

*The Guide to Map Design.*

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# The Guide to Map Design

Cartography is a design and data synthesis that balances information, color, readability, and accuracy. The essentials of good visual communication are key to making a map that guides while encouraging visual exploration and quick comprehension.

Modern mapping tools and technologies allow product owners to architect elegant, considered mapping experiences for their products and end users. Tools like Mapbox Studio and Mapbox GL JS, give product owners control not only over the look and feel of their maps, but also over the map's responsiveness to user inputs, environments, and other factors.

## Why design custom maps?

As you navigate the world it's important to know where you are in relationship to where you are going. It's also important to understand context along the way—what will you find on the way from here to there? Designing a custom map for your brand or product allows you to:

- Keep users visually connected to your brand and in your app as they use the map.
- Highlight or downplay information as necessary to your map's use case.
- Design a basemap for your data and product narrative to build interactions upon.
- Integrate user inputs and environments into their experience with your brand in real-time.



# How to use this guide

Designing a custom map style for your product or brand starts with context and intention. Begin your journey by answering, "How will this map design reinforce the information and experience my brand or product aims to convey?"

This guide will lead you through the process of defining and designing your custom map style. It will:

- Explain how vector maps work
- Illustrate some best practices in map design, such as:
  - Customizable design elements: color, typography, texture, and iconography
  - Principles of good map design: visual contrast, hierarchy, density, and legibility
- Special considerations for design maps for navigation, mobile, and data visualization
- Get you started with Mapbox maps
  - Define the global coverage and zoom levels provided with web maps
  - Describe Mapbox-provided map styles and when to use them
  - Describe Mapbox-provided vector tiles (data) and what it covers

## Let's get started!

# How vector maps work

Before designing a single road, waterway, or city label, it's important to understand how vector maps function.

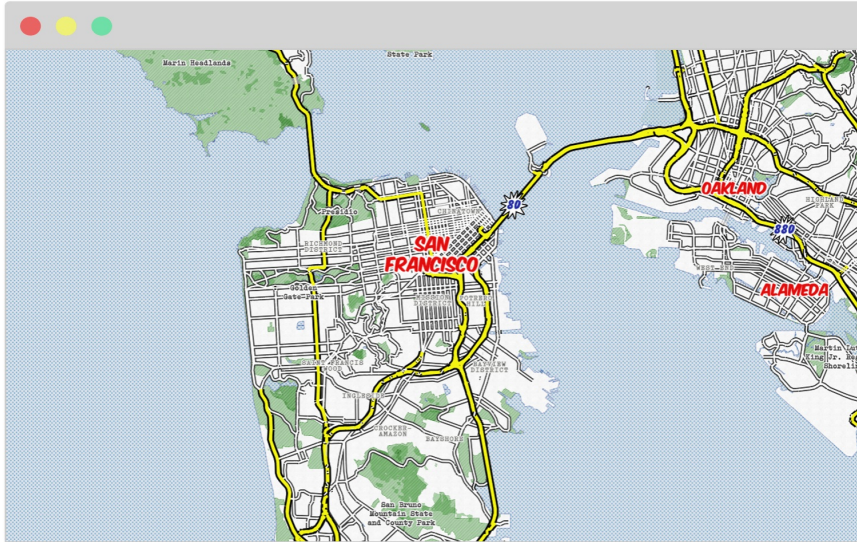
Vector maps are an advanced approach to mapping where map data is delivered and precisely rendered in real-time. They are delivered to the browser or mobile device using WebGL or OpenGL which dynamically draws data with the speed and smoothness of a video game. The result fast interactive maps.

Since the map is literally being drawn in browser or device, you can dynamically change styled elements during runtime. Lighten or darken the map based on the time of day, personalize icons and the colors based on user activity, switch languages on the fly, or bump label sizes based on user preferences to improve legibility, all in real time.

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

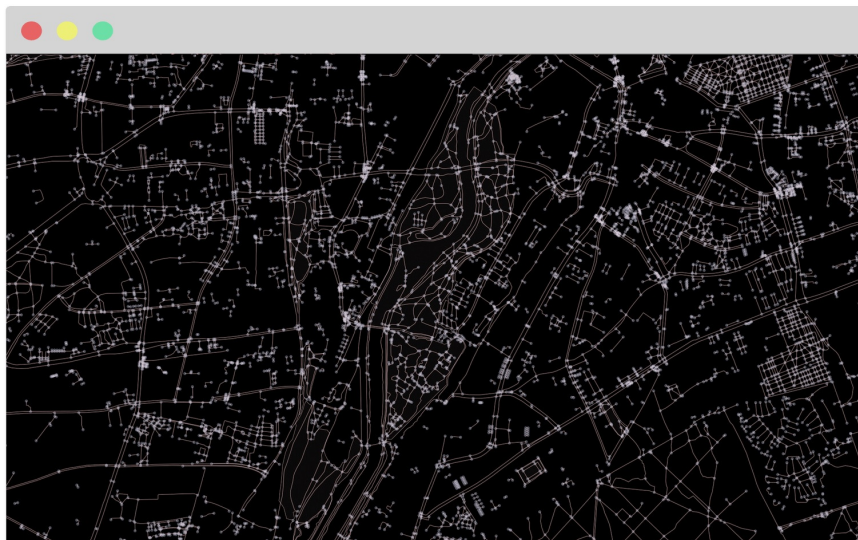
## 1) The renderer

Vector maps are rendered with Mapbox GL. Mapbox GL uses the power of WebGL to combine vector data and style instructions and draw them in the client. To display a map in web browsers, use the Javascript library Mapbox GL JS which 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, use Mapbox GL Native.



## 2) 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.



### 3) 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. Mapbox Studio's style editor provides the user interface where you can define your map style. Behind the scenes, Studio creates this file the `style.json` and hosts it on the Mapbox Styles API when published. This style is then accessible via endpoint to add to your mobile or web app.

View the live version of map style hosted on the Mapbox Styles API at a url like:

```
https://api.mapbox.com/styles/v1/mapbox/streets-v9.html?<access-token>#0/0/0
```

View the `style.json` style rules document at a url like:

```
https://api.mapbox.com/styles/v1/mapbox/streets-v9?<access-token>#0/0/0
```



```
{
  version: 8,
  name: "whaam!",
  + metadata: {[-]},
  - center: [
    -122.40041294788173,
    37.7667664679347
  ],
  zoom: 11.247547497362104,
  bearing: 0,
  pitch: 0,
  - sources: {
    - composite: {
      url: "mapbox://mapbox.mapbox-terrain-v2,mapbox.mapbox-streets-v6",
      type: "vector"
    },
    - mapbox://mslee.3rd3tnlg: {
      url: "mapbox://mslee.3rd3tnlg",
      type: "vector"
    }
  },
  sprite: "mapbox://sprites/mslee/cii8323c8004w0nlvtss3dbm2",
  glyphs: "mapbox://fonts/mslee/{fontstack}/{range}.pbf",
  - layers: [
    - {
      id: "background color (cream)",
      type: "background",
      - layout: {
        visibility: "visible"
      }
    }
  ]
}
```



# Best practices: Map design

Map design is essentially a design problem that requires design thinking, planning and vision. (This is the fun part.)

In this section, we will look at the design elements in your map style that should be customized to reflect your product or brand's design aesthetic. You have complete control over your map style—in fact, any feature can be customized. We recommend you begin designing the following elements: color, typography, iconography, and texture.

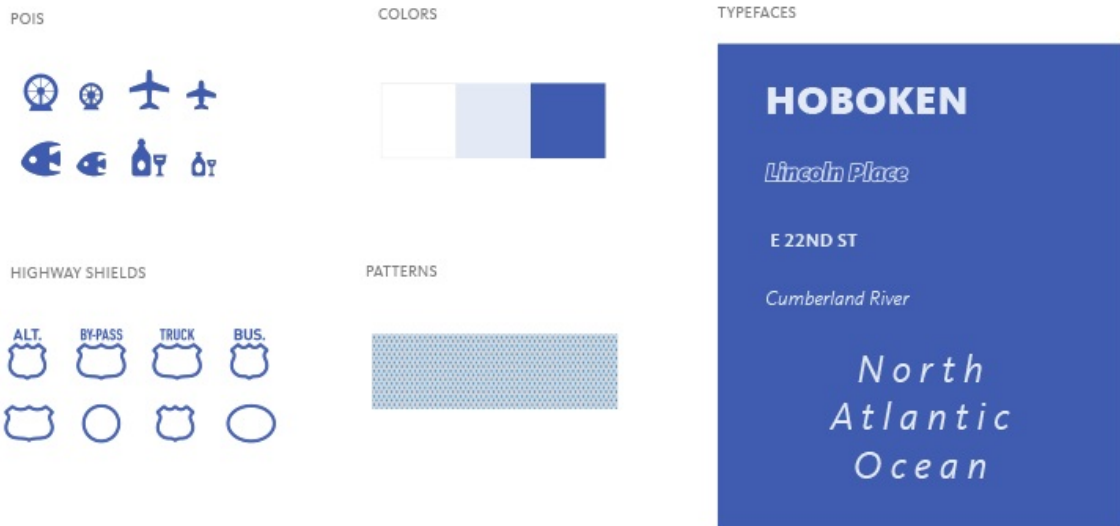
Next, we will introduce some design principles important to cartography. Adhere to these principles as you design to ensure the visual relationship is maintained. These principles are not to be applied in isolation, but instead are complementary. Collectively, they help cartographers and map designers create maps that successfully communicate geographic information.

# Design elements

Consider the following elements to be the customizable parts of your map. The best place to identify the design elements for your map is in your product or brand's styleguide. This styleguide should contain fonts, colors, imagery, etc. specific to your brand and 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 they have on your map style.

## Blueprint



Styleguide from the Blueprint map style.

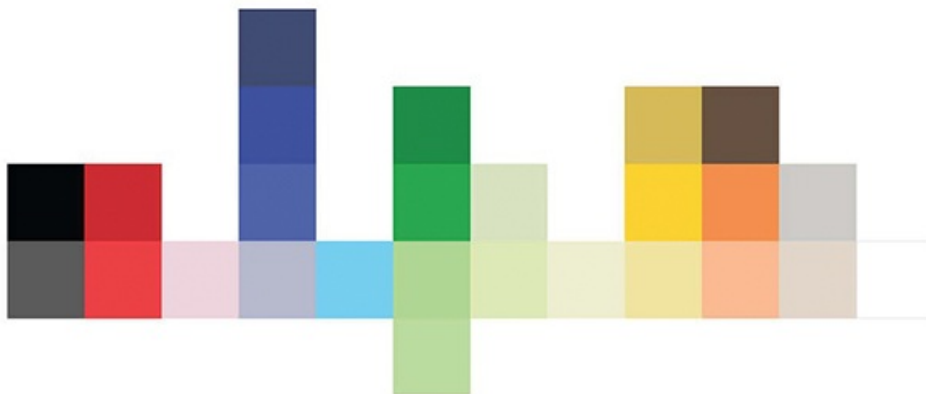
## Color

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.

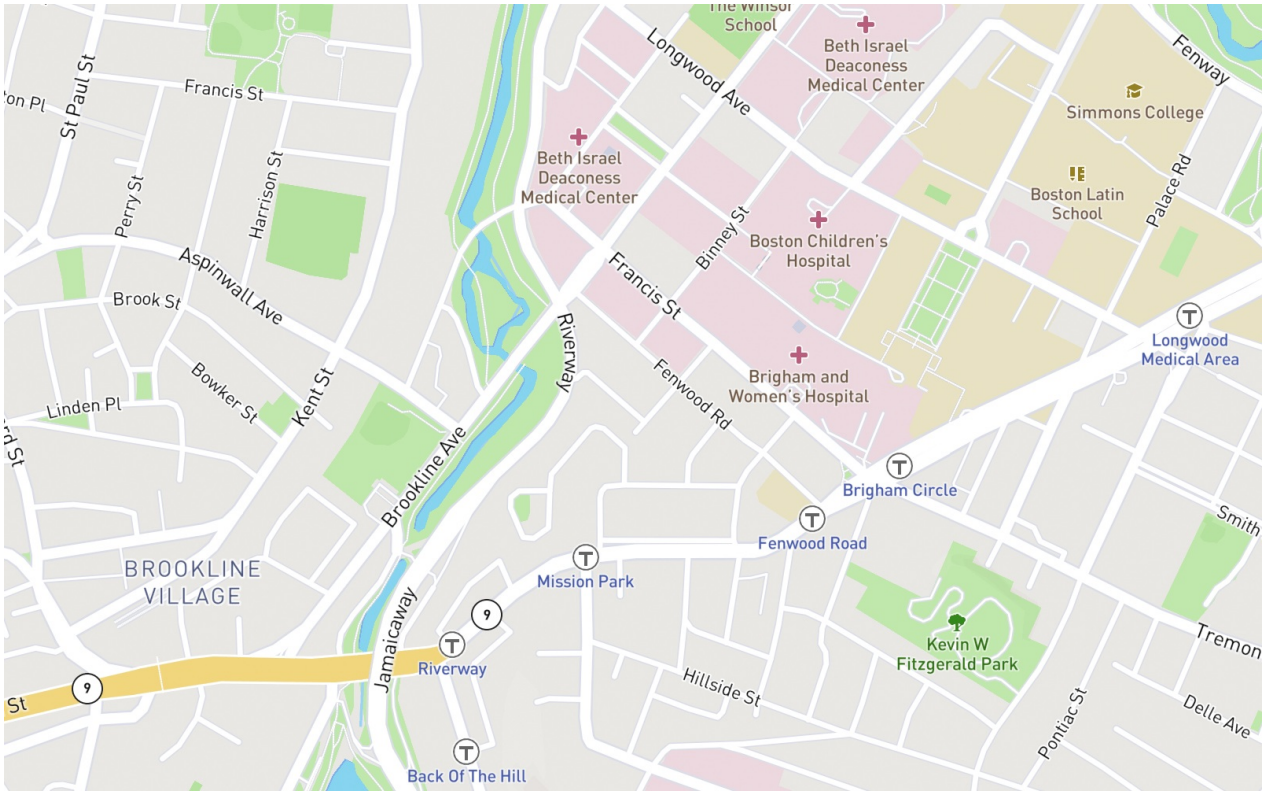
### Number of Colors

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.

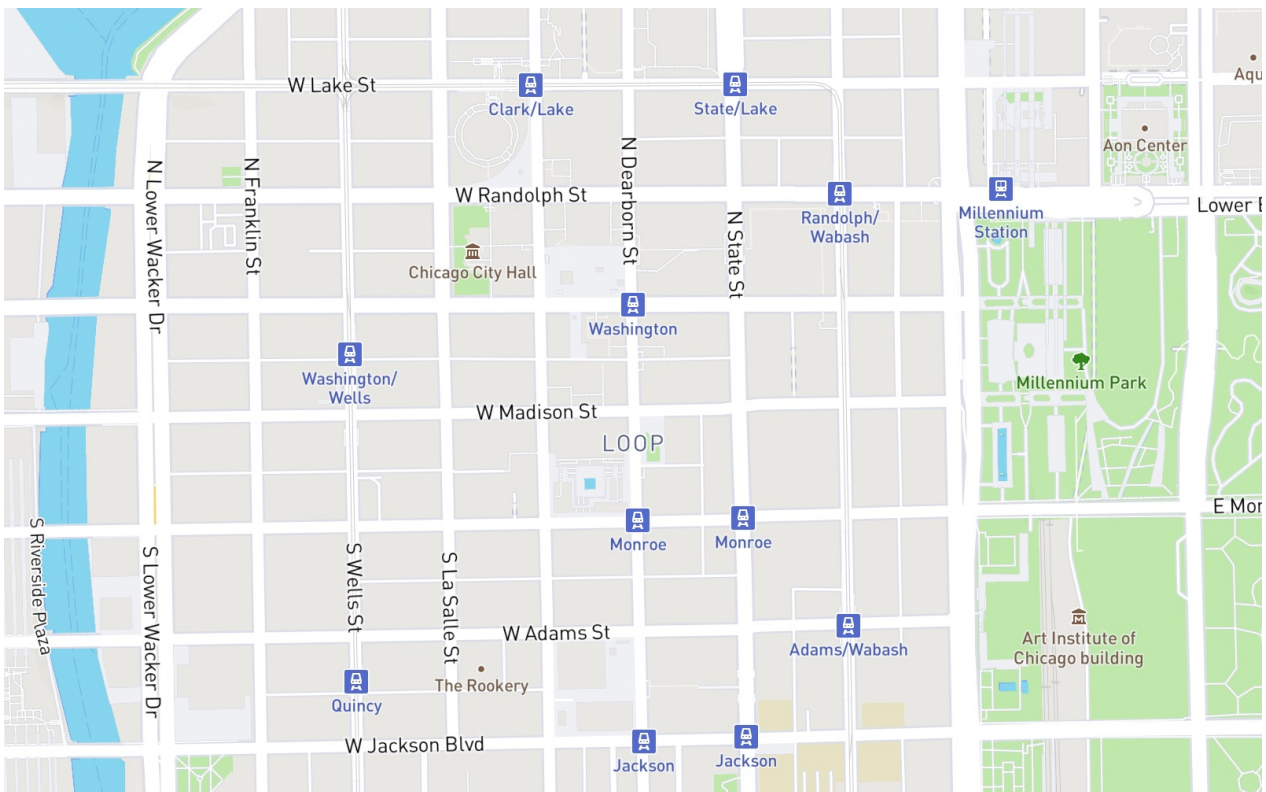


Many conceptually similar features share the same hue value, to reinforce their meaning and create a more cohesive map.



Mapbox Street color variety

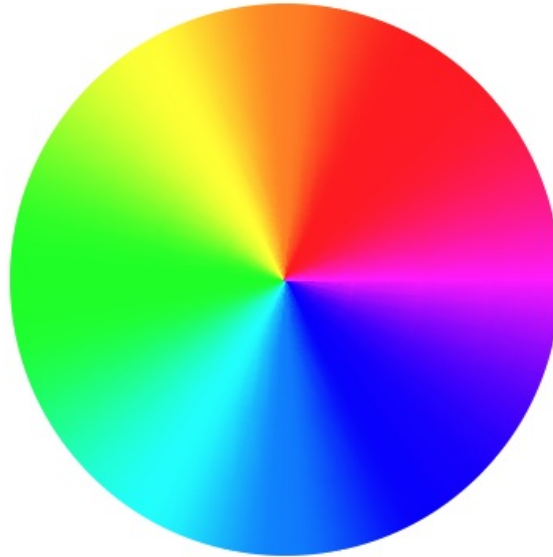
Limiting your colors will also help with visual harmony. For example, many features related to navigation and transportation share the same blue hue: rail labels, highway shields, ferry routes, and even road casings for this purpose.



Mapbox Streets blue transit icons

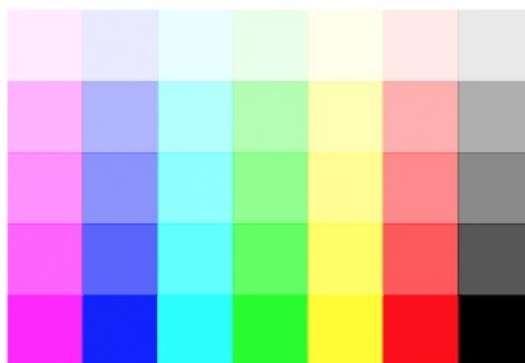
## Color Consistency

You can make subtle adjustments to your color palette while maintaining visual harmony by using the same hue but altering the color's saturation or value levels. The hue value simply represents the color of an item in the color wheel.



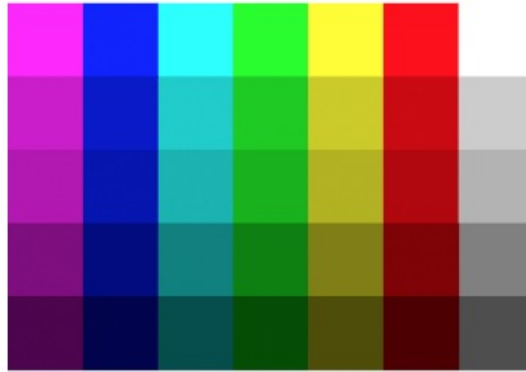
## Saturation

Saturation represents the level of intensity in the color or the color's dominance. As you decrease the saturation, the hue we becomes less vibrant and the color dominates less and less. When you reach 0 saturation, no hue dominates and you end up with a dull gray color.

