Transforming the Cultural Landscape: The Representational Metamorphosis of the American Wetland

by

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Introduction

wetland, n.¹

Pronunciation: /ˈwɛtlænd/

Etymology: < WET adj. + LAND n.¹ >

An area of land that is usually saturated with water, often a marsh or swamp. Also attrib. Also pl. (sometimes const. as sing.).

See Also:

marsh, n.¹

Pronunciation: Brit. /mɑːʃ/ , U.S. /mɑrʃ/

Etymology: Cognate with Old Frisian mersk marsh (West Frisian marsk, mask, mersk...)

a. Low-lying land, often flooded in wet weather and usually more or less waterlogged throughout the year; a tract or area of such land.¹

I came into the world of wetlands unintentionally. Though it could be said that we all did. For many millennia before the present, prehistoric humans were engaged in a mutualistic relationship with wetlands, utilizing them for food, water, and shelter, which led to the success and growth of the human species. Documented use of coastal wetlands for activities such as fishing and livestock grazing date back to the Neolithic period, these environments acknowledged as productive and resource rich since the dawn of humankind.² The lower Mesopotamian freshwater wetland, or Fertile Crescent, was home to some of the earliest known human civilizations, often called the cradle of civilization. Cushioned between the Tigris and Euphrates rivers in southern Iraq, this area is one of the first examples of a wetland converted to a hub of human interaction,

thriving cities, and abundant agriculture, all facilitated and sustained by the lush wetland located there. ³

My personal experience with wetlands began with my quest to gain more “real-world” experience as a rising junior pursuing a career in environmental (specifically water resource) conservation. I accepted a job at the University of Nevada, Reno, working as a “historical re-photographer” at Lake Tahoe. Tahoe is a glacial lake set majestically at an 8,000-foot elevation, not at all a typical setting for a wetland. But, hidden along Tahoe’s southern shore lay a struggling freshwater marsh overtaken by the garish catastrophe of a 1950s suburban expansion project—The Tahoe Keys. My job within this wetland was to photographically assess the spread of Eurasian Water Milfoil, an invasive species that was quickly taking over due to the high levels of toxins in the water. The next summer, I pursued more of an immersive experience with wetlands. I became what my father termed an “accidental microbiologist”, working with a team of UMass Boston biologists to investigate the composition of microbial communities in Plum Island Sound salt marsh, an expansive wetland located on the northeastern coast of Massachusetts. This marsh, vast and fertile, riddled with insects of all sorts and always smelling faintly of sulfur, somehow captured my interest, and subsequently captured my heart. I became enamored with these environments, socially misunderstood, and politically overlooked, a culturally unrecognized ecological goldmine. Combining interests in their social evolution with interests with the visual arts and photography, I embarked upon this thesis.

Humans on a liquid Earth

The ecosystems that we classify as wetlands have always played a formative part in Earth’s evolutionary and social history; even so, the term “wetland” is relatively new, its technical use first emerging in the mid 1950s. It was adopted as a euphemistic substitute for the term “swamp”, the scientific precursors being mire, bog, and fen. Culturally, all of these terms had a negative connotation, construing a soggy and barren environment that was unpleasant and less than ideal for human purposes. Wetlands have long suffered from this public relations problem, only recently taking on a broader meaning, spanning social, scientific, and economic fields. In the mid twentieth century, there was a remarkable shift in the public image of wetlands, finally surpassing its negative reputation to become a scientifically and culturally valued environment.

Piqued by personal interest in the history of wetland use in the United States, I began to investigate the source of this transformation in public opinion. Upon further analysis, I found that this shift corresponded with the rise of satellite imagery use within wetland science. As I continued to research United States wetland use, I found many similar shifts in public and scientific attitudes towards wetlands all corresponding to a turnover in imaging technology. The trend of distinct changes in public perception following technological change prompted me to question: how much influence do the techniques of physical observation have on the cultural opinion of wetlands? How does the way we physically view our wetland landscapes impact their treatment in American culture? As it turned out, advancements in imaging technology and the changes in scientific thought that accompanied them held a lot of clout over the role of wetlands in

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4 U.S. Department of Agriculture, Swamp and Overflowed Lands in the United States, by J.O. Wright, Circular 76, 23(1907).
American society, the ideal space of the wetland being closely tied to the real space of social practice, as it is culturally produced and experienced through image.

**Wetlands of the Human Landscape**

Wetlands are diverse ecosystems that link human and external environments through the worlds most valuable and prevalent resource: water. Yet once armed with technology, human endeavor has focused primarily on their destruction. The American relationship with wetlands has shifted and evolved positively alongside its verbal connotation, but with this shift new issues and debates arose, as it became a topic of environmental concern. They can be viewed from many different perspectives, for some, they are a diverse natural resource, to be used sustainably (or not); for others, they have cultural or historical significance. For many, they may possess no value at all. Wetlands, while an important natural ecosystem, also have a much broader role as part of the complex cultural landscape, in which it is essential to consider ecology, economics, and technology in their care and preservation.

In the economy of nature as a whole, one organism looms well above the rest in respect to this distribution: Homo sapiens. Mankind’s role in the changing face of the earth is difficult to determine, because “men must live on and off the land as the first condition of their survival”\(^6\), yet, we are also the species that has impacted it most negatively. Our landscape is a cumulative record of the human impact on the natural world, good and bad, with wetlands providing a heavily utilized environment.\(^7\)

Throughout most of American history, wetlands were “wastes”: useless,

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\(^6\) George Caspar Homans. *English Villagers of the Thirteenth Century.* (New York: Russell & Russell, 1941)

bothersome places that bred mosquitoes, frustrated colonization, and generally threw up a barrier to human progress. The ancient Greeks believed marshes to be home to limniads (water-nymphs) who would occasionally drown lonely travelers. Scottish folklore warned of shape-shifted witches disguising themselves as airborne cattail fluff. In the US, wetlands carry names such as the Great Dismal Swamp in Virginia, and Hell Hole Swamp of South Carolina. The marshes of New Jersey’s Meadowlands are a vast and productive environment, but are perhaps better known for their filth and rumored resting place of Jimmy Hoffa. Cultural references and books have reinforced the view of wetlands as wastelands, instilling this notion in US residents from childhood—popular children’s films favoring wetlands quite poorly. See, for example, the “bog of eternal stench” in David Bowie’s Labyrinth, the “fire swamp” of The Princess Bride, and the “Swamp of Sadness” which swallows up dear Artax in the Neverending Story. The underlying theme in all aforementioned is to avoid these terrible lands at all costs.

Up until the second half of the twentieth century, the most common response to their presence was to drain them without question, and yet we have surprisingly few historical studies or maps documenting this process—a testament to their low cultural and ecological value for much of American history. This prevalence of the historical, and, as I hope to show in this thesis, still prevalent modern exploitation of the world’s wetland resources, brings me to the concept of “cultural determinism.” This is the view of nature as a passive object upon which human society may inscribe its larger goals. This was primarily the way the American landscape was utilized by European colonists upon their arrival in the United States. While this type of totalitarian view of nature may

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11 Whitney, From Coastal Wilderness to Fruited Plain, 4
be looked down upon in present times (though it may be argued that we occupy this worldview now more than ever), it is understandable in the context of a small group of colonists with a new world unfolding at their feet. It was through this worldview the natural landscape gave rise to the cultural landscape, humanized to the point that it became a collection of human artifacts—houses, fences, farms, factories and roads, reflecting human society’s material culture.\textsuperscript{12} Human civilization has been transformed from an “aquatic society” to a “hydraulic society”, one that controls water resources through technology, rather than living in harmony with them.\textsuperscript{13} This sense of entitlement is what led to the sorry state that many American coastal wetlands are in today.

The story of United States’ wetland use begins with the land’s native inhabitants for which wetlands were an indispensable source of sustenance, transforms into vast colonist livestock grazing operations in the seventeenth and eighteenth centuries, climaxied with mass channeling, tiling, dredging, and draining in the eighteenth and nineteenth centuries, their use winding down with the current political and cultural interest in preservation and restoration. However, this story is far from its end. As the nineteenth century, French-born American farmer J. Hector St. John De Crevecoeur stated in 1925, the Americans had “done the most in the least time of any people”; the American lifestyle was a “struggle between civilized man and barbarous, uncultivated nature.”\textsuperscript{15} While nature is no longer widely considered barbarous in American culture, the struggle persists, sacrifices having been made on both sides. Much of the ecological

\textsuperscript{12} D.W. Meinig and John Brinckerhoff Jackson. \textit{The Interpretation of Ordinary Landscapes: Geographical Essays.} (New York: Oxford University Press, 1979.)

\textsuperscript{13} Whitney, \textit{From Coastal Wilderness to Fruited Plain}, 11

alterations that have occurred in the United States have coincided with advancements in technology, whether this technology was agricultural, industrial, or visual in nature. The evolution of scientific imaging technology is the most pertinent, a double-edged sword, that changes not only how the landscape is used, but also how humans relate to it, while simultaneously documenting this change.

Presently, although considerably depleted in area from their historical extent, a new perspective of wetlands is now developing, and it is this change in approach and technology that encompasses the motivation of this text. Our notion of wetlands has evolved alongside progressive changes in society, following changes in scientific imaging technology and cartography. The U.S. public perception has, indeed, undergone an extraordinary revolution since European colonization. As Sheriff Hartwell of *The X-Files* aptly observed, “we used to have swamps, only the EPA made us take to callin’ them wetlands.”16 The term wetland itself projects a certain respectability that was otherwise lacking in the terms “swamp” and “bog.” Now, wetlands are being viewed less as mosquito-breeding nuisances and have become respected as productive and sometimes beautiful environments. School children learn of the benefits of these environments rather than being taught to fear them, and since the 1960s, they are being preserved left and right. This thesis argues that the transformation of cultural perceptions and interactions with wetlands was impelled by changes and advancements in cartographic imaging technology and the evolving modality of scientific thought that accompanied them. In tracing the lineage of prominent methods of landscape representation from conventional illustration, through photography, aerial photography, and satellite imagery, I work to show that the changing modalities of the American visual relationship to

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16 Gardner, *Lawyers, Swamps and Money*, 8
wetlands has been key in determining their reputation, and functional relationship to humans. The evolution of this relationship is prompted by the changing notions of ecological ethics and scientific practice in response to each successive form of representational technology. To trace the implications of these changes is to recognize that altering the way the world looks on paper alters the way people look at the world, and thus interact with it.

Coincident with each consecutive stage in imaging technology is an evolution of the practices of subjectivity and objectivity and their relation to the notion of accuracy within visual representations of nature. Objectivity or the rhetoric of objectivity is central to the market for modern terrestrial representations, but is not a prerequisite to accurate representation. Objectivity, in the most basic of terms, lies in contrast with subjectivity, which refers to ideas and beliefs within the human mind, which are thus personally biased. Objectivity is consequently synonymous with realism. Within this thesis, a subjective representation refers to anything created via human hand, or framed within an “artistic” perspective, while objective technologies are mechanical in nature, including photography, and satellite imagery. While the emphasis of the practice of objectivity within representations of nature will be mentioned many times throughout this text, I want to emphasize that I am referring to the idea of epistemological objectivity (i.e., how we know) as opposed to ontological objectivity (what we know). This type of objective view has become recognized within scientific thought as a standpoint from which to determine the human relationship with nature, and vice versa. Thus, as technology enables humans to view the global landscape on larger scales, with less and less need for human mediation, simply by way of natural technological

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evolution; landscape representation has become more objective in practice. I must point out that full objectivity is not something that is obtained through any of the technologies mentioned in this thesis, due to the experiential nature of fact, but is rather something that is being strived for. I seek to trace the evolution of imaging technology from that considered subjective to modern objective practice and how it has impacted the place of values within science and our moral relationship with nature. Each chapter in this thesis thus follows not only changing imaging technologies, but also the notions of accuracy and scientific “truth” that accompanied them.

**Objective**

To answer the question of how the American public’s perception of wetland ecosystems bloomed from that of noxious wasteland to later become revered, I examined the evolution of imaging technology, objective practice, environmental legislation, and land-use practices within the United States that has allowed wetlands to flourish or be forgotten in American culture.

This project is organized into five chapters, each of which inspects a distinct advancement in cartographic technology and coinciding changes in scientific thought, the last being a case study of Jamaica Bay, a coastal wetland environment in New York.

Chapter one presents an overview of wetland classification, ecosystem functioning, and use in the United States. I analyze the broader relationship of humans to salt marshes in terms of goods and services to humans and the overall potential impacts of human action on wetlands.

Chapter two deals with the early cartographic history of the United States. Until the nineteenth century, maps were either engraved or hand drawn, and subject to the personal tastes and bias of the author. Maps of the Eastern United States, which were
colonized first, were often exploratory in nature and possessed an imaginary, artistic-type quality not present in the thematic maps used today. Truth to Nature as an epistemic virtue within scientific thought arose at this time, representing what I have nicknamed the “subjective-objective”, a method of representation that relied on human intervention to decipher the “ideal forms” and principles of nature. The prominence of this way of thinking within seventeenth and eighteenth century culture dictated land use practices, provoking wetland destruction.

Chapter three examines the changing paradigm of wetland mapping in response to the invention of, and coincident increased use of photographic techniques, extending through the invention of aerial photography. I begin my discussion of mechanical objectivity and the quest for objective representation here, in attempt to shed light on the turnover in scientific thought at the time and its relation to land use change.

Chapter four discusses the onset of the use of satellite imagery in the twentieth century. The technology of remote sensing came to the scientific forefront after World War II, its development driven mainly by military use. With the advent of high spatial resolution imagery and the increasing popularity of networks of scientific data circulation, wetlands have become more prominent landscape within the public consciousness. This chapter questions what happens when the image of the wetland landscape is finally brought out of the human subjective, and what alterations to the perceptions of the human relationship with nature occurred in response.

Chapter five uses Jamaica Bay, New York as a case study of a wetland environment that was extensively subjected to the changing social ideals of wetland use and worth over the last several centuries. An environment that is currently on the cusp of destruction, straddling the line between a heavily urbanized landscape and the Atlantic
Ocean, its current state and use presents a complex set of environmental and social issues which exemplifies the many problems of wetland management nationwide, and, indeed, worldwide.

Certain issues are outside the scope of this thesis. I chose to focus only on changing paradigms of imaging technology, but beyond advancements in cartography, there was a rapid evolution of other scientific technologies that I cannot even begin to cover in this thesis. This is a study intended to familiarize and deconstruct the history of an environment that often went unnoticed to America’s general public, but imaging has brought to the forefront. It goes beyond analyzing U.S. land-use practices in attempt to analyze the communal evolution of the nationwide perception of nature. The approach I have taken is one that traces the broader history of perceptions of nature and visual representation of the natural world to regard its impact on a controversial environment. This study rests on the assumption that images play an instrumental role in the evolution of cultural sensibility; it argues for the partial autonomy of images of wetlands in shaping attitudes and values towards them.  

Lefebvre once stated that landscapes are not produced “in order to be read and grasped, but to be lived by people with bodies and lives in their own particular context.” In analyzing the changing nationwide context of the American wetland, the picture presented does not merely show an environment redeemed, but the intellectual growth of a nation.


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Chapter 1: Coastal Wetlands— A Cradle of Society

“To stand at the edge of the sea, to sense the ebb and flow of the tides, to feel the breath of a mist moving over a great salt marsh, to watch the flight of shore birds that have swept up and down the surf lines of the continents for untold thousands of years, to see the running of the old eels and the young shad to sea, is to have the knowledge of things that are nearly eternal as any earthly life can be.”

-Rachel Carson, Under the Sea Wind

Life as we know it exists solely within two planes of being: the geosphere, and the biosphere. The geosphere, the inanimate, or “rocky” portion of the earth provides the foundation for the biosphere, the ever fertile web of life which we as humans along with every member of the myriad species that occupy this earth all share. The biosphere is an “integrated living and life-supporting system comprising the peripheral envelope of planet Earth together with its surrounding atmosphere so far down, and up, as any form of life exists naturally”. 2 The Earth can be thought of as a living, complex creature, with the geosphere representing its bones, the biosphere separated into portions: the lithosphere, a conglomerate of regolith, is the muscles, fat and skin, while the hydrosphere serves as the lifeblood of this planet, providing sustenance to the being as a whole. The two systems are integrated within the oceans and water systems through transfers of energy and matter.

The hydrosphere, in reality, contains the entirety of the world’s water resources, ranging from the aquifers that lie just beneath the Earth’s crust, to the vast oceans that comprise over 70% of its surface. Water provides one of the only known requirements for life; the maintenance of which is also dependent on its constant presence. Unfortunately, we have found ourselves in the midst of a potential water crisis. Due to the rapid growth of the human population, and the resulting increasing demand for resources, our consumption of fossil fuels and the environmental impacts that follow such usage, humans have become one of the greatest agents in geospheric and biospheric change to have ever occurred throughout Earth’s history. Much of this change is illustrated within our Earth’s water systems through physical and chemical alterations, and these ecosystems have been slowly degrading in health for centuries at the hands of humans.

