus in your map design toolkit. It represents the perceived surface quality of a design piece. Patterns can be added to map features to differentiate or blend elements. They can also stand independently as a texture for the map or full background patterns.

Textures need to be seamless to properly apply them to your maps in Mapbox Studio. A seamless texture is an image or pattern that can be placed side-by-side with itself without creating a noticeable boundary between two copies of the image.

Textures should also be small because they are repeating patterns. Typically they are between 16x16, 32x32, or 64x64 pixels.



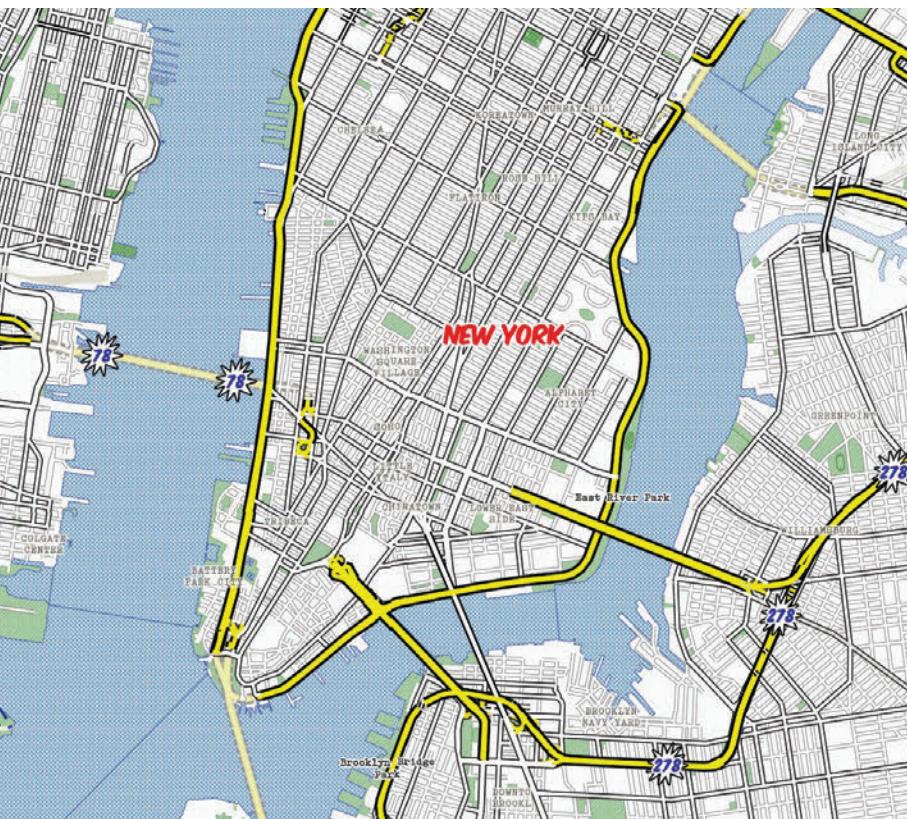
## Adding an aged texture

Vintage was designed to mimic the look and feel of traditional printed maps. Digital patterns were added layer-by-layer to give a worn, imperfectly printed look from the days of old etched or engraved printed maps. I also added a custom bathymetry dataset from Natural Earth and available open source. This added layers of depth into the bodies of water which I used to add more layers of very low opacity with slightly different color tints to bring out my worn texture.

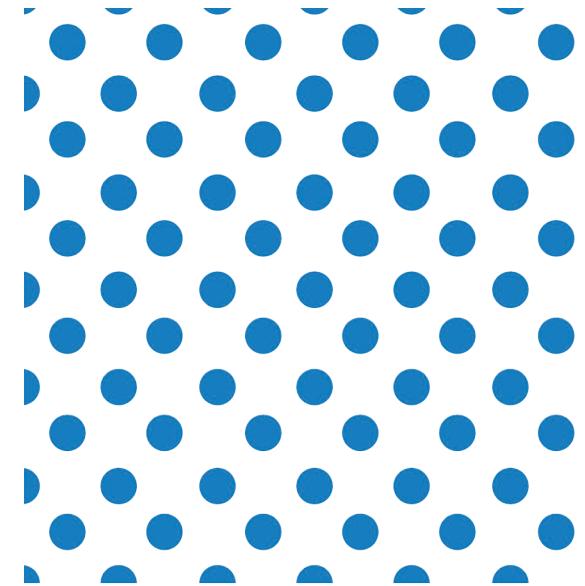


## Adding a pop art feel

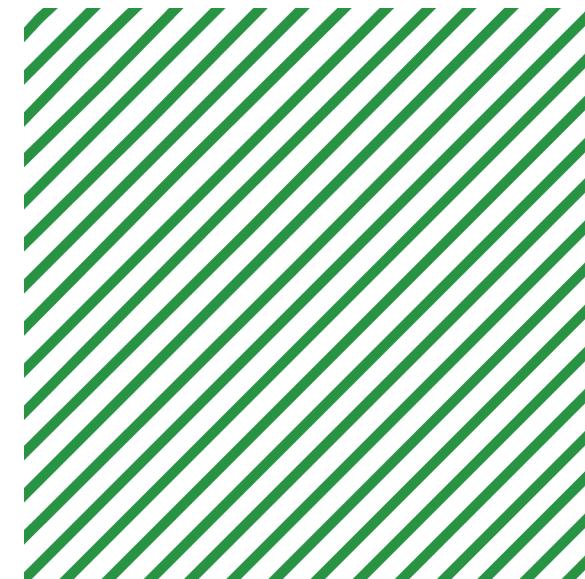
Whaam! has bright, playful pattern which bring in visual texture and evoke the pop art period; the inspiration for this map. Water layer doubles as a light blue fill color with an applied darker blue dot pattern a layer above. All park and green space areas have a green fill layered under a brighter striped green pattern at low opacities. This creates an artistic, overprint appearance; again referencing the pop art inspiration while showing actual land elevation and terrain.



Whaam!, by Amy Lee Walton



Blue dotted pattern for water (32 x 32 px)



Vibrant green diagonal pattern for parks (32 x 32 px)



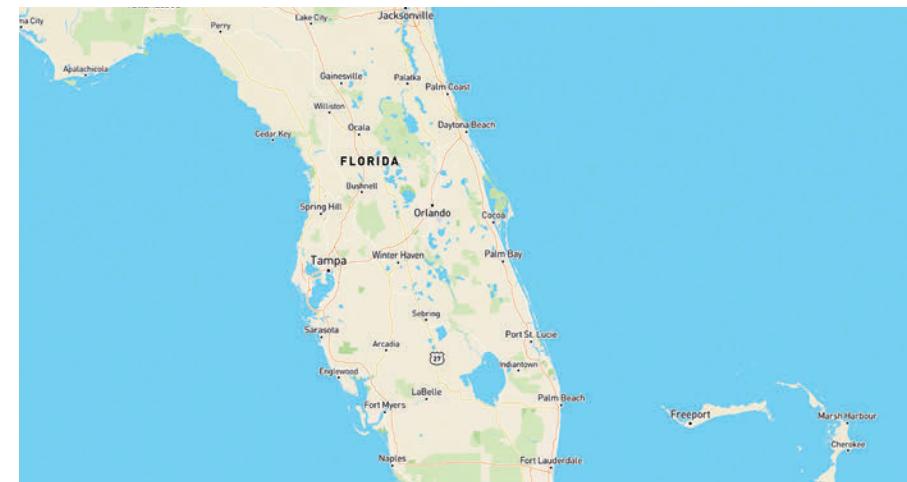
## Design principles

Now that we've determined the four design elements to customize on your map, here's how you add polish to your map style. Here are some of the core design principles that cartographers and map designers apply as they style their maps. Together these core design principles form a system for seeing and understanding the relative importance of the content in the map and on the page. Without these applied principles, map-based communication will fail:

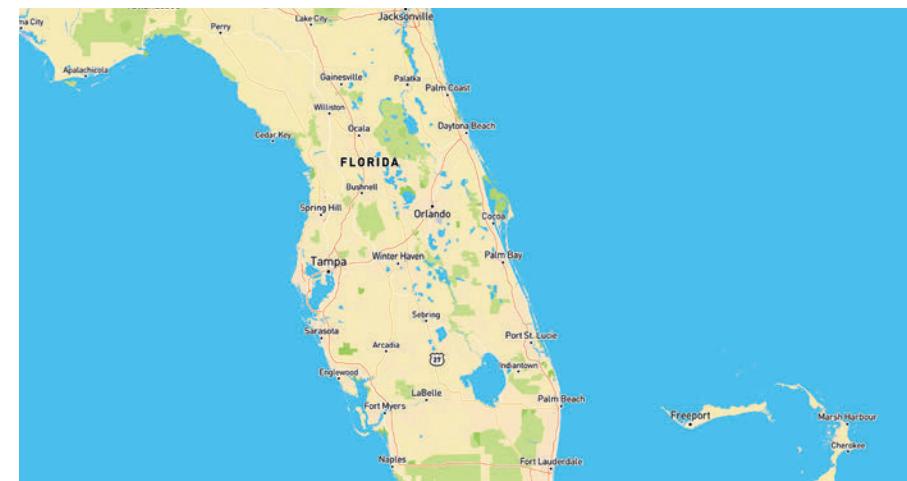
- Contrast
- Hierarchy
- Density
- Legibility

## Color contrast

Keep a healthy amount of color contrast in your map style to keep it vibrant and legible. You don't want too much contrast or your colors could scream at the viewer. If your colors are too muted they may start to blend together. Increase the saturation of your colors to push the contrast if necessary.



*Less color saturation*



*More color saturation*

## Contrast

Human beings are wired to notice difference. This is what makes contrast such a powerful design principle in map design. Contrast attracts attention and draws the eye. This separates features from the surrounding elements and can instantly create emphasis and interest. In addition to attracting attention, contrast establishes boundaries between elements.

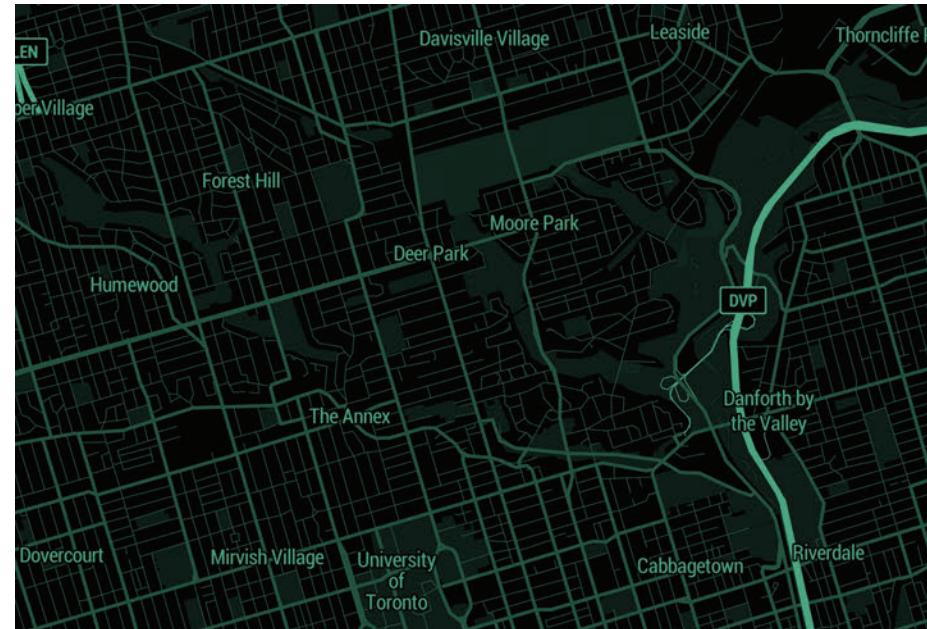
## Contrast and readability

The amount of color contrast in your map style can affect your map's readability. For example, the text labels and iconography could either blend into the background elements or stand out in a glaring way.

Keep this in mind as you are working with your map's color palette. A healthy amount of color contrast in your style will help those with low vision, color blindness, or worsening vision better see and read the text on your map. Make sure you have a fair amount of contrast between elements, but not too much.

## Visualizing data

Many maps use bright, primary colors against a stark, muted background map to highlight important elements or show data visualizations. As long as there is simplicity and harmony within your color palette this technique works well and can be super easy to customize or alter with other color schemes. Decimal is one such style. This minimalist map style works great as a base for data visualizations or as a backdrop for your next game.



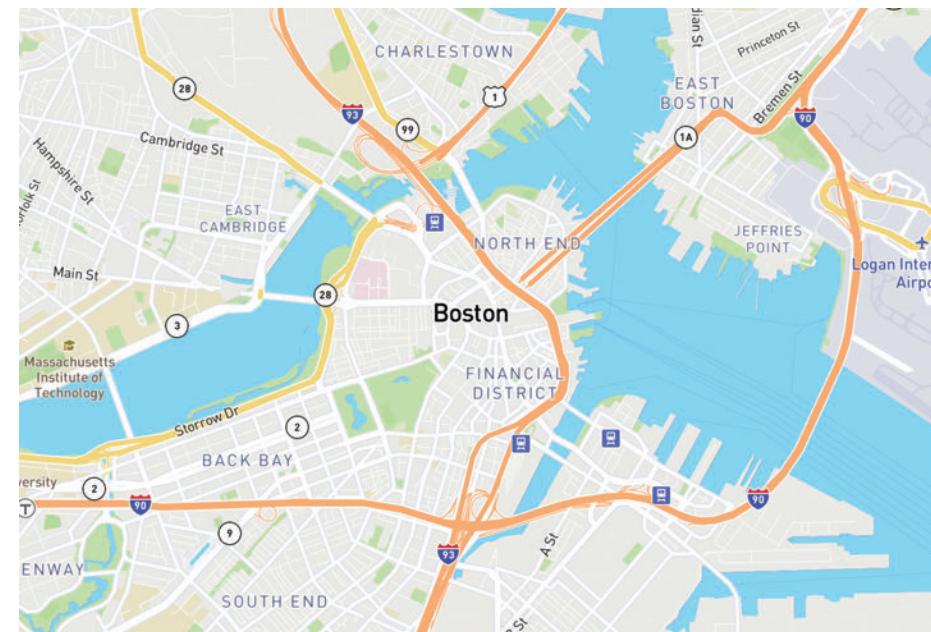
Decimal, by Tristen Brown

## Hierarchy

Hierarchy helps viewers focus on what is important while identifying patterns. A strong, visible hierarchical system is one of the most effective ways to increase comprehension. Color and scale are two major design elements you want to finesse to leverage the visual hierarchy of your map style.