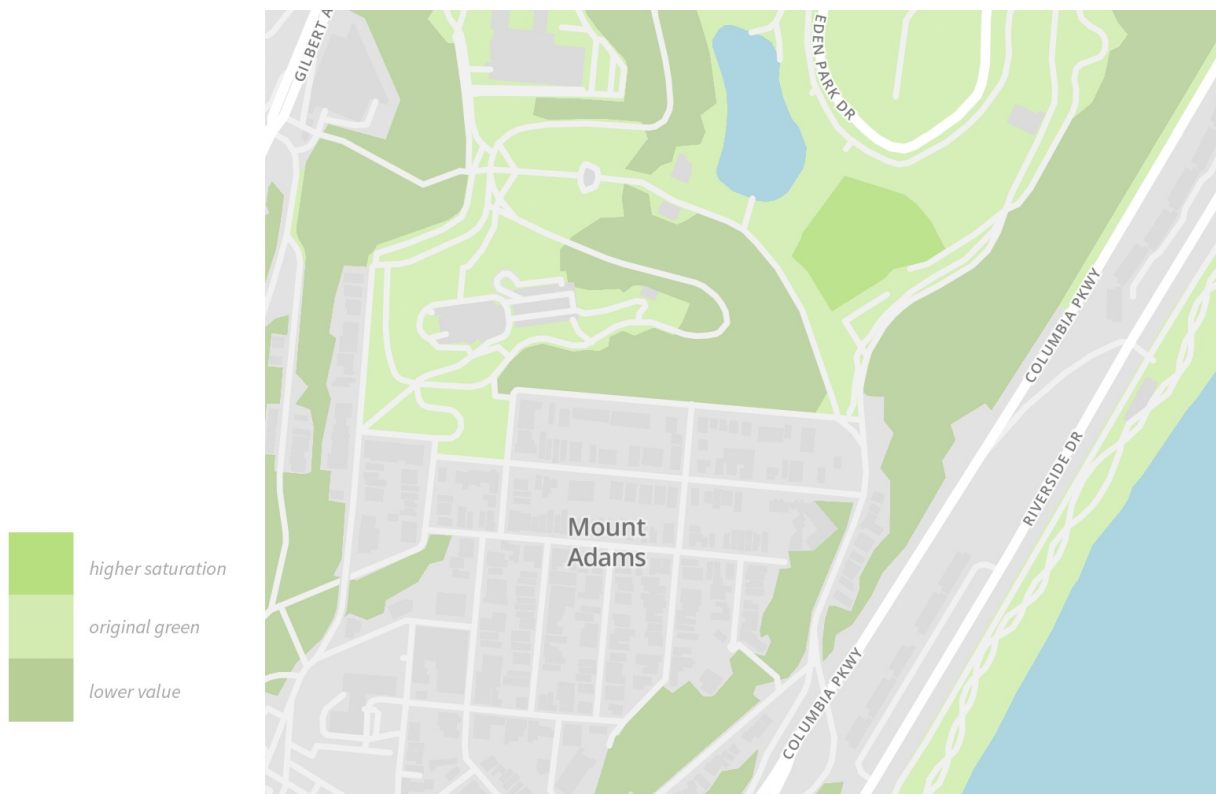


## Value

Value is the dimension of lightness/darkness describing the overall intensity of light in the hue. As you decrease the value, the hue becomes darker and at 0 becomes completely black.



Let's say you start with a pale green from your color palette to use to style park polygons. Then decide you want to differentiate between wooded areas and grass. Taking the original green (shown below), I've create two new colors by lowering the value for a darker green and then adding saturation for a brighter. Resulting in three color variations within the same hue and harmoniously.



# 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 you map style. In that case, choose a font directly from Studio that both 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.

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 create character to support all languages, so a unicode fallback is necessary to ensure global coverage.

## Mapbox Streets

DIN Offc Pro Regular

Washington, DC

DIN Offc Pro Medium

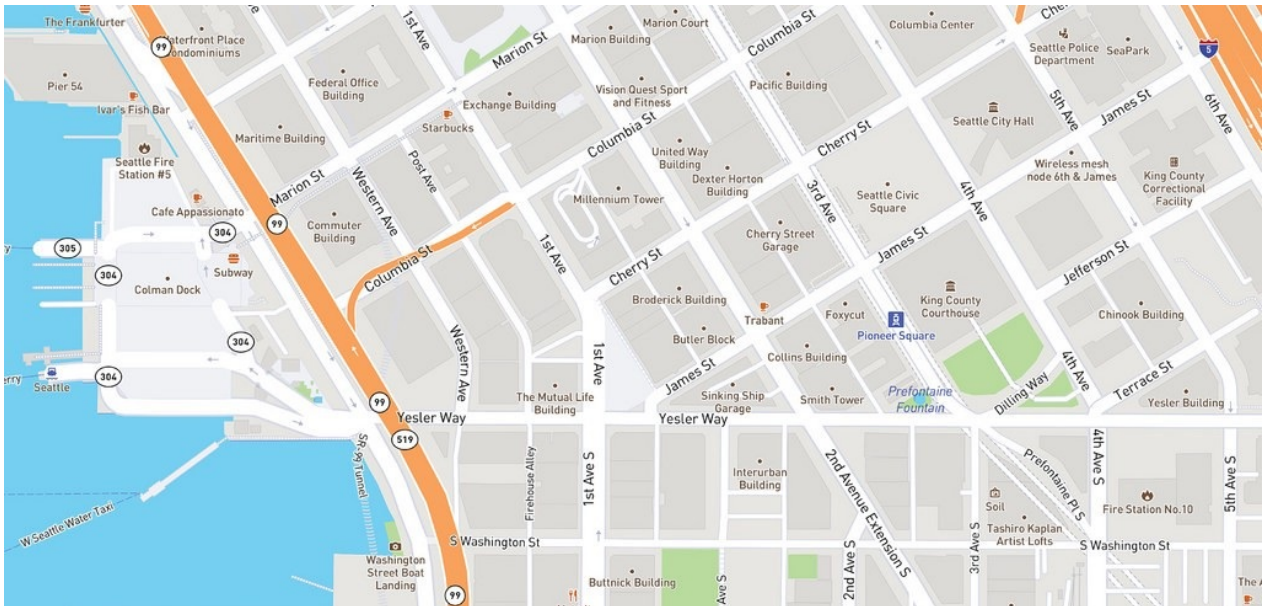
Washington, DC

DIN Offc Pro Italic

*Washington, DC*

DIN Offc Pro Bold

**Washington, DC**



## Blueprint

The Blueprint style is very minimalist and is primarily driven by one hue and one superfamily typeface. The typeface is `FF Kievit` a typeface that explores the synthesis of the sans serif form to the structure and proportions of a traditional serif font. The family spans nine weights and includes small caps, true italics, and multiple figure sets – everything necessary for creating sophisticated typographic systems.<sup>2</sup> This typeface ships with Studio and only employed Light, Light Italic, Italic, Bold, Black, and Black Italic variations.

Kievit Offc Pro Light

Washington, DC

Kievit Offc Pro Bold

**Washington, DC**

Kievit Offc Pro Light Italic

*Washington, DC*

Kievit Offc Pro Black

**Washington, DC**

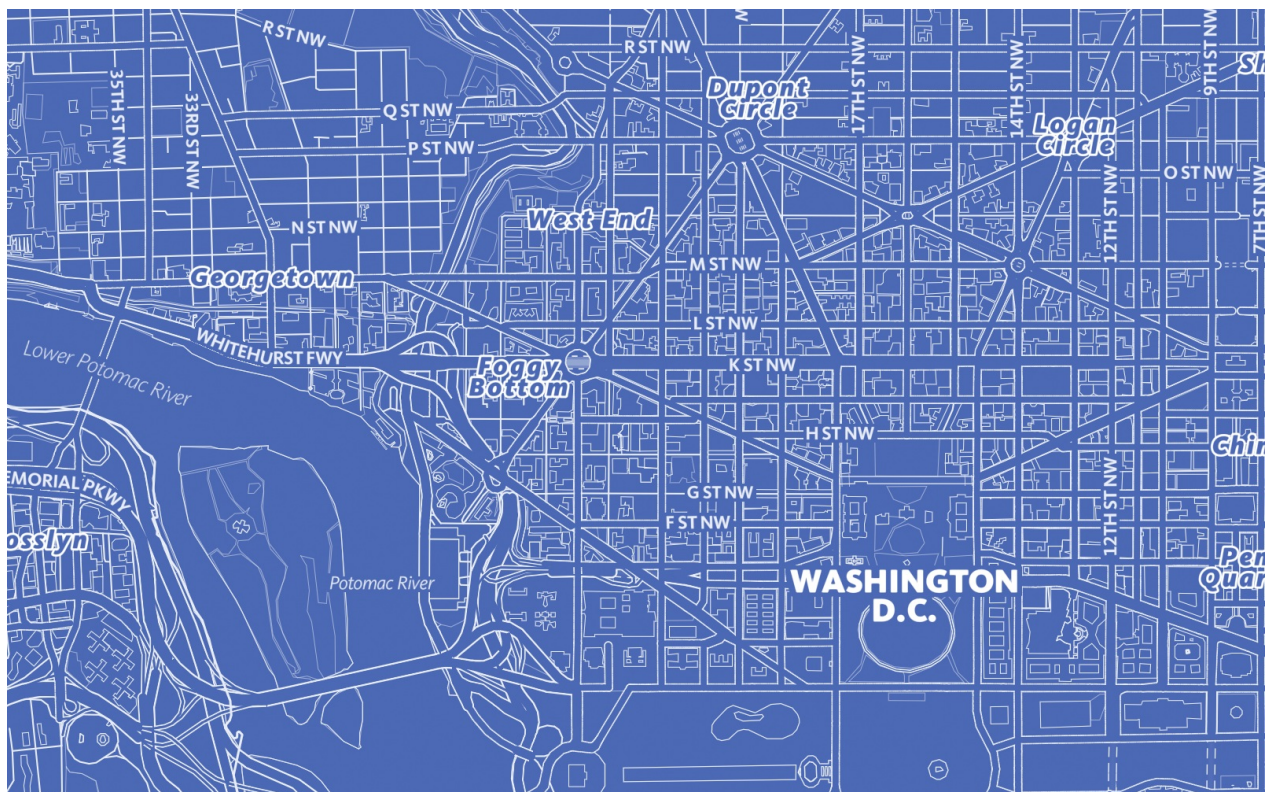
Kievit Offc Pro Italic

*Washington, DC*

Kievit Offc Pro Black Italic

***Washington, DC***





## Readability

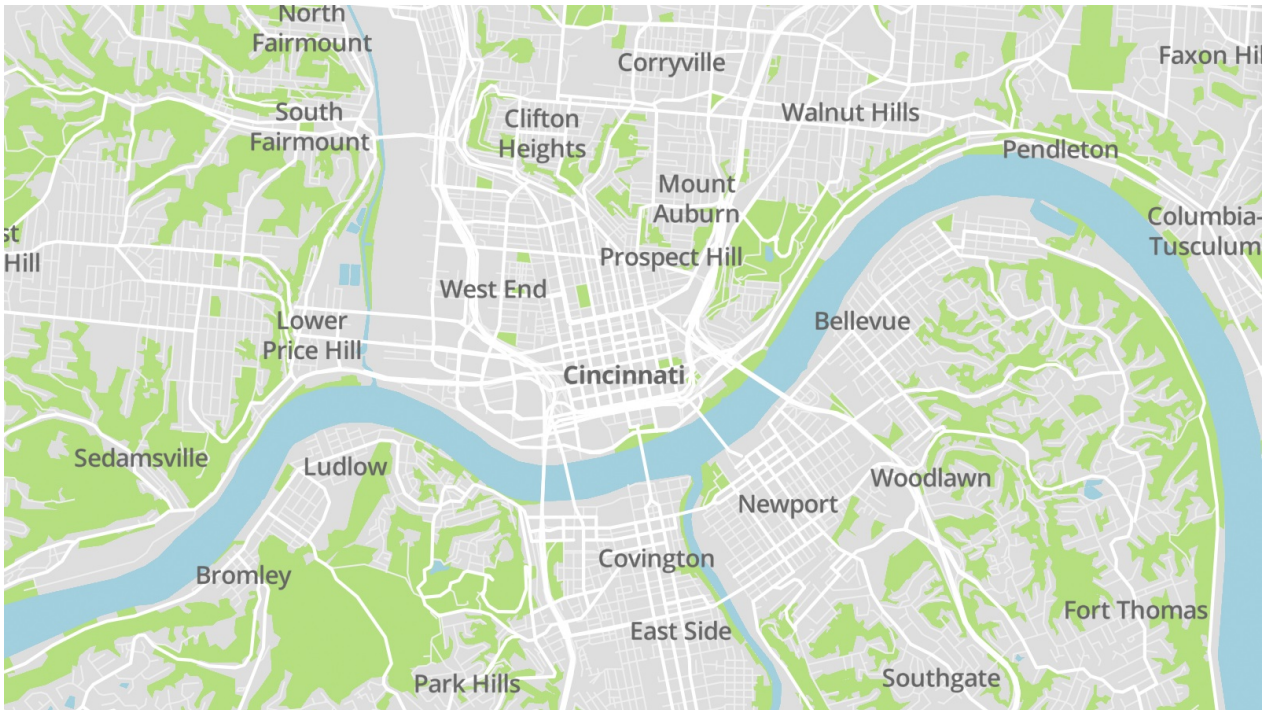
Readability is about arranging words in a way that allows the readers eye to access the content easily and intelligibly. This skill takes time to honed, but here are a few stellar ways to greatly enhance the readability of your maps:

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, use 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. Something to be mindful of when working with Bold, Black or just more heavily typefaces.

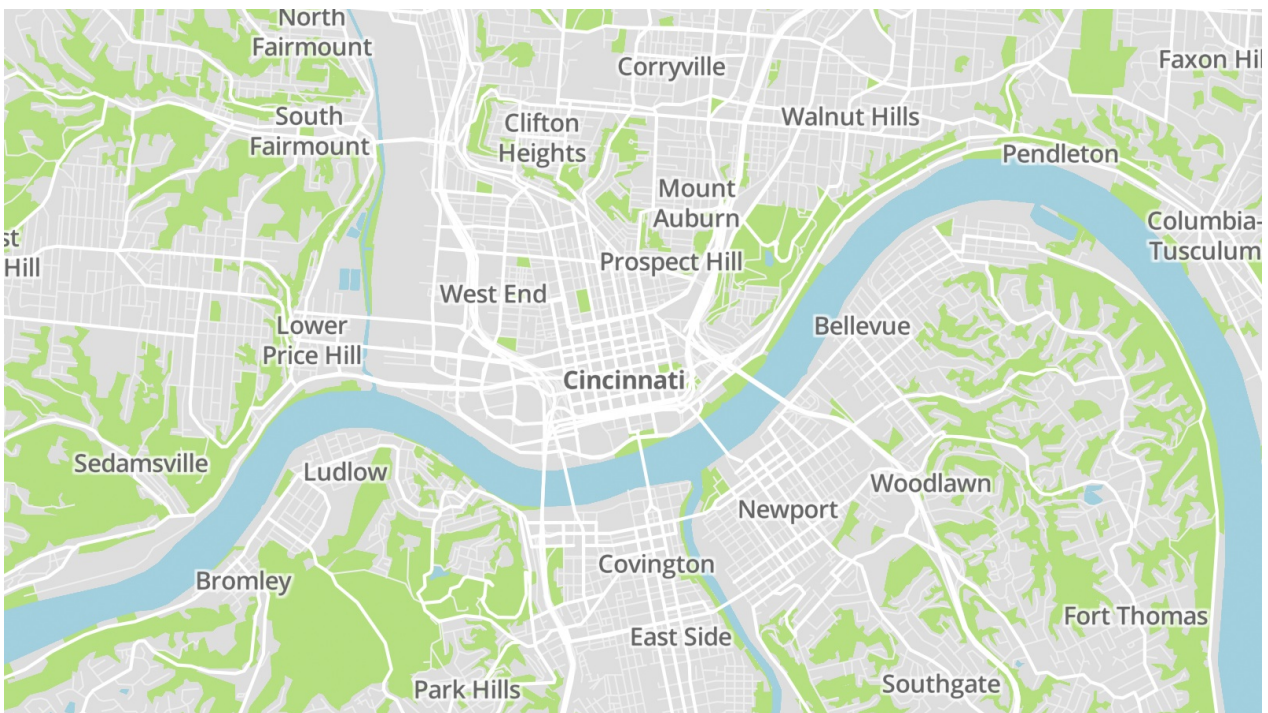
## Text halos

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.



*Before: No text halo applied to labels*



*After: With text halo applied.*

# Personality

The personality of a typeface speaks to the voice and energy it exudes. Major typeface styles are sans serif, serif, and script however sans serif fonts are popular on the 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.

The fact is the details of a typeface—such as contrast, proportions and angles—can have a big effect on its emotional characteristics. To help you decide, here are five questions you should ask of any typeface you're considering...

- Purpose and mood?
- Serif or sans serif?
- Collaborative or contrast?
- Creative or classic?

Take a look at some personality of these fonts used in a few of our designer map styles.

## Roboto : Modern yet approachable

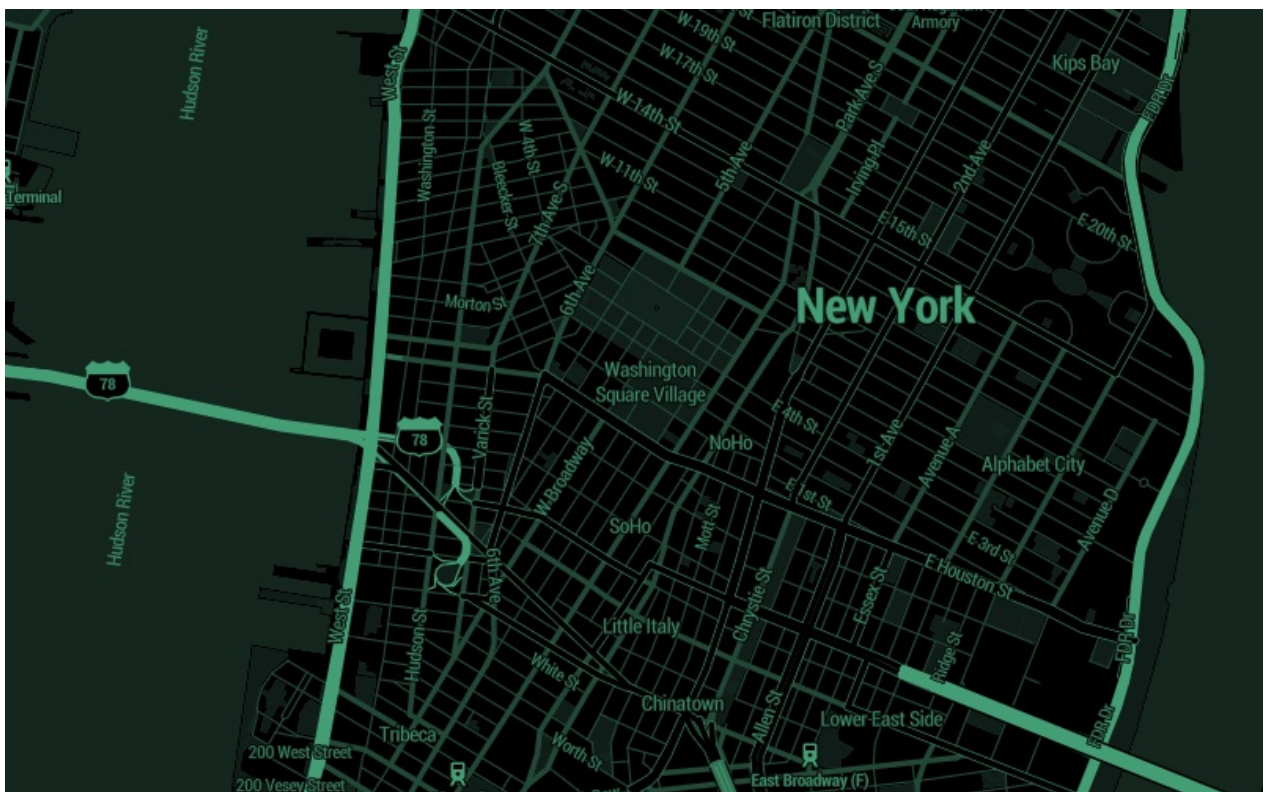
Roboto Condensed

Washington, DC

Roboto Bold Condensed

Washington, DC

Decimal uses [Roboto Condensed](#) and [Roboto Bold Condensed](#) to achieve this modern yet approachable feeling for it's dark but vibrant map style. 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.



## Roboto Mono & Old Standard : Modern classic

Roboto Mono Thin

Washington, DC

Roboto Mono Light

Washington, DC

Roboto Mono Regular

Washington, DC

Old Standard TT Italic

*Washington, DC*

Roboto Mono Italic

*Washington, DC*

Roboto Mono Medium

**Washington, DC**

Roboto Medium Italic

***Washington, DC***

North Star uses [Roboto Mono](#) in a variety of weights and styles. While "modern, yet approachable" the monospace format which have the 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 combinations promotes the old modern mix of this map style.



