Topography

General

· There was a 20 ft hill where the bronze Wall Street Bull statue stands that the Dutch called Verlettenberg – it was very popular for sledding in winter, so much so that colonial merchants passed an ordinance against reckless sledding.

· All shoreline around lower Manhattan was soft, meaning beaches and marshes.

Sandy beaches extended from the Battery to 34th St along the Hudson and tidal wetlands/marshes were along the East River due to many streams flowing downhill from approx. Bdwy, Collect Pond, etc. up through the Lower East Side.

· The line of Broadway was an indigenous footpath that wove between lower marshy lands. It wasn't very high, but definitely higher than the lower wetlands and beaches.

2050s

Landfill. Landfill. Landfill.

   o The West Side Highway was the former shoreline of the Hudson pre-contact.

   o Pearl Street was the shoreline street on the East River in Dutch days through 1700 before all the landfilling- now 3 blocks from the river.

   o Water Street became shoreline street by 1722

   o Front Street became shoreline street by 1790

· Until 1790 – wealthy inhabitants lived mostly below Wall Street or in Garden (now Exchange) and Rector Sts (first mention I've found of fancy street West of Broadway). North of Ann Street (1 block N of Fulton) was "all country, only here and there a house."

   South Street became shoreline street by 1810

   WTC excavations in the 1960s and '70s made landfill for Battery Park City.

Citywide social impact
- **More than 400,000 New Yorkers face a 50% risk of a major flood by 2060**
- **More than 40% of those at risk face substantial social or economic barriers to recovery (think Katrina and New Orleans)**
- **There is currently only one boating access site for every four miles of NYC waterfront**
- **Half of NYC's waterfront districts have only 1 or fewer places where residents can touch the water**
- **In 2015, nearly one quarter of all water samples failed EPA safe swimming standards with more than 17 billion gallons of raw sewage discharged into the waterways during a relatively dry year**

Sources & Websites

NYC Sea Level Map:
https://patch.com/new-york/new-york-city/nyc-sea-level-map-state-adopts-official-climate-change-predictions

Impacts of Climate Change on NY:
http://www.dec.ny.gov/energy/94702.html

NY Sea Level Rise:
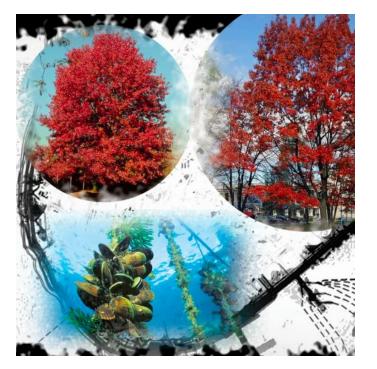http://www.dec.ny.gov/energy/45202.html

Climate Change and Health in NY:
http://www.dec.ny.gov/energy/68917.html

Flora & Fauna reactions to climate change:
http://blogs.ei.columbia.edu/2017/01/06/how-climate-change-is-affecting-new-yorks-plants-and-animals/

Mannahatta: a natural history of New York City by Eric W. Sanderson (2009)

http://waterfrontalliance.org/what-we-do/harbor-scorecard/

- o 50+ NE marine species (2/3 of 82) have moved north due to warming waters and the increased input of fresh water from storms into coastal marine environments
- o Red hake and black sea bass ranges have moved noth approx. 119 miles

- o Lobsters have moved north approx. 200 miles to the Gulf of Maine
- o Southern transitory species will become more common, including invasives like lionfish, trumpetfish, and blue angel fish

Fauna
- o Pre-colonial animals found in lower Manhattan: beaver (more on East River side with streams), wolf, mink, black bear
- o NY species most vulnerable to climate change but not in lower Manhattan – most native species extirpated: Eastern tiger salamander, bog turtle
- o Deer will benefit from milder winters. Any species that require overwintering/snow and cold as part of their cycle will suffer.

Seasonal changes already
- o Spring is currently beginning one week earlier than in 1950s
- o Birds and fish shifting north
- o Bees pollinating in the Northeast arrive 10 days earlier than in the 1880s
- o Plants and animals in North America already migrating to cooler temperatures – as much as 36 ft up in altitude or 10.5 miles north per decade. When they move, they encounter greater competition and stress of adaptation so there is a greater chance of extinction.
- o Increased chances of mismatched food sources and migration timing
- o Increased algal blooms and eutrophication (low to no oxygen in waters – dead zones)

2080s

Sea Level

Water around NYC will most likely rise ~3 ft by 2100. Below are predictions for sea level rise in the area, based on human response/responsibility to cutting greenhouse gas emissions and other pollutants:

Low means a lot of effort made, such as strict regulations and major changes.