What we as a society do with our water—from whom and where we take it, and what we choose to use it for, reveals much about our values as a society and our relationship with nature. Our interactions with the natural world surrounding us are dependent upon our collective perception of them as a society. Coastal wetland ecosystems are an example of a natural environment that has been precariously balanced along the scale of human significance for centuries, with the United States’ relationship with its coastal ecosystems having long been on the rocks. Frequently exploited and destroyed, the utilization of wetlands throughout the developed world can be likened to ‘the passing frontier of nature replaced by a permanently and sufficiently expanding
frontier of technology\textsuperscript{3} Still, following centuries of use, (unsustainable more often than not) wetlands endure.

**Geographical Setting**

Wetlands occur over a range of environments, from the arctic to the tropics, from coastal regions to secluded intercontinental plains. They can be freshwater or saltwater habitats, and ecologically, are high among the ranks of the most essential ecosystems on Earth. The total wetland area on earth has been estimated to cover approximately 6\% of its total land surface at a \textit{minimum}. In the United States and Canada, there is an estimated 35 million acres of saltwater wetlands while globally there is an estimated 5 million square miles\textsuperscript{4} In the US, saltwater wetlands span almost the entire east coast and are also extensive along the Gulf of Mexico, but are less commonly found on the steeper, rockier Pacific coast, where water rarely pools. Unique and complex environmental interactions take place within these ecosystems, in which the biotic and abiotic world are fully linked.

Among the most productive ecosystems on the planet, wetlands are utilized by humans and a variety of other organisms as a source of water, food resources, recreation, transportation, and building materials, and are cherished by many cultures worldwide for their unique beauty. Despite their economic and aesthetic value, over the past few centuries human population growth and advancement has caused unprecedented change in these environments. Over-consumption of wetland resources has led to a range of environmental troubles, many of which may be irreversible. In the United States, urban and agricultural development reinforced by negative perceptions of wetlands have

\textsuperscript{3} Carl Ortwin Sauer, and John Leighly. \textit{Land and Life; A Selection from the Writings of Carl Ortwin Sauer}. (Berkeley: University of California Press, 1963), 154.

contributed to the loss of approximately 122 million acres of the 221 million acres of wetlands that were present prior to arrival of Europeans. In other words, U.S. wetlands, landscapes that took thousands, perhaps millions of years to form, have been depleted by 55% in a matter of three or four centuries. This trend is reversing however, and for the first time in 300 years in the United States, wetlands are being created, restored, and enhanced, rather than destroyed. The movement to protect our wetland resources as well as a stricter adherence to federal and state regulations is borne of the desire to understand and describe the characteristics and values of all types of land, and to wisely and effectively manage wetland ecosystems. Studying the health of these ecosystems over the course of history can be a reasonable barometer of American society’s attitude towards its natural wetland resources, their future wholly dependent on economic, political, and social progress, rather than natural process.

**Living Off the Land: Benefits of Wetlands**

Coastal ecosystems possess one of the most dynamic interfaces between human civilization and the outside environment, acting as a filter of anthropogenic pollutants and helping to protect the vast oceans beyond. In the United States, half the human population resides within a coastal county, while worldwide, 38% of people live within the coastal zone. Some fourteen of the world’s fifteen largest mega-cities are classified as being within the coastal zone, with the ocean providing trading routes, food, and recreation. Though a large portion of the population lives within a coastal environment,

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6 Maltby *The Wetlands Handbook.*, 13
these areas comprise a very small portion of Earth’s terrestrial surface area. Coastal counties account for only about 17% of the land in the contiguous United States, and populations within these areas are steadily rising.\(^9\)

Though the coastal zone has been occupied for some time, the appreciation of the ecological role of wetlands and their importance to humanity is a recent development, only being recognized within the sciences during the latter half of the twentieth century. Wetlands protect and maintain water quality by providing a natural biotic filter for sediments and excess nutrients, purifying water in linked water resources, such as oceans, lakes, and rivers, which are used by humans for recreational activities, travel, and oftentimes drinking water. Scientists have estimated that wetlands may remove between 70% and 90% of the world’s entering nitrogen, in addition to the removal of pathogens, toxic metals such as lead and copper, and surface water pollutants.\(^{10,11}\) For this reason, wetlands are sometimes described as “the kidneys of the Landscape”.\(^{13}\) Salt marshes alone sequester more carbon in their soils than any other temperate biome reportedly sequestering roughly 771 billion tons of carbon, the same amount that is currently in our atmosphere. Wetlands are thus global climate stabilizers additionally contributing 1% or more to the annual global loss of fixed nitrogen via microbially mediated denitrification.\(^{14}\)

Change is the norm in coastal wetlands, meaning they are highly dynamic environments that adjust easily to many different ecological conditions. Coastal and estuarine wetlands undergo extreme environmental changes from wet to dry with the inundation of the tide on a daily basis. Northeastern salt marshes are mottled with salt ponds and pannes that form along the “high marsh” (the high marsh is the portion of the marsh that is of higher elevation, which floods less frequently than the rest of the marsh). These salt ponds and pannes are hence replenished only when the marsh is flooded at spring tide. Between each spring flush of the marsh there is a lengthy evaporation period, in which water within the ponds becomes stagnant, and conditions become increasingly harsh. These ponds are micro-ecosystems, functioning entirely differently from the surrounding marsh. Consequently, the unique organisms that live within the different areas of a salt marsh must be able to tolerate a range of salinities and temperatures, making it a very specialized environment that is not easily re-created or remediated. Other areas of the marsh that are flushed at higher frequency also must be resilient to temperature, salinity, and pH change, some areas being flushed by sea water on a twice-daily basis.

Because many coastal wetlands undergo radical environmental changes regularly, they were historically identified as resilient to anthropogenic disturbance. However, they have recently been found to be less hardy than previously thought. Coastal salt marshes, the most common coastal wetland, in particular were traditionally classified as resistant to anthropogenic disturbance due to their young features (on a geologic time scale), having been built quickly by ecosystem engineering plants, called halophytes (salt marsh plants that reproduce clonally, and only thrive in environments that are inundated

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frequently), which indicate that they have the potential to rebuild quickly if destroyed. Furthermore, salt marshes and their vegetation rapidly adapt and recover to frequent flooding of marshes due to the tides, which consistently alter and disturb the environment by depositing wrack (dead plant material), sediment, and sand upon the marshes. The durability of wetland sediments, which support thriving environments through regularly anoxic and saline conditions, also suggests resilience to contamination, nutrient loading, and long-term inundation. Because it was assumed that marshes could easily adjust to changing circumstances, not much emphasis had been put on the health of salt marshes by governmental and conservation organizations. Even William A. Niering, expert on wetland ecology, and a revolutionary in wetland restoration science, in his 1977 paper, “Our dynamic tidal marshes: vegetation changes as revealed by peat analysis”, insisted that they can rebound quickly after human activity. Nevertheless, even an esteemed wetland scientist such as Niering could not recognize the magnitude of the anthropogenic stress that was being placed on coastal wetlands by humans through increasing urban and industrial pollution.

**Separation from the Land: Wetland Loss**

Upon the colonization of the United States, wetlands were viewed by the general public and legislators as not only disease ridden and dirty, but were often said to be riddled with demons and evils, feared by the traveler. This was not a novel perception, as wetlands have been depicted through many historical accounts as sinister and valueless. Dante, in his *Divine Comedy* describes the marsh of Styx as the final resting place for the evil, stating:

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17 Tiner, *Wetland Indicators* 52-56.
Thus we pursued our path round a wide arc or that ghast pool,
Between the soggy marsh and arid shore,
Still eyeing those who gulp the marish foul.¹⁹

Many slang phrases within the English language which typically have a negative connotation find their root in wetlands; for example to be “bogged down”, or “swamped” with work, and mythical monsters such as the boogey man (Bog-ey man) originated from adverse views of wetland ecosystems.

Because of their reputation at the time, wetlands were subsequently deemed as an obstacle to progress and expansion, and in turn, many were drained via hand-dug ditches to facilitate development.²⁰ As a result of the cultural perception of wetlands, drainage and destruction of wetlands for transformation into farmland and other more beneficial uses became a customary practice. The most common historical use of coastal salt marshes within the United States has been as pasturelands for livestock. In fact, marsh-holding farmers within the US tended to support 45% more livestock than non-marsh holding farmers in the seventeenth century.²¹ The cultivation and use of salt marsh hay continued to be a component of New England’s agricultural economy through the twentieth century, until the economy shifted from being agriculturally based to the trade of food resources and livestock. (Figure 1.) As development continued to travel across the United States with the Westward Expansion of the 1800s, freshwater wetlands provided major logistical problems for travelers. Attention at this time shifted towards the development of routes around or through, and proposals to use and alter the landscapes, providing some of the first post-industrial wetland maps.

¹⁹ Mitsch, Wetlands, 13.
²¹ Dahl, History of Wetlands in the Conterminous United States.
As the industrial revolution began, an increasing immigrant population and urban expansion yielded a population that had little sense of connection with the land. Population growth during this time caused increased pressure to convert marshes into “valuable” space, such as parks, dumps, housing and industrial factories. The onset of new technology such as the steam engine and mechanized farming equipment led to the rapid degradation of coastal wetlands throughout this time, and as agriculture moved inland, marshes became further reviled. During this period the public perception of natural environments was shaped by their perceived “economic worth”, a trend that continues today. Coastal wetlands, which were no longer very useful for hay production, food, or livestock with the onset of new machinery and industrial practices, were set aside as useless wilds, only becoming expedient when converted to another type of environment. This resulted in mass dredging and filling of coastal wetlands, a practice that led to the expansion of northeastern urban centers such as New York City and Boston. Mayor Joseph B. Sargent of New Haven stated in 1891 that they must “fill the

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22 Whitney, From Coastal Wilderness to Fruited Plain, 4
marshes at public expense”, then “sell them for manufacturing sites and lumber and coal yards, and for storage sheds”, which would eventually “free the city from this constant menace to health and life, without loss to the finances of the city.” The menace to health abovementioned was the growing mosquito populations within New England wetlands. With the onset of mosquito borne diseases across the world, and salt marshes being common breeding grounds, this fostered the public perception of coastal wetlands as vile, dirty environments.

By the late 1800s, coastal wetlands were being extensively eradicated and mosquito ditched, due to public fear and disgust. An 1868 volume of Scientific American stated,

The draining of the swamp lands is not a new idea. Such lands are not only unproductive of anything which can subserve any important purpose, but they are productive of numerous evils. Teeming with miasma, the home of mischievous and annoying insects they are blotches upon the otherwise fair face of nature. To tender them fruitful and productive of good rather than evil, is a problem for which a solution has been anxiously sought, but heretofore only partially obtained.

Based on this perspective, which was prevalent in US citizens at the time, it is not difficult to imagine why a large percentage of United States’ wetlands were lost or degraded between the 1800s and the present. Thus, for many centuries, the conviction that natural swamps and marshes were troublesome and unusable went hand in hand with public actions and government policies: swamps were drained by citizens, and the government supported these actions through land grants and subsidies.

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23 J.B. Sargent "Mayor's Inaugural Address." In City Year Book for the city of New Haven for 1890, (New Haven: O.A. Dorman, 1890.), 325-354
An Evolving Classification System

As society within the United States expanded, the necessity for a classification of the particular land cover and land use of a region became pertinent to the expansion of civilization. A distinct categorization for all landscapes, including wetlands became necessary. Without a clear hydrologic and ecologic understanding of wetlands, early settlers saw no reason to treat them any differently than other land cover types. Following in their footsteps, generations of Americans have continued to misunderstand the essentially liquid nature of wetland landscapes. The Lockean tenets of labor and land ownership on which American concepts of property were based failed to account for variances in the nature of land, and often discounted the uniqueness of wetlands for this reason. Traditionally, land has been considered private property while water is public. Because wetlands are technically both, their very nature generated confusion. To resolve such confusion and formally determine their use, wetland delineation became necessary.

The United States went through a series of wetland classification endeavors before settling on the method of wetland delineation and classification that is used today. Nathaniel Shaler, in *A General Account of the Freshwater Morasses of the United States*, published in 1890, made one of the earliest categorizations of the nation’s wetlands. This system was developed as a basis for identifying, classifying, and mapping wetlands for the means of developing a national database, as well as building a list of plant species that occur in these habitats for use by other organizations and scientific institutions. Remarkably, the U.S. had been populated for nearly three centuries prior to the advent of this system, so maps created at this time still don’t account for a large percentage of the wetlands that were present beforehand. Shaler’s classification system and newfound interest in wetlands as an ecosystem coincided with a public change in scientific values,
prompted by the rise of objective visual practice. After many years of evolution, the current classification system is still used comparably to Shaler's, working in concurrence with methods of mapping and photography to provide a comprehensive classification system of landscape cover and change in the U.S that can benefit US citizens for generations to come. In all cases, the classification systems were made and represented through cartographic techniques, their use more common and widely used as imaging technology improved.

Modern wetland definitions are biologically based, due to the fact that botanists and biologists were among the first to recognize the ecological values of wetlands. The delineation of Wetlands is under the control of the Army Corps of Engineers, in conjunction with the Environmental Protection Agency, the Fish and Wildlife Service and the Soil Conservation Service, and has been under the jurisdiction of these organizations for nearly three decades. Prior to 1986, there was no formal governmental methodology for wetland classification in the United States. In 1987, the Army Corps of Engineers released the first comprehensive wetland classification system, which was modified in 1989. A merged form of the two original (1987 and 1989) Corps of Engineers manuals continue to be the method of classification abided by today.

The current established definition for wetlands within governmental agencies is defined by the National Academy of Sciences, identifying wetlands as,

> Ecosystems that depend on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturated at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils, and hydrophytic vegetation. These features

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will not be present where specific physio-chemical, biotic, or anthropogenic factors have removed them or prevented their development.\textsuperscript{27}

Because of the current state of US wetlands, anthropogenic effects upon them must be taken into account before classification. Federal authority to regulate wetlands derives principally from Section 404 of the Federal Water Pollution Control Act of 1977, which requires landowners and developers to obtain permits prior to dredge and fill activities in navigable waters. Though wetlands are not technically navigable, their adjacency to, and connections with rivers, lakes, oceans, and other bodies of water have great impacts on these resources, and thus are lumped into the definition.\textsuperscript{28} The mapping of United States’ wetlands is additionally under the jurisdiction of the U.S. Fish and Wildlife Service (FWS). Currently, the products of these mapping endeavors are held in the FWS Wetland database, or the National Wetlands Inventory.\textsuperscript{29} The first comprehensive inventories of the wetlands of the United States were under the jurisdiction of the U.S. Department of Agriculture. These inventories were initiated in 1906, with the goal of identifying those that could potentially be drained and converted to other uses.\textsuperscript{30} However, before wetland mapping was a federal responsibility in 1906\textsuperscript{31}, it was the responsibility of local governments and communities. The National Wetlands Inventory was initiated in 1974 to prepare detailed wetland maps, and how now covered over 90% of the conterminous United States, Hawaii, 27% of Alaska, and the majority of U.S.

\textsuperscript{27} \textit{Wetlands: characteristics and boundaries.} (Washington, D.C.: National Academy Press, 1995)
\textsuperscript{31} Ibid.
territories.\textsuperscript{32} As this thesis will show, though more widely delineated by the mid twentieth century, the onset of sustainable use of United States wetlands coincided with the adoption of a formal surveying practice by the government.

**Modern Anthropogenic Stressors on Coastal Wetlands**

While the rate of loss has since been reduced through the implementation of legislation and classification techniques, the wetlands of the United States’ still receive a relentless flux of anthropogenic disturbance. Though significant protection efforts began in the 1960s, wetlands have continued to disappear at a staggering rate. Twenty years ago, in 1990, an average of eight hundred acres of wetlands were lost each day. Coastal wetlands are at the highest risk, only comprising 5% of wetland land cover in the conterminous United States in 2004, freshwater wetlands making up the 95% remainder.\textsuperscript{33} The predominant modern anthropogenic stressors on coastal wetlands are fairly similar to those affecting wetlands centuries ago, and include dredging, coastal squeeze\textsuperscript{34}, clearing of upland land, industrial and agricultural runoff, insecticides, sewers, mosquito ditches, and trash. These stressors threaten the balance that maintains the supply of wetland products and service that are valuable to humans and other species alike. However, as in many environments, this balance is fragile, and the removal or over-abundance of any one key element could alter the way the entire ecosystem functions. As you can see, the provision of wetland services is reliant on the


\textsuperscript{34} Caused by floodwalls built between wetland and developed area (thus limiting the landward migration potential). Floodwalls, which can reduce the amount of sediment accretion within wetlands, combined with the added stressor of sea level rise could cause the coastal marsh platform to evolve to an elevation lower than mean high tide, increasing the potential for it to become flooded which may cause it to drown. This will cause the area to be more susceptible to erosion and could convert it to sub-tidal flats.
maintenance and protection of these ecosystems, and this maintenance is contingent on political decisions and human social practices.