## Color hierarchy

Use color to differentiate and show a hierarchy of importance between map features. The road networks in Mapbox Streets while using the same width are distinguished by color to show hierarchy. Motorways are styled orange, high performance roads are yellow, and primary roads are white while maintaining the same line width. The next level of roads is styled with a thinner width and less vibrant white and recedes more into the background, still noticeable but docile.

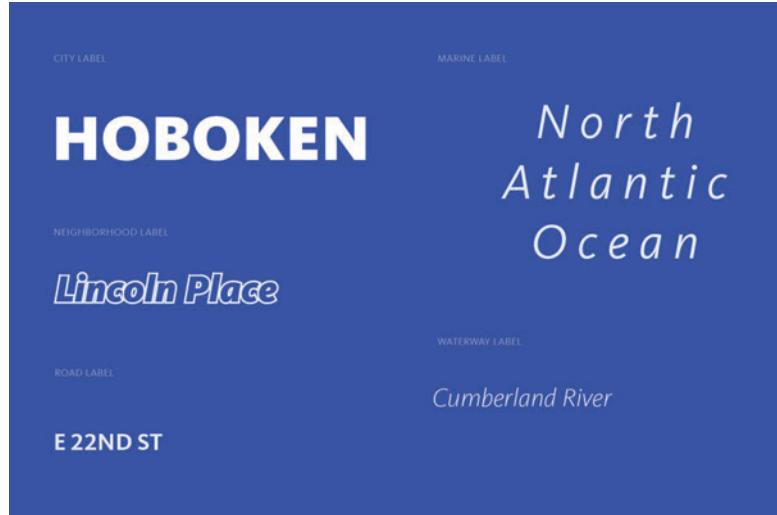


Mapbox Streets, by Mapbox cartography team

## Typographic system

Typographic systems employ scale, stylistic variations (like font weight, i.e. light, normal, bold, etc.), as well as treatment (like uppercase, lowercase, italic, outline only, etc.) to establish an order of importance. This system will guide the viewer easily and quickly to the start and end of information, whilst enabling them to isolate certain information based on the consistency of use in the style throughout.

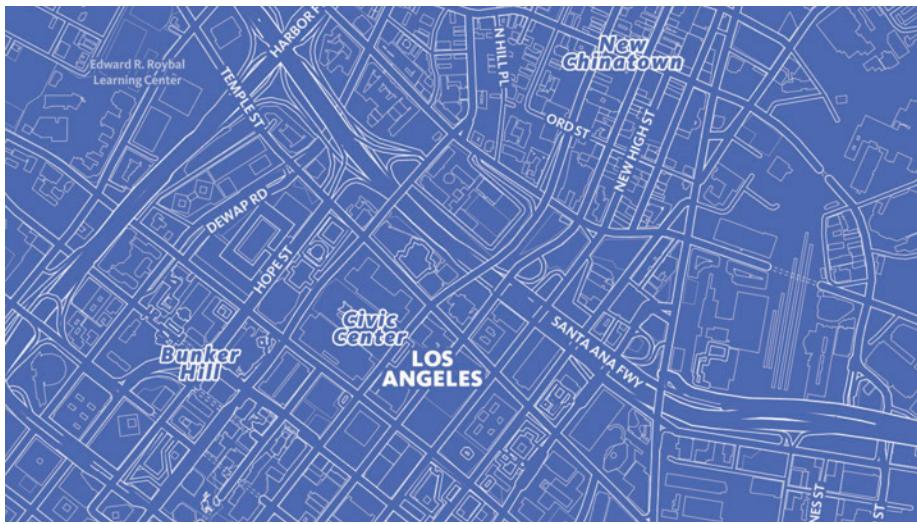
Here the hierarchy system for Blueprint uses a variety of techniques to indicate importance and differentiation by forming visual patterns for the user to better comprehend the map style.



Typographic system of place, road, marine, and waterway labels in the Blueprint map style



Typographic system relies on hierarchy of scale based on the data, structuring type size by city population size



Typographic style treatments differentiate cities and neighborhoods

## Scale hierarchy

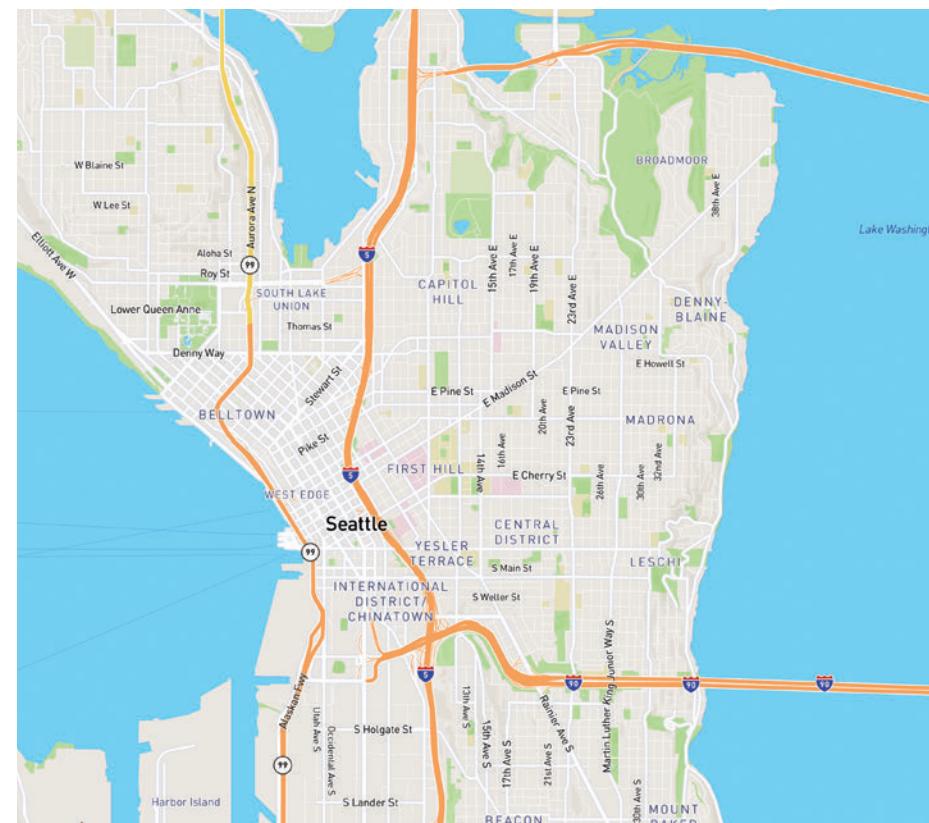
Scale is both the overall size of an object and that object's size in relationship to other elements around it. Identifying a system of sizes to rank map features like labels or road widths will help to indicate the hierarchy of these features.



## General purpose maps

Maps that style a variety of physical and cultural features, like terrain, roads, transit stops, and points of interest (POIs) are general purpose maps. They show hierarchy differently than thematic maps which normally feature a single attribute or the relationship among several attributes.

For general purpose maps, features should not overpower each other and should essentially lie on the same visual plane. Here hierarchy is usually more subtle and the viewer brings elements to the forefront by focusing attention on them.



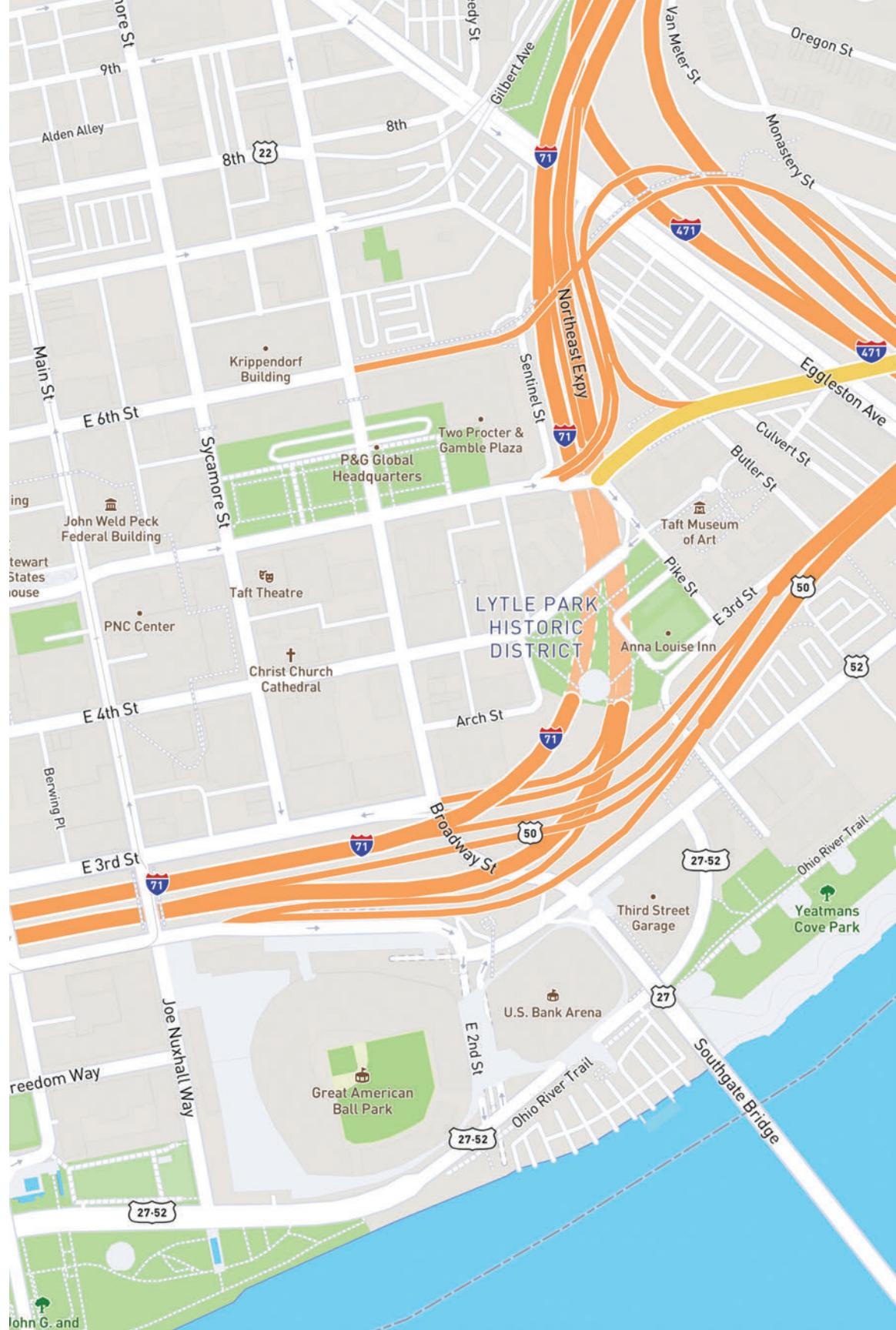
## Thematic maps

Thematic maps typically emphasize specific features or locations to show prominence. Oftentimes, the theme itself is more important than the geographic context. Hierarchy then starts to present itself in the grouping of features as stylistic elements by color, texture, scale, and/or style.



## Density

Although map features may be available at a certain zoom, features should not be styled based on availability. Revealing too much information at a certain zoom may cause confusion or dilute your map's focus. As you design your map, consider how the density of information may increase the visual weight of the map, disturbing the visual hierarchy.





Global view z1

## Zoom levels

Web maps, as opposed to print maps, have more flexibility in what information can be shown and when, thanks to zoom levels. Users can explore the map from a global level and/or zoom into street level detail and everything in between. Zoom levels move from  $z0$  to  $z22$  and along the way the appropriate data is available from vector tiles to be styled.