## Magda Clean Mono : Nostalgic grunge

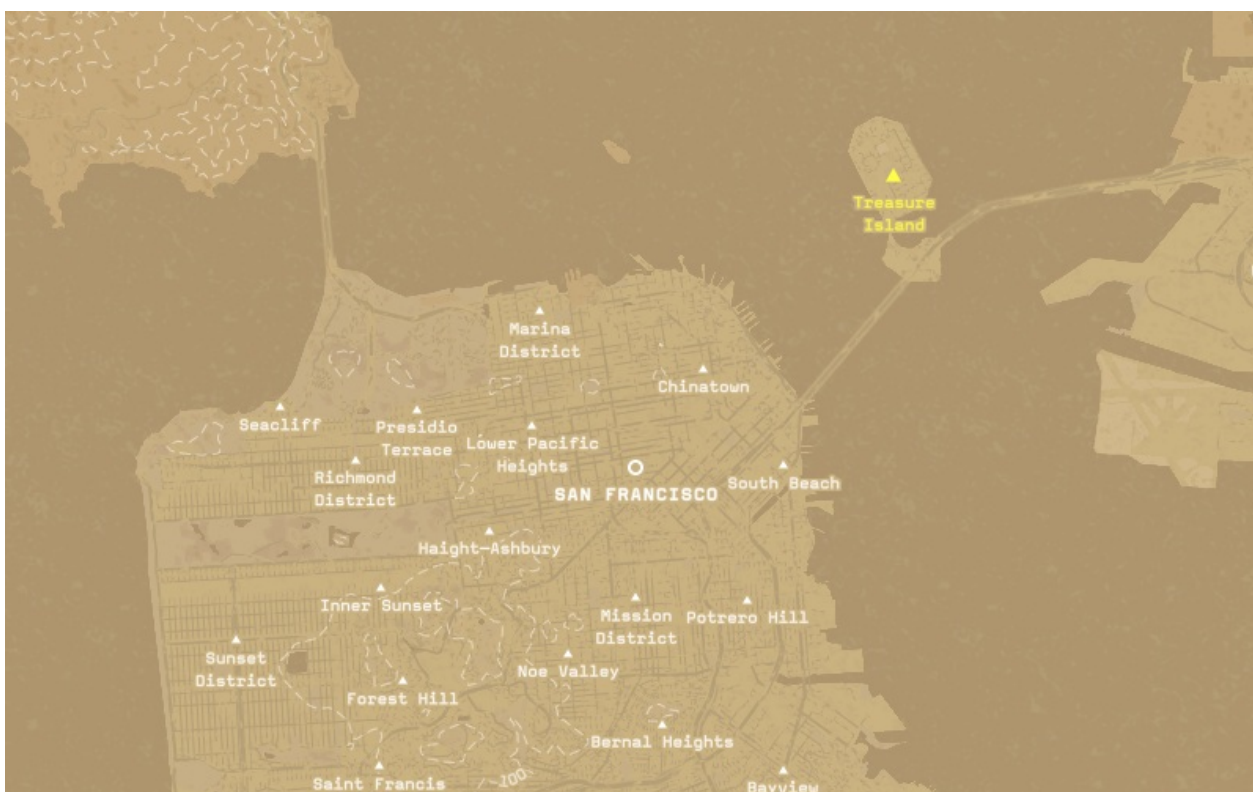
Magda Clean Mono Offc Pro Bold

**Washington, DC**

Magda Clean Mono Offc Pro Black

**Washington, DC**

**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 dystopic map style.



1 [https://en.wikipedia.org/wiki/Unicode\\_font](https://en.wikipedia.org/wiki/Unicode_font)

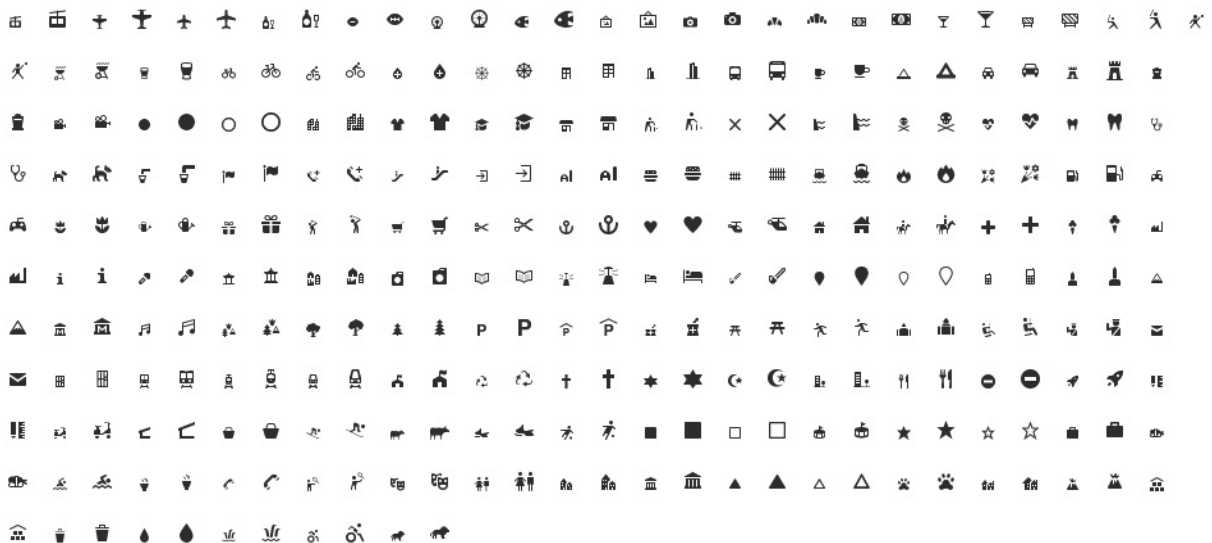
2 <https://www.fontshop.com/families/ff-kievit>

# Iconography

The icons you use on your map typically indicate points of interest or POIs. These can be anything from libraries to cafes 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 these icons, categorize and style them in groups, and download them for your map styles.



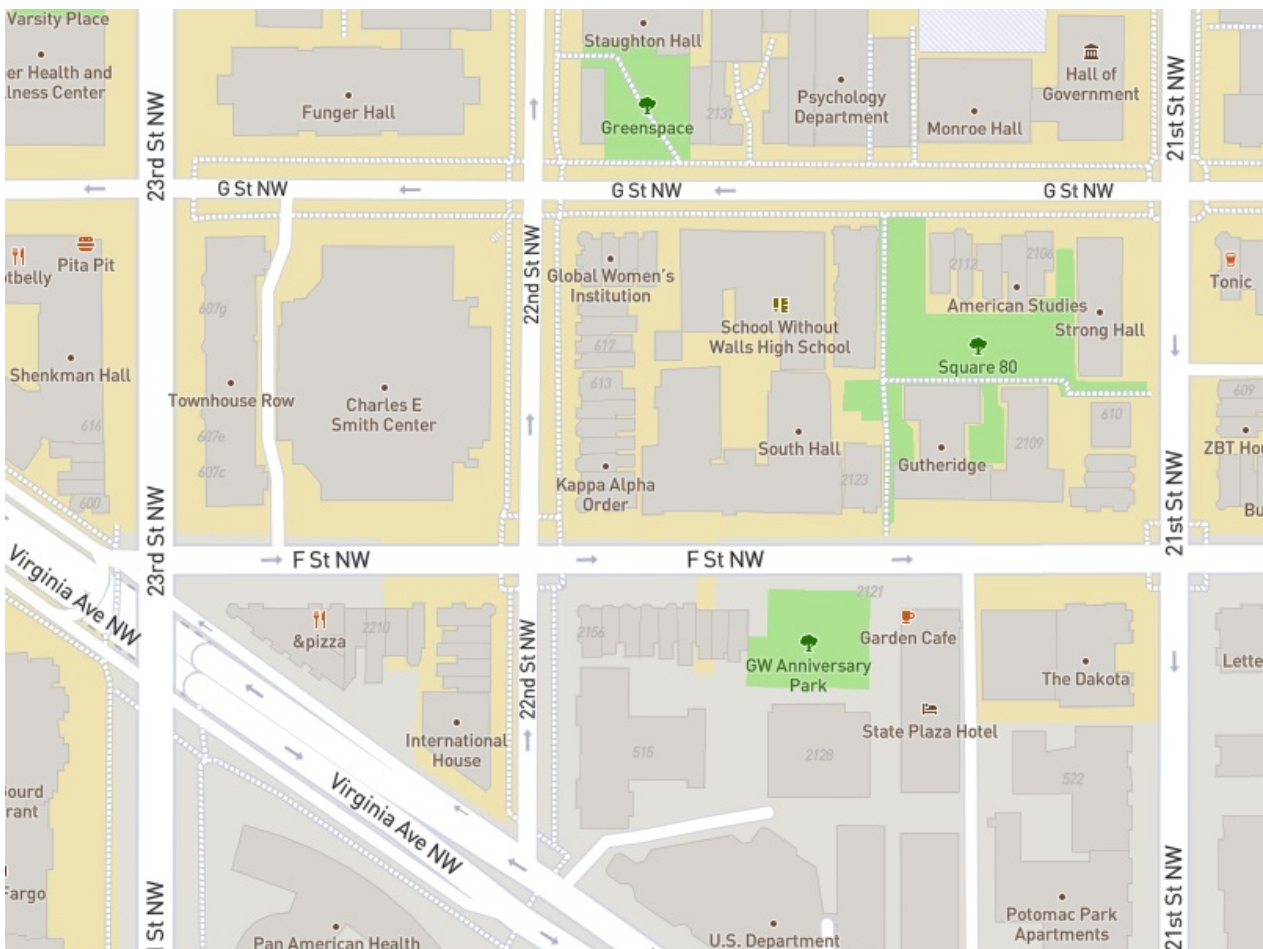
*Full Maki icon set.*

## Mapbox Streets icons



*Maki icons used in [Mapbox Streets](#) map style.*

Notice that the icons are grouped and style into familiar categories. For example, the food category is all orange and the transits all blue. These groupings help the viewer recognize and find POIs more easier as they navigate the map.



*Styled and categorized icons each with a light stroke to pull them slightly from the background in the [Mapbox Streets](#) map style.*

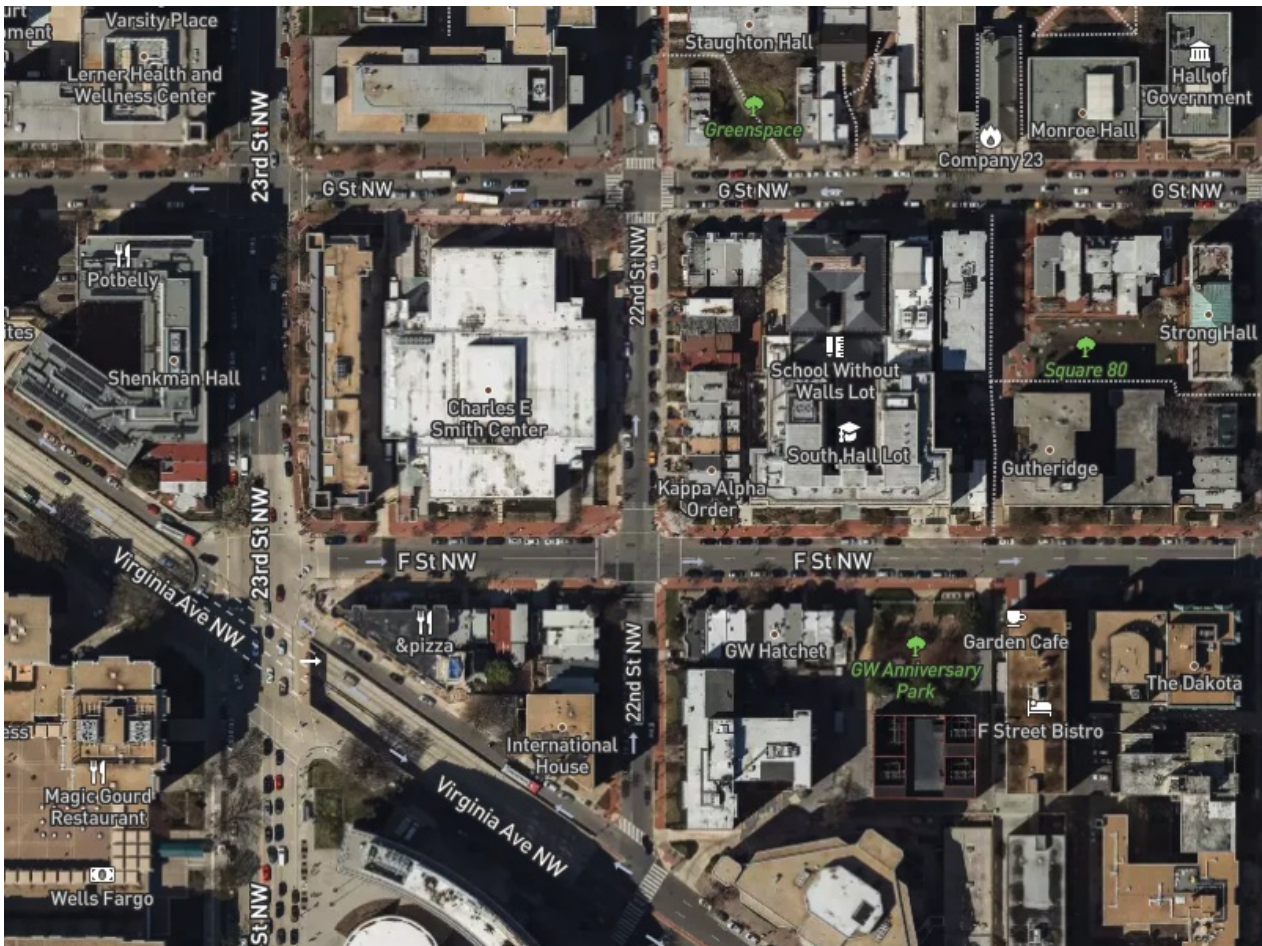


## Mapbox Streets icons

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.

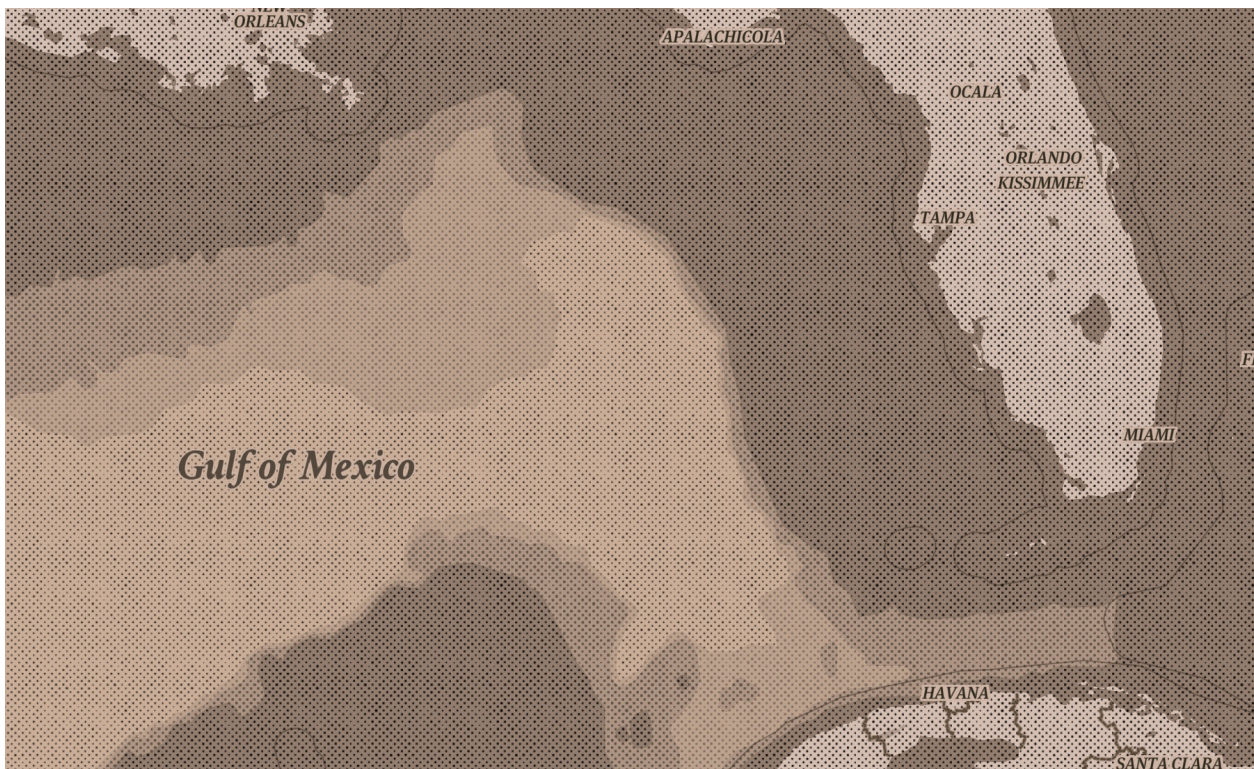
# Texture

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.

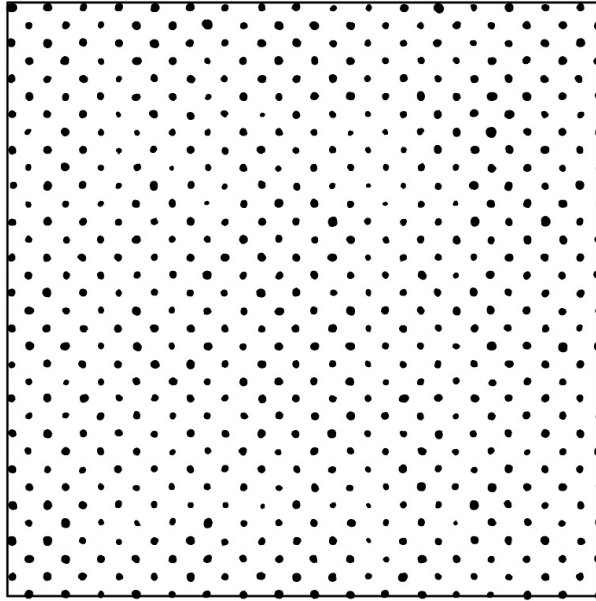
Textures need to be seamless us properly apply them to your maps in Mapbox Studio. A seamless texture is an image or pattern that can be placed side-by-side with itself without creating a noticeable boundary between two copies of the image.

## Adding an aged texture

The [Vintage](#) map style was designed to mimic the look and feel of traditional printed maps. The aged pattern is applied to the land and bathymetry custom that was data added to the map style. Over two dozen layers were styled layer-by-layer at a very low opacity with slightly different color tints to get this effect.



*Dark brown dot pattern is meant to add subtle texture to the water and is added layer-by-layer at low opacity for effect.*



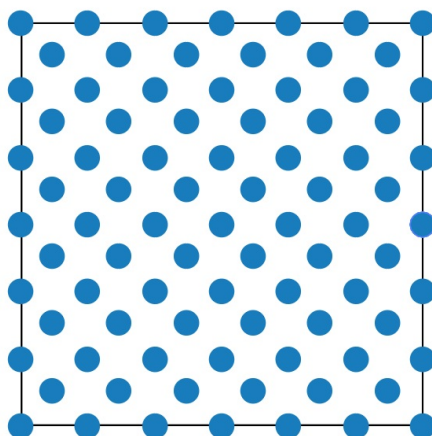
64x64px.svg texture applied to the [Vintage map style](#).

## Adding a pop art feel

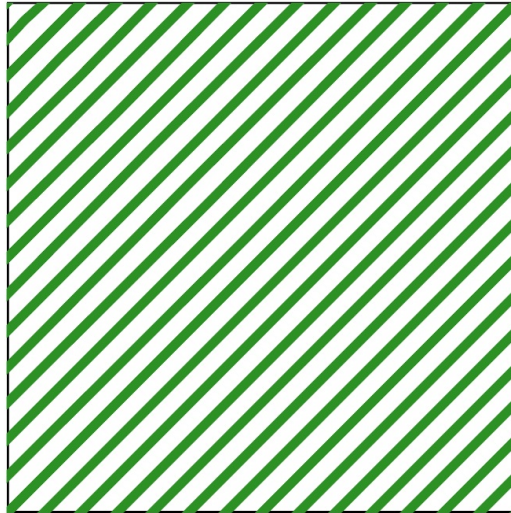
The [Whaam! map style](#) employs bright, playful patterns to show both texture and evoke the feeling of this pop art inspiration. The entire water feature is filled with a blue dot pattern. Landuse polygon features are all classified separately with a green striped pattern and are slightly transparent. This allows for areas with overlapping landuse types to appear darker showing elevation and hill shading in the land.



A contrasting blue dot pattern applied over light blue water and vibrant, green line texture for park-type land use.