Medium is what is expected if some effort is made, and is what most experts predict for the near future

High would be what is projected if no changes are made to our current consumption and pollution. Based on research from Columbia University, Cornell University and Hunter College (ClimAID):

	Low		Med		High
2020s:	2 in,	4 in,	6 in,	8 in,	10 in
2050s:	8 in,	11 in,	16 in,	21 in,	30 in
2080s:	13 in,	18 in,	29 in,	39 in,	58 in
2100:	15 in,	22 in,	36 in,	50 in,	75 in

o   The rate of water rise in NY is 1.2 inches/decade. This is almost 2x the global rate of 0.7 inches/decade

Temperature and Weather

o   Average precipitation from 1859 to 2005: 4 inches/month. It has been remarkably consistent, but this rate is currently increasing, and the variability per month is more pronounced

o   In the past there was more precipitation in the summer than in the winter – this is changing, now there is more precipitation in the winter and less in summer.

o   From 1958-2010 the amount of precipitation that falls in very heavy events, aka downpours, has increased more than 70% across the northeast US

o   We should expect more extreme events with floods and droughts

o   Stream flow will be altered – less snow + more storms = more freshets, or sudden intense rushing downstream waters that overflow banks with force

o   Oak and hickory to move in along with invasives like kudzu

o   Future crops: loss of dairy cows, apples, cabbage, potatoes. Replaced by southern crops like peaches and watermelons. But increased pathogens.

o   Any species that require overwintering as part of their cycle will suffer.

Birds

o   Nationally already seeing changes in body size, coloring, wing and bill structure, sex ratios.

o   New York species most vulnerable to climate change alterations to habitat or prey supply: spruce grouse, saltmarsh sparrows, egrets, peregrine falcons, red knot (migratory – depend on horseshoe crabs)

o   Any species that require snow and cold as part of their cycle will suffer.

 Fish

o   Pre-colonial sea life found in lower Manhattan: of note – oysters and other shellfish on beach and marsh sides.
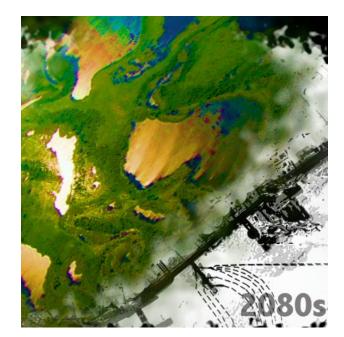
Abundant crabs, fish, eels, etc.

o   New York species most vulnerable to climate change:
All sturgeon (lake, shortnose, Atlantic), Atlantic salmon (CT more than NY), bay scallop, oysters and clams (increase in ocean acidification which weakens calcium-based shells)

o   The temperature of the ong Island Sound (LIS) has increased 3º F since 1976

o   Changes in species caught in LIS in January 2017:

    § Warmer water species: scup, black sea bass, summer flounder (fluke), Northern kingfish

    § Past cooler water species: winter flounder, cod, bluefish, striped bass

o   Precipitation predictions:
  2020s – increases by 8%
  2050s – increases by 12% (~1/2 inch more rain per month)
  2080s – increase by 15%

o   From 1970 to 2010 the annual average temperature has increased 2.4ºF
o   Winter has been as much as 4.4 degrees warmer
o   Temperature predictions:
  2020s – increase 3ºF
  2050s – increase 6ºF
  2080s – increase 10ºF
o   By 2100: the growing season will increase by one month but will be much less predictable, with extreme heat and heatwaves in summer and milder winters

o   Health risks associated with increased temps and milder winters:
  Increased pollen, ozone, and air pollution = increased asthma, allergies, and respiratory problems
  Increased insect populations, types, and range = increased pest carried diseases for humans (mosquitos, ticks – West Nile, Lyme, Zika, ???) and trees (elm, ash, chestnut, etc.)
o   More harmful algal blooms in coastal waters and more diseases for shellfish

Flora & Fauna
Trees/Plants
o   Pre-colonial lower Manhattan: sandy and marshy habitat = pitch pines, red oak, red maple, wild berries, cattails and other marsh grasses. Slightly higher land:

beech, hickory, oak. Stream or riparian habitat: aspen, alder, willow.
o   Around New Paltz: more birch than oak – colder climate. Expect this to change as temperatures warm, meaning oak and hickory (hardwoods) replacing birch
Expect sugar maple, beech, birch, elm, ash, and cottonwoods to move north.