**A Visual Impetus for Change**

Human alterations to the Earth’s landscape are as old as humanity itself, the land reflecting the social and economic needs of the society occupying it, or otherwise reflecting the lack of society thereof. Under the beliefs of some theoreticians, much of the world has been converted from natural landscape, to cultural landscape. The vast majority of wetland landscapes can be muddled into this definition, or exist within the margins of civilization. A fundamental aspect of the outside landscape is that it is a continuously evolving place. However, current landscape changes are increasingly seen as a threat, “characterized by loss of diversity, coherence, and identity of the existing landscapes”, due to the fact that the root of the change is no longer natural, but dictated by humans. Motivated by being able to track wetland land cover change through the progression of cartographic technology, wetlands, a landscape rarely celebrated or preserved until the twentieth century, have found themselves at the heart of environmental preservation. Their conservation is not a matter of science alone—but one of culture as well.

There has long been uncertainty about whether the basis for landscape evaluation should be subjective or objective in nature. From this point on, I plan on tracing the evolution of cartographic technologies from the subjective to the increasingly objective, and determining what sort of widespread social practices and landscape

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interactions arose from the changing modes of visual representation. Within the modern scientific community, the term “subjectivity” has a fairly negative connotation, believed to be prejudiced in nature and decidedly untrue, however, its use is prevalent throughout history. Much of the past destruction of wetlands within the United States stemmed from the prominence of subjective, or immersive views within visual and cartographic practice. The terms subjectivity and objectivity are seldom used in reference to cartography, generally believed to be an objective or ‘accurate’ field, rarely biased, its inaccuracies only based on the primitive nature of equipment used at the time. However, up until the rise of mechanical objectivity, cartography was not limited to the objective. I argue that the evolution of scientific cartography and visual practice has been a quest to find the truly objective, to oppose the Kantian representations of subjectivity in which cognition cannot escape internal representation.

Through the evolution of cartographic technology from illustration and engraving, to the lithograph and photograph, to aerial photography, satellite imagery, and perhaps someday, beyond, cartographic representation has become increasingly objective in nature, requiring less and less human analysis and intrusion. Representation, like subjectivity, has always been a controversial word within the scientific world, yet it sits at the core of scientific practice and knowledge production. It inherently refers to an image, for some—man is “taken in the flow of the world, s/he is primarily a hearer of the world, and this is why the world cannot be an image”37, for others, such as Plato, “the world is primarily seen, put in front of us, and can thus become an object of representation.”38 Plato’s ideas of representation is that which is expressed through

38 Ibid., 13.
cartography—the world as an object of representation, first decided through subjective experience, later put in front of us via machine, displaying contemporary geography to humans without first being perceived by humans—producing truthful and unequivocal images of the geographical world.

Studying the fluctuation of human land use practices can allow us to monitor these changes, and a key conduit towards this monitoring is cartography. Wetland maps are a prerequisite for wetland inventories, ecosystem planning, management, protection, and restoration. Maps provide information on wetland type, location, and size. Detailed wetland maps are necessary for providing baseline spatial data for the assessment of the effects of national policies and undertakings, as well as more localized effects in small communities. There are many uses of wetland maps, including the development of resource management plans, environmental impact assessments, natural resource inventories, and habitat surveys. Historical maps provide added value by offering insight to a greener time in America’s past.
Chapter 2: Illustrated Maps and the Rise of the Epistemology of Truth to Nature

Once there were brook trout in the streams in the mountains. You could see them standing in the amber current where the white edges of their fins wimpled softly in the flow. They smelled of moss in your hand. Polished and muscular and torsional. On their backs were vermiculate patterns that were maps of the world in its becoming. Maps and mazes. Of a thing which could not be put back. Not be made right again. In the deep glens where they lived all things were older than man and they hummed of mystery.

— Cormac McCarthy- The Road

Humans are unique in that we wish to illuminate and make note of our own history. Unlike animals and many indigenous societies who wish to “leave no trace” on nature, the goal of the modern human has been to leave a mark of presence. Through cartography, we have taken it into our own hands to track our progress and incidence. Maps, popularly considered a geographical task, give a visual impression of the earth’s features, reduced to a manageable scale. They can display physical geography, but also play a large role in displaying cultural geography. As a quality shared by all advanced civilizations and created only by humans, maps are a testament to the intelligence and analytical nature of human beings. The geographer Yi-Fu Tuan stated,

Drawing maps is indubitable evidence of the power to conceptualize spatial relations. It is possible to find one’s way by dead reckoning and through long experience with little attempt to picture the overall spatial relations of localities… cartographic ability presupposes not only a talent for abstraction and symbolization on the part of the primitive cartographer, but also a comparable talent in the person who looks on, for he must know how to translate wriggly lines and dots back to real terrain.

1 Cormac McCarthy. The Road. (New York: Alfred A. Knopf, 2006.)
2 Yi-Fu Tuan. "Spatial Ability, Knowledge, and Place." In Space and Place: The Perspective of Experience, (Minneapolis: University of Minnesota Press, 1977), 73.
This skill is common across all cultures, the oldest known map being a Babylonian map from the sixth or fifth century B.C, illustrating the expanse of its empire at the time. Even this map took on a perspective referred to as the birds-eye, or as I will refer to it God's-eye view of an area, a perspective long used, present in the rock art of many ancient societies, such as the Mughal, Persian, and Egyptians\(^3\), but only physically realized in the past century through aerial photography.\(^4\) This heightened perspective existed within Western art from well before the term “aerial perspective” was coined in the late fifteenth century by Italian Renaissance architect Filippo Brunelleschi.\(^5\) Examples include Ambrogio Lorenzetti’s fresco cycle in Siena’s Palazzo Publico, notable for their oblique views, which, historians have said, perfectly anticipate the idea of a landscape survey, which would emerge in the late eighteenth century.\(^6\) (Figure 2.)

![Image](http://www.wga.hu/frames-e.html?/html/l/lorenzet/ambrogio/governme/ (Accessed April 8th, 2013)

**Figure 2:** Ambrogio Lorenzetti, *The Effects of Good Government in the Countryside*, 1338-40, Fresco, Palazzo Publico, Siena. http://www.wga.hu/frames-e.html?/html/l/lorenzet/ambrogio/governme/ (Accessed April 8th, 2013)

Now, take a moment and consider whether you have ever come in contact with a map that was not drawn from the objective view of a heightened perspective. Now imagine what a map of that sort would look like. It would be very limited, would it not?

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\(^6\) Cosgrove *Photography and Flight*, 32.
Though maps of this sort exist, they are not popular, typically only being found in the period before aerial photography became possible. The horizon, unfortunately, presents a barrier, and if maps were created from the ground, the spatial expanse they could successfully cover would be quite minimal. As one moves further and further upwards, say enclosed in Wonka’s glass elevator, more becomes revealed, until, at last, the elevator breaks through a glass roof and you are hovering in the air, able to view a landscape as vast as an entire city with your own naked eye. This is the definition of the “God’s –eye view”.

The majority of pre-modern maps only covered areas of dozens to hundred of miles at the most, being limited by the constrictions of human travel, and the sensory constrictions of a ground-based perspective. Studying these early maps helps to illuminate the course of human history throughout the world by providing modern scientists and historians with insight to the lay of the land of the past, sometimes allowing us to trace our impact over a specific parcel of land across multiple centuries, through the hands of many different societies, years of hardship, and blooming success alike. The earliest maps were, of course, all hand drawn, maintaining an air of the personal no longer encouraged through modern cartographic techniques, but with the invention of aerial photography the earth’s landscape that was previously painfully scrutinized and still often mapped inaccurately, could now not only be viewed at accurately within a single image, but also at larger scales.

What purpose then, could an imperfect hand-drawn map have for modern science? What relationship, if any, do we have to a landscape centuries old? A map does not merely serve the purpose of deconstructing a landscape. In fact, it does not

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necessarily need to refer to a genuine landscape at all. A timeline, for example, could be referred to as a map of time. A sky map refers you to the lay of stars, while a dream map, or fictional map, such as those J.R.R. Tolkien created for his Lord of the Rings trilogy may represent an area that has never been and will never be physically seen, but enable us to translate the fictional to that which is perceptibly real. While maps are currently associated with geography and science or history, it is important to remember that cartography, like any other art-form can be just that: an art-form. Maps allow the viewer, through their own mind’s eye, to be transported temporarily somewhere else, whether that landscape be authentic or one of fantasy. Thus, maps can be viewed as not just outlining the spatial relationships within a landscape, but are also key in outlining the human association to that landscape, and the way that person, or entire society may have perceived their relation to it. They display “an area shaped by culturally and socially determinative features, including the shifting of whole peoples and languages, not to mention various economic and political forces.”

Under the secular views of a post-renaissance Europe, humans were understood to have been implanted by God with the ‘seed of knowledge’, effectively putting us above other less “intelligent” species. This led to the epistemology that humans held jurisdiction over nature for the reason that God had placed it in front of us as a blank canvas. Pre-modern maps, fearing no loss of accuracy through the subjective favoritism that is now so easily surpassed through technology, show a landscape shaped by human opinion. Much more trust was put on the abilities of the human mind to deconstruct and evaluate nature. For the European settlers of the United States, this pride in the human sensory faculties came not from the belief of an inherent integration or understanding of

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8 Edward S. Casey "Re-Implacement in Mapping and Painting." In Representing Place: Landscape Painting and Maps, (Minneapolis: University of Minnesota Press, 2002), 265.
nature, but stemmed from their strongly held belief in their alignment with God.

Through this philosophy, the practice of “truth to nature” objectivity came to the forefront in the natural sciences, a “natural theology that characteristically praised the regularity of God’s laws as more worthy of admiration than the exceptional marvel or miracle.” By way of this tradition, natural illustration and maps came to reflect only ideas and landscapes that were deemed to be of higher importance and beauty to humans—while still holding onto the idea of representing a truthful ideal. Wetlands, in their association with filth, were often decidedly excluded.

**Exploratory Cartography**

Long before European settlement of the eastern coast of the US, various Native American tribes had been calling this land home for centuries. Unlike European mapping traditions, Native American maps were often less conceptual and followed a narrative structure, relying on cosmological orders of time, rather than spatial relations. As graphic documents from cultures steeped in oral tradition, Native American maps are a unique record of their societies, always playing a secondary role to the oral “picture.” Preservation of maps and images was not a part of American practice, as their knowledge was passed down through oral practice. However, upon European colonization, settlers had the opportunity to preserve some Native American maps. These maps provided a view of the land they were soon to claim. Because they were created and retained as part of the western record, native American maps can be thought of as documents at the intersection of two histories. In modern times, these early maps give a glimpse into what the unaltered landscape of the United States may have looked like—a country that is now so extensively developed that it is hard to imagine that it

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once was left wild. (Figure 3.) Within indigenous maps, the spatial was often less important than the symbolic, offering a view of a seemingly fantastical space that could be imagined, rather than inhabited.

Figure 3a: *Lone Dog’s Winter Count,* reproduced from “Picture Writing of the American Indians by Garrick Mallery,” Tenth Annual Report of the Bureau of Ethnology, Smithsonian Institution. (Washington: Government Printing Office, 1893.)

Figure 3b: *Pawnee Sky Chart,* Pawnee Indian Tribe of Oklahoma, and the Field Museum of Natural History. (Chicago: 1672)

Few official governmental records exist of the earliest European settlements of the United States as the original French, Spanish, Dutch, English, etc. colonies were established and settled before the land was professionally mapped and surveyed, not to mention before a comprehensive government was established. ¹⁰ Despite this, there are a plethora of maps made independently of political or scientific ties, drawn by artists,

engravers, and members of the general public. These maps took on many forms, falling largely under three categories: topographical maps, historical maps, and urban maps.\textsuperscript{11} When compared to modern methods of mapping, however technical the practice of creating these historical maps may have been, all seem slightly inventive in nature. As so, it has been argued that prior to the Enlightenment period, cartography was not a science, but only an art form.\textsuperscript{12} Much of the new “scientifeness” of eighteenth century cartography stemmed from the increasing precision and use of scientific surveying instruments, along with the sudden pertinence of the endeavor to accurately measure the earth’s shape. Historians have adopted the date of “ca.1700” for the “reformation of cartography”.\textsuperscript{13} While instruments were used, maps were still exclusively hand drawn, retaining a subjective quality in contrast to contemporary cartography. However, from a modern perspective, any sort of map created through such unsophisticated instrumentation is positively steeped in technical error in comparison to those used currently. Nonetheless, however spatially imprecise these documents may be, they assume a personal interpretation of nature that can arguably provide historians with a better understanding of the human relationship with the land than any sort of thematic map could.

Maps crafted by European explorers were based wholly on personal experiences within, or traveling to the “new world”, and were decoratively embellished with images of majestic creatures, coats of arms, idealized mountain peaks, and impossibly linear rivers. Still presented in the God’s-eye view, these maps exhibit a view of nature that is

\textsuperscript{12}Brukner \textit{Early American Cartographies}, 287.
undifferentiated from personal fantasy and mythology, similar to the symbolic and spiritual nature of the world expressed through Native American maps. However, they were inclined to show domesticated landscapes and obscure the Native American presence on the land.\textsuperscript{14} Exploratory maps, used almost as an advertisement to beckon overseas settlers to a new land, were quick to show its merits, and disregard what may be considered less than appealing. While the grandiose mountain ranges, forests, lakes, and rivers of the United State’s eastern coast were characteristically featured, it is interesting that some of the east coast’s most prominent and common topographies, the coastal salt marshes, are invariably excluded. They were, undeniably, a landscape on the periphery. (Figures 4 & 5 below.)

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{map.png}
\caption{Nova Anglia Novvm Belgium et. Virgina, Johannes Janssonius Excutit, Gerardi Mercatoris et. 1 Hondii Atlas: 1636}
\end{figure}

A Nation Founded within Wetlands

“Before we present to you the matters of fact, it is fit to offer to your view the stage whereon they were acted, for geography without history seemeth a carkasse without motion, so history without geography wandereth as a vagrant without a certain habitation.” With these words, the infamous Captain John Smith explained the necessity of describing the landscape that would soon be founded as the United States.

A formidable gulf of time now occupies the expanse between our familiar present landscape and the pure landscape found by Smith and his fellow English explorers in

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Often being the first landscape encountered when approaching the eastern coast of the United States, the pure extent and abundance of the eastern salt marshes instilled a sense of awe in the initial colonists of the United States. Dutch settler Adriaen Van Der Donck described the marshes at the mouth of the Hudson rivers as “brooklands and fresh and salt meadows some so extensive that the eye cannot oversee the same”\textsuperscript{17}

All told, the wetlands of the Atlantic seaboard, stretching from the northeast through Georgia amounted to roughly 41.3 million acres of fresh and saltwater wetlands, roughly 19\% of the estimated wetlands of the continental United States.\textsuperscript{18}

Thus, the nation was essentially founded upon wetlands. When colonized by the puritan colonists of the Massachusetts Bay Company, led by John Winthrop in 1630, the pastoral landscape of the marsh became their home, utilized as lands for grazing, fishing, and agriculture. For some period of time it was considered undesirable to begin a community that wasn’t in close proximity to marshlands. However, as populations grew into the eighteenth century the extent of east coast wetlands began to hinder development. So began the age of dredging, draining, and filling. Their initial recognition as valuable landscapes faded to that of a hindrance to prosperity.\textsuperscript{19} Wetlands violated norms of human orderliness in contrast with bucolic European countryside. The perception of wetlands as evil places was perpetuated by their relationship with Native Americans—who were associated with the sinful and fearful. In his popular book, \textit{The Pilgrim’s Progress}, published in 1678, John Bunyan describes the story of a Christian man searching for salvation, fleeing from the “city of Destruction” who falls into the “miry

\textsuperscript{16} Ibid., 11.
\textsuperscript{17} Ibid., 14.
\textsuperscript{18} Ibid., 17.
\textsuperscript{19} Ibid., 33.
slow of Dispond”—unable to reach redemption. This disdain for swamps and wetlands was only overcome by the need for timber and commercial profit, which eventually fueled an unrestrained transformation of many of these landscapes. Strangely enough, though US wetlands were extensively documented as being utilized and colonized during the seventeenth century, their presence was still often excluded from cartographic representation, much like that of the Native American lands and practices they were associated with. Their lack cartographic representation could also be attributed to the rapid pace of their transformation, or perceived lack of need for maps that specifically delineated wetlands.