32x32px texture applied to water for the [Whaam! map style](#)



32x32px.svg *pattern applied to greenspace land use for the [Whaam! map style](#)*

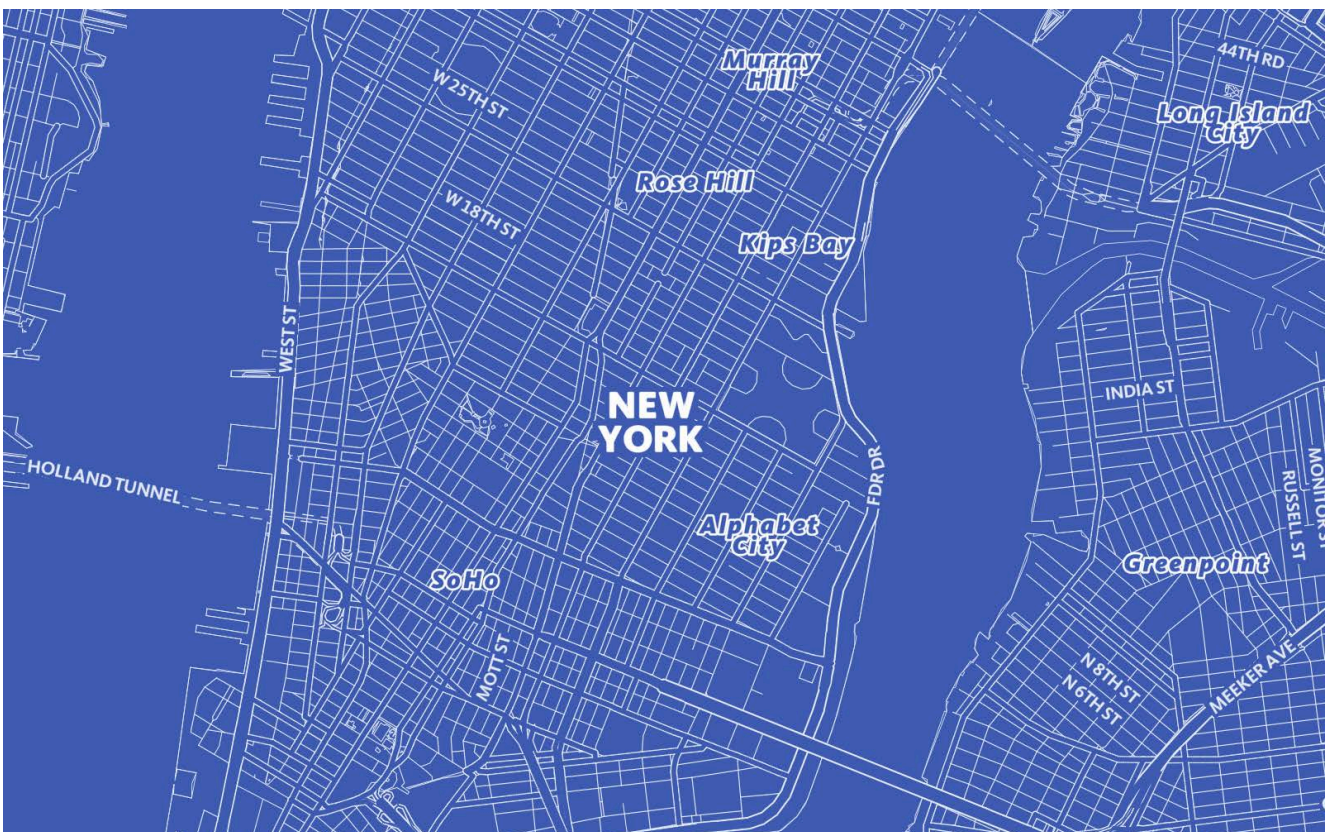
## Recommended Reading

- [Designing the Vintage map in Mapbox Studio](#)
- [Designing the Whaam! map style in Mapbox Studio](#)
- [Making and importing your custom patterns and textures to Studio](#)

# Design principles

Here are some of the core design principles that cartographers and map designers apply as they style their maps. Together these principles form a system for seeing and understanding the relative importance of the content in the map and on the page. Without these, map-based communication will fail. The four design principles we will cover include:

- Contrast
- Hierarchy
- Density
- Legibility



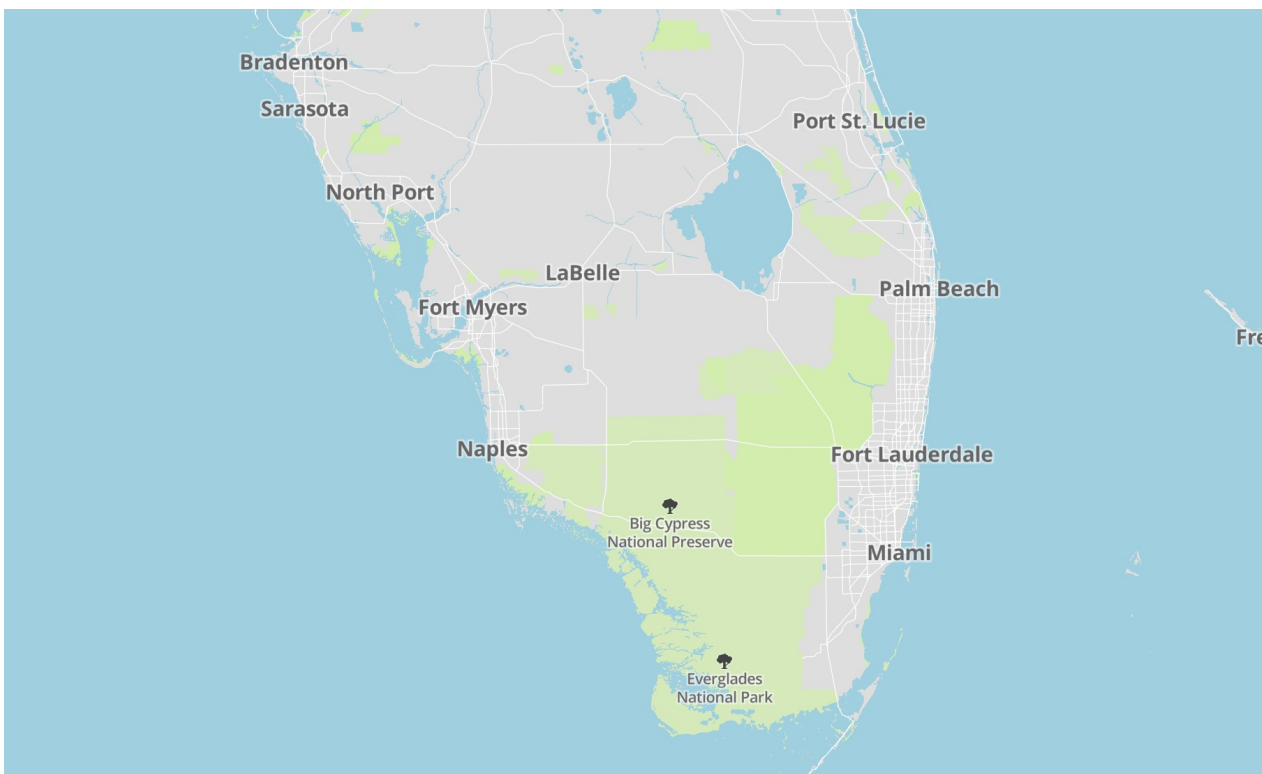
*Blueprint map style*

# Contrast

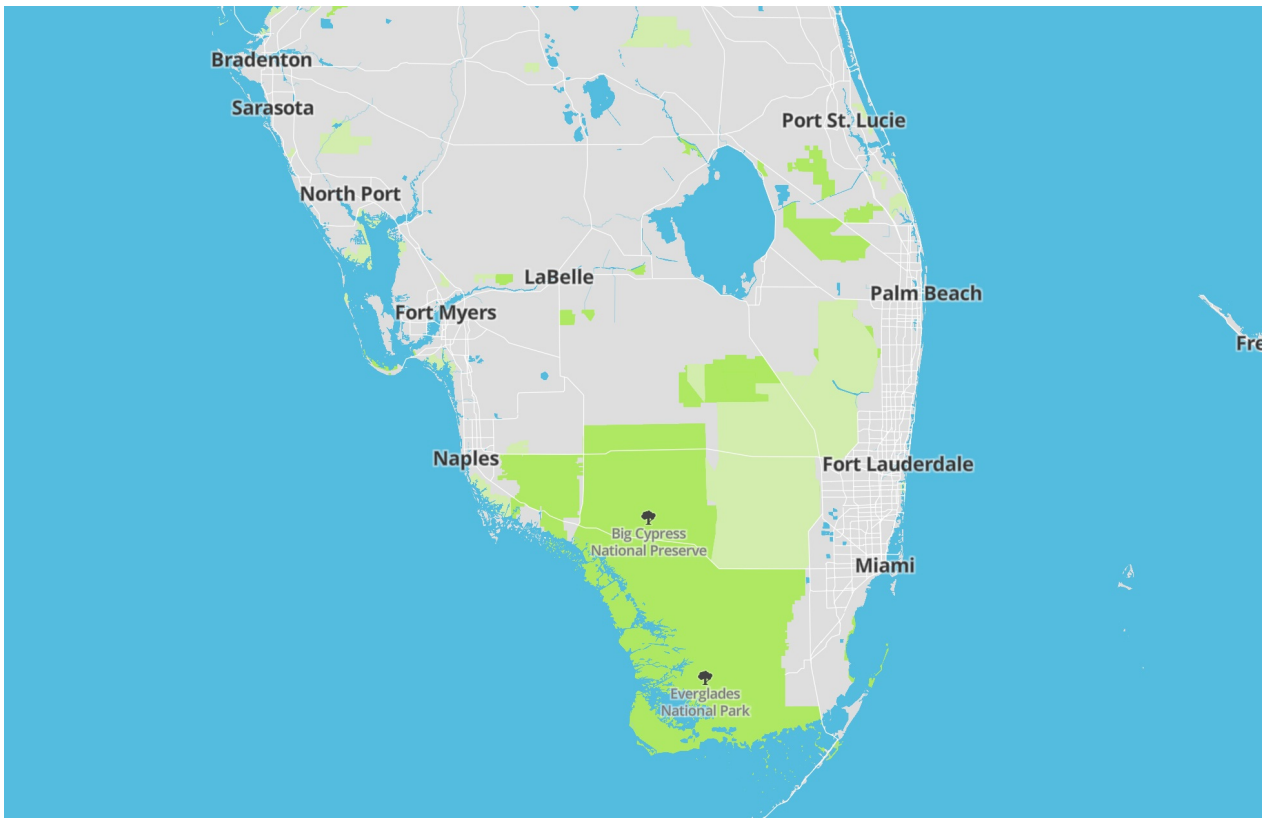
Human beings are wired to notice difference. This is what makes contrast such a powerful design principle in map design. Contrast attracts attention and draws the eye. This separates features from the surrounding elements and can instantly create emphasis and interest. In addition to attracting attention,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

## 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.



*Low contrast map with soft, less saturated blue, greens, and a baseline gray for labels.*



*High contrast map with vibrant more saturated blues, greens, and a darker gray for labels.*

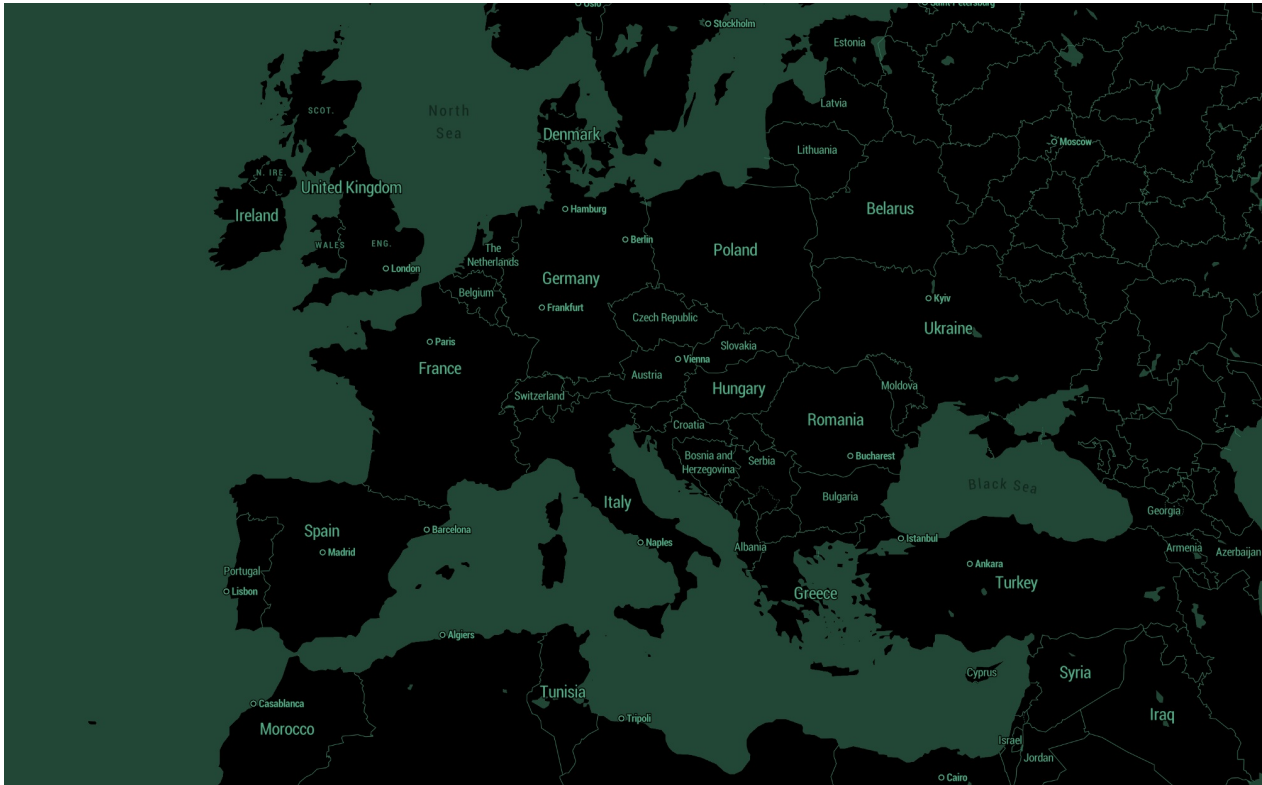
## **Contrast and readability**

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 that works great as a base for data visualizations or as a backdrop for your next game.



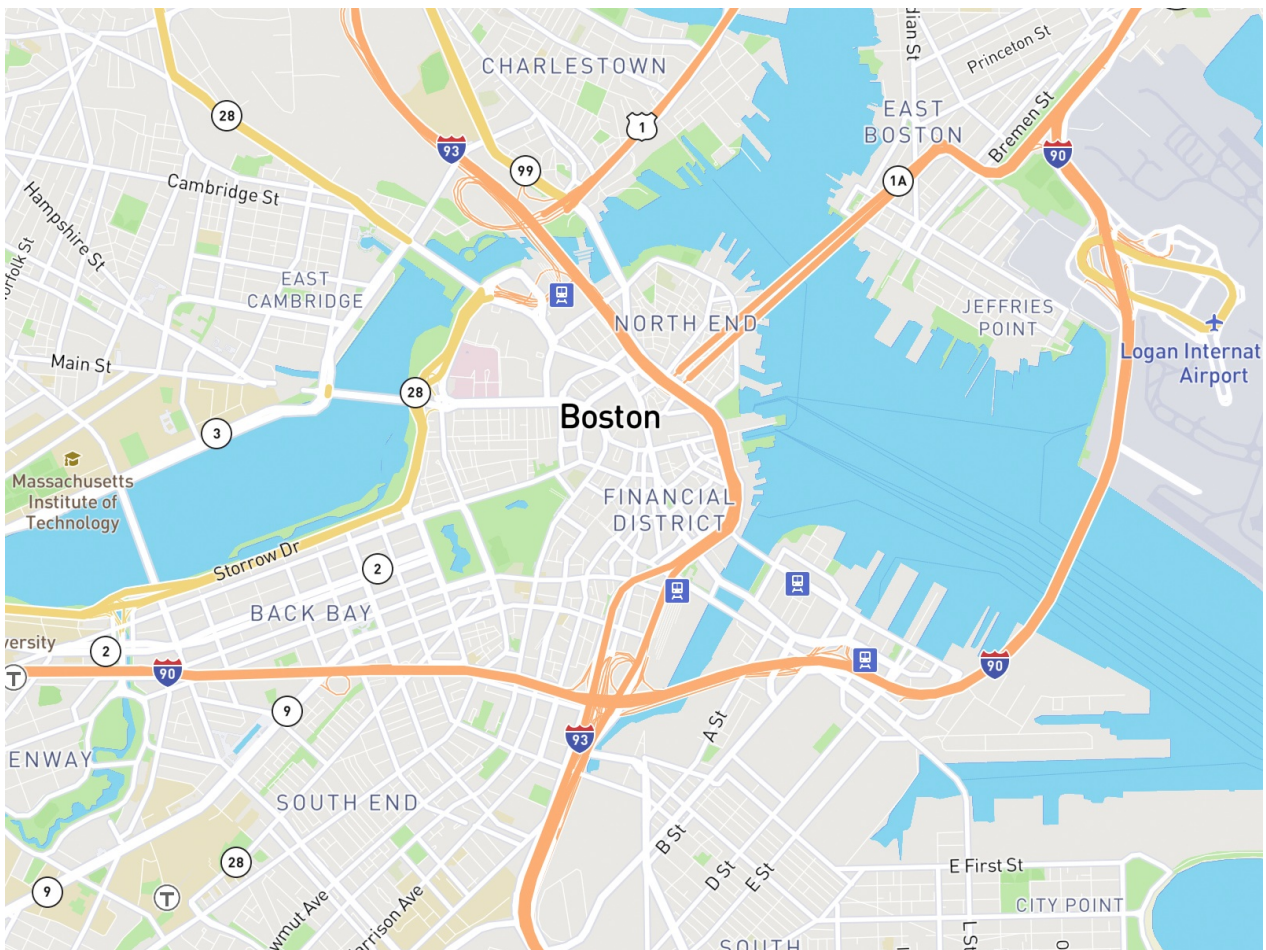
*Decimal map style, [Tristen Brown](#)*

# Hierarchy

Hierarchy helps viewers focus on what is important while identifying patterns. A strong, visible hierarchical a 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

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 are styled with a thinner width and less vibrant white are recedes more into the background, still noticeable but docile.



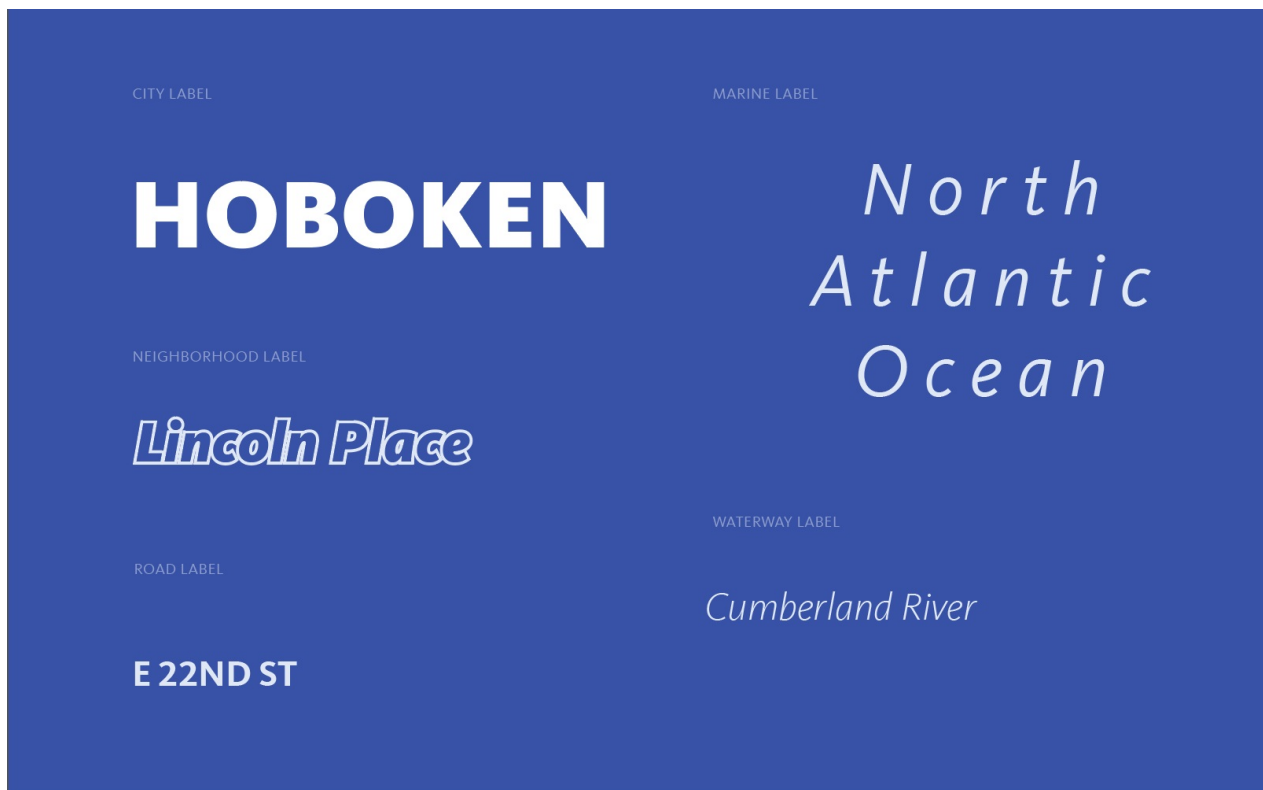
## Scale

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.

### Typographic hierarchy

This system employs both scale, stylistic elements (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 hierarchy 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.

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



*Typographic styling of place, road, marine, and waterway labels in the Blueprint map style.*



Typographic hierarchy structured by city size.



Differentiation in typographic treatment for city and neighborhoods.

Here in Mapbox Streets, the scale variation is more subtle overall but your eyes are lead around the map by order of scale in the place labels.



## 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 are typically emphasize specific feature or location 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.

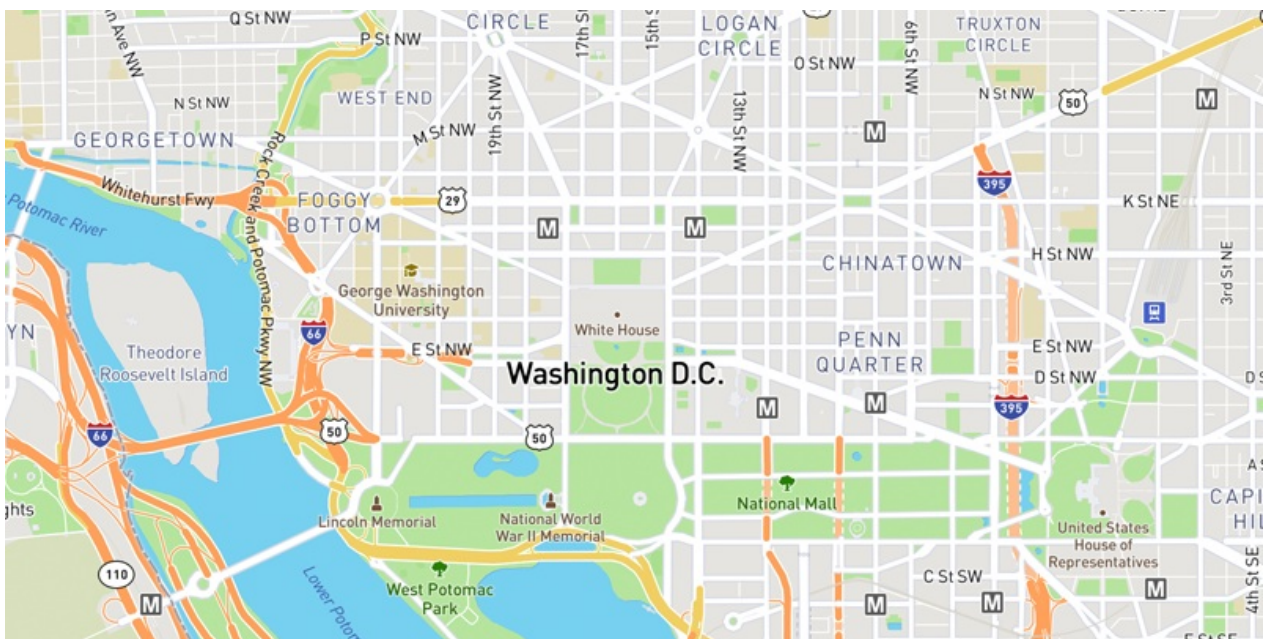


*Whaam! map style - thematic styling with high hierarchical focus.*

## 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 as the visual weight of the map, disturbing the visual hierarchy.