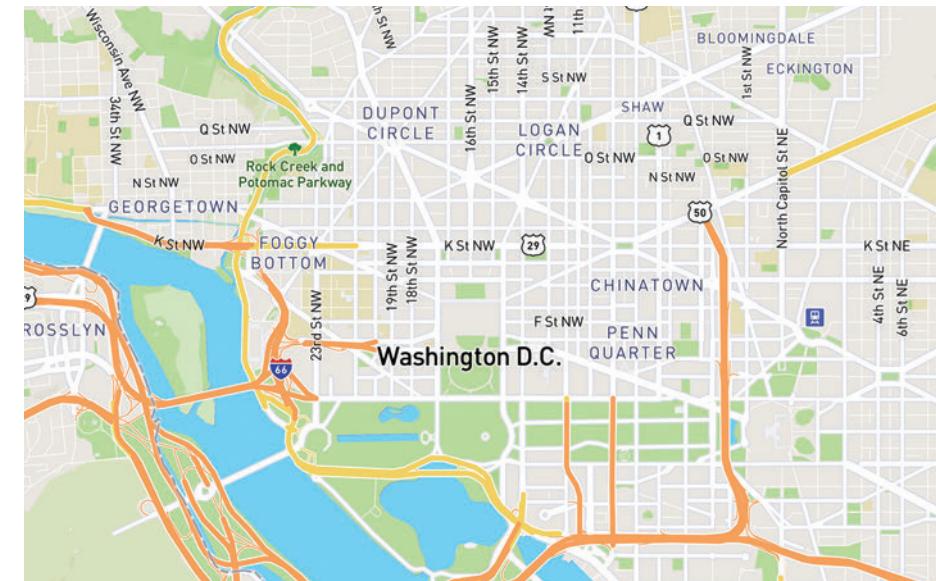
Sometimes, it is not possible to legibly display data at a given zoom level. For example, a dense series of topographic lines would turn into a jumble of features when viewing the map at the state or regional zoom level. Conversely, styling every POI, like parks, buildings, restaurants, etc., at a city level would appear too coarse and hard to comprehend at a glance. To prevent these potential issues, the cartography team has determined optimal maximum and minimum zoom levels to make data available in our Mapbox vector tiles.



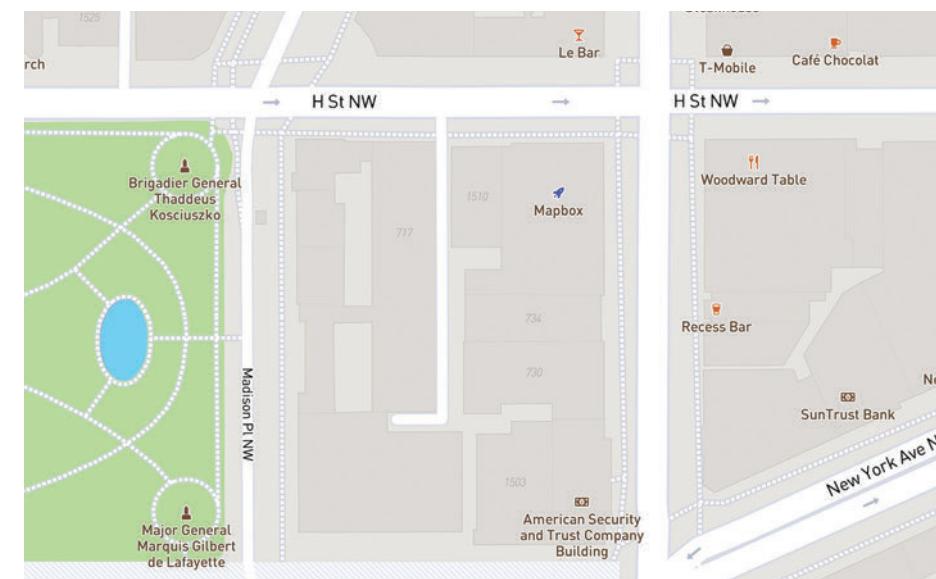
National view z3



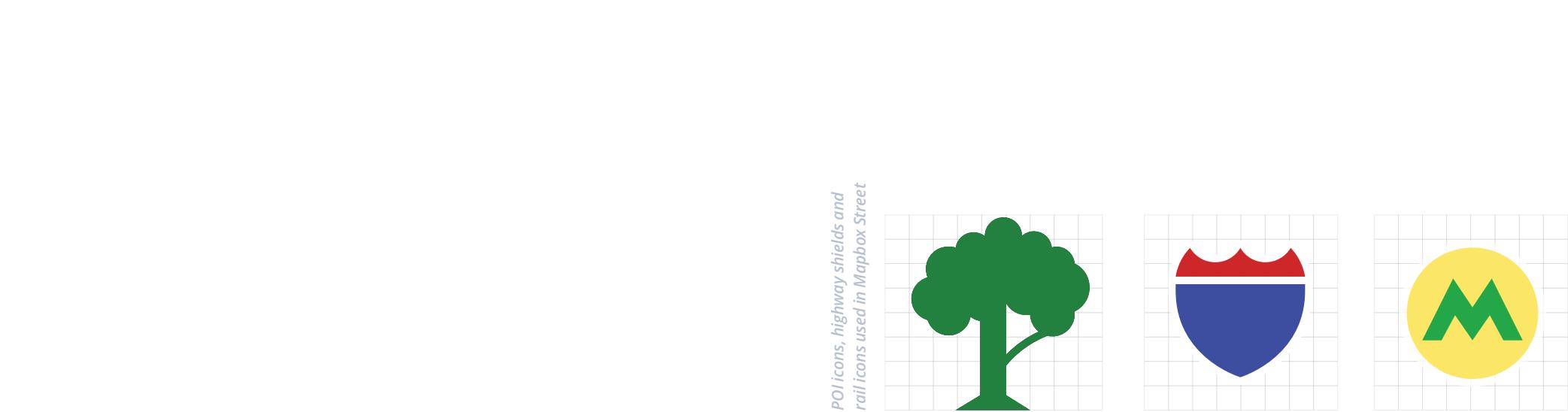
Regional view z7



City view z12



Street view z17



## Legibility

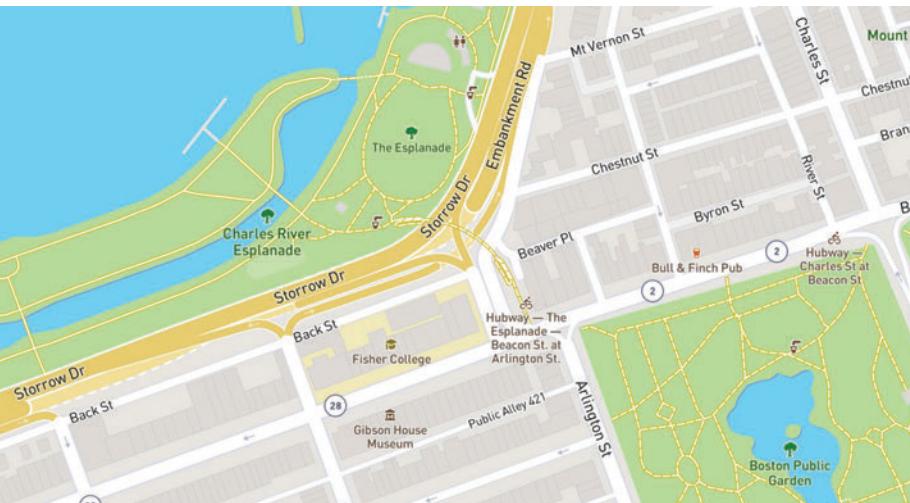
To be legible is to be easily read which is of utmost importance in map design so the user can easily understand how to navigate the represented space. Legibility of most map features depends on color and size, and in addition to labels and text, can be iconography too. Icons must be designed simply enough to recognize at small sizes and offer good contrast against the background.

## Iconography

For select cities and countries, our Mapbox Streets icons feature local public transit icons and highway shields to help orient the user by visually connecting the map to their environment. We redesigned original symbols, simplifying the details and exaggerating the form while balancing good pixel-alignment and visual parity with the originals.

## Text

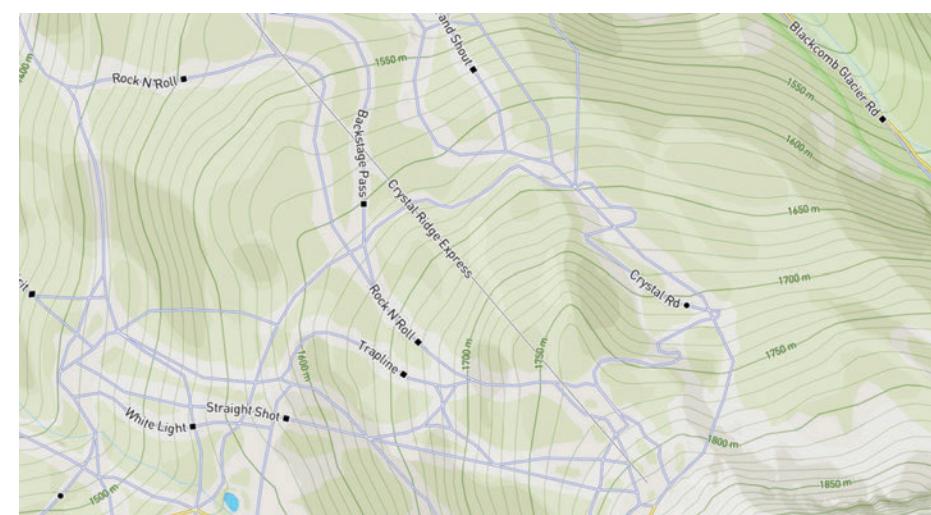
A good choice of font with high x-heights and suitable at smaller sizes, color contrast for visual separation between foreground and background, as needed letter spacing, and the use of text halos can vastly improve legibility in text labels.



*Mapbox Outdoors showing typographic variations in color, contrast, scale, and spacing in this cityscape*

## Proximity

The proximity of map elements to each other is also important to the overall legibility. Proximity calls for related items to be grouped visually, creating less clutter and making for a more organized layout. At times you will have features very close or overlapping on your map. As you style, create a balance by using lighter color saturation, softer opacity, and, if text is involved, substantial contrast and text halos. Balance is key.



*Mapbox Outdoors styles ski paths in Whistler, BC over contour lines and hillshades using color and style to differentiate*

## 04 special considerations

*Mapbox core map styles are full coverage, general purpose workhorses that are ready to add to your mapping application. Both usable and beautiful. But sometimes you need something more targeted to your brand.*

Specialty maps require the user experience to be prioritized, design execution to be optimized for platform and performance, and for the map style to fit the overall environment it be used in. Environmental considerations can be anything from the time of day, location of interaction (outside in the sun, inside an office), mode of transportation (car, bike, or foot), the platform being used to view the map (mobile, web, etc.), or even the user interface associated with the map style.

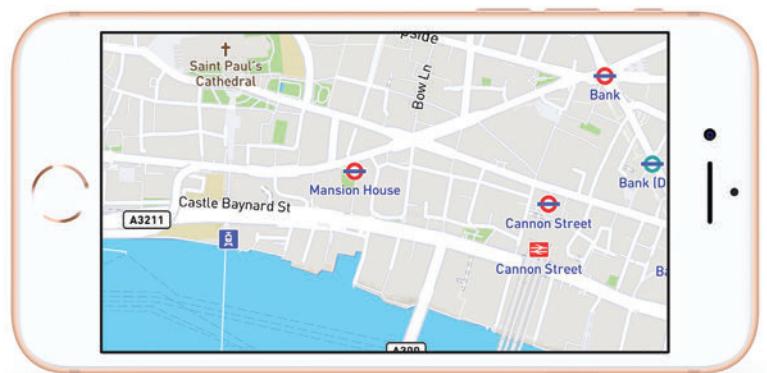
Let's look at best practices we've discovered for:

- Maps for mobile
- Maps for navigation
- Maps for data visualization
- Maps for mobile

## Maps for mobile

Smartphones play an important role in helping people navigate their environment and get where they need to go. 67% of smartphone owners use their phone at least occasionally for turn-by-turn navigation while driving.

As we design more and more for mobile here at Mapbox, we take into account the unique challenges that mobile maps face as opposed to that of desktop and print maps. Mobile maps have a range of user and environmental variables that require consideration throughout the design process.



Mid-zoom view of POI icons and highway shields in Mapbox Streets

## Considerations

- **Spatial restriction.** The mobile screen reintroduces spatial restriction to the design process. Not only is the screen smaller, but it's also a smaller viewport showing a similar-sized desktop map, meaning much less map data is viewed at once. This means visual cues and connections are going to be harder to make, and different styling decisions must be made since fewer map elements can be seen.
- **Map interactivity.** The mobile map user is constantly fiddling with the map. Luckily interactivity such as zoom, pan, and pitch variables can be automated and controlled by other information such as user location, user speed, and defined route distances. Not only does this free the user's hands, but it also adds to list of variables designers must account for when designing mobile maps.
- **User manipulation.** Users tend to manipulate the mobile maps constantly. Although using one's fingers to zoom, pan, and pitch a map is really no different than using a mouse, the size constraint typically requires more user interaction and manipulation to view more map context and content. We can see a loose connection between screen size and interactivity, due to the simple fact that there is less map information shown at any given time on mobile maps.<sup>1</sup>

## Testing platforms

Testing our maps on as many devices as possible gives us critical feedback that propels the iterative design process, and verifies that the user experience will be as fun and productive as possible. One of the main tools we use to quickly test styles is the recently released **Studio Preview for iOS**. A companion to Mapbox Studio, the preview app allows us to log into our account and quickly prototype map styles within the environments it will be used in, and to mimic the user experience.