Not until the widespread settlement of the United States began in the eighteenth century began did wetlands begin to be more prominently represented in maps, perhaps in an effort to become more honest about the nature of the land now that it had been claimed and conquered. Maps typically identified human settlements, routes and travel, but left other areas blank. In the case of wetlands, cartographers used a universal symbol for sedges growing in water. Feasibly at fault for this lack of formal depiction was the absence of a universal land classification system, one of which would not be formally adopted until the twentieth century. Because of this, it is difficult to trace the physical extent of historical US wetlands using visual practices. It was not until the United States adopted an official land survey practice that wetlands were first officially delineated (however informally); in 1785 the passing of the Land Ordinance Act established the United State’s Public Land Survey, which required partitioning of land prior to European settlement. Although the purpose of the Public Land Survey was not to specifically provide information on resource and ecosystem demarcation, but rather provide a

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20 Ibid., 55.
21 Ibid., 53.
estimate of land use, these original surveys do provide a small amount of information about the distribution of United States’ salt marshes, particularly in the northeastern United States, where colonization was most prolific.22

Wetlands were, undoubtedly, not the target environment for colonization. Instead, they represented areas to be avoided. If not, they would most certainly not be allowed to remain in their less that favorable natural state, and were often “improved upon” in order to transform them into productive landscapes. While later on I will discuss the distinction between the lovers and improvers of nature, at this time there was no such discrepancy. Rather, it was in common practice to be an “improver”; that is, if a landscape does not fit human needs, then by all means, one should change it. Wetlands, considered largely negligible to humans due to a lack of knowledge about environmental productivity, and more often than not, perceived to be a total nuisance, were often the subject of improvement schemes. Colonists, lacking understanding of the interconnections between resources, sought to rid the landscape of the wetlands, annihilating the very source of the natural wealth of America that made it desirable in the first place.

**Representations of Truth to Nature**

The mass conversion of wetlands began with the emergence of truth to nature as an epistemic virtue in the early eighteenth century, at the height of United States colonization and the peak of the European Enlightenment. Truth to nature relied on the “patience and talent” of an experienced naturalist to determine the ideal form of a scientific object and “extract the typical from the storehouse of natural particulars.” Under the values of truth to nature, “the human mind must fix the empirically variable,

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exclude the accidental, eliminate the impure, unravel the tangled.”23 Thus, it was up to the human mind to tame nature’s chaotic variability in order to show the ideal forms of nature. Because of this, “science pursued under the star of truth to nature rather than of objectivity looked different”.24 In extending this theory of knowledge to representations of landscapes, maps exemplified the attempt to domesticate nature accordingly. Though more emphasis was beginning to be put on the use of instruments such as the quadrant, the sextant, and the astrolabe, their use only affected spatial representation, while the remainder was left up to the observer. For those who sought truth to nature, a faithful image was “emphatically not one that depicted exactly what was seen.”25 The image created was dependent upon imagination and sensation, and thus in the realm of exploratory cartography, only the “ideal” was displayed. Under the tenets of truth to nature, “neither artists or anatomists sensed any tension between the demands of truth and those of beauty; on the contrary, an ugly drawing was more likely a false one.”26 So what becomes of an environment that is wholly perceived as ugly? It is beautified, simplified, and improved; such was the fate of the American salt marsh.

Remaining the primary method of visualizing nature through the early nineteenth century, the rise and fall in eminence of truth to nature epistemology can be tracked through patterns of wetland use at this time. Because of their negative reputation, and perceived uselessness, drainage and destruction of wetlands for conversion into farmland and other more “productive” environments became a widely accepted custom well into the nineteenth century. Increasing pressure to develop the land triggered by population

23 Daston and Galison, Objectivity, 59.
24 Ibid., 60.
25 Ibid., 98.
26 Daston and Galison, Objectivity, 102.
growth and industrialization prompted a transformation of marshes into what was
deeded more usable spaces: farms, parks, dumps, housing, and industrial factories.

Through figuratively, and in the case of wetlands, literally taming nature’s
variability through the doctrine of truth to nature, society gave itself the right to tame
nature as a whole. It was early in the eighteenth century, the peak of truth to nature
objectivity that the term wilderness arose, and it carried quite a negative connotation.
Wilderness was deemed to be “all that was not man… nature as the lonely places.” For
a landscape to be a wilderness was akin to it’s being savage, this association stemming
from teachings of the bible, where wilderness was often represented as the “places on
the margins of civilization, where it is all too easy to lose oneself in moral confusion and
despair.” Wilderness was associated with the realm of the devil, and even Christ himself
was burdened by its unbridled enticements, “and he was there in the wilderness for forty
days tempted of Satan.” In its raw and tangled, unaltered state, wilderness thus had
nothing to offer humans aside from fear and bewilderment. Even now, three centuries
later as I struggle to find a less foreboding word for wilderness, the only synonyms
offered to me are “wasteland” and “desert”, environments that tolerate no life. Milton,
in Paradise Lost brought to culmination the ancient idea of wetlands as desert wilderness
in his account of the Serbonian Bog:

Rocks, Caves, Lakes, Fens, Bogs, Dens, and shades of death,

February 2013)
31 Henry David Thoreau, and Henry Seidel Canby. "Walking." In The Works of Thoreau, (Boston:
Houghton Mifflin Co., 1937), 672.
(http://www.oed.com/view/Entry/229003?redirectedFrom=wilderness&)

42
A Universe of death, which God by curse
Created evil, for evil only good,
Where all life dies, death lives, and Nature breeds,
Perverse, all monstrous, all prodigious things,
Abominable, inutterable, and worse…

(Book. 2, lines 619-26)\textsuperscript{33}

The swamp here embodies eighteenth century notion of wetlands as evil, in relation to the attitude of disliking “all those things in nature which are neither sensuously pleasing, useful, safe, symmetrical, or gaily coloured.” \textsuperscript{34} The belief that humans had been given the land by God to reap, in alignment with the permission given by truth to nature to “perfect” nature, provided humans with consent to modify these unfavorable environments to their use and liking. Many colonists saw reclamation of the east coast wetlands as their duty to God, improving public health by eradicating disease and encouraging the proliferation of mankind. \textsuperscript{35}

By the end of the nineteenth century, there is a complete turnover in naturalist thought, and the concept of wilderness shifts from that of wasteland, to that of an Eden. Wilderness was no longer given to humans by God to exploit, but now physically personified God’s presence on earth. Such a striking shift is evidence of the changing social values at the time, as God’s chosen species continued to grow more numerous. As technology advanced and the ratio of human to natural landscapes grew larger, it became less and less common to come in contact with unadulterated nature. The environment began to resemble less of God’s kingdom, and more of an industrial wasteland, indicating not only a drifting away from nature, but also a drifting away from God. Indeed, man’s own attempt to improve their environment had destroyed their ties with

\textsuperscript{34} Miller, \textit{Dark Eden}, 48
\textsuperscript{35} Vileisis, \textit{Discovering the Unknown Landscape}, 47.
it, and thus, the urban landscape became the “lonely places”, and the wilderness-- the sublime. In response, mechanical objectivity emerged as a new form of visual theory in the latter half of the nineteenth century, which sought to “let nature speak for itself”\textsuperscript{36}, wary of human intervention in the natural sciences. An increasingly secular and commercial USA required accurate measurements of the world and realistic depictions of it, mechanical objectivity adapting accordingly to this need. It represents a human struggle with subjective temptation and a search for the sublime, a shift from emphasis on the merit of images produced via human mind and hand to those produced by machine—the camera. While many environments became revered within this line of thought, wetlands—the ever-unsightly pariah of the natural world for some time remained disdained.

\textsuperscript{36} Daston and Galison, \textit{Objectivity}, 81.
Chapter 3: Aerial Photography

Generally speaking, a howling wilderness does not howl: it is the imagination of a traveler that does the howling.

- H.D. Thoreau, “Allegash and East Branch”

Visualization through Machine

In the first quarter of the nineteenth century, lithographs and county atlases became common in the United States, using the God’s-eye view as a method to document and promote new townships in effort to suggest order and regularity in a recently “conquered” landscape. Through the aerial view, dirt roads, disheveled farms, and cluttered town squares were transformed into neat uniformity. By the 1920s when aerial photography was increasing in popularity, over 4,000 aerial lithographs of 2,400 towns had already been produced. Aerial photography, in its unbiased mechanical nature, revealed through its lens the less than orderly reality of such landscapes. The late nineteenth century embraced what media theorist Jean-Louis Comolli described as a “frenzy of the visible”, in that via increased motility combined with new visual media, the world is almost entirely visually accessible. Humans, without utilizing the extension of technology, were previously limited seemingly only by their inability to fly, and thus were also limited in the potentials of sight and perception. Aerial photography abolished those limits. The mastery of flight and its combination with photography— another technology which makes up for the incapacity of human capability (the inability to

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preserve exact images beyond memory) — produced a dominant way of documenting the modern landscape. Photography is now embedded in our lives, its role so common that it almost escapes notice. But its first use was groundbreaking, and photography, when paired with flight’s ability to cut the tether of gravity that keeps humans grounded, further provoked the human sense of mastery over their environment, while simultaneously providing a concrete visual method of viewing the human impact on nature, and vice versa.

Aerial photography, of course, could not exist without the advent of land-based photography. A camera is a fairly simple invention, with all cameras, on their most basic level, relying on the same essential components. Light enters a darkened space through a small aperture, whose exposure time is limited by a shutter, which can be opened and closed accordingly. The lens gathers and concentrates the light onto film, and voila, a simple camera. The first successful “camera” was created in 1826 by Niepce, who photographed the view from the window of his home in the French Countryside, using a camera obscura, employing bitumen of Judea, and oil of lavender. It supposedly took 8 hours in bright sunlight to produce the

Figure 6: View from the Window at Le Gras c. 1826, Joseph Nicéphore Niépce, Harry Ransom Humanities Research Center, The University of Texas at Austin
photograph.  

(Figure 6.) By the nineteenth century, capturing a single exposure took a fraction of this amount of time, and became a leading form of representation as both art form and scientific tool.

With the popularization of photography and other related technologies such as the lithograph, the epistemology of mechanical objectivity emerged in the late nineteenth century, headed by a group of naturalists who sought to minimize the subjective bias in representations of science. First referred to by the French physiologist E.J. Marey in 1878, he envisaged a “wordless science” that spoke through photographs rather than illustration, a semantic science spoken through the “language of the phenomena themselves.”  

By means of mechanical objectivity humans were required to subdue their “psychological tendency to improve”, cast away the need for calculated regularity and embrace natural law. Under this philosophy, scientists possessed a horror at the personal, seeking to provide total neutrality. As positivist art critic/poet/essayist Charles Baudelaire declared as a mantra to all mechanical objectivists, “I want to represent things as they are, or as they would be in supposing that I do not exist. The universe without man.”

This is the notion of epistemological realism: that knowledge about an object exists independently of mind. Through mechanical objectivity, the observer attempted to remove him or herself entirely from the observed. Thus, the idiosyncratic maps flowing with creativity produced up until that point would be rejected as false, falling prey to subjective intrusions, which were believed to encourage ambiguity and bad faith.

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5 Daston and Galison, Objectivity, 81.

6 Ibid., 187.

Through photography, a method of image-making that is realized fully outside of the self, scientists were one step closer to extirpating human intervention between object and representation, and emphasis was put on the “truth” of mechanical realism.

The aforementioned camera obscura represents one of the first steps towards mechanical objectivity. It was originated in 1030AD by Al Hazen of Basra, who is sometimes referred to as the “father of modern optics” for his contributions to study of vision and the physiology of the eye, and was later elaborated upon by Leonardo da Vinci in the late fifteenth century. Literally translating to “darkened room”, in essence, the camera obscura consists of a process in which light is transmitted through a pinhole in one wall of a darkened room, whereupon the lighted scene appears upside-down on the opposite wall. This practice was a far cry from an objective perspective, did not provide any means of preserving the images produced (aside from tracing it upon paper) and did not obviate the need for selective judgment on the part of the scientist or observer, but was nonetheless a crucial stepping-stone towards the venerated objective view.

Through the further advancement of photography, objectivity no longer seemed such an outlandish goal in some areas of science. However, in the realm of cartography, it did not yet hold significant clout. Not only was it a long and complicated process, but also the heavy early cameras laden with film were very much grounded, and not much help in this field. Though of crucial significance in other fields, such as botany and anatomy, photography could only capture portions of a landscape at a time, and, in only being able to do so, required the judgment of the observer to select the area necessary.

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9 Estes, “RSCC. Volume 1.”
Thus, however accurate they may be, photographs of landscapes were likened to an art form along with early maps, and early (nineteenth century) photographs of wetlands, the unnoticed and avoided, were not particularly common for this reason. (Figure 7.) It was not until the rise of aerial photography in the mid-nineteenth century that the fields of cartography and photography mingled, and wetlands became noticed.

![Figure 7: Jacob A. Riis, Shelter Island; View over South Ferry, 1892, Museum of the City of New York, New York City. Available from: ARTstor (Accessed April 1st, 2013)](image)

**Aerial Photography**

Three decades after Niepce built the first successful camera, French photographer, cartoonist, and hot air balloonist, Gaspar Felix Tournachon (otherwise known by his penname of Nadar), took the first known aerial photograph in 1858. Having just patented the idea of balloon photography in 1855, the intended use of his original designs was for mapmaking and surveying. It took him many years of trial and error before he successfully produced his first aerial photograph, the first aerial photograph, consisting of the small French village of Petit-Becetre taken from a tethered
hot air balloon, only 80 meters above the ground. This invention, lovingly nicknamed “Nadar” after its inventor’s popular pseudonym, was truly an advanced feat of technology in its time, a landscape having never been mechanically represented from a God’s-eye view until then. While aerial photography was only first successfully used in 1858, Dominique Francois Jean Arago, a French geodesist, had proposed its use in the preparation of topographical maps nearly twenty years before in 1839. By 1851, Aime Laussedat, a French Army Engineering Officer had created early photogrammetric techniques for air based mapping. Photogrammetry involves the process of geographical measurements from photographs, used in conjunction with “triangulation.” The potentials for aerial cartography were great, finally able to provide a view of the world from above, rather than the illusion of it, enlarging the scope and frame of human vision, allowing the human omniscience. Like maps, aerial photography placed human societies in a relationship with a broader topography.

As demonstrated through early maps, the ability to transform space into place—or abstract representations into meaningful environments is a skill that is seemingly innate to all humans. The capacity to picture places was coined as the term “geographical imagination” by Denis Cosgrove and William L. Fox, a skill that they deem essential to survival. The ability to recognize one’s own relationship to or locality within an environment through an aerial photograph is virtually identical in both modern and primitive cultures, anthropologists finding that when presenting aerial photographs to Aborigines in Australia, the people could navigate through the country without ever

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10 Cosgrove, Photography and Flight, 17.
11 Ibid., 24.
12 Ibid., 24.
14 Cosgrove, Photography and Flight, 10.
having seen the land from that perspective before. The inherent response to viewing an aerial photograph, no matter the culture, is to determine one’s place within the landscape portrayed. Unlike illustrated maps and engravings, the aerial perspective serves as a reminder of the vast earth around us, the continuity of nature rather than a handpicked representation. Photographs, for better or for worse, are more honest than any illustrated map ever could be.

Humans, even when faced with a (seemingly) objective view cannot be separated from the subjective, and thus it is no surprise that once able to physically achieve the God’s-eye view that it should first be used to view what we have made of the lands made use of, to congratulate or condemn. Accordingly, the first aerial photographs taken were of human-constructed landscapes. After some years of trial and error, on October 13th 1860, the first sharply focused aerial photograph was taken by a photographer from the United States, James Black, from 1200 feet above Boston Massachusetts, documenting the city at the height of its expansion and development. (Figure 8.) James Black’s photographs of Boston represent the first large-scale views of a coastal wetland that was converted from its natural state to urban center. Boston, one of the United State’s first major cities, was built almost exclusively on coastal salt marsh and mudflat in the eighteenth century. The photograph documents the North End of Boston, framed by the Charles River and the Boston Harbor on either side. The scene depicted in this photograph is that of a cramped and modern city, far different from the extensive marshland discovered by John Winthrop on June 12th 1630. As the story unfolded for

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15 Ibid., 11.
16 Ibid., 3.
17 Benjamin Shurtleff. John Atwood of Plymouth, Massachusetts; the Descendants of John Atwood of Plymouth, Massachusetts, 1614-1676 and his Wife Sarah Masterson, 1620-1701/2. (Boston: MA, 1972.)
this area, as well as many other coastal wetland environments during the eighteenth century, it was completely dredged, filled, and converted into the buzzing urban center that lies there today. Instead of a productive natural landscape lies a city literally built upon its own trash. Nevertheless, whatever may lay beneath Boston’s winding streets, from the air it represented a prime example of human achievement. Framed as an oval cameo resembling the fashionable pendants of the time, its representation serves as a reminder that even the land that people inhabited was still subject to be treated as human accessory.