The map below shows Washington DC styled with a measured density for the points of interest or POIs. More prominent POIs are styled based on `scalerank` which is a field included in Mapbox Streets data. `scalerank` is determined based on an algorithm that ranks importance based on size and appended data from Wikipedia. Mapbox Streets brings in POIs ranked at 1 most important and is styled in lower priority than neighborhoods, highway shields, and transit stops. Using information like `scalerank` or other classifications to vary styling and priority are good ways to control density.



*POIs grouped by `scalerank` and prioritized accordingly.*

The example below groups all POIs into one layer which doesn't allow for differentiation in styling. POIs show up at city view although they may not be recognizable landmarks and add no value to the map at this level. A few of these POIs are also appearing instead of transit stops or highway shields which doesn't help navigation or wayfinding. Measured density makes your map more readable and helps focus the narrative and usability of your map.



*POIs styled densely with no prioritization.*

## 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  $z_0$  to  $z_{22}$  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.

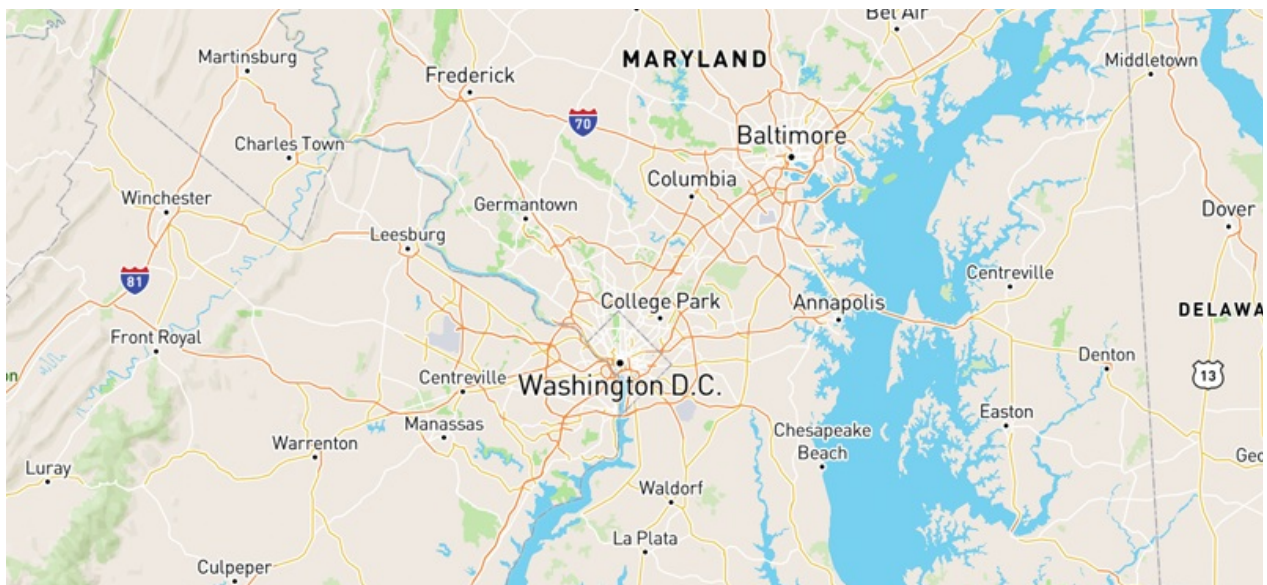


*Global view*  $z_1$

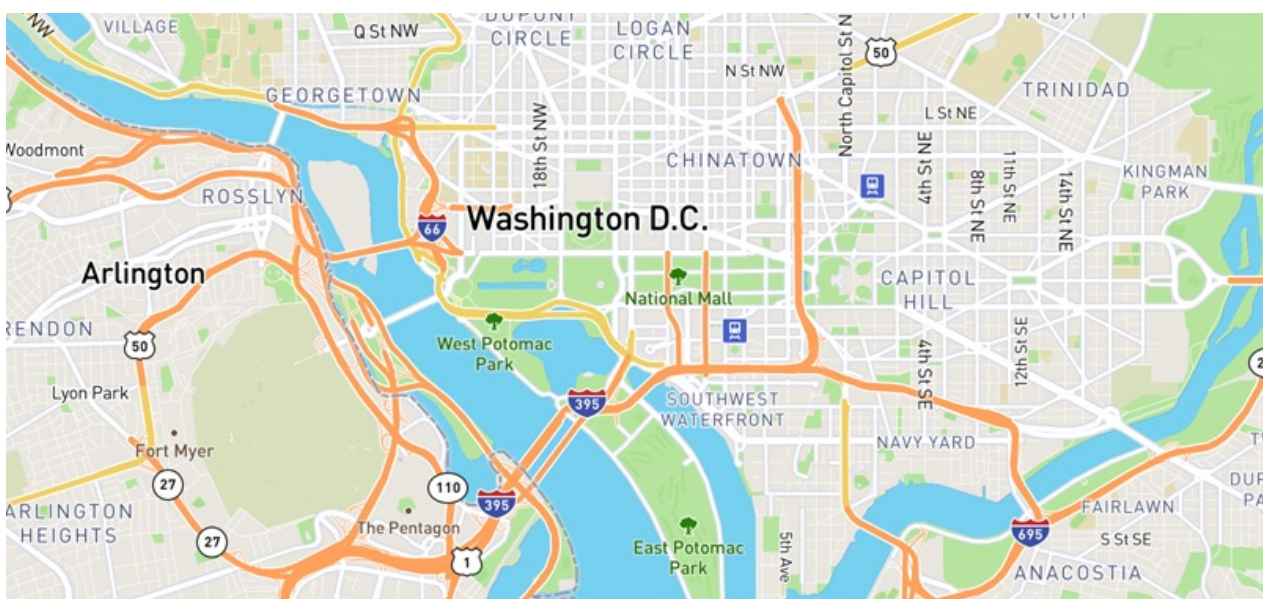




National view z3



Regional view z7



City view z12



Street view z17

## Legibility

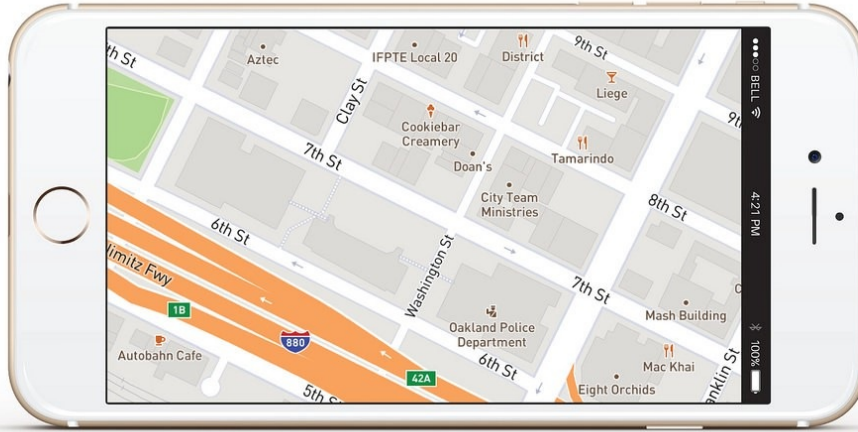
To be legible is to be easily read which is of utmost importance in map design so the user can easily understand how to navigate the represented space. Legibility of most map features depends on color and size, and in addition to labels and text, can be iconography too. Icons must be designed simply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



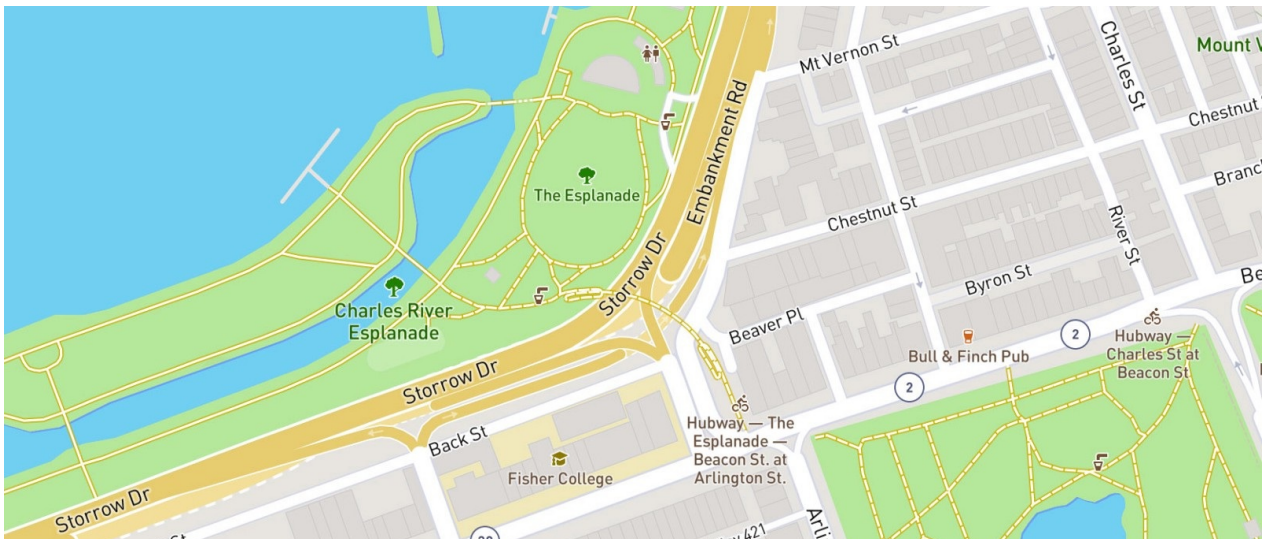
*POI icons, highway shields and rail icons used in Mapbox Streets.*



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

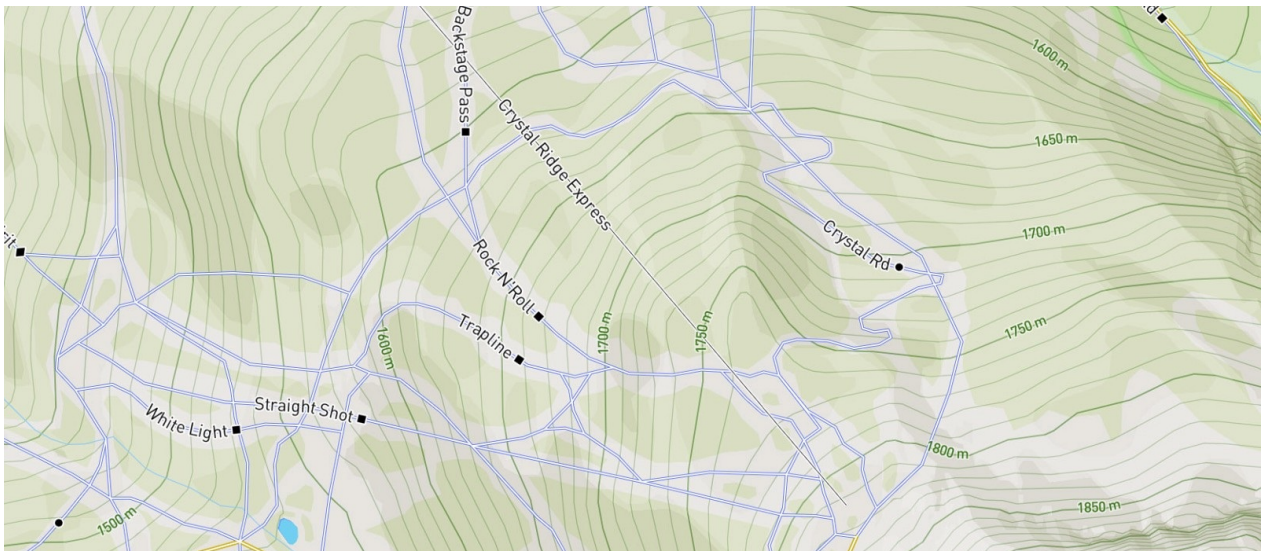
## Text

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.



## 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 your map, as you style create a balance by using lighter color saturation, softer opacity, and substantial contrast text and text halos if text is involved. Balance is key.



*Mapbox Outdoors styles overlapping ski paths, contour lines, and hillshades using color and style to differentiate.*

## Recommended Reading

- [Designing Mapbox Streets and Outdoors for Mobile](#)
- [Mapbox Outdoors redesign](#)

## Special considerations

The Mapbox Cartography Team prides itself on making maps are both usable and beautiful. Our core Mapbox map styles are created largely for general purpose use. The Cartography Team styles almost every map feature and classification using our global Mapbox data, and the maps are ready to plug and play into any mapping app. We also have a few speciality maps we've been working on with specific use cases, conditions, and/or users in mind.

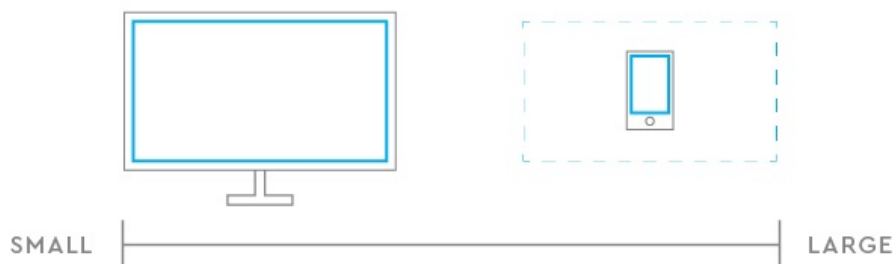
For these kinds of maps use design thinking, we to help ensure that the user experience is prioritized, design execution is optimized for platform and performance, and that the map works in the overall environment it will ultimately live in. Environmental considerations can be anything from the time 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.

This process helps us build holistic design solutions for our products and the experience of end users. These are the use cases we are developing design processes for:

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

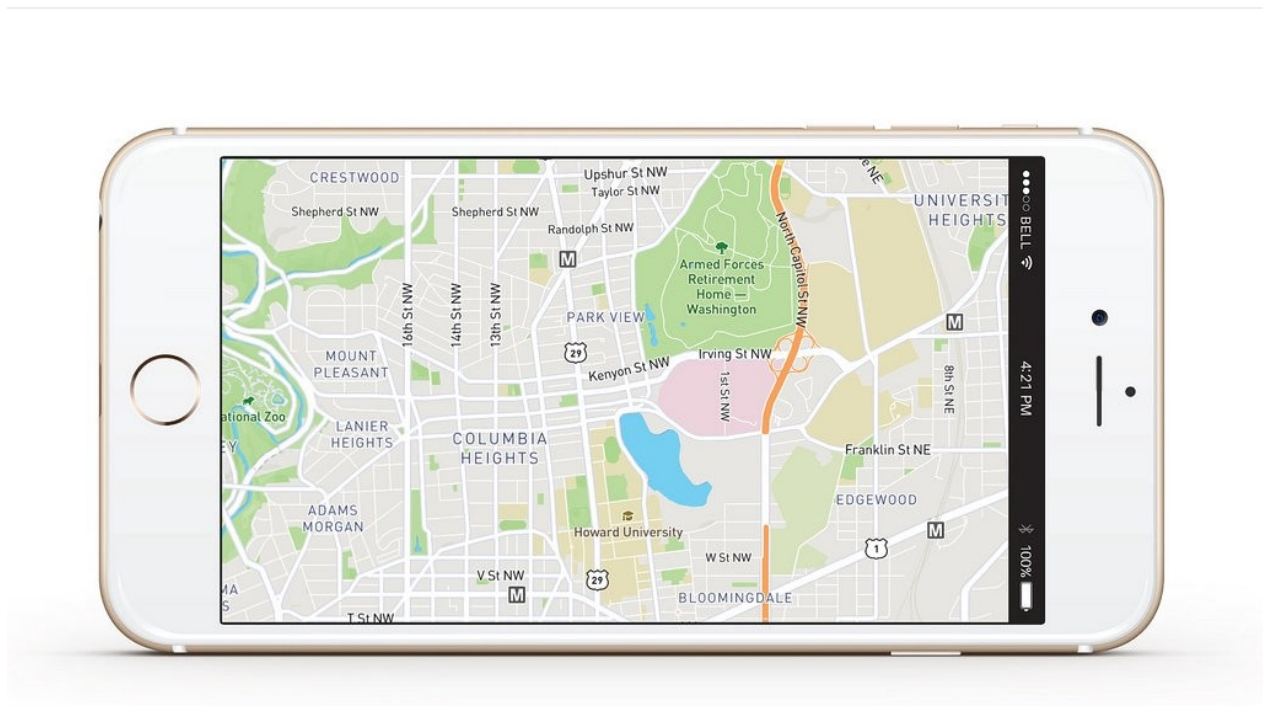
# Maps for mobile

Smartphones play an important role in helping people navigate their environment and get them to 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.



## 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>



*Mapbox Streets on mobile device.*

## 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.

## Recommended reading

- [Say hello to the Studio Preview app](#) - view map styles directly from your device
- [Bring your maps to life with Runtime Styling on mobile](#)
- [Designing Mapbox Streets and Outdoors for mobile](#)

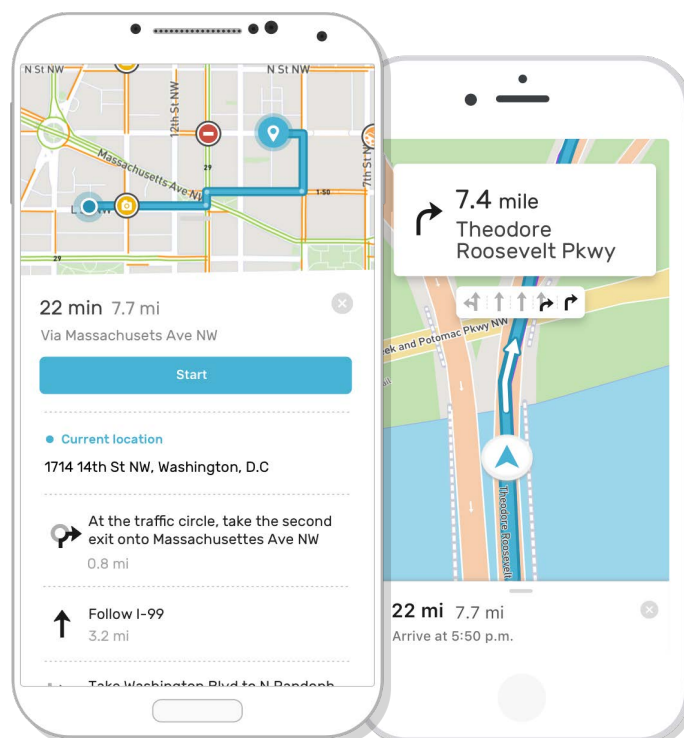


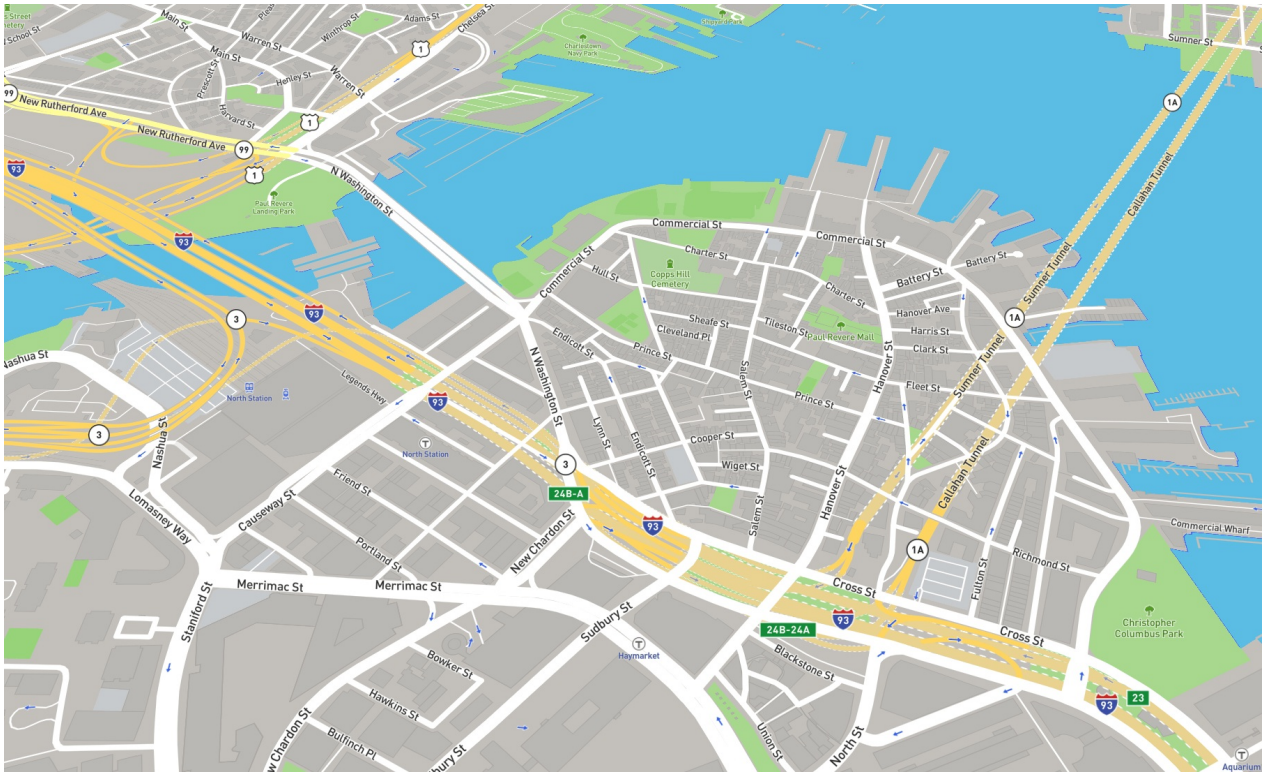
# Maps for navigation

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 pedestrian, the Cartography Team took into consideration a variety of environmental, speed, and time factors for the Mapbox Navigation suite of maps.