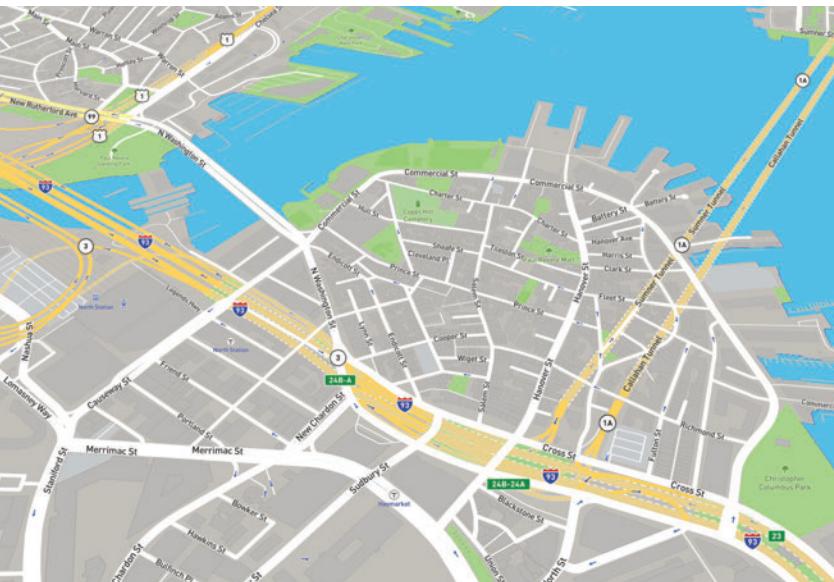
In the early phases of the map design process, we consider:

- **Proximity of the map and the user:** How close is the map to the person? In a pedestrian's hand, or fixed to a driver's windshield?
- **Viewing time:** Are these short, fragmented glances, or longer sessions?
- **User manipulation.** If the user is driving to a coffee shop, turn-by-turn directions are paramount. As they get closer to the destination, they'll probably rotate and zoom the map to better see what's around them. Make sure to test the map at different angles like rotation and pitch.
- **Controlled Density.** When overlaying data, i.e. traffic or bike lanes, overlay must be in harmony with underlying map elements. Focus the density, only show what's necessary for context.

## Maps for navigation

There is a lot of overlap between designing for mobile and navigation because, primarily, navigation mapping is done on a mobile device. In addition, navigation maps must harmoniously integrate toggleable traffic data and other information overlays to provide user controlled context. To provide guidance to the map for drivers, cyclists or pedestrians, the Cartography Team took into consideration a variety of environmental, speed, and time factors for the Mapbox Navigation suite of maps.





Mapbox Navigation Guidance Day, by Mapbox cartography team



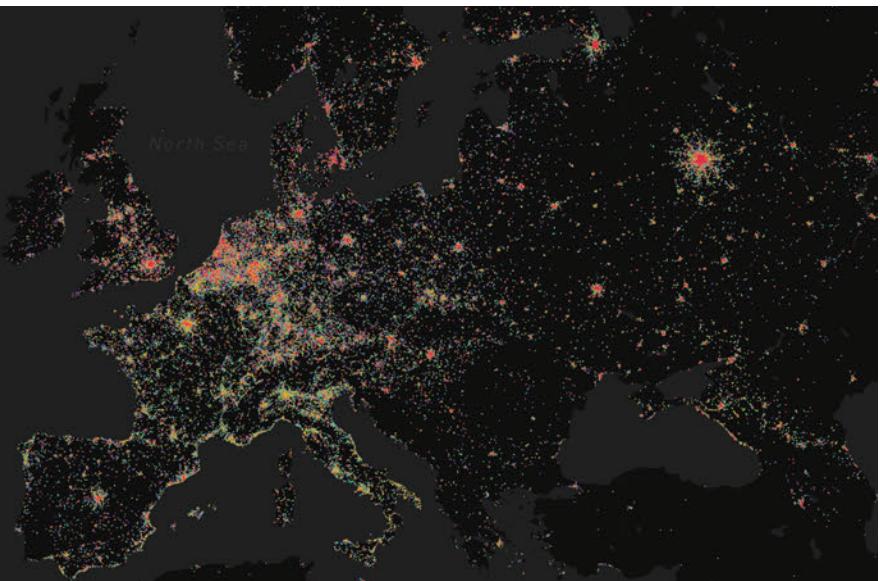
Mapbox Navigation Preview Night, by Mapbox cartography team

Consider the following as you co-design your map and data visualizations:

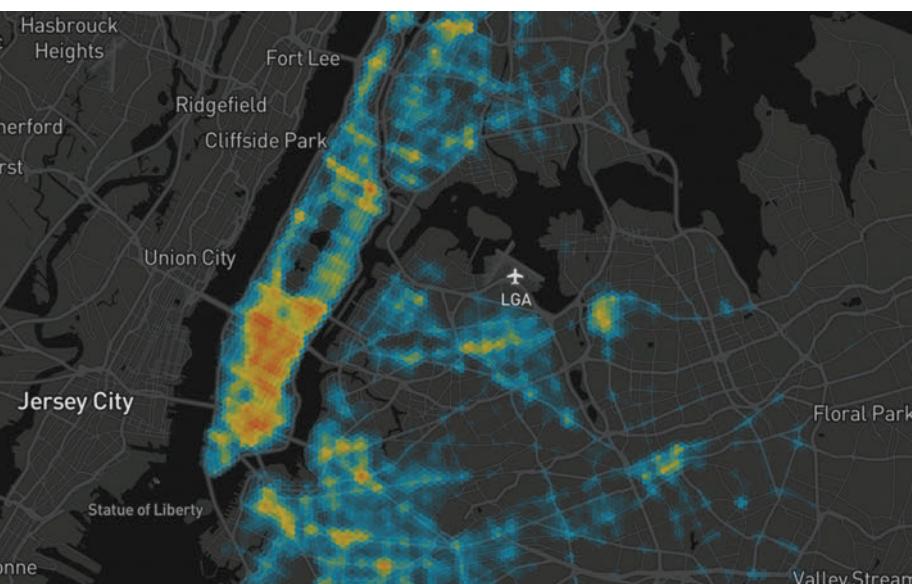
- **Explore or explain your data.** Exploratory data visualizations are appropriate when you have tons of data and you're not sure what's in it. Exploration is generally best done at a high level of granularity. If you oversimplify or strip out too much information, you could end up missing something important. A data visualization meant to explain is appropriate when you already know what the data has to say, and you are trying to tell that story to somebody else. You know the story and therefore you can design to specifically accommodate and highlight that story. Edit the data by deciding which information stays in, and which is distracting or irrelevant and should come out.<sup>1</sup>
- **Design a three-dimensional visual hierarchy.** Often times we see data visualizations that seem to plop the data onto the map. The key is integration, you want the map and data to work together not against each other. Color, value, and saturation are key for these relationships. Start with a strong, limited color palette with high contrast. If you start with the Light or Dark style, alter the hue to fit your brand, start small with line widths and ease shapes from 0% to 100% opacity. The goal is to produce a three-dimensional effect in which certain key features appear to rise off the map's two-dimensional surface.
- **Categorize similar data.** Early in the design process, identify the best and most accurate way to sort and categorize your data. Depending which technique you plan to use for displaying your data on the map, (choropleth, heat map, etc.), determining the appropriate groupings for your data will keep your data honest and provide valuable insights.

## Maps and data visualizations

Data visualizations can be expressive, powerful opportunities to use maps to tell stories and understand information. A compelling basemap sets the scene and deepens the relationship between the what and the where of the information narrative. When uncovering spatial patterns or getting actionable insights from data, seamless integration between the map and interface are key. The use case is comprehension, and helping the user see the relationships in the data is the ultimate goal.



Visualizing Eurovision Shazam, by Peter Liu



NYC Traffic Incident Heatmap, by Ryan Baumann

## Visualization styles

- **Dot density**—A map style that uses a dot or other symbol to show the collective presence (density) of a feature or phenomenon. For example, showing busy intersections or high/low volumes of activity within areas.
- **Choropleth**—This is a thematic map style that applies shaded color or pattern textures in proportion to the intensity of the data being displayed on the map. For example, showing population density or per-capita income.
- **Hexagonal binning or hexbin**—This map style is good for showing general themes over a geography. It is less granular than dot density and not constrained by boundaries as is the case with choropleth maps.
- **Heatmap**—This map style enables the map viewer to perceive density of points independently of the zoom factor. It is the least constrained of them all because it does not correspond to geographic bounds.

## Custom data

There are a variety of ways to add data to your map. First, you can upload data directly into Mapbox Studio, to convert your data into a web and mobile ready, highly performant tileset. Your custom tileset will be accessible in any Mapbox Studio style.

Another method is to create a dataset with your custom data. This is done in the dataset editor; there you can add data sources, draw new data points, lines, and polygons, combine various data sources and maintain your raw data. Once you are done augmenting your data, you can export it as a tileset and add it to your map for styling. Choosing a tileset or dataset depends on if you are planning to use the data immediately in your style or if you plan to enhance or manage the data over time.

The final way to add data is with Mapbox GL JS; dynamically. Check the Recommended Reading section of this book for links to help you add [GEOJSON](#) and how to uploads work.



## 05 getting started

*Mapbox core map styles ship with our global curated vector tiles. Launch Mapbox Studio, open a map style, zoom down to street view, zoom out to see the ocean, fly to another city, a different coast, and another country. Let's see what global data means.*

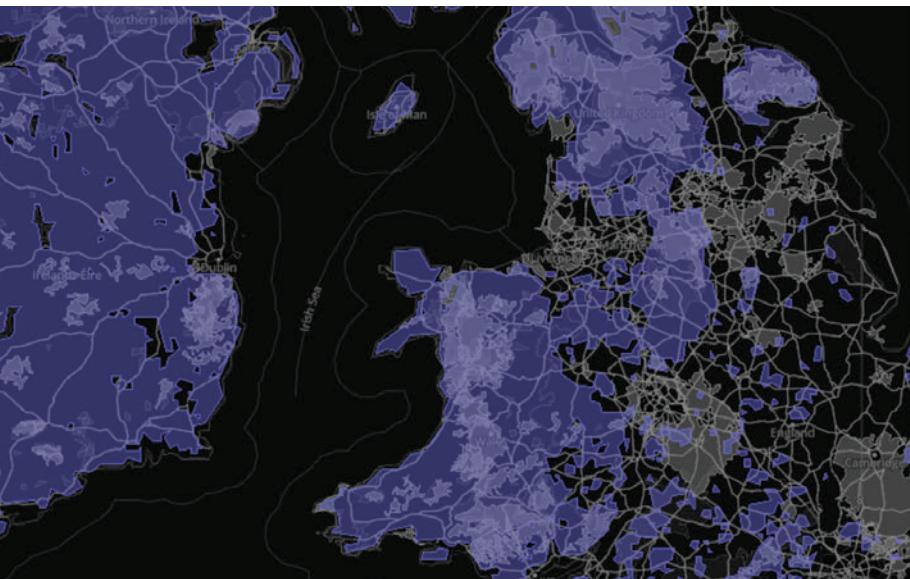
Mapbox web- and mobile-ready vector tiles are 75% smaller than raster tilesets. This results in fast, smooth zooming from the worldview of a map down to street-level detail. Mapbox vector tilesets include: `mapbox-streets`, `mapbox-terrain`, and `mapbox-traffic` which are outlined in the next section.

## Mapbox-provided tilesets

Vector tilesets consist of geographically referenced natural and manmade features converted into points, lines, and polygons. This underlying map data framework is what you will be styling. Map data features typically fall into the following general categories.

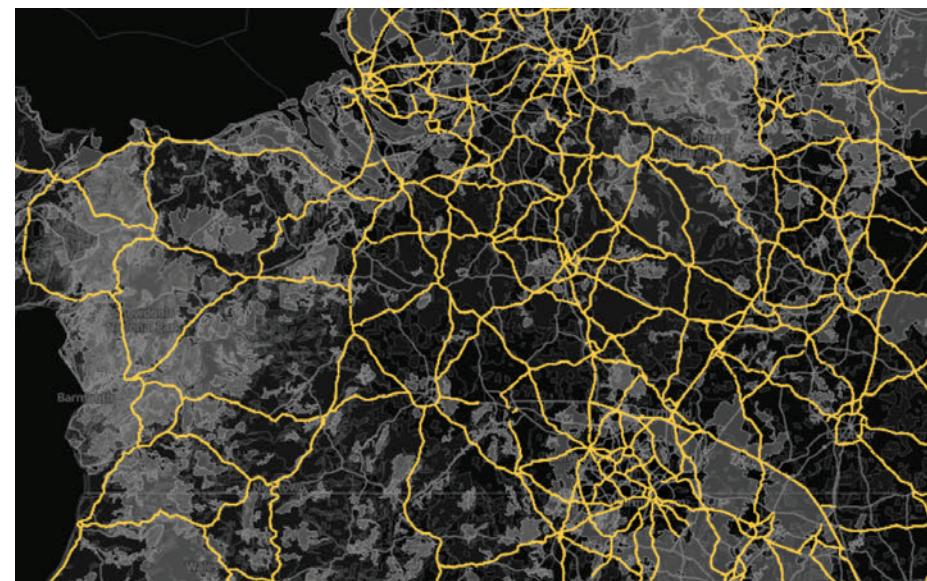
### Natural features

- water
- land
- land use
- terrain



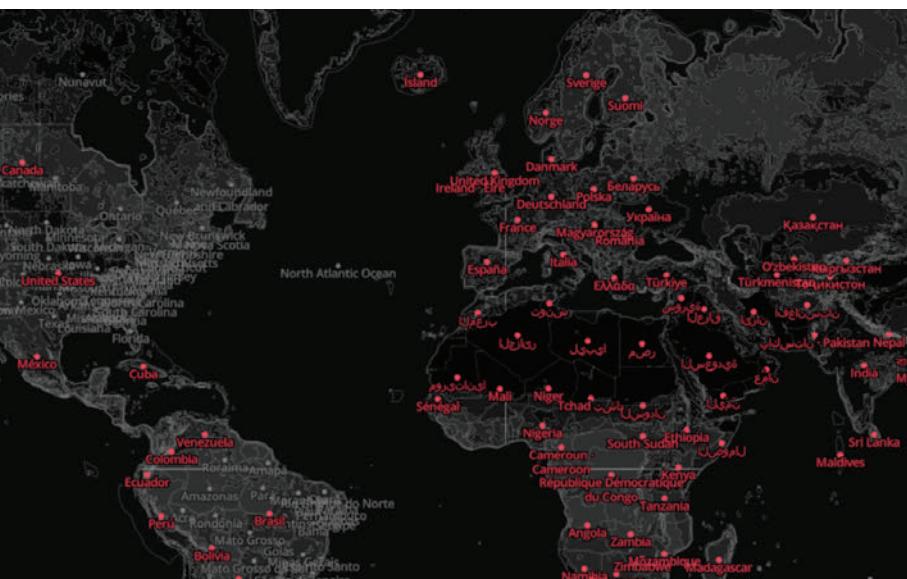
### Road networks

- motorway
- trunk
- primary, etc.