Black, fresh from his success in photographing Boston suggested the use of aerial photography as a reconnaissance tool during the civil war, and in 1862 Lincoln’s troops used a captive balloon to observe Confederate positions. However, this practice was quickly discontinued as it became apparent that the balloons could easily be shot...
down. Though this did not prove to be a successful endeavor, military needs did provoke the first (semi) detailed maps of wetland environments, as it was only when unconverted wetlands became a more brazen obstacle to movement and expansion that detailed topographical maps with accurate wetland delineations became necessary. The American Civil War (1861-1865) provided basis for the necessity of wetland maps. Salt marshes and swamps provided an issue for groups of thousands of troops and their accompanying heavy machinery and cavalry who needed to traverse these areas. The United States Army, both Confederate and Union, became focused on the rapid development of routes through and around wetlands, and thus the production of accurate maps to assist them. These maps offer one of the first glimpses of a cohesive and extensive network of the Nation’s wetlands.

The photographs and maps created at this time are crucial in reconstructing the eastern United States’ past wetland extent. The map below (Figure 9.) displays a historical view of the vicinity of Charleston, VA, in the 1860s, displaying surrounding rivers and marshlands in the area.  It should be noted, that up until the time of the Civil War and the popularization of aerial photography, not to mention photography in general, that wetlands and salt marsh environments had only been recognized on maps as some sort of boundary, distinguished only for their impassibility. Not yet valued socially as a productive ecosystem, wetlands were akin to a natural “do not enter “ sign. This is clearly demonstrated within the map of Charleston Harbor. Because it is a map that was created for the purpose of use within the Civil War, landscape delineation was not the goal. Forests, plains, etc, were not mentioned or drawn, however all marshy areas

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18 Cosgrove, Photography and Flight, 34.
19 Ibid., 30.
were clearly demarcated. While unimportant culturally, logistically they were of absolute significance.

Figure 9: W. A Williams, Civil Engineer. *Charleston Harbor, Illustrated Map*  
Boston, L. Prang & Co.: 1860

During the war the articles of A.R. Waud for *Harper’s Weekly* and similar media representations contributed to the image of wetland as barrier, displaying illustrations that showed “what our brave soldiers have to encounter in their campaign under
Soon after the propagation of aerial photography, in conjunction with other scientific advancements, a new reverence for wetlands emerged, as what is included or excluded was up to the machine, not the human, removing the hierarchy that humans had placed upon different environments. Hence, it can be argued that the God’s-eye view that aerial mapping provided brought humans to a higher understanding of their natural surroundings.

Figure 10: A.R. Waud, *Cypress Swamp on the Opelousas Railroad, Louisiana*, Illustration, *Harpers Weekly*: Dec 08, 1866 Available from: The Louisiana Digital Library

**Scientific Views of Nature**

The first scientific uses of aerial photography were within the field of meteorology, in which scientists began using weather balloons, hot air balloons, and kites equipped with small cameras to acquire meteorological data. English meteorologist E.D. Archibald was among the first to take successful photographs from kites, along with

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Arthur Batut of France, and George R. Lawrence of San Francisco. At the time, cameras were still relatively bulky machines, the camera used for Lawrence’s most famous endeavor, documenting damage from the San Francisco earthquake and fire of 1906 supposedly weighed more than the Wright brothers’ airplane and pilot combined.

One of stranger endeavors into aerial photography was by the Bavarian Pigeon Corps, who used their carrier pigeons for aerial reconnaissance. Julius Neubranner of Bavaria developed a breast-mounted camera in 1903, which would take automatic exposures every thirty seconds. Though mostly used for military purposes, this method of aerial photography became popular by 1909, and was introduced to the Dresden International Photographic Exhibition in the form of artistic postcards displaying aerial photography. Though more objective than traditional cartography, photography still remained intermingled with artistic endeavor. This technique of taking photos was also appealing to many within the scientific sphere due to the fact that the pigeons could cover a large area of land in a short amount of time, independent of human aid. A similar photographic process is used today through remote-piloted planes (drones) equipped with cameras, which photograph wetlands as well as other landscape features and aid in modern geographic survey.

**Accompanying Developmental Changes**

The implementation of these early aerial photographic methods corresponded with the increase in legislature pertaining to wetlands in the United States. However, increased legislation does not necessarily equate to increased protection. Wetland drainage of private property for conversion to agricultural land was extensive across the United States by the early nineteenth century, and the increased demand for resources

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22 Estes, "RSCC Volume 1."
and economic growth to support a growing population resulted in the innovation of new technology for this purpose. The steam powered dredge, which allowed the clearing of small waterways, was invented in 1805 by Oliver Evans\textsuperscript{23} and plows, rakes, and cultivators for use in converted marshes were all implemented between 1810 and 1840.\textsuperscript{24} Mosquito ditching was a common practice, and “tile” drainage of wetlands was first introduced to farmers of the United States by John Johnston of Scotland in 1838, nicknamed “The Father of Tile Drainage in the United States”. Though called “tile drainage”, it actually consists of perforated clay tubes installed below the soil surface.\textsuperscript{25} The 1880s represent the first market production of tile ditching machinery, and agricultural technology was soon further expanded by a series of advancements.\textsuperscript{26} By 1880, 1,140 factories manufactured drainage tiles that were used to drain marshes for farming.\textsuperscript{27} By 1882, over 30,000 miles of tile drains were in place in Indiana wetlands alone. Combined with the use of steam power for digging ditches, wetlands were being drained at unprecedented rates.\textsuperscript{28}

1847 marked the first congressional hearings on federal wetland jurisdiction, which tackled the issue of the sale of federally owned marshland in Indiana. By 1849, the “Act to Aid the State of Louisiana in draining the Swamp Lands Therein” was passed on March 2\textsuperscript{nd}, granting “swamps and overflowed lands” to the state in order to provide for future agricultural potential and economic growth. This act granted to the state “the

\textsuperscript{24} Dahl, History of Wetlands in the Conterminous United States
\textsuperscript{26} A.S. Nottage and P. A. Robertson. The Saltmarsh Creation Handbook: A Project Manager’s Guide to the Creation of Saltmarsh and Intertidal Mudflat. (Bedfordshire: Royal Society for the Protection of Birds, 2005.)
\textsuperscript{28} Pavelis, Farm Drainage in the United States.
whole of those swamp and those that may be or are found unfit for cultivation”.

This was one of the United States government’s first formal permissions to drain and manage the nation’s wetlands, and became the prototype of a series of acts by which US Congress granted wetlands to the states. Following the passing of this act, many other states with large amounts of wetlands, such as Michigan, Florida, and Illinois joined a movement to have federally owned swamplands ceded to them in a similar fashion. This led to the passing of the Swamp Land Act of 1850, which allowed these three states, among Alabama, Arkansas, California, Iowa, Mississippi, Missouri, Ohio, and Wisconsin to reclaim the swamplands within their state boundaries. By 1860, this act was expanded yet again to include lands in two additional states: Minnesota and Oregon.

The Swamp Land Act of 1850 was partially realized by the aid of surveyors’ maps and plots, which provided the basis for selection. While the majority of these maps were likely the product of naked-eye observation, it is documented that at this time photography was beginning to be used to aid in the mapping of the United States. This act ultimately ended up in transferring 64+ million acres of designated wetlands to the states.

Evidently, at this point in time, the newfound use of aerial photography, caused humans not to find respect in nature, but to continue to correct the variability that photographs now so freely displayed. The late nineteenth century exemplifies a period where truth to nature values were being projected upon a mechanically objective view.

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32 Wetlands: Characteristics and Boundaries.
The irregularity and utter messiness that photographs showed the general public provided more popular reasons to “improve” and “clean up” the environment, and in this time period much of the wetland environments, as well as many other environments in the US were irreversibly developed. However, as early endeavors into aerial photography such as balloons, kites, and bird mounted cameras transformed into motorize flight, wetlands became topics of scientific focus, and the need to develop transformed into the need to preserve, an urge that was propagated through the theory of mechanical objectivity.

**Motorized Flight**
The early 1900s marked the onset of airplane transportation, and also marked the beginnings of widespread aerial photography. While the first air force was established by Napoleon in France in 1784, utilizing hot air balloons and blimps, the first aerial photograph taken from an airplane did not occur until 1908, by L.P. Bonvillain, a passenger of Wilbur Wright of the Wright brothers, just five years after their initial flight on December seventeenth 1903 in the famed Kitty Hawk, North Carolina. These were in the format of motion pictures, taken of a Military field at Cento Celle, near Rome, Italy. Aerial photography soon overshadowed sketching and drawing of maps by pilots and aerial observers in World War I, with cameras being placed aboard Zeppelins proving to be of valuable assistance to the military. Aerial photography gained prominence through this military use, and World Wars I and II provided urgency in the need for both air travel and photography alike. (Figure 11.)

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34 Ibid., 35.
Coupling propulsion with photography meant that a flight could now be directed over a target and record it via motion or static picture to be analyzed back on the ground. Reconnaissance photography allowed military planners to track the movement of troops and their supplies over hours, days, and weeks. The global nature of World War II stimulated rapid advanced in aerial photography, and by 1944, American flights in the various WWII theaters produced as many as 3 million photographs each month.\(^{35}\) While these images were for the purposes of military mapping and monitoring, their usage documented many other landscapes. These historical military images provided some of the first large-scale photographs of the world’s salt marshes and coastal landscapes. Stereoscopic viewing of aerial photographs provides another level of interpretation by displaying topographic breaks, changes in vegetation, and wetland boundaries more accurately than ground based soil surveys or illustrated topographic maps ever could.

Systematic surveys using aircraft to photograph extensive areas became popular by the 1920s, and were increasingly used for resource mapping and planning. It was of particular use in areas where surface transportation was not well-developed or access and

\(^{35}\) Ibid., 55.
transport difficult, a prime example being that of the salt marsh. (See Figure 12. Below.)

Figure 12: Hammonasset State Beach Salt Marsh (Extensive Mosquito Ditching is displayed), Fairchild Aerial Photography CT State Library: 1934, compared to a modern satellite image (Available from: Google Earth.) http://magic.lib.uconn.edu/mash_up/1934.html (Accessed: April 7, 2013)

Powered flight made it possible for humans to experience a new view of the world, and the futurists of the early twentieth century took advantage of this potential, using it within their books and artwork to signify a displacement of nature by technology.

With the proliferation of commercial air transportation in the early twentieth century, aerial photography similarly flourished. The God’s-eye view increasingly became a way that Americans came to see and interact with the environments that they occupied, and became a reliable way of documenting the mounting urbanization of the country. In 1921, the first aerial photo mosaic was made of the island of Manhattan by Sherman Fairchild, founder of Fairchild Aerial Surveys, covering 24 square miles in just

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36 Ibid., 42.
37 The first aerial survey of Connecticut. Mosquito ditching and marsh creeks are clearly seen in the image to the left, with remnants of ditching still present in the modern image. While ditching did not continue, there has since been modern channel development. The 1934 survey of Connecticut, one of the first statewide surveys of its kind displayed the darker side of human transformation within wetland environments, here clearly displaying how the marsh was taken over by human action.
38 Cosgrove, Photography and Flight 35.
69 minutes. Soon after, cities such as Kansas City, Missouri, and Los Angeles commissioned similar photo mosaics for the purposes of urban planning. Architect E.A. Gutkind’s 1952 text *Our World from the Air* marked the onset use of aerial photography in fields such as architectural and landscape planning. The book displayed 400 aerial photographs, which supported Gutkind’s argument about the need for rational planning of human impacts on the earth. Many images showed “nature untouched”, images of floods and erosion, followed by photos intended to show the destruction that follows humans exploiting the environment through industry, warfare, and agriculture. Flight provided a new frontier of human perspective and interaction with the surrounding environment, not only making way for further advances, but its coupling with photography meant other advancements and expansions of society could now be filed and recorded, changes captured in time.

**Lovers and Improvers**

The exhaustively detailed and undiscriminating nature of aerial photography prompted two distinct reactions, providing means for the differentiation of the “lovers” and “improvers” of nature. To the improvers of nature aforementioned, the unapologetic veracity of the aerial view provided means to alter and transform the environment for human use, their argument being that some landscapes, such as wetlands, are better suited for conversion into productive environments rather than being left natural and economically fallow. The improvers consisted of the capitalists, gilded age developers, ruthless and wealthy business owners. The lovers of nature saw the vertical potential of aerial photography as means of representing the beauty of

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nature, and the negative human impact upon it. The God’s-eye view in this case prompted a widespread urge to preserve nature so as to prevent further conversion. Mechanical objectivity, in seeking to “find real pictures, as nature presents them to us”, found reverence in wilderness.\(^{41}\) Perhaps by coincidence, though I believe otherwise, as I will discuss further, below, the rise of the conservation movement and the opening of the United State’s first National Parks coincided with the increasing domination of unmediated mechanical images as scientific fact.

As technology became more advanced with the 1935 introduction of Kodak Kodachrome color film, and new records were set both in distance flown and altitude achieved, ever more remote parts of the Earth were photographed, and wider expanses were documented. The merits of aerial photography only grew, as did the distinction between improvers and lovers. Through aerial photography, the vastness of nature became apparent, humans microscopic but for their large impression.\(^{42}\) Concepts of natural order became prominent, against the increasingly evident disorder of society. Maps created via aerial photography became the principle tool for revealing the expressions of human agency in transforming landscape, and creating patterns of human occupancy, displaying the spatial structure of culture just as much as they may display the structure of nature.\(^{43}\)

Through mechanical objectivity, nature regained its rank as the superior, and it became romanticized as something humans had become so separated from that they wished to crawl back. It emphasized the rift between wilderness and civilization, and imparted an uneasiness that can only be roused by being put face to face with one’s

\(^{41}\) Daston and Galison, Objectivity, 150.
\(^{42}\) Williams, “Ideas of Nature”, 281.
exclusion. Much emphasis was put on discovering the merits and beauty nature had to offer when “unimproved” by the capitalist improvers of European Modernity, and through mechanical objectivity and the use of aerial surveys, attention shifted from photographing urban landscapes to photographing wilderness. Rousseau described the original, natural man as “instinctive, inarticulate, and without property”, while modern society is “competitive and selfish”. In order to become a “lover” rather than an improver of nature, one first had to become the enemy to nature, and then recognize the “all too human disease” that they were intrinsically a part of. While to improvers of nature the neat grids shown in human altered landscapes represented advancement, to the lovers it represented an utter disconnect with the environment. Wilderness became the “antithesis of an unnatural civilization that has lost its soul…. The ultimate landscape of authenticity.”

The attitude that urban landscapes represented through photographs are garish and unnatural is reflected in the fact that, for means of tourism, lithographs, in their selective composition remained dominant—presenting a softer, pristine graphic interface with the land, while the aerial photograph became the cultural standard for environmental conservation and topographical mapping.

Along with the nineteenth and twentieth century emphasis on mechanical objectivity came an environmental movement within the United States. It was in this time period that the first national parks were opened and laws to preserve nature were passed. This shift from the mass exploitation of many unique environments, many being coastal, to that of their mass preservation and social reverence extended from the

46 Ibid., 17.
47 Cosgrove, Photography and Flight, 48
epistemological realism gained through mechanical objectivity. In environmental terms, mechanical objectivity helped people to become aware of the natural intricacies and imperfections of nature, free of human action, though very much affected by these actions when they occur. Beginning with aerial photographs, the mechanically objective view of large-scale environments provided a shift from depiction that celebrated human intervention, to one that disdained it. It’s only natural that preservation of the very environments depicted should become celebrated in turn. In the 1850s and 1860s Americans began turning to new landscapes to address their changing perceptions of nature, in response to renewed apprehension of the mechanical image and its immediacy. The use of photography illuminated emergent attitudes and insights shaped by a changing economic and social reality in the United States, which in turn imparted mystique to landscapes hitherto shunned. The wetland environment, with its tangled greenery challenged conventions of Romantic iconography, and gradually became more embraced in American culture.

William Cronon made note of the distinct shift in public perceptions of nature in his essay “The trouble with Wilderness or, Getting Back to the Wrong Nature”, arguing that the modern inability to interact with nature in an immersive fashion is fueled by perceived separation from it. Mechanical objectivity brought with it not just the notion of merit in nature, but also perpetuated the view that excessive human intervention and landscape conversion was a shameful practice. Thus, the separation from nature, the “otherness” that made humans dominant through truth to nature objectivity had now made a complete turnaround—human actions were now morally beneath those of nature. By the early twentieth century, the conservation movement was in full bloom,

and “Wilderness [which] had once been the antithesis of all that was orderly and good—it had been the darkness, one might say, on the far side of the garden wall—now was frequently likened to Eden itself.”51 Wetlands, in particular, had been characterized as wild places from the earliest years of settlement in North America, yet by the late nineteenth century, the associations of these environments began to gain nuance and sometimes, reversed in social value.52 The ability of photography to provide images of unknown and distant places shaped an attraction to alien places, wetlands and other wilderness environments occupying the role of an alien landscape in America.