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

- **The physical relationship between the map and the user:** How far away is the map from the person? Is it hand-held for a pedestrian, or fixed to a windshield for a driver?
- **Viewing time:** Is the user viewing the map in short, fragmented glances, or contemplatively sitting with it?
- **User manipulation.** If the user is currently driving to their destination the animation along the path is most likely be leading the show. Rotating and zooming as their phone moves closer to their destination. Consider the camera behaviors location (lat/lng) and zoom level (camera position) and rotation and pitch as you style.
- **Controlled Density.** Custom overlay data, such as traffic or bike lanes, should be kept consistent and harmonious with the underlying map style. The data must also add value instead of muddying the waters. The most important information should be clearly visible at a glance.





Mapbox Navigation Guidance Day Map

## Recommended reading

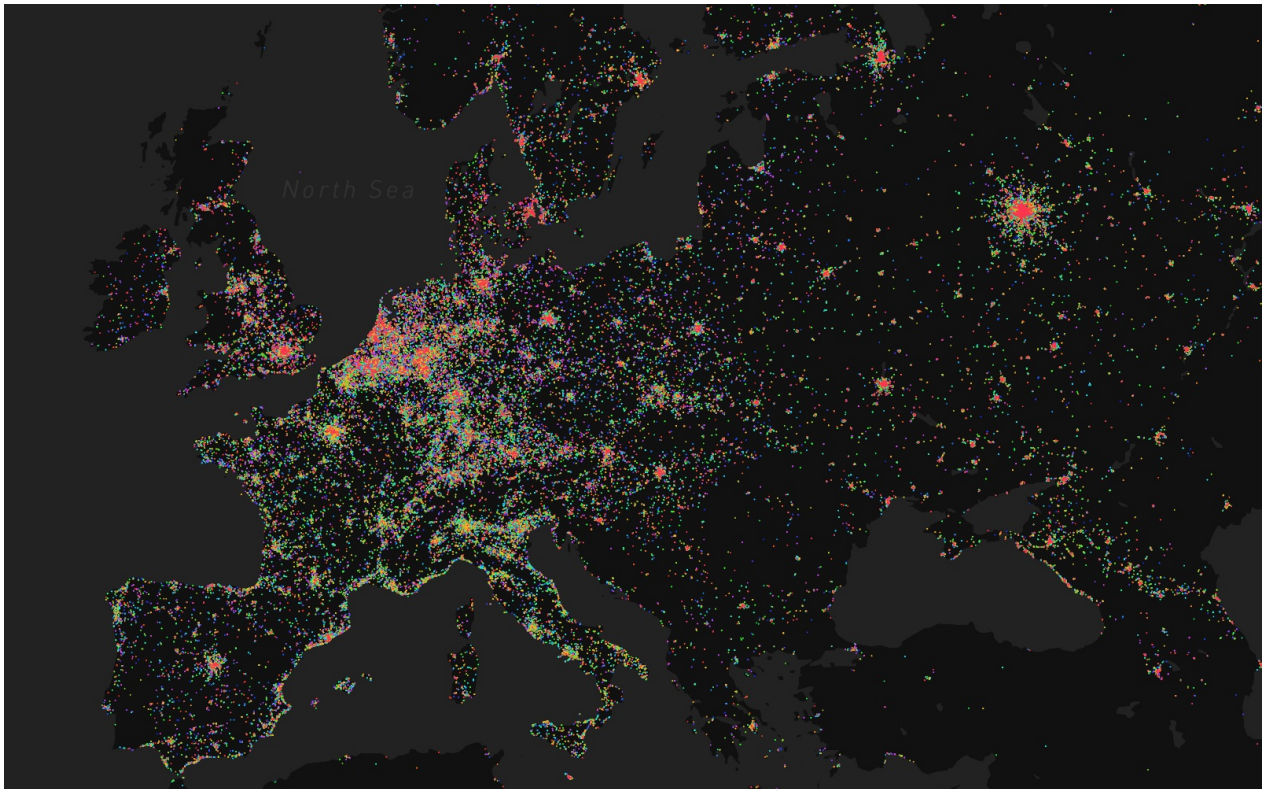
- [Better maps for navigation](#)
- [Offline navigation embedded in cars](#)
- [Designing Maps for Mobile](#)

## 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, map and interface are key. The use-case is comprehension, and helping the user see the relationships in the data is the ultimate goal.

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. Explanatory data visualization 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.



[Visualizing Eurovision Shazam tags with Mapbox GL](#)

## 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, this will 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 which allows you to add the data dynamically. Check this example for [adding live GEOJSON data](#) to your map style. Find out about [How Uploads Work](#) to learn the differences between tilesets and datasets, how the upload process works, techniques for uploading, and resources for getting started.

## Recommended reading

- [Dots vs. polygons: How I choose the right visualization](#)
- [Light and Dark maps for data visualization](#)
- [Data underneath: Labels on top](#)
- [Visualizing Eurovision Shazam tags with Mapbox GL](#)

## Getting started with Mapbox maps

When you design your maps with Mapbox you have access to our global data. This data happens in all locations and at every zoom level. As you style, make sure to zoom in and out and consider how they style looks at each zoom level. The design elements we just covered visually represent the natural and manmade map features that make up our world.



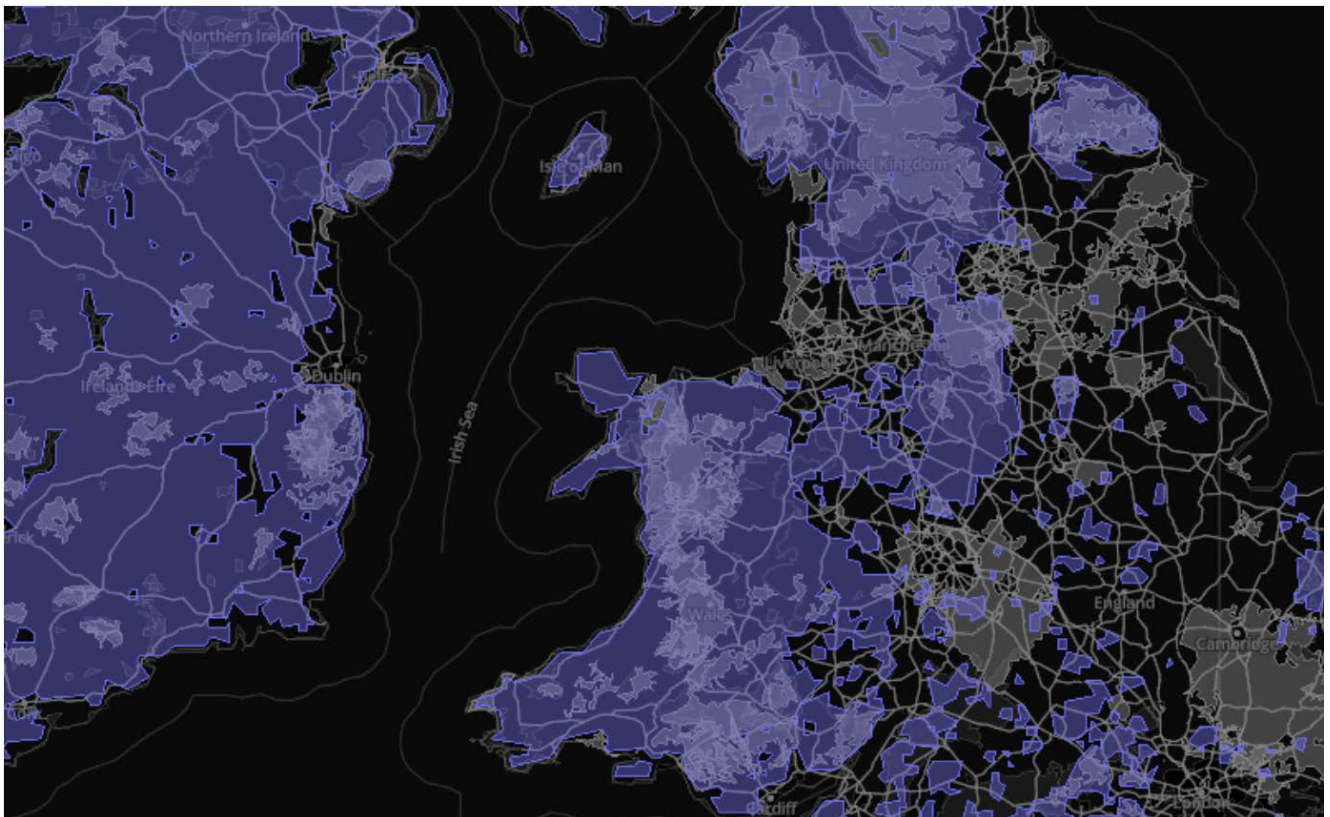
# Mapbox-provided tilesets

Mapbox web and mobile-ready vector tiles are 75% smaller than a 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.

Vector tileset data consists of geographically referenced natural and manmade features converted into `points`, `lines`, and `polygons`. This is the underlying framework of the map and provides the information that will be styled. Map data features typical fall into the following general categories.

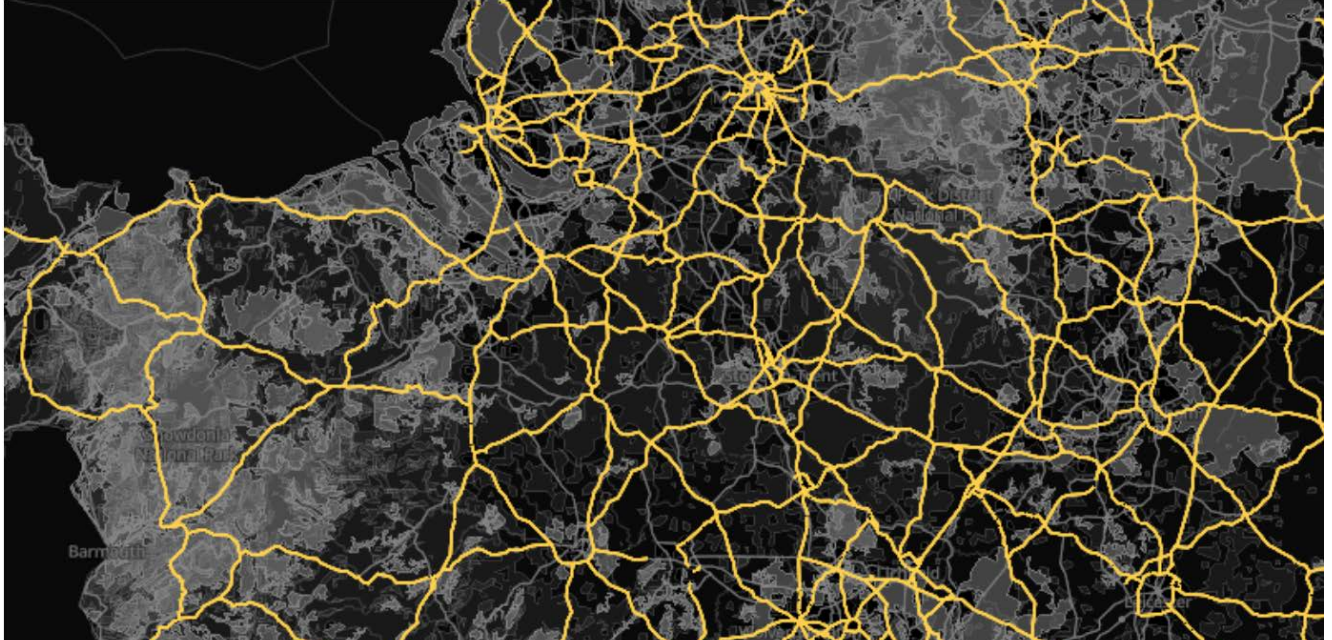
## Natural features

- water
- land
- land use
- terrain



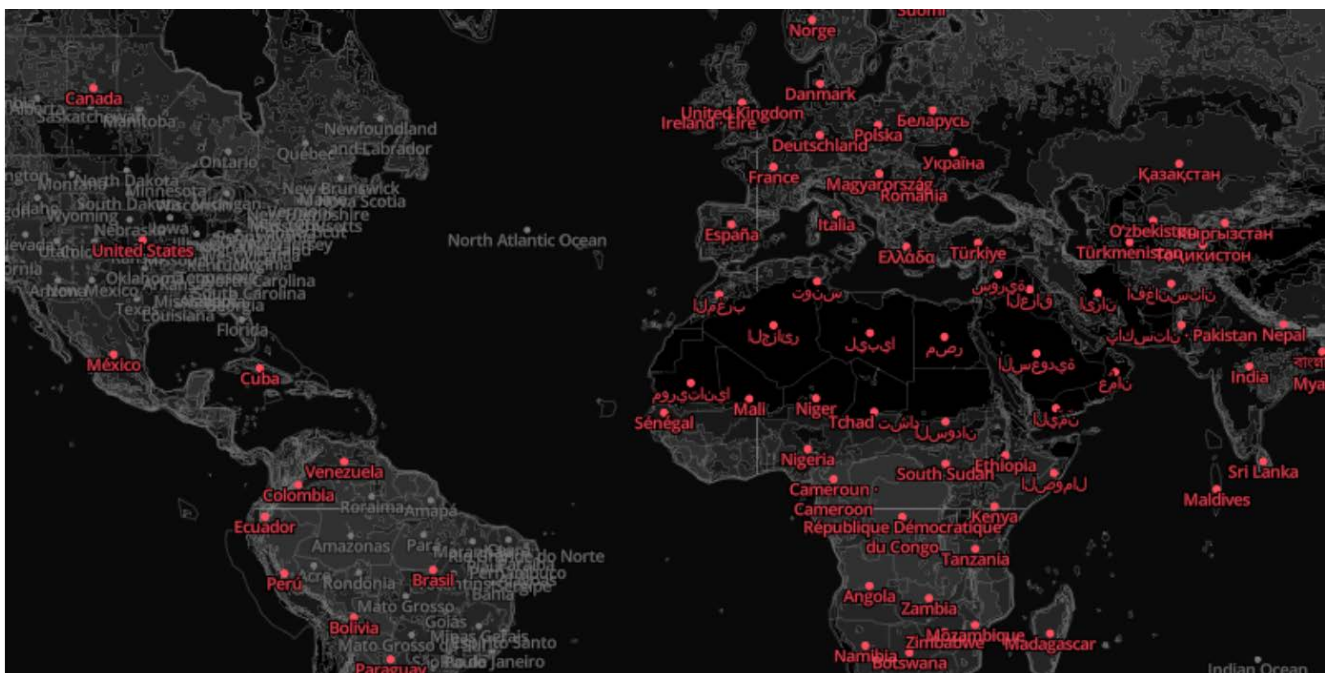
## Road networks

- motorway
- trunk
- primary, etc.



## Place labels

- country
- state
- city
- island, etc.





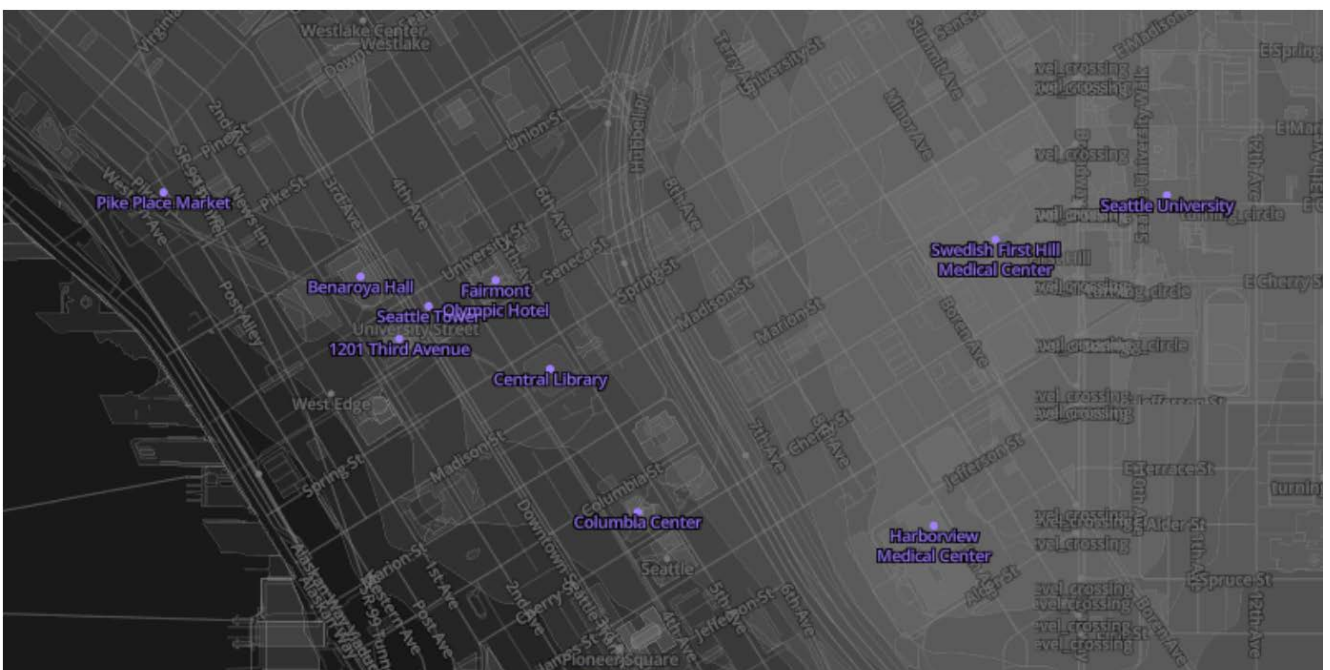
## General labels

- marine
- water
- roads, etc.



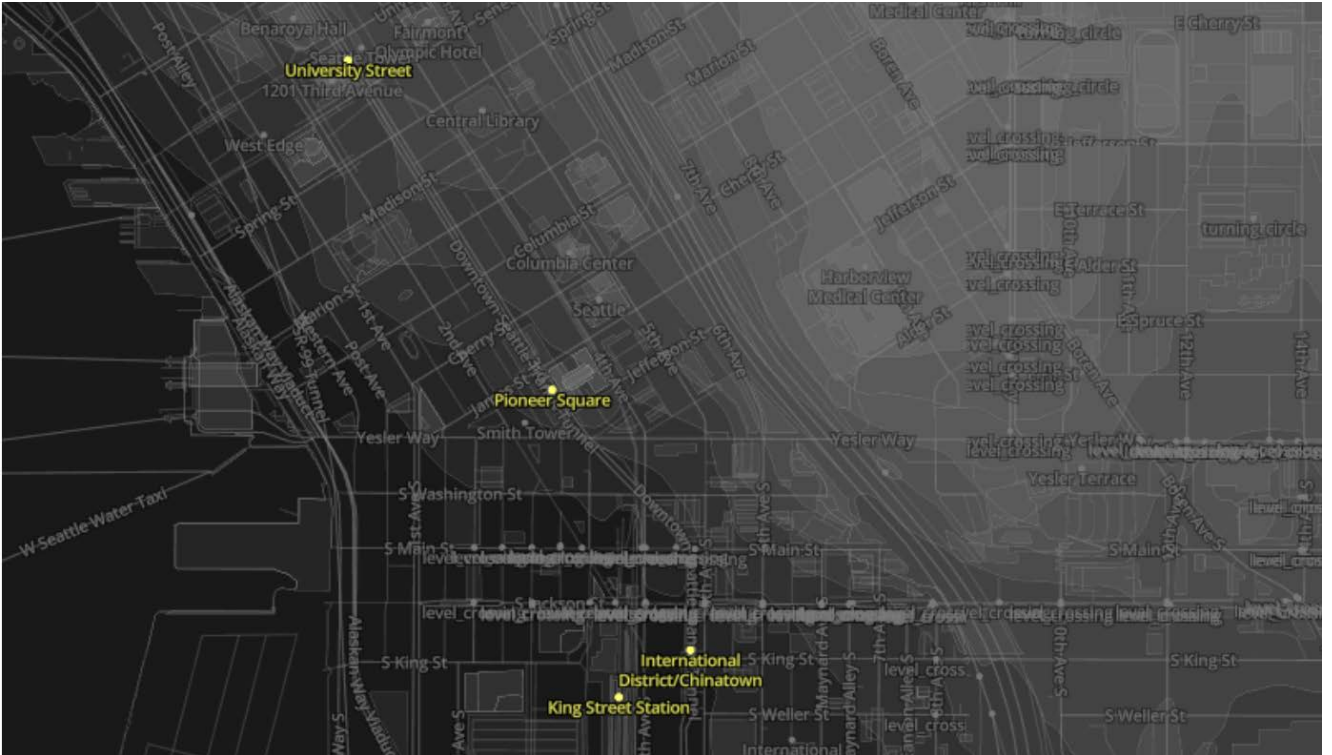
## Points of interest (POI) labels

- 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](#), a free and global source of geographic data built by volunteers. While styling, reference this [Mapbox Streets data overview](#), an in-depth guide to the data contained in the Mapbox Streets vector tileset. This outlines additional layer properties such as types ( `type` ) and classifications ( `class` ) that will allow you to filter your data and style certain elements distinctly.