## Place labels

- country
- state
- city
- island, etc.



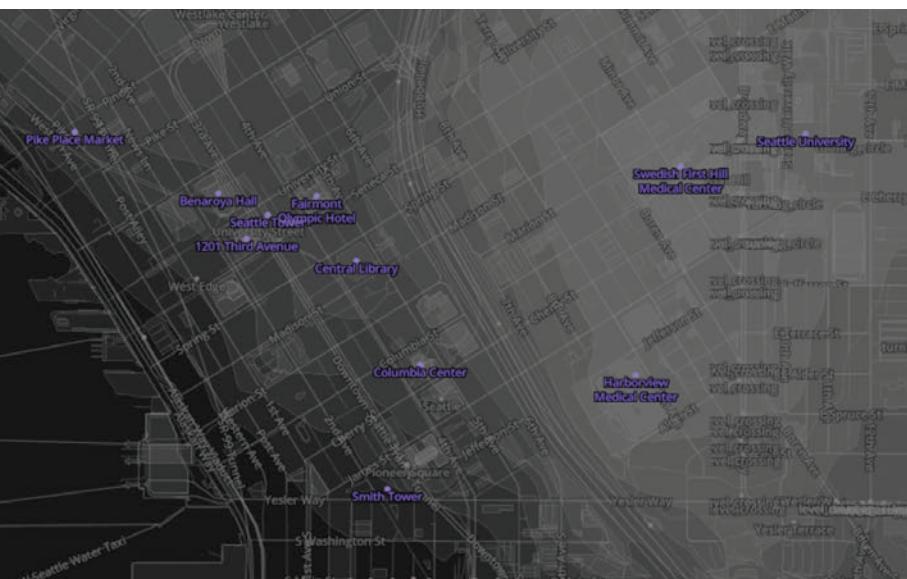
## General labels

- marine
- water
- roads, etc.



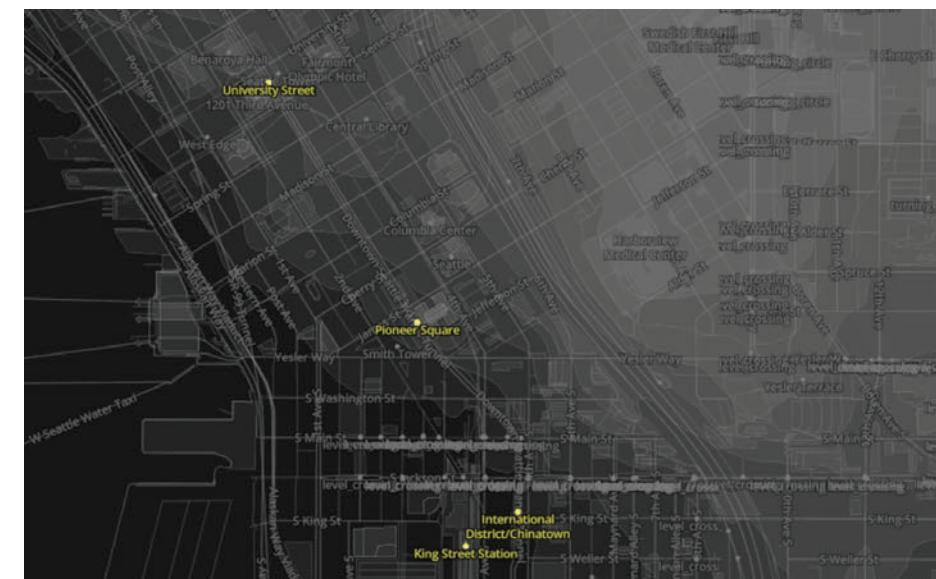
## Points of interest (POI) labels

- natural reserves
- businesses
- restaurants
- attractions, etc.



## Transit labels

- airport labels
- rail labels
- highway shields, etc.





## Mapbox Streets

[mapbox.mapbox-streets-v7](#)

Mapbox Streets vector tiles are largely based on data from OpenStreetMap (OSM), an open source resource of volunteer maintained geographic data. Anyone can make additions to OSM, even you. If you don't see data that should be there, feel free to create an OSM account and start adding. Be careful, it's addictive.

Reference the **Mapbox Streets** data overview (like in the Recommended Reading section) for detailed documentation of all the information in these vector tiles. This reference outlines additional layer properties such as types ([type](#)) and classifications ([class](#)) that will allow you to filter your data and style certain elements distinctly.

Before searching for custom data, explore the **Mapbox Streets** vector tiles we may have what you need already baked in!

## Mapbox Terrain

[mapbox.mapbox-terrain-v2](#)

Mapbox Terrain provides hill shades, elevation, contour lines, and land cover data all in vector form pulled from a variety of sources. While styling, keep the **Mapbox Terrain** data overview open to ensure you are assigning the appropriate classifications to your map style. These values and options are exposed in Mapbox Studio if you have over them in the interface. But this reference offers more details so keep it handy too.



## Mapbox Traffic

mapbox.mapbox-traffic-v1

**Mapbox Traffic** provides updated congestion data for both directions on two-way roads. It also fits inside the roads in the **Mapbox Streets** map style perfectly. The congestion field is a measure of the relative slowdown a road segment is experiencing. The values range from low to severe.

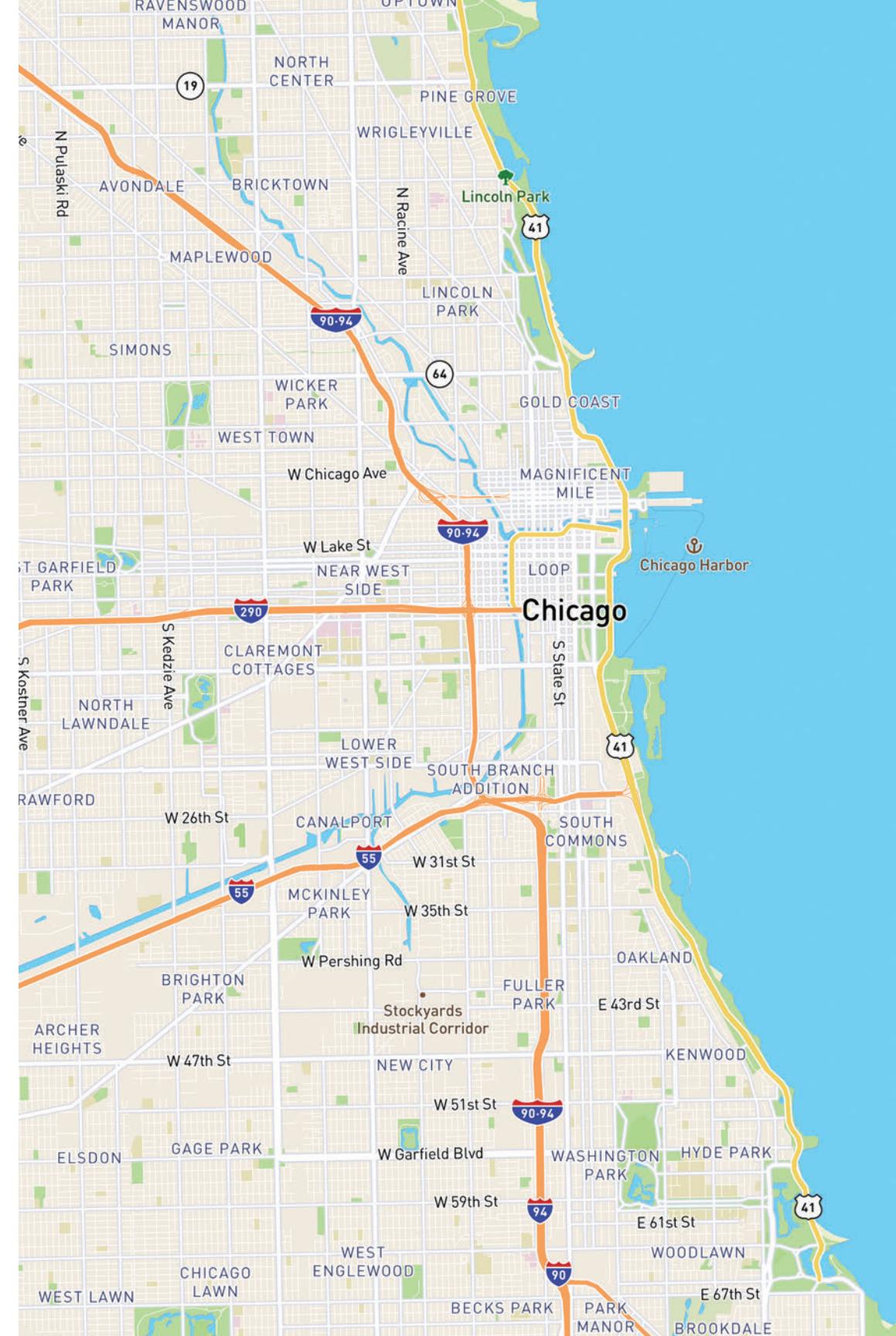
When styling traffic maps, our cartographers typically add a positive line-offset to the layer to visually separate the directions of travel. Remember to reference the Mapbox Traffic data overview to ensure you are assigning the appropriate class values to your map style, see link in the Recommended Reading section. All note that traffic data does not begin to appear until after z6.

## Mapbox template styles

Before you start, we will review the Mapbox core styles that are available in Mapbox Studio. You can use these as templates for your custom map. Which Mapbox core style should you choose? This will depend on the general use case for your application. Mapbox provides the following core styles:

- Basic
- Mapbox Streets
- Mapbox Outdoors
- Mapbox Dark/Mapbox Light
- Mapbox Satellite/Mapbox Satellite Streets
- Mapbox Traffic Day/Mapbox Traffic Night

Let's review each map style and find the one that best fits your mapping needs.

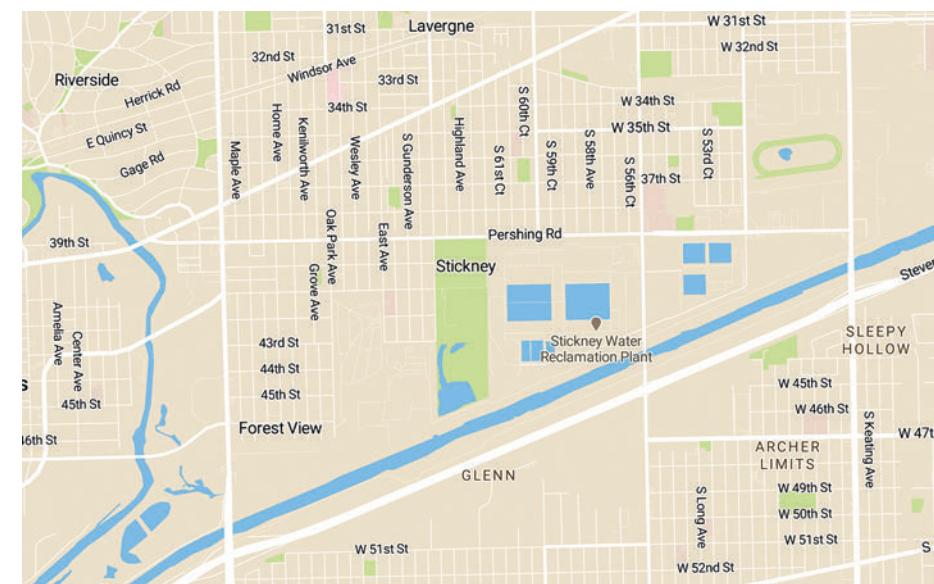
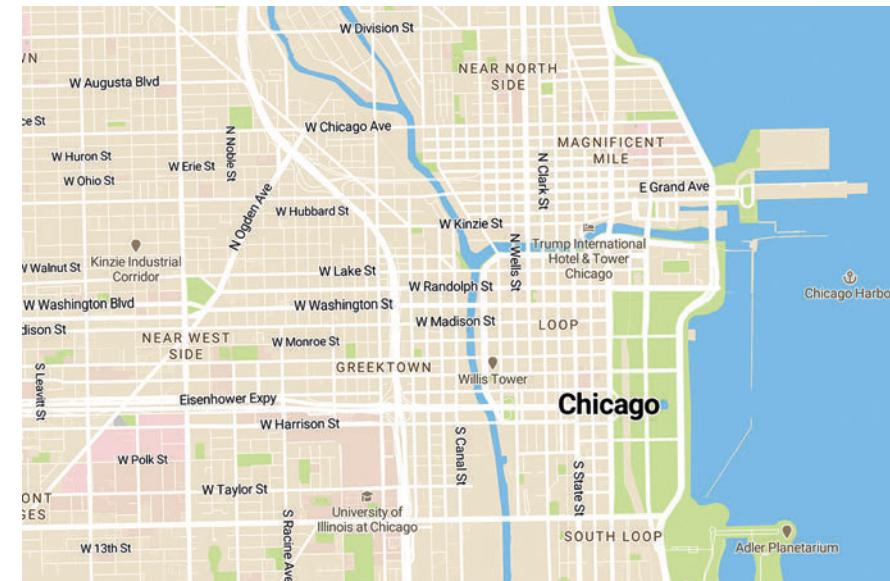