The current wish for preservation of nature is not a new concept. However this conservation is always prompted by a changing set of social and political values. Modern western, and namely American society, in their perceived separation from nature, has formulated a distinct, and ever shifting relationship with it. Wetlands, as are any other wilderness, are not exempt from the judgment of humans. Cronon describes wilderness as “the last remaining place where civilization… has not fully infected the earth. It is an island in the polluted sea of urban-industrial modernity, the one place we can turn for escape from our own too-muchness.”53 National parks such as Yellowstone and Yosemite were preserved for their natural abundance and ecological value, but this preservation was stimulated by American spiritual and recreational yearnings. As civilization became burdensome, nature became increasingly interiorized and relativized. The first national parks all fell into a “sublime”, religious ideology. Edmund Burke, British natural philosopher described a sublime experience as “The passion caused by the great and sublime in nature, when those causes operate most powerfully, is

51 Cronon, "The Trouble with Wilderness", 9.
52 Miller, Dark Eden, 2.
53 Cronon, "The Trouble with Wilderness", 7.
astonishment; and astonishment is that state of the soul, in which all its motions are suspended, with some degree of horror.”54 The great mountains, rivers, monstrous caverns of the Untied State’s first national parks all possessed the ingredients to create the sublime—icons to the power of God, the power of nature. It was not until the 1940s, with the rise of aerial photography that the first marshland would be honored as a national park: Everglades National Park in Florida. Wetlands represent the dark side of the sublime, not often appreciated, but those “who in plain characters may read divinity from so many bright parts of the earth, choose rather these obscurer places that spell out mysterious being.”55 Despite this, wetlands maintained their negative associations in the face of ‘mountain glory’, and although there was growing fascination for the swamp during the nineteenth century, they continued to be developed and suppressed until the mid 1900s.56 As long as wetlands eluded recognition in the public canon of beauty, the landscape remained under the control of negative associations. Still serving as a physical metaphor for spiritual waywardness, their preservation was not priority. As America rounded the corner from the nineteenth to the twentieth century, the country’s transition from a rural society into an urban society overtook whatever naturalist agenda was beginning to bloom in the late nineteenth, and he growing demand for farm products and building materials caused further filling and draining of the nation’s wetlands.

**Advantages of Aerial Photography**

Though wetlands did not rise to the forefront in environmental science until the late twentieth century, aerial photography has been used to map salt marshes since at

54 Edmund Burke. *A Philosophical Enquiry into the Origin of our Ideas of the Sublime and Beautiful With an introductory Discourse Concerning taste, and Several other Additions.* (London: Printed for J. Dodsley, 1757.)
56 Vileisis, *Discovering the Unknown Landscape*, 41.
least the 1940s.\textsuperscript{57,58} Because photographs provide a synoptic view of wetlands and their surroundings, they facilitate rapid interpretation and boundary determination. For salt marshes specifically, many features, such as meandering creeks and salt marsh pannes and ponds must be observed as a whole in order to understand how they interact as an environment, as well as providing a means to visualize their interactions with other environments, such as that of the sea or the ocean to which they are connected to. Wetlands, being particularly difficult environments to navigate by foot, can be disorienting and confusing to map by the naked eye due to tall grasses, hidden ditches and creeks, uneven ground and ponds, and pesky insects and shore-living species. Aerial photography provided a medium with which marshes could be analyzed without detriment to both humans and the environment that created a visual perception of the complexities of the wetland environment not visible to the naked eye. For many Americans, photographic representations of wetlands were their first introduction to these ecosystems, and the growing database of aerial photographs of wetlands that documented change over time gave voice to the case for wetland conservation in the 1960s.

\textsuperscript{57} David P. Olson. \textit{The Use of Aerial Photographs in Studies of Marsh Vegetation}. (Orono: Maine Agricultural Experiment Station, 1964.)

Chapter 4: Cameras in Space

Some work of noble note, may yet be done,
not unbecoming men that strove with Gods.
The lights begin to twinkle from the rocks:
The long day wanes: the slow moon climbs: the deep
Moans round with many voices. Come, my friends,
*Tis not too late to seek a newer world.

– James Joyce– Ulysses

On January 20th, 1949, President Harry S. Truman delivered his inaugural address, outlining his four points, promising to the people of the United States that they would “embark on a new bold program for making the benefits of our scientific advances and industrial progress available for the improvement and growth [of our country].” This speech paved the way for the U.S. involvement in the Green Revolution. Just 10 years later, in 1959, the Corona Satellite program was launched by the United States. One year after that, the first U.S. meteorological satellite, TIROS-1 was launched into orbit on April 1st, 1960. From this point on satellites became a key component of the study of earth’s natural resources. The onset use of satellite imagery was a key turning point in the American perception of wetlands, exposing them as ecologically fundamental environments, and also exposing their historical depletion.

Since the earliest crude meteorological and military satellites, there has been a steady evolution of increasingly sophisticated remote sensing satellite systems. The

1 James Joyce. Ulysses. (New York: Random House, 1946.)
environmental movement, otherwise known as the “green revolution” of the 1960s and
1970s, promoted the evolution of satellite imagery as a scientific tool.

These two decades represent a period of widespread change for the United
States, in every sense. It was a time of technological and cultural advancement,
humankind raced through the Earth’s atmosphere through space travel, Rachel Carson’s
exposure of environmental pesticide contamination Silent Spring rocked the nation, and
America got undressed both figuratively and literally, in response to the changing climate
on the environment, and morality. The term “Green Revolution” specifically refers to
the technological advances in agriculture that occurred at this time, but its impact
extended to many other forms of environmental technology, and changed the way that
residents of the United States interacted with and utilized their surrounding
environment. For wetlands, this period marked their rise to the forefront of importance
and preservation within environmental science.

Sparked by the publication of Aldo Leopold’s Land Ethic in his 1948 book, A
Sand County Almanac, this era inspired a wave of environmental activism. His Land Ethic
provided a base for which humans should interact with and create a cooperative
relationship with the environment. Leopold declared that, to the American public,
“Land, like Odysseus’ slave girls- is still property. The land relation is still strictly
economic, entailing privileges but no obligations.”

Leopold stresses the ethical
responsibility of humans to maintain the health of the environment, by integrating
themselves within the environment, in other words “enlarge[ing] the boundaries of the
community to include soils, waters, plants, and animals.”

4 Aldo Leopold and Charles Walsh Schwartz. "Land Ethic." In A Sand County Almanac, (New York:
Oxford University Press, 1948), 204.
5 Leopold, Sand County Almanac, 204-205.
historically distanced itself from nature, acting as conqueror as opposed to participant. Leopold’s ethic gave rise to a new standard for the treatment of nature, launching a period of moral considerability, and a newfound public focus on conservation. As satellite imagery made much of the American landscape more publicly available, landscapes that had previously been abused received recognition, and coastal wetlands gained a new appreciation in American culture. It was at this time that the link to the destruction of the environment to the interplay of new technology, industry, and political power was made, triggering a turnover of environmental policy to include more public input, and better protection of threatened environments. The heightened involvement of the environmentally empowered public led to the passing of laws such as the Wilderness Act, the National Trails Act, the Clean Air Act, Clean Water Act, and the Wild and Scenic Rivers Act. The movement inspired a rise of scientific focus on the observation of global ecosystem processes, beginning the era of land and ocean satellite observation.

**The Cold War**

The public freedom and interconnectivity encouraged by the environmental movement of the 1960s and 70s was in part driven by the changing political climate in the United States, and within international politics following WWII. In the early twentieth century, during the Progressive Era, driven by the Great Depression and a growing unease that progress within science no longer directly equated to social progress, scientists began to delve into political activism. Progressive scientists sought to create a political structure for postwar science, which could tie research more closely to the general public.

Scientists at this time possessed a vision of public access to scientific data, within the

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framework of a New Deal economy. According to Dino Brugioni, author of *Eyes in the Sky: Eisenhower, the CIA, and Cold War Aerial Espionage*, the 1950s were the “awakening of science as an intelligence collector.” World War II had led to dramatic technological and intellectual advancements in the realm of photographic interpretation, and these new skills were becoming extensively used in the military, and governmental agencies during the Cold War; U-2 airplanes equipped with photographic cameras were commonly used to spy on Soviet military operations. Military scientists began to utilize this technology in the natural sciences, its use becoming so widespread that Arthur C. Lundahl, the nation’s preeminent photo interpreter of post war military intelligence, and founder of the Central Intelligence Agency’s National Photographic Interpretation Center likened the development of aerial photography to that of gunpowder, in that it has changed earth science in the same revolutionizing way that gunpowder changed warfare.

Opportunities for further advancement in the realm of aerial photography, landscape surveys, and environmental monitoring arrived with the first launch of satellites into space.

**Early Satellites**

In the 1945 article “Ascent to Orbit” in *Wireless World* magazine, over ten years before the Soviet launch of Sputnik I, Arthur C. Clarke (author of *2001: A Space Odyssey* and technological prophet) proposed the idea that a man-made satellite could be inserted into orbit above the earth, allowing humans to view the planet in its entirety. By 1956,

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9 Brugioni, *Eyes in the Sky*, 76.
still two years prior to the launch of Sputnik, in a letter to a friend, he predicted the widespread use of GPS and satellite TV. Clarke states,

My general conclusions are that perhaps in 30 years the orbital relay system may take over all the functions of existing surface networks and provide others quite impossible today.¹¹

He quite playfully ends the letter with the statement “I'll have to leave that to the experts to work out; I'll get on with my science fiction and wait to say ‘I told you so!’” Half a century later, he has definitely earned the “I told you so.” The scope of visibility over terrestrial space granted by conventional cartographic techniques has, in many ways, been surpassed by the availability of satellite monitoring of our Earth’s landscapes. Satellites are “seeing machines”¹², an automated eye collecting data on the Earth from beyond its very atmosphere. Despite their distance from the subject they survey, they provide some of the most precise images of Earth’s landscapes, and the interactions that occur within. Vertically extending human sight, they rely on optics from automated mechanics, and have wholly changed the human relationship with their environment.

Remote sensing, termed the “science of observation from a distance”¹³ is an objective technology, contrasted with in situ sensing, in which measuring devices are either immersed in, or at least touching the bodies of observation and measurement. Satellites represent the first instance of mapping in which there is a true distanciation between the observer and the space observed.¹⁴ Designed in the 1940s, launched in the


¹⁴ Barret and Curtis, Introduction to Environmental Remote Sensing, 7.
1950s and commercialized by the 1990s, they represent a portion of human visual history that has brought modern society beyond its immediate landscape, and allowed humans to be in touch with the world on a global scale for the first time. Jonathan Crary, acclaimed authority on scientific visual culture describes satellites as

> Optical devices…. Points of intersection where philosophical, scientific, and aesthetic discourses overlap with mechanical techniques, institutional requirements, and socioeconomic forces. Each of them is understandable not simply as the material object in question, or as part of a history of technology, but for the way in which it is embedded in a much larger assemblage of events and powers.\(^{15}\)

In order to understand this assemblage, it is necessary to understand its predecessors, and what forms converged, or may have been forgotten to make this technology present.

**The Human Presence in Space**

In October of 1950, National Geographic released an issue that contained an article titled “Seeing the Earth from Space”, displaying photographs taken from a V-2 rocket in the late 1940s, a precursor to the Saturn Rocket that brought astronauts to the surface of the moon. These photos, taken at an altitude of 65 miles above the Earth’s surface, were taken at a rate of one photo every second and a half before the rocket plummeted back to the ground moments later. Clyde Holliday, who developed the very camera used in the V-2 launch, described the photos, as “how our Earth would look to visitors from another planet coming in on a spaceship.”\(^{16}\) Shown within these photos is a clouded and blurry earth, grainy and vague, set upon the black backdrop of the empty expanse of space. These first images represent a metaphorical vision of the human condition—

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displaying a lonely planet adrift in a dark void.\textsuperscript{17}(Figure. 13) Not 10 years later, Sputnik was launched into the Earth’s atmosphere by the Soviet Union, spurring a new age of scientific imagery.

\begin{center}
\includegraphics[width=\textwidth]{v-2-rocket-eye-view-from-60-miles-up.png}
\end{center}


In 1946, the United States Army Air Corps requested that the Research and Development (RAND) Corporation consider how objects might be put into orbit in the Earth’s atmosphere.\textsuperscript{18} The satellite would provide “an observation aircraft which cannot be brought down by an enemy who has not mastered similar techniques.”\textsuperscript{19} After many years of failure, the US military successfully launched the Discoverer in August of 1961, meant to support biomedical research and earth observation, just after the Soviet launch of Sputnik-1. The Discoverer was preceded by a reconnaissance satellite program called Corona, launched in 1959 and jointly managed by the CIA and the U.S. Air Force, under the jurisdiction of President Eisenhower. The first meteorological satellite, the Vanguard, launched by the United States a year later in 1959 was a groundbreaking step forward in

\textsuperscript{17} Daston, “Language of Power”, 4.
\textsuperscript{18} H. Mark, United States Space Foundation “Space Education”, \textit{Symposium Report on Space, the Next Ten Years} (Colorado Springs: 1984), 27-30.
\textsuperscript{19} Kosta Tsipis, “Arms Control Treaties Can be Verified”, \textit{Discover 8}, No.4 (1987) 78-79.
scientific imaging technology.\textsuperscript{20} Since Sputnik’s launch on October 4\textsuperscript{th}, 1957, more than 600 Earth satellites have been orbited.\textsuperscript{21}

In the late 1960s, there was a convergence of thought within the US military, political, and scientific spheres, which determined that synoptic coverage of resources was necessary. With roughly 5 billion people on the planet at the time, and populations rapidly increasing, there was dire need to know the distribution and availability of the Earth’s resources, remote sensing potentially providing a solution to this need. At this stage in satellite imagery, most observations came in photographic form, and the information provided by the satellites were largely qualitative. Modern satellite remote sensing relies on electromagnetic radiation (EMR) to propagate image from source to sensor.

By 1964 NASA inaugurated programs in testing satellites equipped with multiband photography as well as quantitative, calibrated measurements of earth processes such as sea surface temperature, wind, and sea ice density, many of which would soon be realized as crucial for wetland monitoring.\textsuperscript{22} Soon after these programs began, William Pecora of the USGS (United States Geological Survey) proposed the idea of a remote sensing satellite to gather facts not just about meteorological data, but the natural resources of our planet as well. This line of thought prompted the creation of Landsat, an unmanned Earth Resources Observation (EROS) satellite, the first of its kind. The objectives were announced in a memorandum dated July 12\textsuperscript{th}, 1967, addressed to the US Department of the interior, stating that goals were to 1) fly an EROS by the end of 1969, 2) provide unclassified remotely sensed data to facilitate the assessment of

\begin{thebibliography}{9}
\bibitem{20} National Research Council, \textit{People and Pixels}, 24
\bibitem{21} Ibid., 26.
\bibitem{22} Ibid., 5.
\end{thebibliography}
land and water resources of the Untied States and other Nations, and 3) design specific systems on the basis of users’ data requirements, distribute such data to users, and make operational use of the data in resource studies and planning.\(^{23}\) NASA and the USDA combined forces to successfully launch the Earth Resource Technology Satellite (ERTS-1), or Landsat-1 in July of 1972.\(^{24}\) The launching of Landsat marked not only the beginning of American satellites created solely for the purpose of environmental monitoring, but also the beginning of widespread public access to environmental imaging data, and consequently, wider exposure of wetland ecosystems.

By 1984, Landsats 2 through 5 had also been launched, with each successive satellite becoming more advanced. Forty years later, we are up to Landsat 7. Landsat 5 recently made headlines by breaking the Guinness World Record for “longest-operating earth observation satellite.”\(^{25}\) The introduction of Landsat satellites stimulated a new remote sensing paradigm, becoming the keystone around which remote sensing technology would grow. Multispectral satellites, which combine sensors across ultraviolet to active microwave frequencies, allowed analysis of the hydrosphere, biosphere, lithosphere, and atmosphere at once, an ability that has proved to be helpful in fields such as the study of wetlands, where ecosystem processes are dependent on the presence of both aquatic and terrestrial systems.\(^{26}\) Data from these satellites are used regularly by national and local government agencies, environmental consultants, oil companies, academia, social scientists, and the general public, providing new insight into geologic,


\(^{24}\) National Research Council, People and Pixels, 35


\(^{26}\) National Research Council, People and Pixels, 39.
agricultural, and land use science. Their use has opened new paths in the exploration of the earth’s resources, and spurned a new era in the relationship of American society and nature.\textsuperscript{27}

**Data for a Mass Market**

With the onset of pervasive military satellite reconnaissance at the peak of the Cold War, the Eisenhower administration made the groundbreaking proposal of “open skies” which holds that images produced through remote sensing, in the interests of mutual cooperation should be “openly used by both sides in the Cold War to observe and monitor each others’ respective weapons development programs.”\textsuperscript{28} This concept extended into the 1990s and was a crucial component in the passing of the Land Remote Sensing Policy Act of 1992 (LRSPA), a set of federal regulations regarding the public usage of remote sensing data. Since the passing of this act, high-resolution satellite imagery has become more widely available to the civilian public of the United States. Prior to this act state agencies and scientific researchers, such as NOAA and NASA, privatized remote sensing data following the merge of land, ocean, and weather sensing systems in 1979.\textsuperscript{29} Following this decision a national crisis ensued, in which the community of independent Landsat data users requested access to the data. Instead, the first Reagan Administration, accepting bids to maintain EROS satellites, passed the Land Remote-Sensing commercialization Act of 1984. Bids were accepted from a wide range of users—aerospace companies, geoscience firms, and a crop farmer from North Dakota— a testament to the fact that satellite data usage spanned many fields. The LRSPA reversed the 1984 decision to commercialized data, under the principles

\textsuperscript{27} Ibid., 40.
\textsuperscript{28} Harris, “Technology and Transparency as Realist Narrative”, 82.
\textsuperscript{29} National Research Council, *People and Pixels*, 42.
proposed by Congressman George E. Brown, co-author of the LRSPA, that the comprehensive worldwide data that remote sensing offered was essential to an open and consequently ideal society.\textsuperscript{30}

The wider availability of scientific data is associated with the concept of “global transparency”. This term was coined in 2001 by the American Society for Photogrammetry and Remote Sensing (ASPRS) and the RAND Corporation with the release of the document \textit{Commercial Observation Satellites: At the Leading Edge of Global Transparency}.\textsuperscript{31} The currency and availability of satellite data in the modern scientific movement has created the possibility for almost utopian political change within the United States, by providing more equal, democratic access to scientific photographic datasets. With access to satellite imagery through large databases and online archives, the general public “will be able to peer behind the walls of national sovereignty, accelerating a shift in power that is already under way.”\textsuperscript{32} Multi-national corporations such as Google, and GeoEYE have been slowly shifting military hegemony over global scale mapping and imagery to the hands of anyone who wishes to have access, creating a public domain for world imagery.