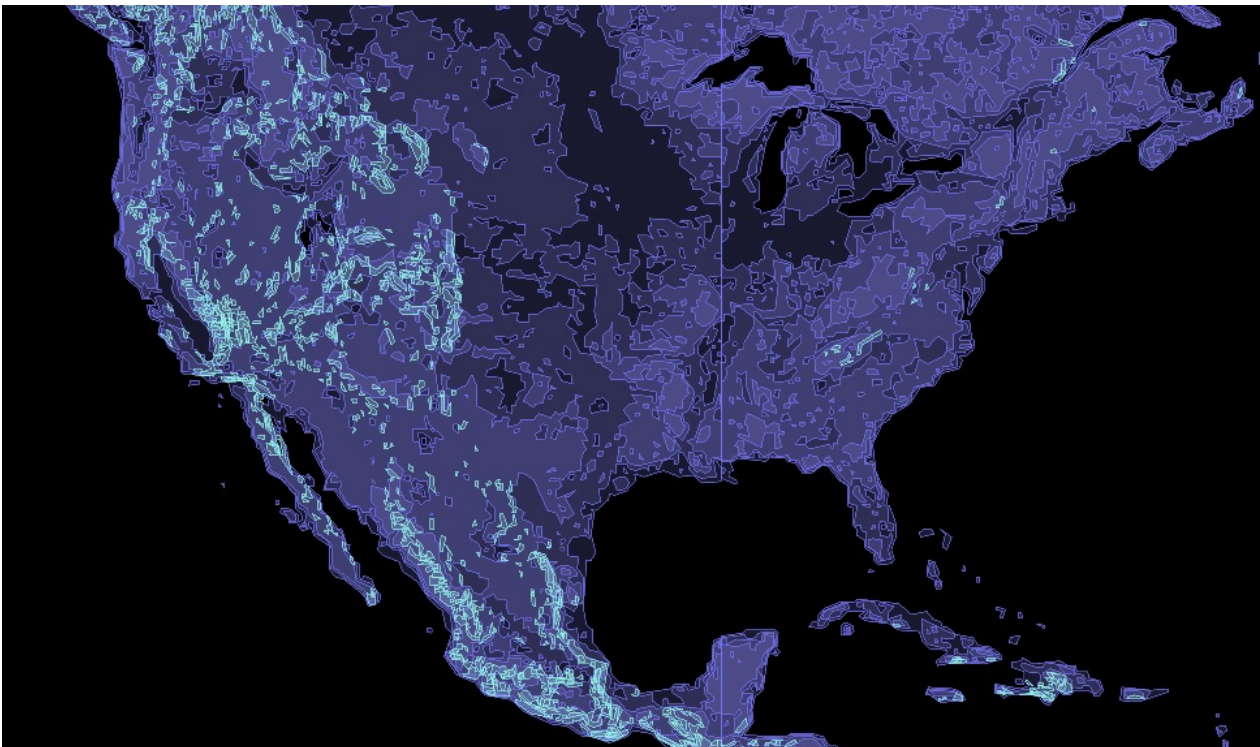
Explore the Mapbox Streets tileset! You may not need to add any custom data. Mapbox Streets may have the data you need, and you can filter this data to a separate layer and style it accordingly.



# Mapbox Terrain

`mapbox.mapbox-terrain-v2`

Mapbox Terrain provides hillshades, elevation contours, and land cover data all in vector form. Mapbox Terrain is based on data from a variety of sources (see the [about page](#) for details). When using the Mapbox Terrain layer publicly in a design or application you must provide [proper attribution](#). While styling, keep the [Mapbox Terrain data overview](#) open to ensure you are assigning the appropriate classifications to your map style. These values are also automatically shown to populate as filters directly in Studio, but the reference offers more details to their definition.

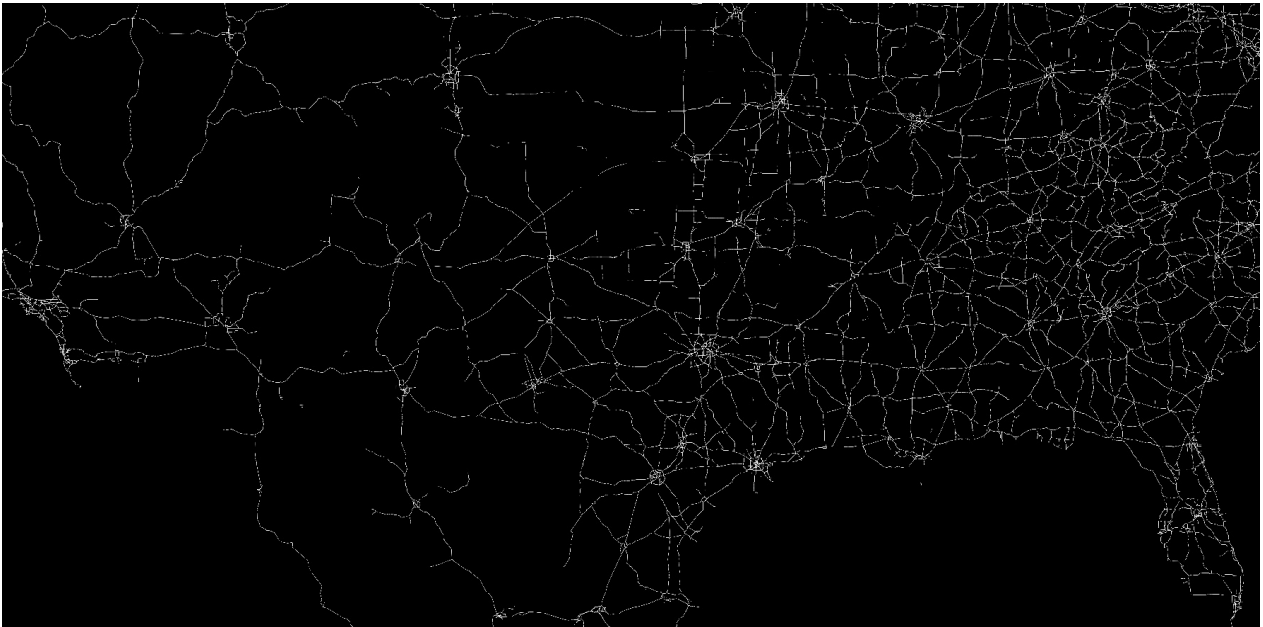


# Mapbox Traffic

```
mapbox.mapbox-traffic-v1
```

Mapbox Traffic provides constantly updating congestion for both directions on two-way roads. Traffic data aligns with Mapbox Streets `roads` layer and you can filter based on `class` values. The `congestion` field is a measure of the relative slowdown a road segment is experiencing. The values range from `low` to `severe`.

When styling congestion, our cartographer's typically add a positive `line-offset` to the layer to visually separate the directions of travel. While styling, reference the [Mapbox Traffic data overview](#) open to ensure you are assigning the appropriate class values to your map style. Keep in mind, this data does not appear until `zoom level 6.0`.



## Mapbox-provided map styles

Before you're off to the races, let's go over the template styles that are available in Mapbox Studio. You can use any of these templates as a starting point your map style. You just need to start a new style with one of the Mapbox provided styles and begin customizing it to fit your brand. But which style should you pick? That depends on what you are trying to achieve and what kind of data your map wants to highlight.

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

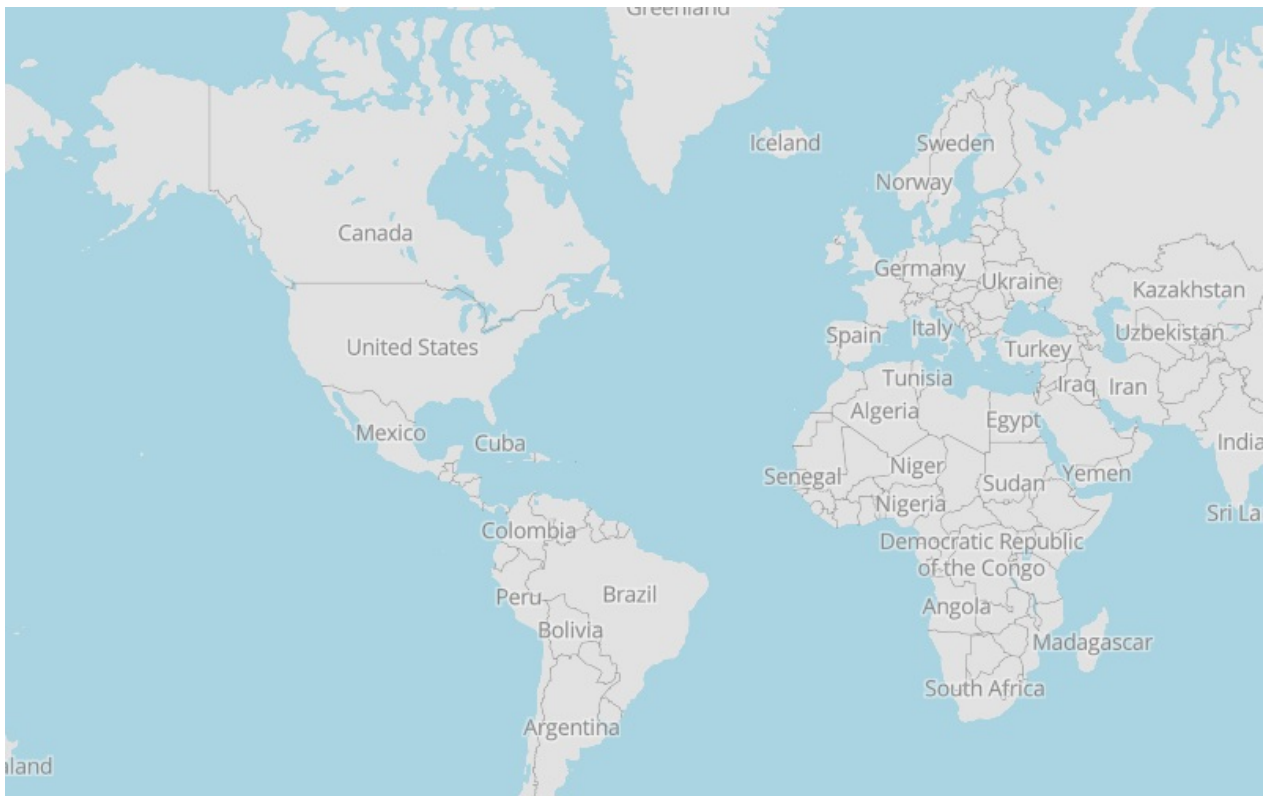
Let's review each map style, so you can find the one that best fits your needs.

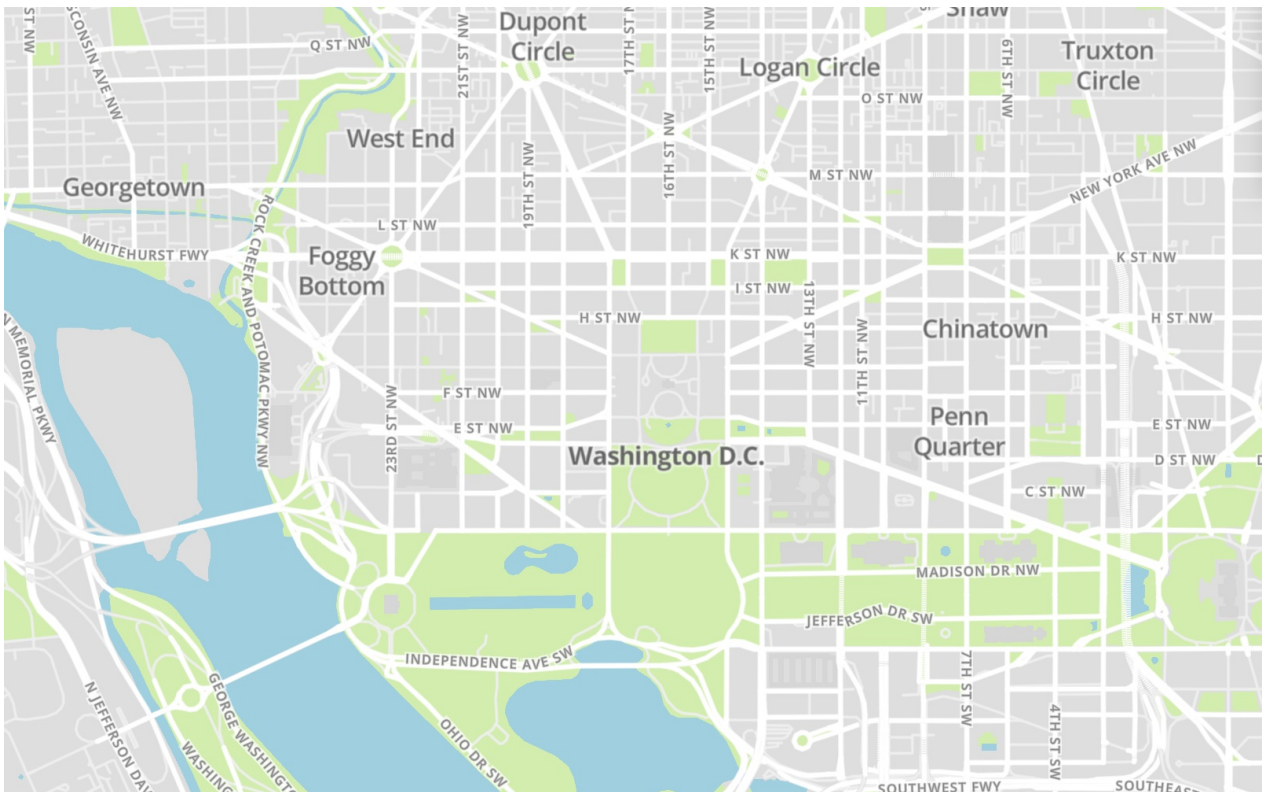
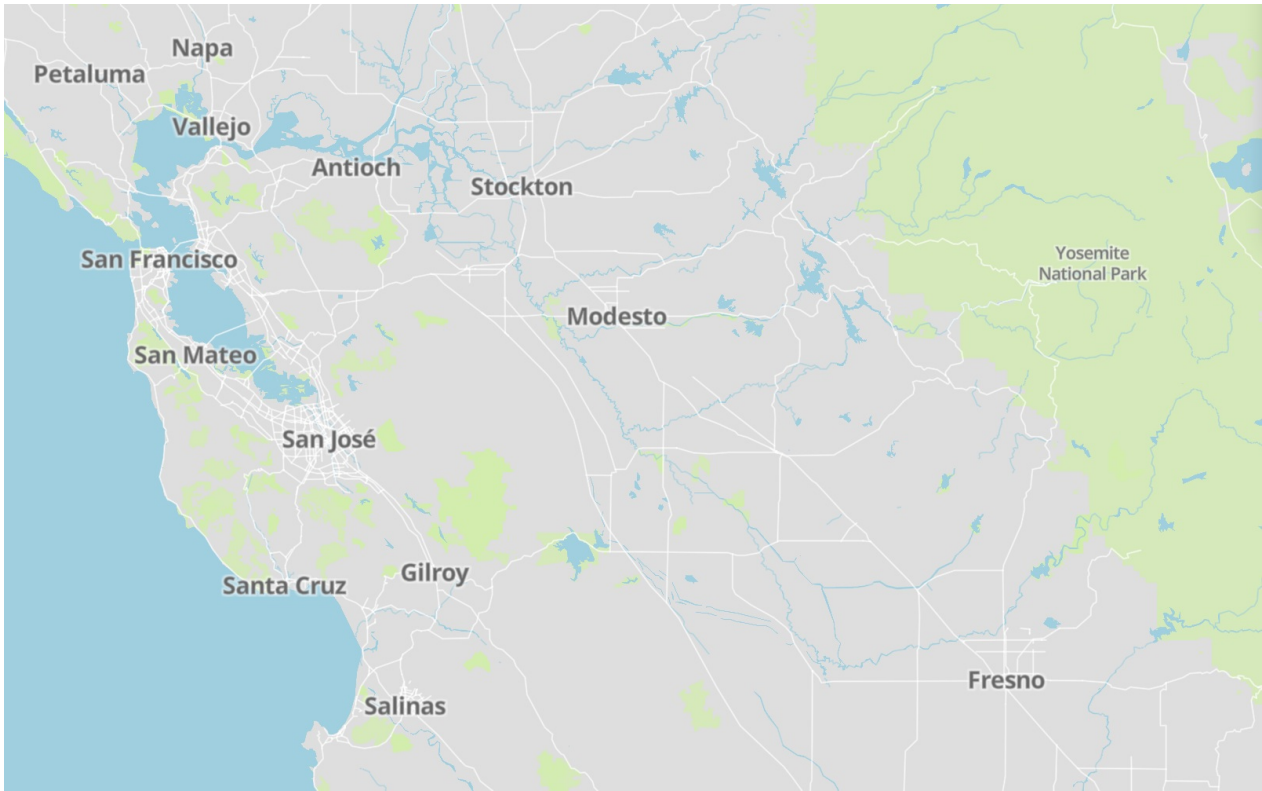
Both Basic and Bright are open source map styles that are primarily for learning about Mapbox map styles.

## 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, and suburbs, towns, hamlets, villages, and neighborhoods.





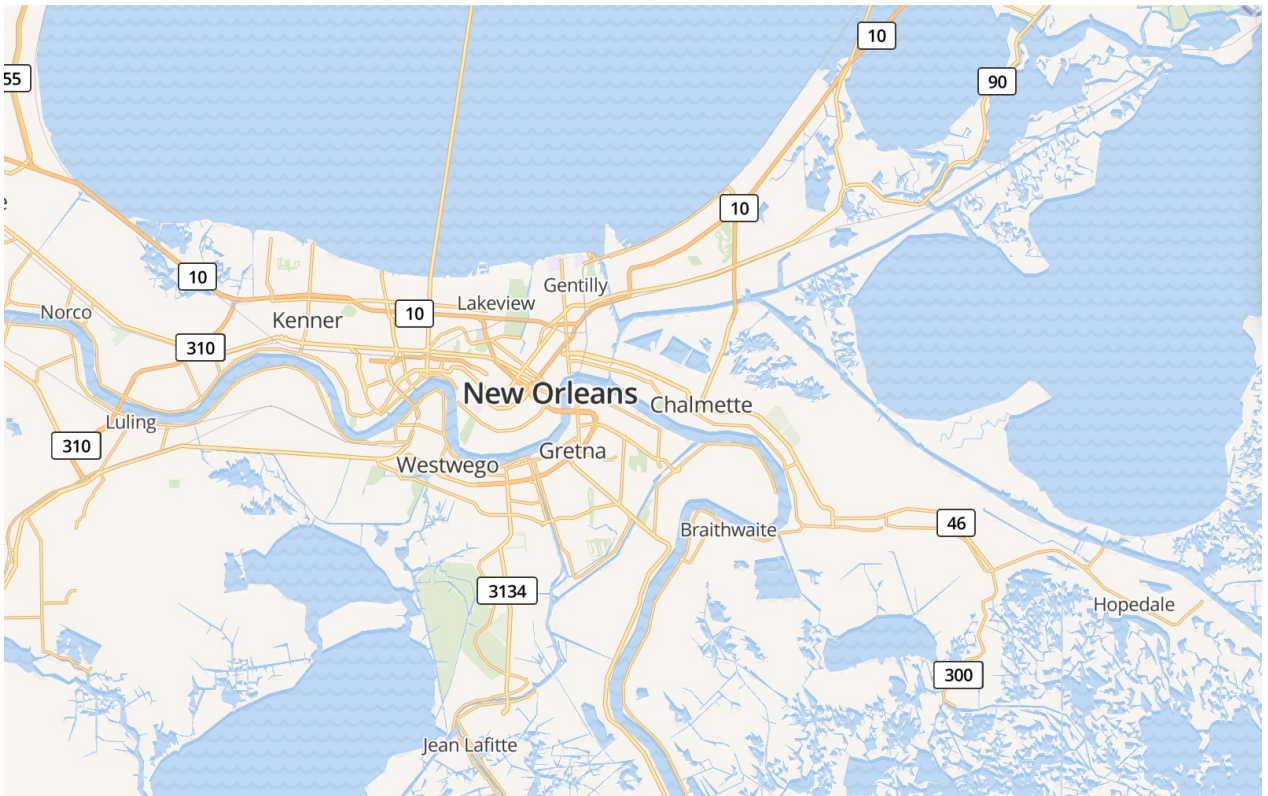


# Bright

[Mapbox Bright](#) is another good template to learn how data layers are categorized and generally styled. This style includes more classifications of label and road types and puts data layers into relevant categories covering the following types of features:

- **Roadways.** Organized road data, designed to show the different classifications of road types available with Mapbox Streets.
- **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 general hierarchy of location labels, from countries to cities, towns, and villages and neighborhoods.
- **Iconography.** This style includes general motorway highway shields and uses a texture for the water layer.