## Basic

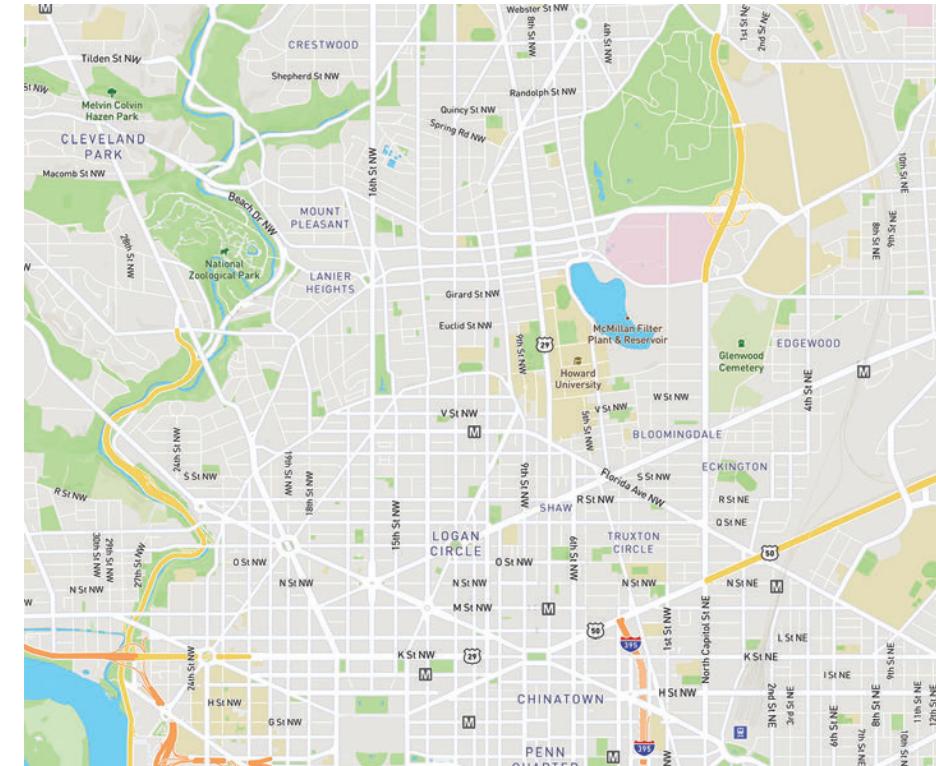
**Mapbox Basic** is a simple, flexible starting map style if you just need a simple style. The classifications for roads and place labels have been generalized into major or minor categories covering the following types of features:

- **Roadways.** Lightly organized road data, designed to show very basic major and minor road hierarchy.
  - **Administrative boundaries.** Only country boundaries are styled.
  - **Built features.** Building footprints, rail stations, urban parks, land use, and only highly ranked points of interest are styled with only text.
  - **Natural features.** Rivers, lakes, streams, oceans, coastal boundaries, parks, land cover, and beaches.
  - **Places.** General hierarchy of location labels including countries, islands, cities, suburbs, towns, hamlets, villages, and neighborhoods.



## Vibrant colors

The Mapbox Streets high-contrast color system allows the viewer to easily recognize the map's features and quickly understand its hierarchies and classifications. The color system is fine-tuned to work perfectly at each level and shifts subtly across zooms.



## Mapbox Streets

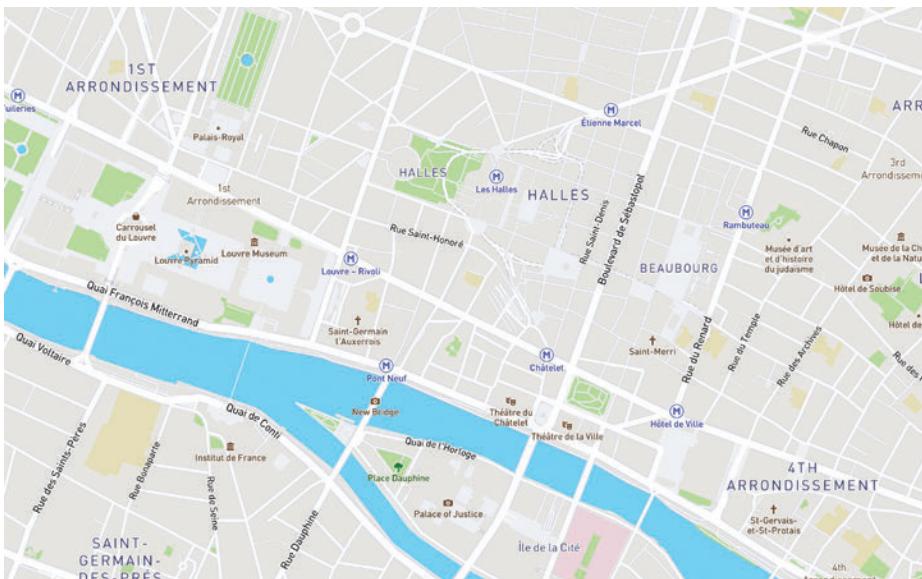
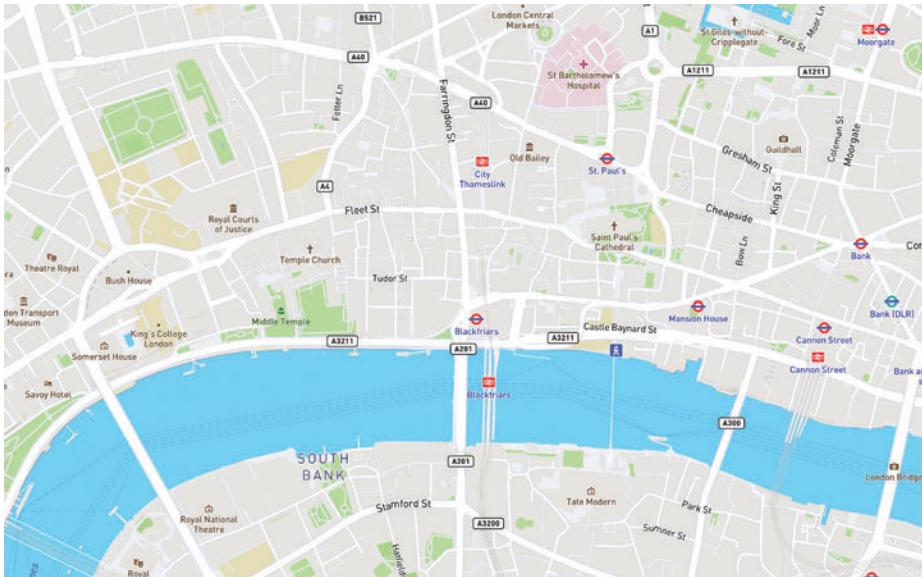
**Mapbox Streets** is our flagship style, it is a comprehensive, general-purpose map that emphasizes accurate, legible styling of road and transit networks.



## Detailed transit styling

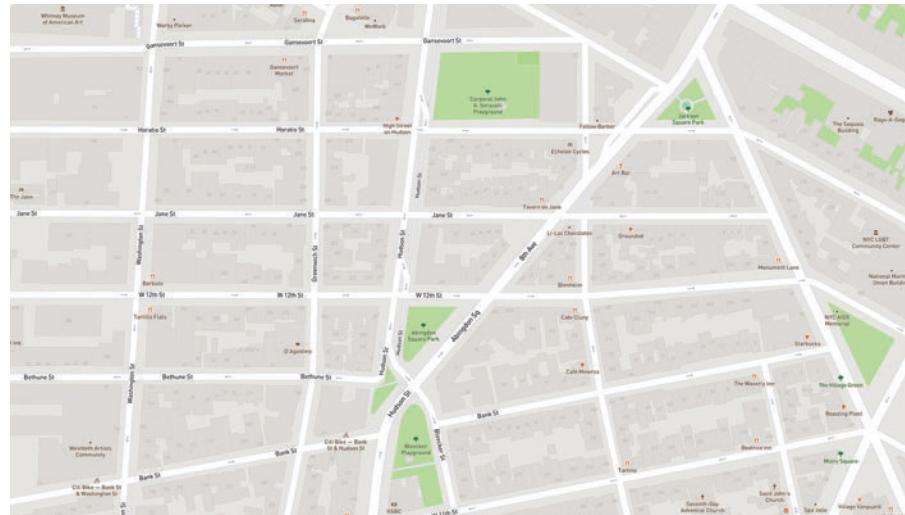
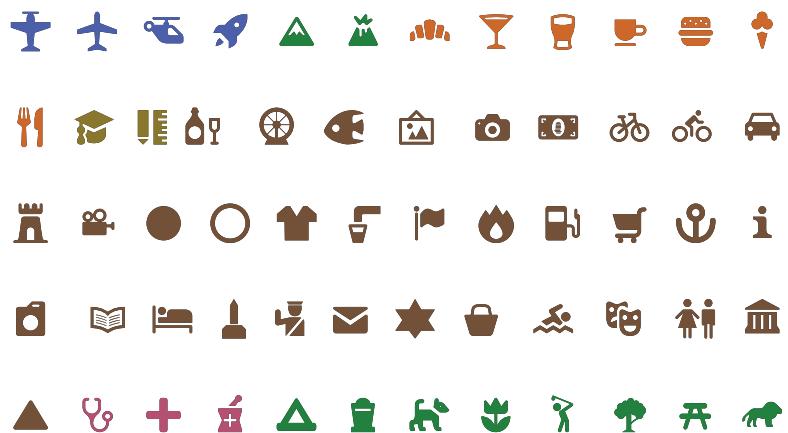
Mapbox Streets includes a wide variety of transit layers – from motorways to paths to ferries – and has been designed to provide an intricate rendering of their routes, intersections, and overlaps. In select cities and countries, Mapbox Streets also features local public transit icons and highway shields to help orient the user and connect the map to their environment.

For increased legibility and consistency, the Cartography Team designed each global transit over a two dozen icons and added them to this map to add in place and comprehension for global usage.



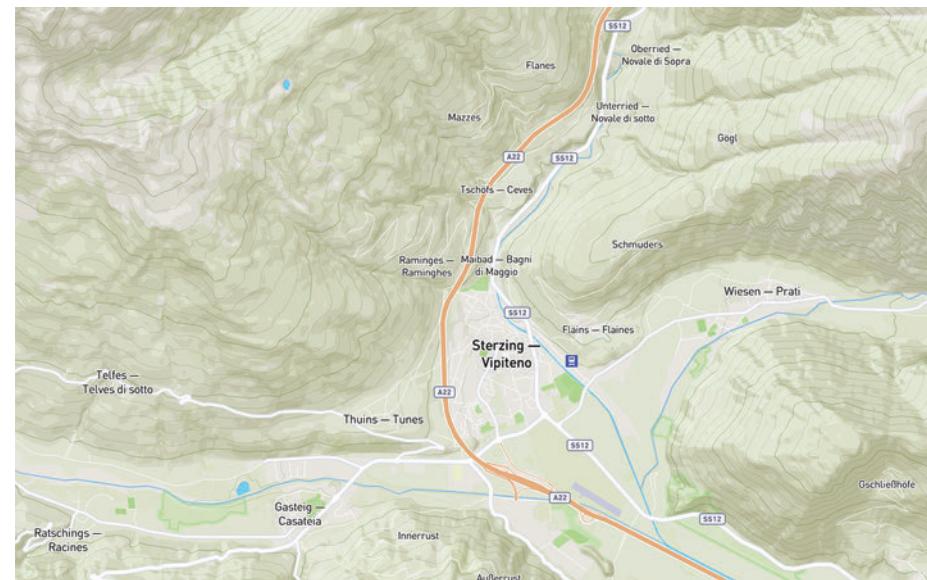
## Points of interest (POIs)

Mapbox Streets features a broad range of POIs styled to indicate category and filtered to only show the most important POIs across the zoom range. These icons from our set of open source **Maki icons**. Maki icons are designed simply and work seamlessly with Mapbox Studio. The **Maki icon editor** allows you to customize the style of your icons you can add and remove these icons, categorize and style them in groups, and download them for your map styles.



## Additional design features

- **Roadways.** Highly organized road data, designed to present a clearly legible hierarchy of all road types across a wide zoom range.
- **Administrative boundaries.** A global political and administrative boundary layer.
- **Built features.** Building footprints, rail stations, urban parks, land use, famous landmarks, and neighborhood stores.
- **Natural features.** Rivers, lakes, streams, oceans, coastal boundaries, parks, land cover, and beaches.
- **Places.** A complete hierarchy of location labels, from countries and states down to villages and neighborhoods.
- **Terrain.** Vivid hillshading show elevation, contour lines, and a tactile topography.
- **Unique iconography.** Select countries and cities feature custom highway shields and public transit icons.