This newfound transparency provides an outlet for intervention, allowing a better-informed democracy to make better-informed decisions. Because of the global nature of satellite remote sensing, the data provided by its use are key drivers in the flow of information across national borders. As satellite imagery becomes integrated in systems of representation in wider civilian culture through education and the media, it

\textsuperscript{30} Ibid.
becomes a realist narrative regarding the relation between the subjective experience of its viewers and the “real” or outside world, placing them within an objective experience. Because of their visual nature, “graphical displays can transcend organizational and linguistic barriers.”

Previously associated with military surveillance, the public is now able to use satellite imagery as a source of knowledge and evidence for the goings-on of nature and our interactions within it. The United States, functioning as a democracy is already more transparent than most other governmental systems; as a democracy, open scrutiny of institutional structures of power is encouraged, providing citizens with the ability to affect and change legislative decisions. This power combined with the added awareness of the global and national environmental system provided by remote sensing has proven to be key in enacting change in ecosystem use and exploitation.

The V-2 rocket photographs represent the first moment in history when humans were put face to face with their place within the living being of Earth. This new visual contact with the solidarity of the only planet we will likely ever call home sparked a wish to respect and preserve it. Neil Armstrong, upon viewing his home, the Earth, atop the surface of the moon made the statement:

It suddenly struck me that that tiny pea, pretty and blue, was the Earth. I put up my thumb and shut one eye, and my thumb blotted out the planet Earth. I didn't feel like a giant. I felt very, very small.

Even in gazing upon the “blue marble” of the earth from the surface of another heavenly body, humans prioritize their presence within it, or without it. Humans cannot be viewed from satellites. Our houses, our structures cannot be seen via satellites.

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33 Edison M. Cesar, Strategies For Defining the Army’s Objective Vision of command and Control for the 21st Century (Santa Monica, RAND: 1995), 42.
our impact can. This new relationship between interface and observer presents a form of scaled perception that renders relationships and the interaction between objects and distance the primary connection to space.\textsuperscript{35} Satellite imagery has enabled humans to view their impression on the Earth as a whole. The sharing of data that has marked the modern conservation movement forced people to become aware of their impact, an impact that has been deemed unnatural, and largely negative. Nature consequently embodies a vision, in which the human is outside of the natural; however in being exposed to nature on a large scale, we have made it our duty to protect what we have damaged.

**Use of Satellites in Wetland Science**

Stacy Ozesmi stated in her essay “Satellite Remote Sensing of Wetlands” that “it was only once we were able to continually and reliably monitor our wetlands that we became concerned with their preservation.”\textsuperscript{36} In fact, the rise of wetlands as a conservation priority did not occur until satellite imagery became a scientific priority. Satellites, which up until recently were unable to measure anything less than 1m in scale, and thus unable to represent humans within the images they produce, display a world devoid of humans, with the exception of the alterations to the landscape we have caused. In viewing a landscape outside of the reality of one’s typical perspective, the viewer is forced to recognize the space for what is, and in doing so, draws attention to the unseen relation of the viewer to that space. As Kees Boeke, author and illustrator of the 1957 book \textit{Cosmic View} stated,


We all are inclined to live in our own little world, in our immediate surroundings… We tend to forget how vast are the ranges of existing reality, which our eyes cannot directly see, and our attitudes may become narrow and provincial. We need to develop a wider outlook, to see ourselves in our relative position in the great and mysterious universe in which we have been born and live.\textsuperscript{37}

Satellite imagery provides the outlet into a broader field of view, enabling contact between human action and global interaction. Satellites can thus be seen as “agents of moral truth”\textsuperscript{38}, displaying unaltered and non-subjective views of a landscape frozen in time. This relationship with the global landscape and the processes and issues affecting it has been further reinforced by our increased mobility as a species throughout the twentieth and twenty-first centuries, allowing us to develop the ability to physically see beyond our immediate localities. That being said, satellite imagery is not required to be viewed on a global, or landscape based scale. As technology has progressed, and resolution becomes more exact, satellite imagery has also given humans the ability to come in contact and understanding with the physical processes occurring in the specific environments they reside in, providing insight into the smaller-scale ecosystem response to their own actions, an understanding which can then be scaled up to its relation on a national, or global level. The very nature of satellite imagery, with its ability to place subjective environments into an objective scale, thus increasing awareness to global issues may have been a large factor in the increase in public interest in wetland conservation in the late twentieth century.

\textsuperscript{37} Brannon, “Standardized Spaces”, 3-4.
\textsuperscript{38} Ibid., 4.
Satellite imagery is unique in that it can conduct automated surveys of environments at regular intervals, allowing the same location to be monitored consistently. This type of monitoring is called “change detection”, and allows alterations made or occurring within a landscape to be visualized on a real-time basis. (Figure 14.)

As opposed to historical photographic surveys that took place at wide intervals (less than annually), satellite images of the same locale could be captured multiple times per year. The ability to track wetlands at regular intervals shed light on the rapid pace of their degradation in the twentieth century due to lack of legislation regarding wetland use. While this process is now replicated through the use of drone-piloted airplanes, these surveys do not occur on a global scale. The sequential images that are the product of a time series of satellite images shed light on the causality of land cover and land-use change (LCLUC) events in wetlands.

The nature, and future of environmental change is often debated, and the introduction of satellite imagery has been a way to help settle these debates, reinforcing environmental change with visual fact. Historical data sets from aerial surveys and early remote sensing surveys can now be used as a basis for comparison with modern remote sensing data. While only a few decades ago, remote sensing could accomplish no more than basic photography and meteorology, remote sensing technology has now expanded to encompass infrared photography, radiometry, radar altimetry, charged-coupled devices, sonar, geodetic (gravitational) sensing, and heat sensing. Satellite imagery now allows us to view ecosystem processes as a tangible image—images created via the direct interaction of physical processes and electromagnetic energy, images that could potentially be interpreted in the same way by all viewers no matter their relationship with the landscape displayed. This has opened up many new doors for water scientists, making it possible to collect detailed data in dangerous or inaccessible regions.

However, though remote sensing platforms are widely used in ocean science, there has been a technological lag in their use observing coastal wetlands. This, in part, is due to the high complexity of the coastal zone. Wetlands are often very shallow, thus reflectance provides an issues for satellite sensors. Suspended sediment concentrations are high within these areas, and thus different spectral signatures must be used in different areas of a salt marsh. Because of these and other similar problems, specific and complex algorithms must be made that are tailored specifically for these regions. Because the majority of Earth observing satellites are optimized either for terrestrial environments or ocean waters, many are not well suited for observation in an environment that combines the two. In order for coastal remote sensing to be
successful, the satellites used must have very high spatial resolution, and many spectral bands.\textsuperscript{39}

Even so, remote sensing has grown to become a dominating observation and sampling technique within wetland science. Specialized satellites have emerged, such as LiDAR and NIMBUS, and Landsat data has been made available at no cost to user communities since early 2009.\textsuperscript{40} Remote sensing has become one of the primary data sources to produce land cover and land use change maps that may indicated landscape growth patterns and human developmental and expansion processes. This data has become a shared resource, utilized by politicians, resource managers, and now the public, facilitating and ecosystem approach to coastal environmental issues.

Satellite imagery is unique to other cartographic techniques in that it fortifies the facts in contentious LCLUC claims. In wetland environments, the rigid classification system described earlier has buttressed the ability of satellite imagery to accurately display landscape change by fixing the classes of interpretation. The Landsat MSS system now has over 21 years of high spatial resolution satellite image data for monitoring land surface change in wetland ecosystems caused by human activity.\textsuperscript{41} Several major programs to develop satellite image databases have been initiated by both U.S. governmental agencies and private businesses, such as the NASA Pathfinder Data Set Program, and the NOAA Pathfinder Advanced Very High Resolution Radiometer Land Data Set to provide research-quality structured time-series data for use in global change


research to whomever may want it.\textsuperscript{42} The expansion of remote sensing expertise within the U.S. along with the constant expansion of public image databases has not only enabled more detailed observation techniques, but also engenders the conditions for improved transparency in policymaking.

\textbf{Revolutionary Political Attitudes towards Wetlands}

Following the burst of interest in scientific satellite imagery, the last forty years have observed some remarkable changes in social and political attitudes towards wetlands. There has been progressive recognition of the role of wetlands within various policy frameworks within the United States, leading towards the passing of legislation such as the Clean Water Act, and the commencement of the Ramsar Convention [on Wetlands of International Importance Especially as Waterfowl Habitat]. Some of the first moves towards a new regime of wetland legislation arose from the wish of the hunters and birdwatchers of America to preserve waterfowl, which were disappearing along with their wetland habitats. Ironically, this was preservation based in destruction. However, the increased focused on decreasing bird populations shed light on the degradation of global wetlands as a whole, and in conjunction with satellite imagery, emphasis was placed on the study of these environments.

The Ramsar convention, a key turning point in wetland treatment, was established in 1971 amid the throes of social and technological revolution. Under the criteria of the early Ramsar Conventions (The Conference of Parties), a wetland may be considered internationally important if “it supports an appreciable number of rare, vulnerable, or endangered species or subspecies of plant or animal; if it regularly supports either 10,000 ducks, geese, swans or coots; or 20,000 waders, or 1\% of the

\textsuperscript{42} Harris, “Technology and Transparency as Realist Narrative”, 107.
individuals in a population, or of the breeding pairs in a population.”43 By the 1990
conference in Montreux, this criteria was expanded to include plants and other animals,
and “unique” wetlands, that is “a particularly good representative example of a natural or
near natural wetland, characteristic of the appropriate biogeographical region OR plays a
substantial hydrological, biological, or ecological role in the natural function of a major
river basin or coastal system.” This swift change in criteria marks a growing scientific
consensus in the literature of the time, and a mass shift in motive of preservation, from
the bird lobby of the 1960s to the recognition of the wider functional benefits of these
ecosystems in the 1980’s.44

In 1987 at the Conference of Parties in Regina, Canada, two improvements were
made, which modified the criteria for designation of wetlands of international
importance, and the elaboration of “Wise Use” of wetlands, which took into account the
wider benefits of the preservation of wetlands (and thus the human environments they
support), including flood control, maintenance of water quality and fisheries support.45
The wise use of wetlands, as defined by the Wetlands Programme Scientific Advisory
Committee, referred to their “sustainable utilization for the benefit of mankind in a way
compatible with the maintenance of the natural properties of the ecosystem… so that it
may yield the greatest continuous benefit to present generations while maintaining its
potential to meet the needs and aspirations of future generations.”46

Since these conferences, wetlands have received much more public recognition,
with concerns regarding alteration or loss of these environments being more widely

44 Ibid., 15.
45 Ibid., 53.
46 G.E. Hollis and Others. ”Wise Use of Wetlands: Proceedings of the Third Meeting of the Conference
of the Contracting Parties to the Convention on Wetlands of International Importance.”
voiced. These concerns are supported by an increase in public access to scientific papers, journals, and databases through advancements in technology that occurred at this time. While the Ramsar Conference was a huge leap for Wetland legislation, in scientific circles, the perception of salt marshes has changed so that their role as quintessential mediators of human impacts is recognized. The ecosystems can no longer be viewed as swampy wastelands, used to buffer the ocean against human alteration, and vice versa. Instead, they must be appreciated as highly valuable habitats, whose ecosystem services provide a suite of functions that are not only critical for the ongoing livelihood of coastal populations, but humankind as a whole.

Over the past 40 years, the goal of the scientific community in collaboration with legislators has shifted to identifying and addressing the value of the ecosystem services of wetlands, as well as the world’s ecosystems as a whole, to create an integrated management practice termed ecosystem based management. Yet, despite the increasingly wide recognition of the importance of coastal wetlands, their degradation continues worldwide, and includes well-publicized examples of the past few decades such as the shrinkage of Central Asia’s Aral Sea, the desertification of the marshlands of Southern Iraq, and the continuous desiccation and eutrophication of the Florida Everglades. Such major degradation reduces options for future sustainability and restoration of these ecosystems.

Satellite imagery can be key in recognizing ecosystems in jeopardy, and preventing future loss. Satellite data from EROS satellites provides scientists with a continuous stream of information regarding the health of wetland, and the commercial

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and political use of this data allows policy-makers more advanced information regarding wetland loss and degradation. Government regulation over wetlands has changed greatly during this time period, and this change in attitude reflects a congruent change in public attitude towards wetlands. A notable increase in U.S. commitment to wetland water quality was observed through the passage of the Federal Water Pollution Control Act amendments of 1972, and 1977, more commonly known as the “Clean Water Act”, wetland use regulated under Section 404.49

Coincident with the increased recognition of wetlands’ value for humans was awareness by policymakers that wetlands were disappearing at an alarming rate. By the early 1990s, the policy of “no net loss” of wetland ecosystems was enacted by the United States Government under President George H.W. Bush.50 National Wildlife Federation authority, Edwin H. Clark II described the birth of this concept in 1993, prompted by the Environmental Protection Agency’s National Wetlands Policy Forum, in 1987. 51 The “No net loss” policy represents a compromise between development and conservation. They are persuasive and work well in theory but may be difficult to implement in practice. While it seems a straightforward concept, there have been misunderstandings its meaning. For example, the word “net” is tricky because it suggests that wetland losses can be counteracted by gains in other areas. The word “loss” also has a multifaceted meaning; this loss could refer to a loss of wetland area, or a loss of wetland functionality. Despite this policy, these loopholes have allowed a continuous stream of wetland conversion and mitigation, and between 1986 and 1997 the United States lost roughly

50 Ibid., 34-36
51 Ibid.
58,000 acres of wetlands per year, roughly 20% of the loss of the previous decade.\textsuperscript{52} Thus, the national policy has been more of a “slow net loss” until recently. Net change has deceased from a net loss of 58,000 acres per year to a net gain of 32,000 acres per year in 2004.\textsuperscript{53} However, this gain is unfortunately focused on freshwater wetlands, and the acreage of coastal wetlands has decreased by roughly 360,000 acres, between 1998 and 2004.\textsuperscript{54} Satellite imagery of wetland environments, in conjunction with new technologies such as Geographic Information Systems (GIS) can be valuable tools in determining wetland losses and changes in wetland use. Through the use of these technologies, and the new relationship to nature that they bring to the American public, their implementation has been key in making conservation of wetland ecosystems a mainstream practice, as opposed to destruction

\textbf{Preservation to Integration}

In the broadest of terms, satellite imagery is a combination of a photograph and a two dimensional map. Maps, like photographs, are theoretically meant to represent visual truth. “Inaccuracy, we are told, is a cartographic crime.” John Brian Harley, a prolific modern cartographic theorist once stated.\textsuperscript{55} However, the difference between the two lies not only in the fact that one is produced through mechanism while the other is produced by way of the human hand, but an illustrated map can be described as subjective representations as the world “in terms of relations of power, and of cultural practices, preferences, and priorities”\textsuperscript{56}, while satellite imagery, on the other hand, though

\textsuperscript{54} Ibid., 8.
\textsuperscript{56} Harley, “Cartography, Ethics, and Social Theory”, 4.
possessing the same God’s-eye view as maps, show an unadulterated, automated image, independent of human interference. Satellites actively orbit, archive, and transmit signals automatically, traveling unseen while collecting and documenting data autonomously.