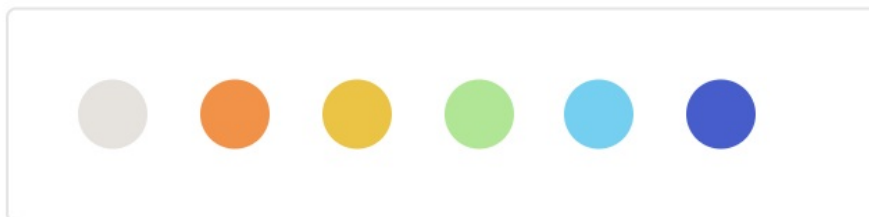
## Mapbox Streets

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



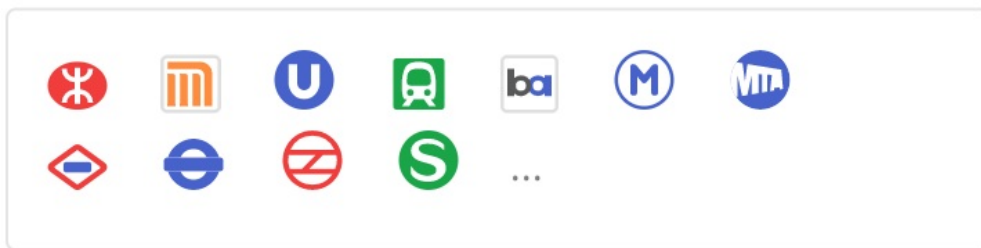
## Vibrant colors

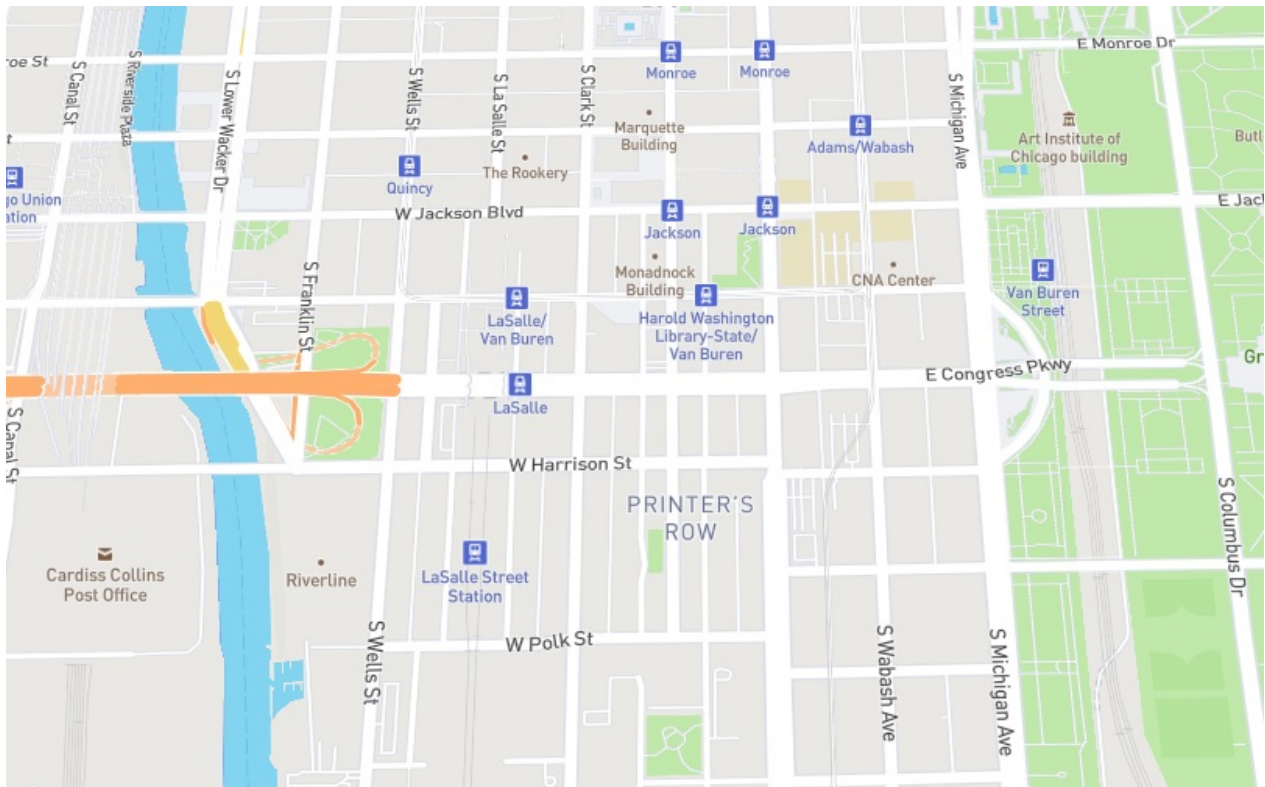
The Mapbox Streets high-contrast color system allows the viewer to easily recognize the map's features and quickly understand its hierarchies and classifications. The color system is fine-tuned to work perfectly at each level and shifts subtly across zooms.



## 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.

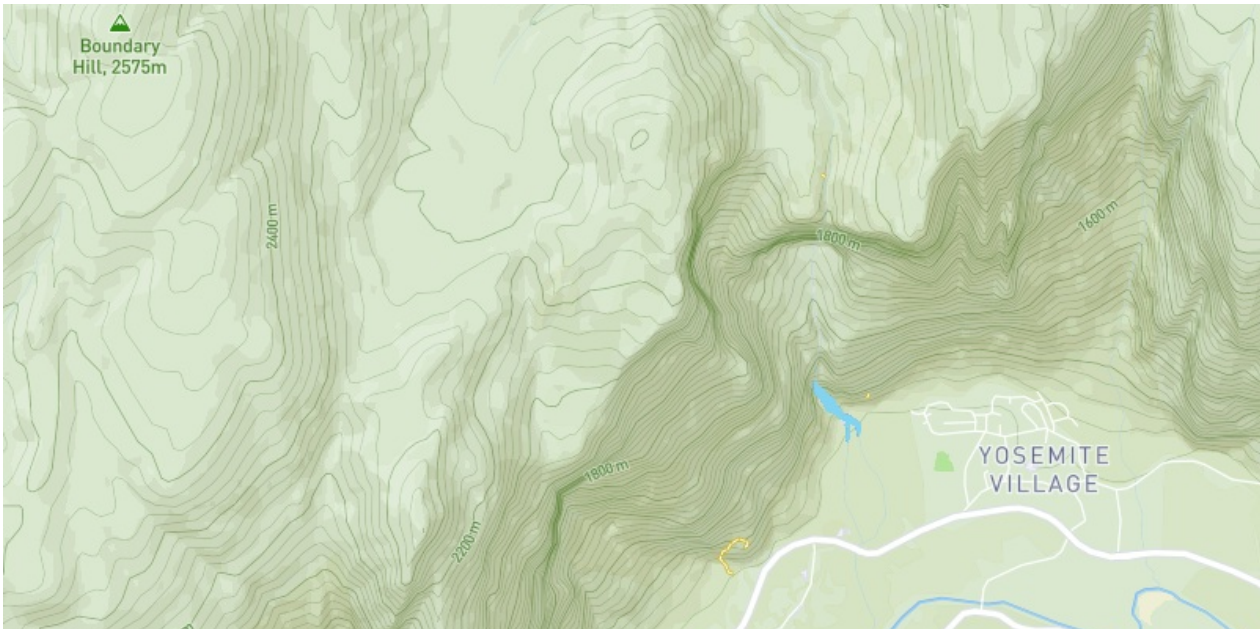
# Mapbox Outdoors

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.



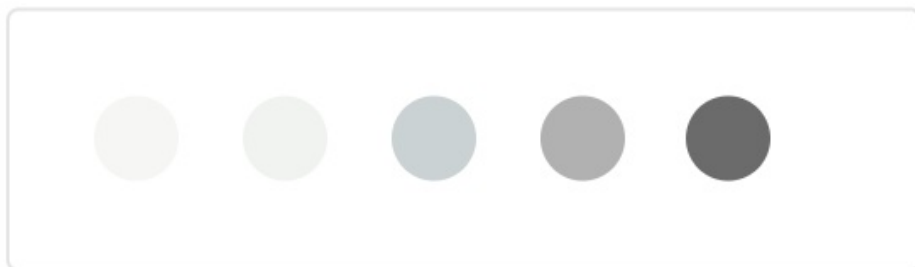


## Additional design features

- **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.

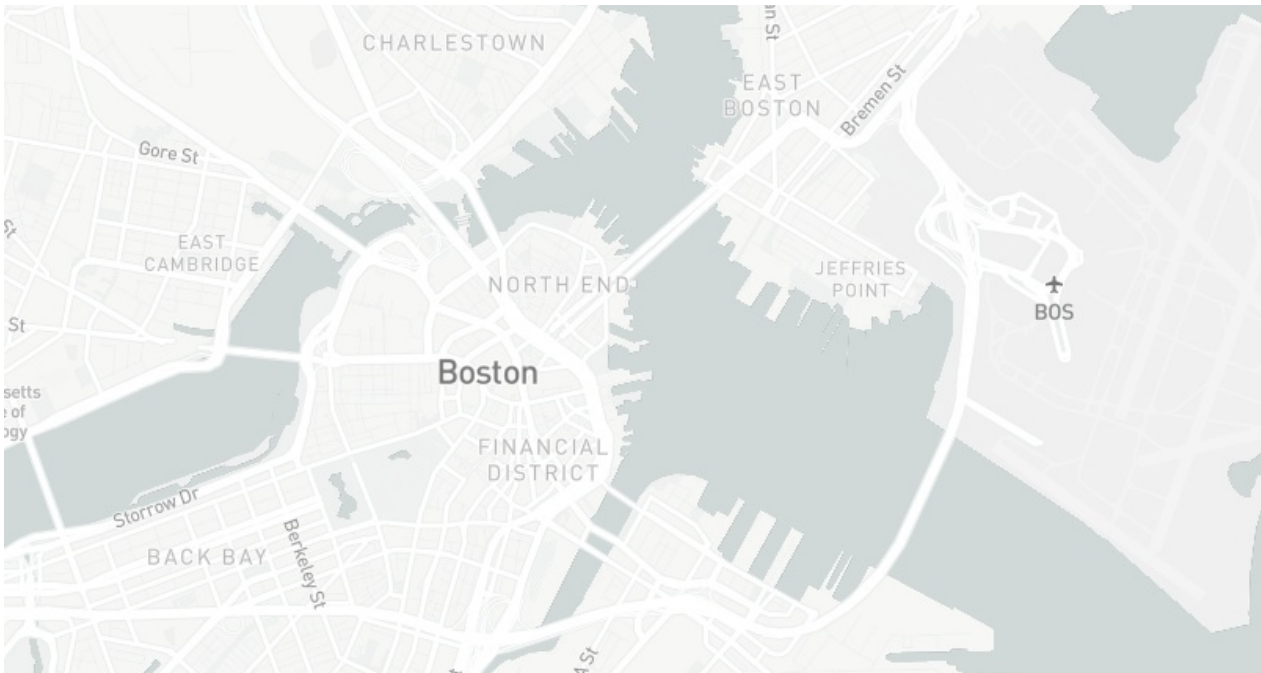
## Mapbox Dark and Mapbox Light

[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.



## Mapbox Streets data

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, reducing contrast – to make sure they always complement your project.



## 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.** Subtle hillshade complements the simple design with topography for context.

## Mapbox Satellite and Mapbox Satellite Streets

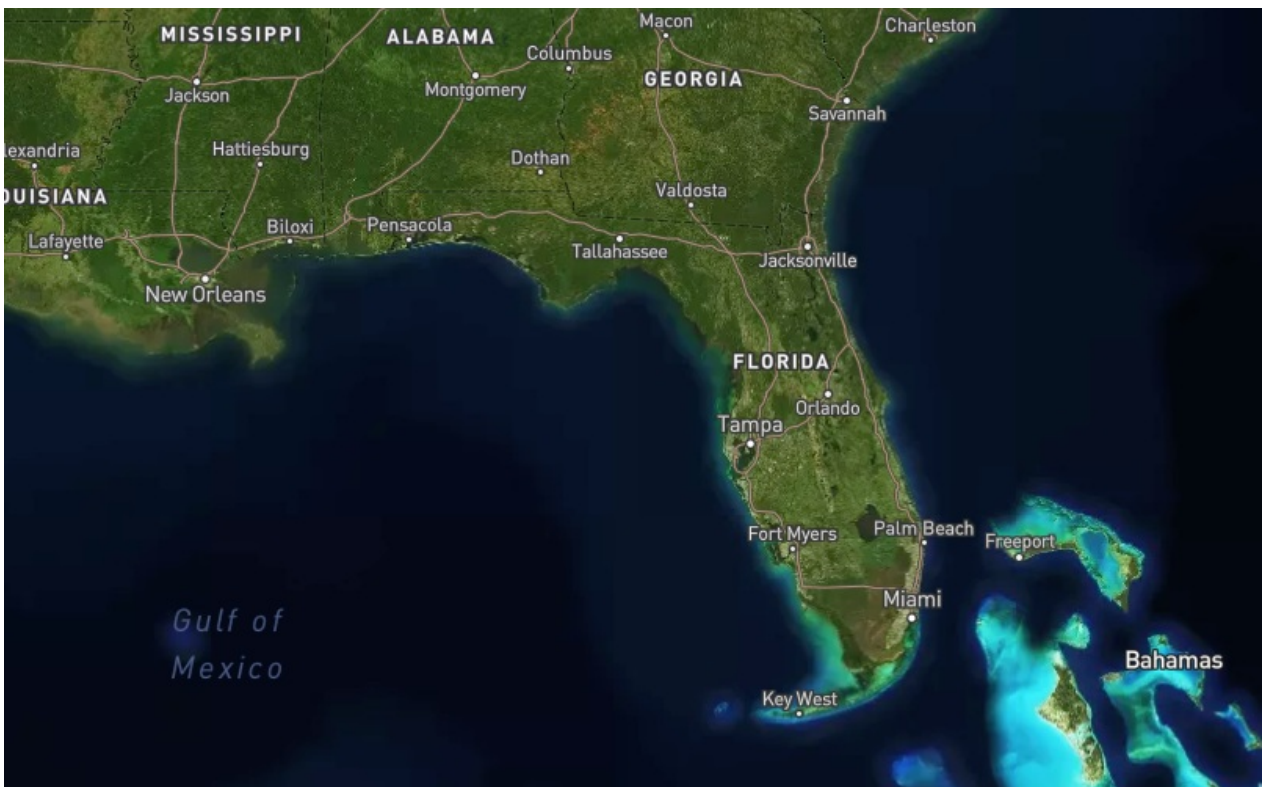
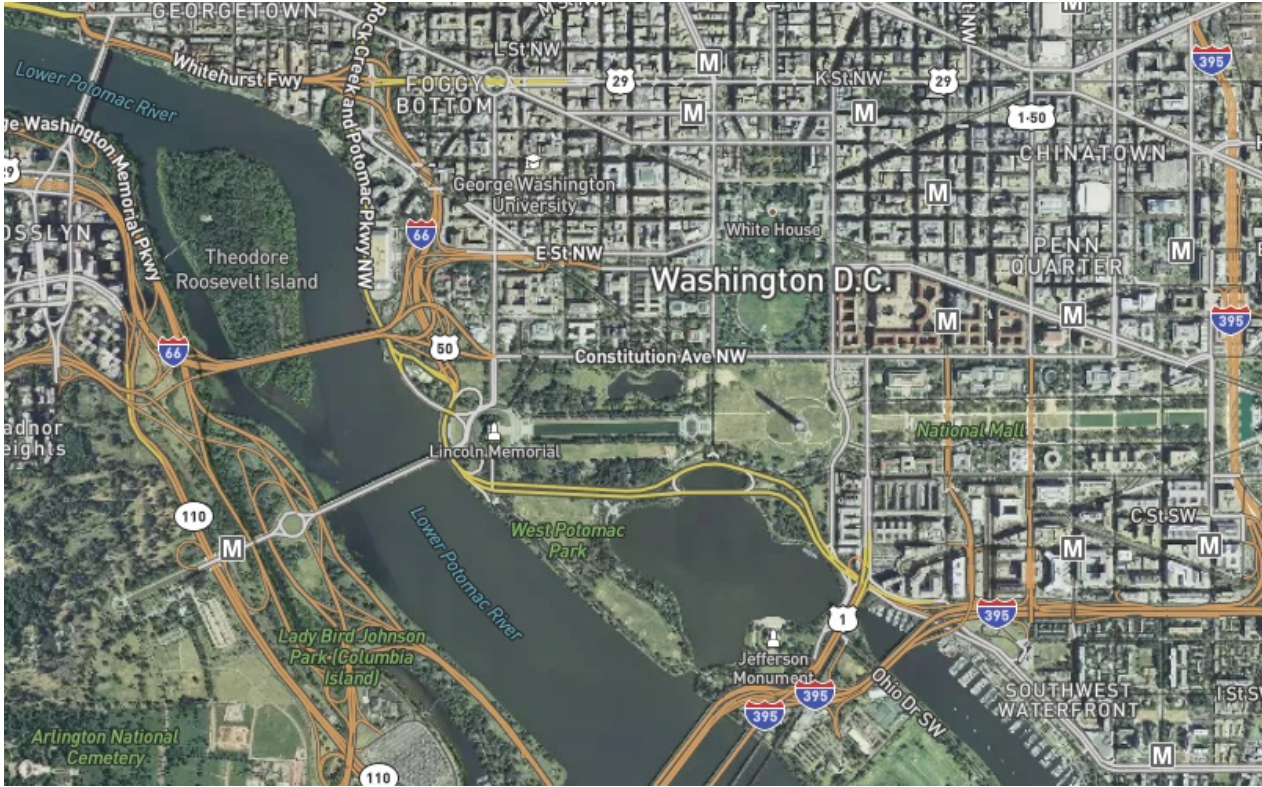
[Mapbox Satellite](#) is our global high-resolution satellite imagery. [Mapbox Satellite Streets](#) combines the Mapbox Satellite basemap with vector data from Mapbox Streets to bring contextual information. Mapbox Satellite Streets is designed to enhance our vibrant Satellite imagery with a light layer 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 a color-corrected, cloud-free raster tileset. As cities and landscapes change, we add newer, clearer, and more attractive imagery.



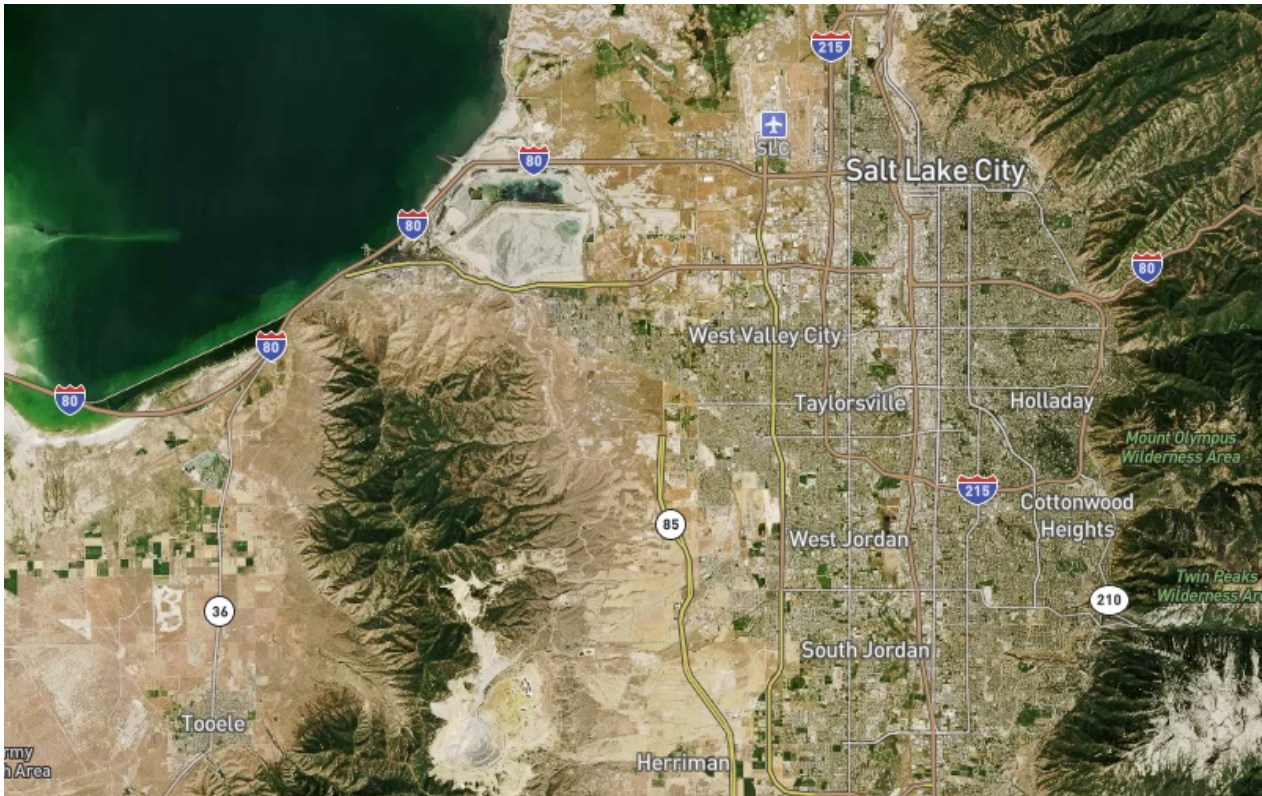
## Global coverage

Cloudless for zoom levels 0–8 and available from 20–19 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 [DigitalGlobe](#) 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.
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- **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.

Amy Lee Walton is a multidisciplinary designer that walks the fine line between design and code. At [Mapbox](#), she brings visual narrative and systems-based design thinking into her cartography work. She touches many facets of cartography and user experience design including designing beautiful thematic maps, designing and maintaining general purpose Mapbox GL maps, querying open source datasets, conducting online and in-person user testing, and delivering valuable insight to product roadmaps for user-centered improvements. Amy Lee holds an MFA in graphic design from the [Maryland Institute College of Art \(MICA\)](#), where she coalesced graphic design with physical computing, generative and creative code, and digital fabrication. She has designed, engineered, and shown her interactive installations abroad with in multiple shows in The Netherlands and done project-based documentation work in Israel.

An active speaker, Amy Lee builds curriculum for and leads talks and workshops discussing the design process, purposeful programming, cartography and visual narratives. She's passionate about engaging in acts of social good, cultivating your personal network, and championing diversity and inclusion at your place of employment. Check out her [Revision Path interview](#) to hear her thoughts on design thinking, treating code like a paintbrush, and changing the way people navigate the planet. Read her Communication Arts interview, [Designer as Navigator](#), to find out how she got started with cartography.