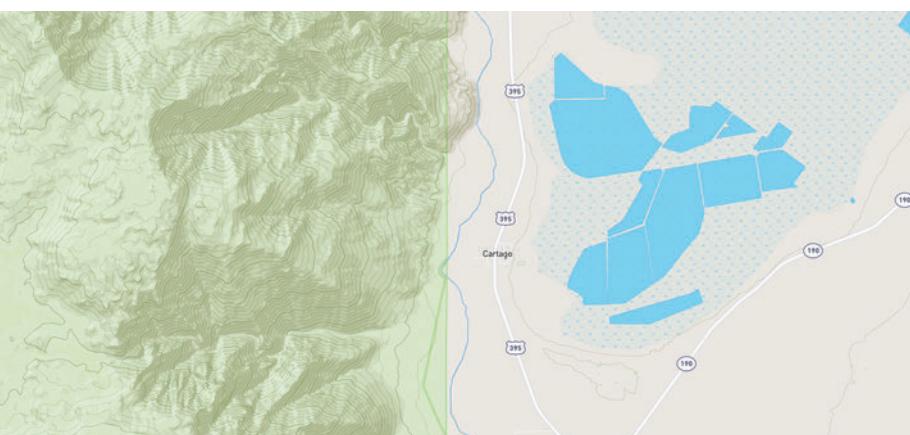
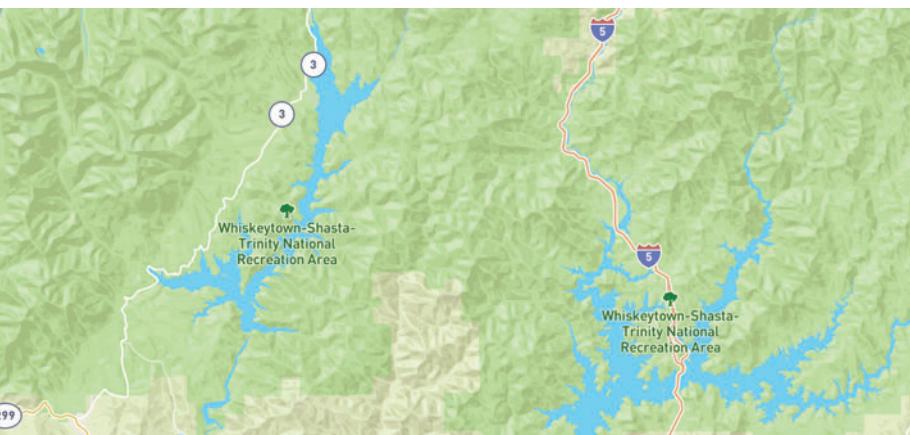


## Mapbox Outdoors

**Mapbox Outdoors** is a general-purpose map with curated tilesets and specialized styling tailored to hiking, biking, and the most adventurous use cases. To meet the needs of the bikers, hikers, runners, and skiers that rely on Mapbox Outdoors, our cartographers mined OpenStreetMap for its extensive trail, path, and piste information, and developed styling that clearly articulates each type for maximum legibility.

## Curated terrain data

Mapbox Terrain's global elevation and hillshade data lie at the heart of Mapbox Outdoors. We processed sources from 24 datasets across 13 organizations, including the U.S. Geological Survey, Norwegian Mapping Authority, and Canadian GeoBase, combining the natural features into a robust tileset with necessary path and trail data for an outdoors map.

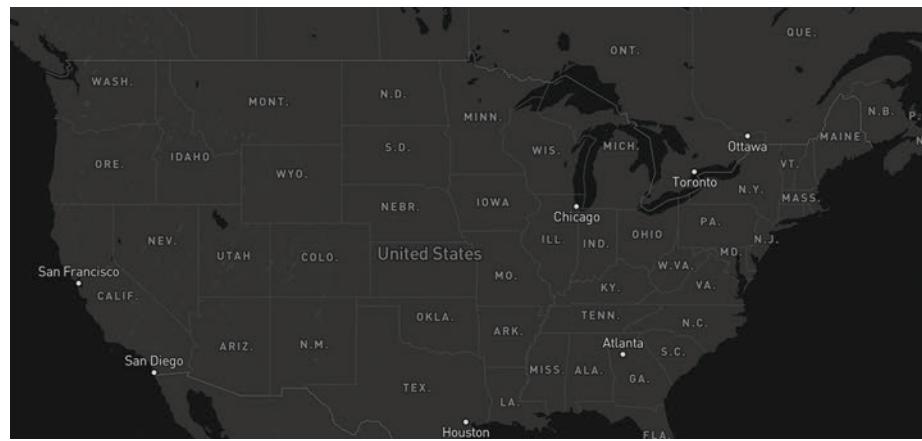


## Relevant points of interest

Mapbox Outdoors contains an array of points of interest (POI) data relevant to active use cases: you can find campsites, public restrooms, and even water fountains in these specialized layers.

## Additional design features

- **Roadways.** Highly organized road data, designed to present a legible hierarchy of all road types across a wide zoom range.
- **Administrative boundaries.** A global political and administrative boundary layer.
- **Paths and trails.** Hiking paths, footways, cycleways, and ski trails.
- **Built features.** Building footprints, rail stations, urban parks, land use, famous landmarks, and neighborhood stores.
- **Natural features.** Rivers, lakes, streams, oceans, coastal boundaries, parks, land cover, and beaches.
- **Places.** A complete hierarchy of location labels, from countries and states down to villages and neighborhoods.
- **Terrain.** Vivid hillshading delivers visually tactile topography for outdoor and active lifestyle apps.
- **Unique iconography.** Select countries and cities feature custom highway shields and public transit icons.



## Mapbox Dark and Mapbox Light

Mapbox Light and Mapbox Dark are subtle, full-featured maps designed to provide geographic context while highlighting the data on your analytics dashboard, data visualization, or data overlay. The Cartography Team created two tightly constrained color palettes that use slight shifts in hue and value to provide depth and space without overwhelming overlaid content.



## Less layers, better focus

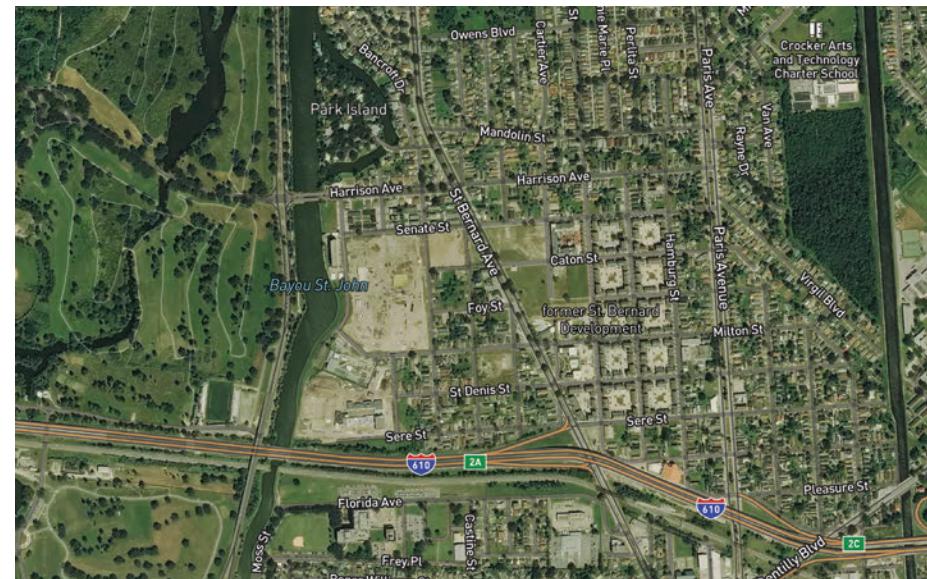
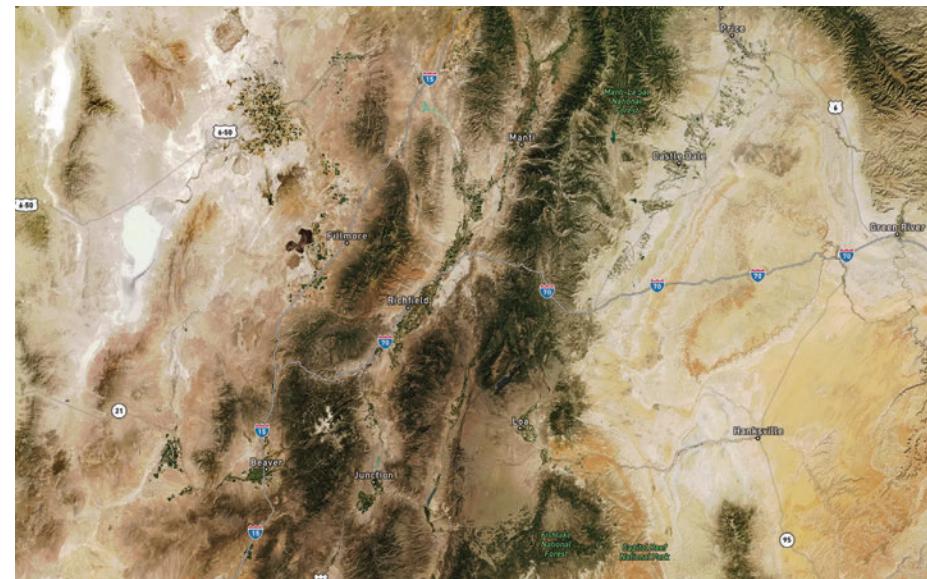
Mapbox Light and Dark use the same vector tile source as our general-purpose maps, Mapbox Streets, and contain the full range of geographic information required to provide context for overlays. Light and Dark are specially designed to show a full set of cartographic features without distracting from your content.

The Cartography Team modified every element of these maps; thinning line widths, lowering label densities, and reducing contrast, to let you data take center stage.



## Additional design features

- **Roadways.** Highly organized but more scaled back road data, designed to present a clearly legible hierarchy of the majority of road types across a wide zoom range.
- **Administrative boundaries.** A global political and administrative boundary layer.
- **Built features.** Building footprints, rail stations, urban parks, land use, famous landmarks, and neighborhood stores.
- **Natural features.** Rivers, lakes, streams, oceans, coastal boundaries, parks, land cover, and beaches.
- **Places.** A complete hierarchy of location labels, from countries and states down to villages and neighborhoods.
- **Terrain.** Subtle hillshade complements the simple design with topography for context.



## Mapbox Satellite and Mapbox Satellite Streets

Mapbox Satellite is our global high-resolution satellite imagery.

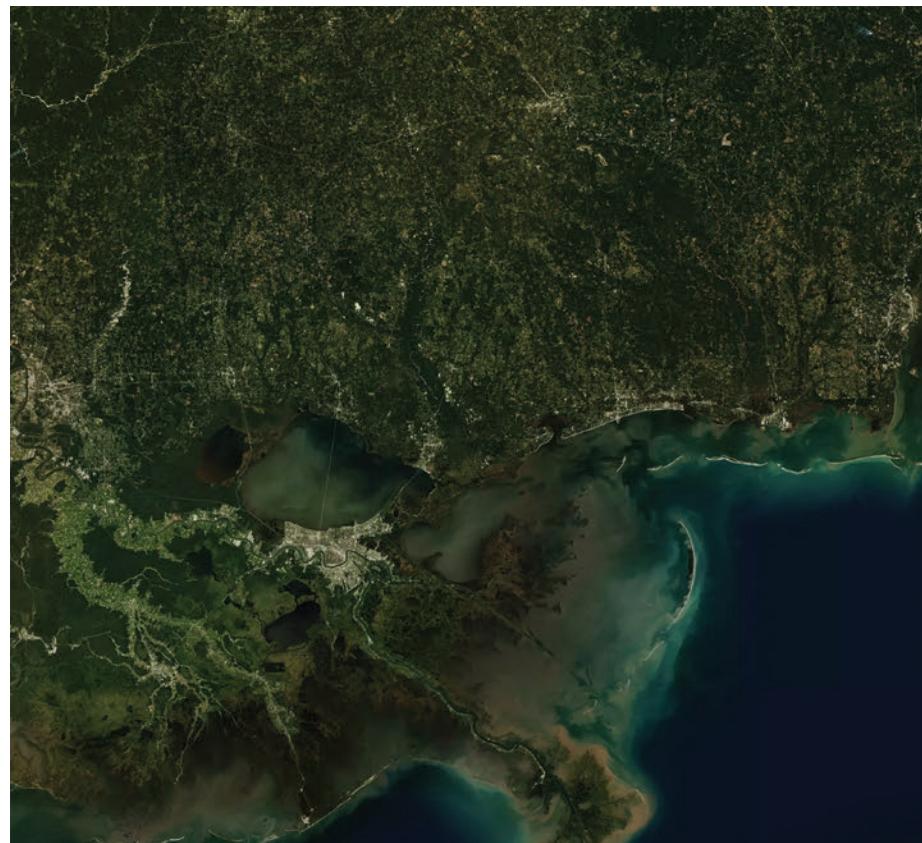
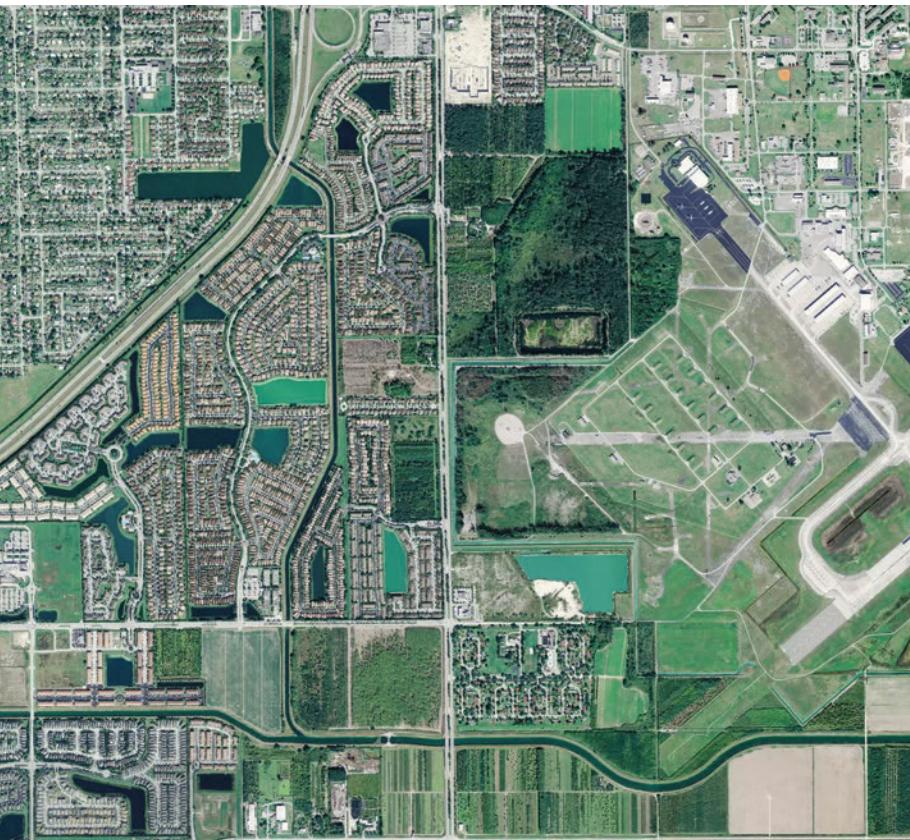
Mapbox Satellite Streets combines the Mapbox Satellite basemap with vector data from Mapbox Streets to bring contextual information.

Mapbox Satellite Streets is designed to enhance our vibrant Satellite imagery with a light layer of Mapbox Streets data. Our designers have created clear and legible road hierarchies with a comprehensive set of road, place, and feature labels that balance legibility and usability.

Mapbox Satellite Streets uses same vector tile source as our general-purpose maps and contains the full range of geographic information required to provide context for overlays.

## Imagery

Mapbox Satellite imagery comes from a variety of commercial providers, as well as open data from NASA, USGS, and others. It is color-corrected, cloud-free raster tileset. As cities and landscapes change, we add newer, clearer, and more attractive imagery.



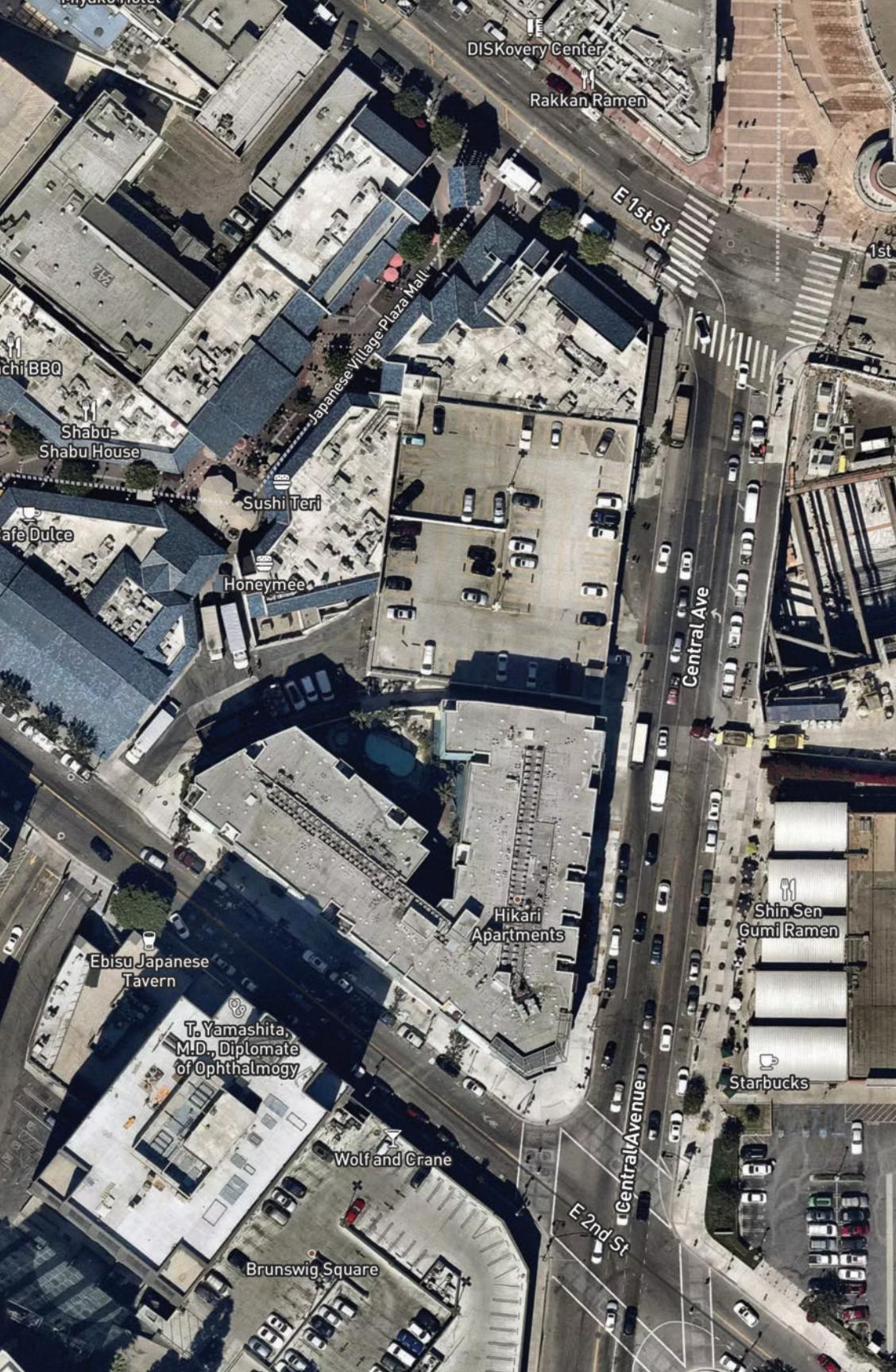
## Global coverage

Cloudless for zoom levels 0–8 and available from z0–19 Mapbox Satellite imagery comes from a **variety of sources** depending on zoom level and geographic availability.

- **Zoom levels 0–6.** Uses cloud-free data from NASA MODIS satellites.
- **Zoom levels 7–12.** Uses the **NASA/USGS Landsat 5 & 7** imagery.
- **Zoom levels 13+.** Use a combination of open and proprietary sources, including **Digital Globe** for much of the world, USDA's NAIP 2011–2013 in the contiguous United States, and open aerial imagery from Denmark, Finland, and parts of Germany.

If you notice an area where imagery needs improvement or updates for any reason, let us know by leaving your feedback with our **imagery request tool**. This tool adds your requests to a master list that we consult when prioritizing updates. If you wish to recommend an imagery source, please mention it in your request. Please note that imagery is not improved on a set schedule and is updated when and where it becomes available.





## Additional design features

- **Roadways.** Highly organized road data, designed to present a clearly legible hierarchy of all road types across a wide zoom range.
- **Administrative boundaries.** A global political and administrative boundary layer.
- **Built features.** Building footprints, rail stations, urban parks, land use, famous landmarks, and neighborhood stores.
- **Natural features.** Rivers, lakes, streams, oceans, coastal boundaries, parks, land cover, and beaches.
- **Places.** A complete hierarchy of location labels, from countries and states down to villages and neighborhoods.
- **Unique iconography.** Select countries and cities feature custom highway shields and public transit icons.



## 06 about the author

*Amy Lee Walton is a multidisciplinary designer that operates in the intersection of design, experience, and place. At Mapbox, she simplifies complex workflows while bringing visual narrative into a robust array of interactive and cartographic projects.*

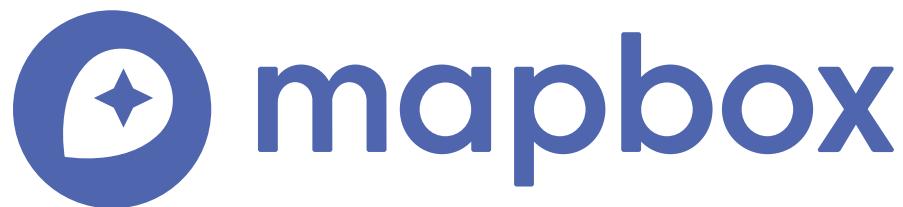
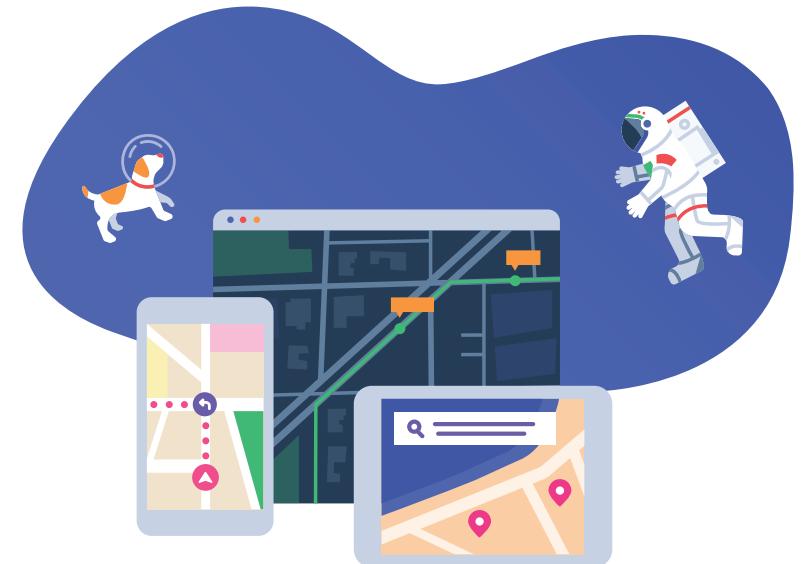


Amy Lee touches many facets of cartography and user experience. She designs beautiful thematic maps, leverages big data with Mapbox developers to visualize narratives, writes about workflow and process on Mapbox's blog, Point of Interest, leads cartographic design workshops, conducts user testing and analysis, and helps craft improved UX/UI across product roadmaps.

Active speaker and thought leader, she's spoken at the North American Cartographic Information Society (NACIS), FOSS4G, and Design Week San Francisco, Portland, and Tallahassee, and counting. Her work has been featured in the Wired, Communication Arts, technical.ly/dc, and the Atlas for Design Vol. III, among others.

Amy Lee holds an MFA in Graphic Design from the Maryland Institute College of Art (MICA). At MICA, she coalesced design, physical computing, creative code, and digital fabrication. Currently, she serves on the board NACIS and is Vice President for Thursday Network, a non-profit community service and civic engagement organization. Amy Lee is passionate about social good, connecting with others, and championing diversity and inclusion in tech.

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Mapbox is the location data platform for mobile and web applications. We provide building blocks to add location features like maps, search, and navigation into any experience you create.

We're changing the way people move around cities and explore our world. Through the apps Mapbox powers, we reach more than 300 million people each month.

## Recommended reading

### 02 vector maps

- **Vector Tile: Data guide**  
<https://www.mapbox.com/vector-tiles/>
- **Mapbox GL Style Spec**  
<https://www.mapbox.com/mapbox-gl-js/style-spec/>
- **Mapbox Vector Tile Specification**  
<https://www.mapbox.com/vector-tiles/specification/>

### 03 map design

- **View from the sky: Designing the Cali Terrain** | by *Amy Lee Walton*  
<https://blog.mapbox.com/mapbox-cali-terrain-style-bea8cd410523>
- **Designing the Vintage map style** | by *Amy Lee Walton*  
<https://blog.mapbox.com/designing-the-vintage-style-in-mapbox-studio-9da4aa2a627f>
- **Designing the Whaam! map style** | by *Amy Lee Walton*  
<https://blog.mapbox.com/designing-the-whaam-style-in-mapbox-studio-47a90bfaeaf0>
- **Building a map taxonomy chart** | by *Nat Slaughter*  
<https://blog.mapbox.com/map-design-taxonomy-chart-ae17b23df019>
- **Rise and Lè Shine: Designing a custom map style to explore the globe**  
by *Nat Slaughter*  
<https://blog.mapbox.com/rise-and-l%C3%A8-shine-c0eaf9a964d5>
- **Natural Earth's open source datasets**  
<http://www.naturalearthdata.com/downloads/>

### 04 special considerations

- **Designing maps for navigation** | by *Alex Parlato*  
<https://blog.mapbox.com/designing-maps-for-navigation-186fe1c67363>
- **Dots vs. polygons: How I choose the right visualization** | by *Amy Lee Walton*  
<https://blog.mapbox.com/right-way-visualize-data-945d6010fab0>
- **Designing maps for mobile devices** | by *Nat Slaughter*  
<https://blog.mapbox.com/designing-maps-for-mobile-devices-32d2e49d2096>
- **How Uploads Work**  
<https://www.mapbox.com/help/how-uploads-work/#how-uploads-work>

- **Add live realtime GEOJSON data**

<https://www.mapbox.com/mapbox-gl-js/example/live-geojson/>

### 05 getting started

- **Mapbox Satellite Streets redesigned for mobile**  
by *Amy Lee Walton*  
<https://blog.mapbox.com/mapbox-satellite-streets-redesigned-for-mobile-9fd5e8ce51ff>
- **Say hello to the Studio Preview app** | by *Eric Wolfe*  
<https://blog.mapbox.com/say-hello-to-the-studio-preview-app-75627661039e>

### 06 about the author

- **Studio Ames: The Studio of Amy Lee Walton**  
<https://studioames.com/> | @amyleew
- **Points of Interest: Mapbox blog**  
<https://blog.mapbox.com/> | @mapbox