Similar to the merits of aerial photography, satellite imagery puts the viewer within a new optical perspective that must be adapted to. Offering a different type of viewing than looking upon a map, single image, or drawing, modern satellite images, often captured through the use of radars or a grid system require a new understanding of organizational patterns that combine perspective, space, and scaling.\(^57\) Planners and landscape architects have long been using objective measures of documenting the environment. However, the general public that is just recently gaining access to this type of information views their surroundings without the trained eye of the environmental professional. Donald Appleyard, urban designer, made note that because the public was not immersed in these technologies, “The paradox is that as planners become more adept and sophisticated at conceptualizing so called objective city—through the use of aerial photographs, maps, statistics, and mathematical modeling—their conceptual distance from the inhabitant’s subjective personal [landscape] usually increases,”\(^58\) meaning that there was a distanciation between perceptions of environmental professionals, and the public. Satellite imagery rectifies this problem by going a step further, into what Daston and Galison named “trained judgment”.

There lies fault in mechanical objectivity in that it may only capture an object on one plane, thus in certain fields can become confusing and convoluted, and with features often indistinguishable. In doing so it becomes an image that must be interpreted by its


\(^{58}\) Donald. Appleyard, Planning a Pluralist City: Conflicting Realities in Ciudad Guayana. (Cambridge, MA: MIT Press, 1976.)
viewer, therefore unable to separate its practice from the subjective. Reacting to the problem of self-denial seen in mechanical objectivity, scientists now insisted on the importance of the capacity to interpret. Trained judgment utilizes the expertise of an experienced individual to smooth over and interpret mechanically obtained data in order for humans to better understand it. Scientists at this time emphasized the necessity of “a capacity of both maker and user of images to synthesize, highlight, and grasp relationships in ways that are not reducible to mechanical procedure.”

Daston artfully explained the co-mingling of truth to nature objectivity with mechanical objectivity saying “in this hushed domain of science, the whispered voice of nature still needed to be amplified by machinery, and could only be heard against the muted background of a silenced scientific soul.” In making policy decisions, it is equally important to maintain both an objective and subjective perspective on nature. If mechanical objectivity sought to “never answer for her (nature) nor hear her answers only in part”, trained judgment accepted the responsibility of hearing her answers, but mediating them for human use.

As more people sought out the sublime experiences that untouched wilderness could provide when operating under the beliefs of mechanical objectivity, and National Parks and preservation became more culturally popular, wilderness was transformed into a “sacred American icon” the American frontier. However, as time goes on and the human population keeps growing, as we become more advanced, the barrier between the inside and the outside, between the public and the sublime inevitably grows. The sublime wilderness once sought becomes hidden behind a veil of social grace and civility; technological advancement and resource demand overcame much of the reverence.

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59 Daston and Galison, Objectivity, 314
60 Ibid., 362.
61 Ibid., 95.
nature received. And so begins the modern Green Revolution—not a revolution sparked by appreciation, but by fear, and need, a final attempt at integration within what Dave Forman calls “The Big Outside” that we have long left far behind, a wish to return to what we perceive as, the great “tabular rasa”, the Garden of Eden that modern environmentalists fear that we have destroyed. 63 Cronon claims that,

The critique of modernity that is one of environmentalism’s most important contributions to the moral and political discourse of our time more often than not appeals, explicitly or implicitly, to wilderness as the standard against which to measure the failings of our human world. Wilderness is the natural, unforth antithesis of an unnatural civilization that has lost its soul. It is a place of freedom in which we can recover the true selves we have lost to the corrupting influences of our artificial lives. Most of all, it is the ultimate landscape of authenticity. 64

If wilderness is the landscape of authenticity, where do human altered landscapes fall?

Through practices of scientific mechanical objectivity, humans have placed themselves outside of the realm of the natural. In other words, simply by considering humans distinct from nature, we are in opposition to Aldo Leopold’s Land Ethic.

As visual scientific technology becomes more advanced and humans become increasingly interconnected, our role as both destroyers and keepers of the environment has become intermingled. Satellite imagery, with its ability to show various environmental impacts caused by humans while remaining objective enough to physically “take us out” of the picture has re-integrated us with nature by showing that it adapts to our actions in the same way it would any species. The difference between human impacts and those of other species lie in the rapid rates and extreme levels at which they occur. Our negative influence stems from the fact that nature, the well-oiled machine that it is

63 Ibid., 21.
64 Ibid., 17.
cannot adapt quickly enough to keep up with our growth. Trained judgment mirrors this integration, mingling natural law with human law in attempt to correct for flaws on either side. Thus, the current desire for preservation stems not from the veneration of nature inspired by mechanical objectivity, but from a newfound realization of the human role within the integrated living and life-supporting system which comprises earth. In viewing nature on a global scale, it is impossible to deem the human as anything but an integrated part of nature; the human once again enters the realm of the natural.

This is not to say that there is no longer a prevalent association with “otherness” when discussing the American relationship with nature; this is a distinction that will fade only with difficulty, and is liable to worsen as populations continue to grow and the country becomes increasingly developed. What I mean is that I believe that we are moving towards a worldview in which we no longer distinguish ourselves based upon the notion that nature is purely a resource, or a source of consolation or model whose sole purpose is to support, but rather possess an understanding that our role in nature is just as important as it is to us. This new worldview is reflected in the turnover in wetland use and policy. Perhaps paradoxically, I believe that this re-integration would not be possible were it not for the use of objective technology. Of all three technologies, (conventional illustration, aerial photography, and satellite imagery) satellite imagery came closest to placing the viewer farthest outside of an idiosyncratic view. If objects seen through the lens of truth to nature and mechanical objectivity were so much like social actors that they could not be reduced to “out there”, satellite imagery did just the opposite by removing humans from the image, forcing us to only see the “out there”. Technology of this kind has the potential to bring humans to a closer understanding of

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65 Williams, “Ideas of Nature”, 283.
their role within what has been deemed the “outside”, the wilderness. In response, more value has been put on the treatment of nature within American society.

Americans, immersed in an urban-industrial civilization which contributes the majority of the world’s environmental pollution, but increasingly attempting to get back to a “truer” nature have been purveyors of restoration and conservation practices within degraded coastal ecosystems. In this next chapter I plan on discussing a case study of a coastal wetland environment that has evolved over time along with the changing social views of the nature through advances in scientific imagery.
Chapter 5: The Battle for Jamaica Bay

A town is saved not more by the righteous men in it than by the woods and swamps that surround it.
— Henry David Thoreau

Jamaica Bay is a coastal wetland ecosystem comprising over 39 square miles of land and water. In southern New York whose use exemplifies changing American attitudes towards wetlands in every technological era mentioned within this thesis. From the time it was fertile marshland in the hands of indigenous tribes, this landscape, like many American wetlands underwent a series of transformations until it was on the brink of destruction, at which point the environmental movement prompted its preservation. Its history of settlement, documented by maps, photographs, and personal accounts provide insight into the evolving relationship of the modern American citizen to the wetlands as technology and modes of scientific thought advanced. Jamaica Bay provides a contemporary model for wetland use within the United States, its management a guideline for future practices as the coastal zone of the U.S. becomes increasingly urbanized, and wetlands thus become further threatened.

Jamaica Bay has a complex and controversial history, marked by a long succession of improvements that catered to human use (that may or may not damage the environment), and restorative or preservative improvements that enhanced the natural ecosystem. Until the mid nineteenth century, Jamaica Bay was essentially a wilderness area, its waters left largely intact in order to serve a shellfish and fishing industry that was rapidly growing in prosperity. However, by the 1850s, as Manhattan and its outlying boroughs became increasingly populated and industrialized, the demand for space and
business found a foothold in the widely unused, cheap, and expansive Jamaica Bay. Over
the past 150 years, perimeter wetlands and interior salt marsh islands have been
permanently removed as a result of extensive dredge and fill operations, channels dug,
shorelines bulkheaded, and marshlands harvested beyond recognition. These activities
have synergistically affected historic water flow patterns within the bay, eradicated
natural habitats and species, and thus lessened the fertile ecosystem of Jamaica Bay to a
shell of its previous grandeur. Even so, Jamaica Bay still remains one of the northeastern
United States’ most productive ecosystems, a statement which bears truth to the sorry
state of the American environment.

Now, amidst the towering control towers, glass paned atriums, jumbo jets and
bright lights that is John. F. Kennedy International Airport, one would never guess that
the ground they are standing upon used to be fertile marshland. Previously called
“Idlewild Airport”, JFK, built in 1942, lies in the heart of the salt marshes of Jamaica
Bay. The construction of JFK marked the beginning of a new era of use for Jamaica Bay,
confusingly intermingling industrial and recreational expansion with a heightened
awareness for environmental issues as the bay received mounting scientific and political
attention. In many ways, the historical use of Jamaica Bay embodies many of the
complex environmental issues being experienced nationally today, existing at the center
of competing demands to serve public, private, and ecological needs in the center of a
heavily populated and polluted urban area. Maintaining a healthy wetland environment is
now recognized as imperative for the health of the organisms within, as well as for the
maintenance of the health of the surrounding communities. However, Jamaica Bay’s
proximity to Kennedy Airport, an arguably indispensable component of the economic

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1 City of New York Parks and Recreation, “Jamaica Bay Park.”
and social climate of the Greater New York City area, presents a variety of multidimensional problems that call for sacrifices on both ends—ecologically and socially. Its role as a landmark in the ever-changing relationship of human-nature interaction has been solidified by the ability to track its evolution back to the seventeenth century via visual representation. By tracing the complex history of humans to a single wetland environment—Jamaica Bay—the American relationship to wetlands over time is clearly articulated, providing a concrete example of the three eras of wetland use and representation.

The bay went through three distinct periods of land use, as did most United States coastal wetlands, undergoing a total revolution in public opinion in the early twentieth century, slightly before the boom of wetland conservation in the United States. The first era spanned from the early seventeenth century to the mid-nineteenth century, and consisted of mostly agricultural land use. Following the increasing settlement of the surrounding areas, there is a period of conflicting developmental and social needs from the late 1860s to the 1920s, resulting in high amounts of industrial and urban expansion. The third period is the era of preservation, beginning in the 1920s. Immersed within an urban landscape, the early focus on Jamaica Bay’s preservation by New York City residents was prophetic of the soon to come mass protection of wetlands as science became more advanced, and wetlands became highly respected environments. Each era of land use displays a history of practice that can be related to changing scientific and public values in response to changes in visual representation. Through each era it becomes clear that the way the Bay was represented visually impacted its social role in the greater community of New York City.
A History of Jamaica Bay

Jamaica Bay lies in the southernmost portion of New York State, surrounded by the Rockaway Peninsula and the Burroughs of Brooklyn and Queens. (Figure 15.) It is an example of a wetland environment in an urban backyard—an ecotone, the “place where the transitions between habitat communities occur”\(^2\). In the case of Jamaica bay, the habitats are very distinct—one, the urban, serving mainly humans, while the other, the bay, serves a plethora of organisms. The current marshes of the bay are relatively young on a geologic timescale, forming only 2,000 to 6,000 years ago from sand deposited by the Wisconsin Glacier. The general area, however, has evolved over the last 25,000 years into an important and intricate network of open water, woodlands, salt marsh, and freshwater wetlands.\(^3\) Within this multifaceted mesh of ecosystems is a varied community of coastal organisms, composed of over 91 species of fish and 325 bird species, as well as many significant reptile, mammal, and amphibian populations. It lies just within the path of the Atlantic Flyway Migration route, which extends down the Atlantic Coast of North America, originating in Greenland. This route supports the migration of over 500 bird species, 40% of which are species of conservation concern.\(^4\) It connects some of the most productive coastal ecosystems in the United States to one another, Jamaica Bay being a key habitat for 214 species of endangered waterfowl.\(^5\) One of the largest coastal wetland ecosystems in New York State, it is designated by the New York State Department of State as a Significant Coastal Fish and Wildlife Habitat, and

went down in history as the first site to be named by the National Audubon Society as an “Important Bird Area.”

Figure 15a: Satellite Image of Contemporary Jamaica Bay Watershed NYC EPA, 2010

Figure 15b: Contemporary Jamaica Bay Watershed and Land Use, NYC EPA, 2010

6 Ibid.
Before the mediation of humans, it is estimated that the marshland of Jamaica Bay comprised over 25,000 acres of land. By 1907, immersed in the throes of an industrial revolution, this number had gone down to 16,000 acres, and by the 1970s, even after heightened efforts to preserve the bay only 4,000 acres of healthy salt marsh remained. Interpretation of aerial photographs shows that 51% of salt marshes in the Bay had been lost between 1924 and 1999. At the current rate of loss, the marsh islands will vanish by 2024. The anthropogenic impacts associated with the continuous development of the Jamaica Bay marshlands has already altered the natural processes within the bay, transforming the routes of sediment and water movement within the marsh to the point of limiting its future potential to remain a self-sustaining ecosystem.

Now, as we enter a new era of the American relationship with wetlands through advancements in technology, it has become even more important to focus our efforts on the preservation of coastal wetlands, to ensure our preservation as a species.

Though Jamaica Bay, like much of the Eastern U.S. was not settled by Europeans until the latter half of the seventeenth century, it was certainly not devoid of human presence. Historical and archaeological literature refers to numerous Native American sites within Jamaica Bay, thirteen well known and traversing nearly all land between Kings and Queens County. It was common for Native American settlements to be based along tidal streams and marshes, these tribes utilizing the lush, flat inlands of present-day Brooklyn. At the current time, all sites have been sequentially destroyed by

7 Wang, Remote Sensing of Coastal Environments, 192.
filling and construction, during a tumultuous and prolific time period that I will get to later on, but the lack of significant archeological evidence for these civilizations is a testament to the low impact they inflicted upon the area.\textsuperscript{10} Historically, indigenous populations have typically been perceived as closer to nature than their modern counterparts, perhaps due to the low impact and low level of destruction they appear to impress upon their ecosystems. Thoroughly less business and developmentally based, their sole mark upon the land often being the name they bestowed upon it, names now so intertwined within modern life that one hardly passes thought to its origins, such as Canarsie\textsuperscript{11}, Rockaway or Bergen, Jamaica Bay’s name itself derived from the word “Jameco”, after the Jameco (also known as Yamecah) Native Americans.\textsuperscript{12} These titles, adopted by settlers and used within their maps show a land, and a people overtaken. In contrast, though historically there was a large Native American population, there is a lack of maps and images produced by them, a testament to their small impact.

Between 1636 and 1667, the Native American title to the vast majority of the land in Kings and Queens counties, including the coasts of Jamaica Bay, was terminated.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure16.jpg}
\caption{Native American Burial Ground, The Belt Parkway now covers this site. Flushing Historical Society, 1939 (Queens Borough Public Library, Long Island Division)}
\end{figure}

\textsuperscript{11} Area in Queens
\textsuperscript{12} City of New York Parks and Recreation, “Spring Creek Park.”, http://www.nycgovparks.org/parks/B165/ (Accessed April 6, 2013.)
The vast majority of the Bay’s Western shore as well as adjacent lands were sold to the Dutch by the Canarsie tribe under the condition that “The purchasers once for always a fence shall set at Canarissen for the protection of the Indian cultivation.” In a sequence of events witnessed time after time historically, these rights of occupancy otherwise went along unacknowledged, and soon, the 15,000 acres of land quickly becoming colonized and ravaged by the Dutch, retained no trace of the Canarsie. This colony was later named “Flatlands”, its namesake being the flat and fertile low-lying marshlands on which it lay.

The area was quite instantaneously recognized as valuable economic resource, what truth to nature objectivists would consider an ideal example of low marsh, described by a visitor in 1679 as “a large piece of low flat which is overflown at every tide... mirry at the bottom, and which produces a species of hard salt grass... like all the others, is well provided with good creeks.” Underlying this distinction of Jamaica Bay’s coastal marshes as ecologically healthy and prosperous is the ever-present goal of modern culture-economic growth, the same visitor stating “such a place they call valey and mow it for hay.... And very serviceable for fisheries.” For this reason, the Flatlands and its neighboring communities of New Lots and Flatbush engaged in agriculture as their primary source of industry. This initial push towards development remarkably foreshadows the fate of the remainder of the Bay, much of which was not well used until the nineteenth century.

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Seventeenth and Eighteenth Century Mapping

Historical Mapping demonstrates the colonizing focus at the time, often excluding land-type classifications and the Bay almost completely and focusing instead on the partitioning of land, its use, and ownership. Because the vast majority of settlers were large families, most maps available are crude representations of the settled area, weak attempts at spatial perspective under the god’s-eye view that wouldn’t be truly attained by aerial photography for another two centuries. Below is a map of Long Island from 1675 identifying the shoreline of southern New York.

Regrettably, this map covers a relatively large area, and Jamaica Bay is not the main focus. The resulting representation of the bay misleading and unclear image of it, the shorelines estimated and the marsh islands excluded. The style of this map falls under the category of “exploratory map” that I mentioned in Chapter 2. Abound with color and artistic flourishes; this map better serves as artwork than as geographic reference material. The focus within this map lies in the names of the various locales included, rather than geographic or environmental features. Many of the seventeenth and eighteenth century maps of the American colonies fall under this structure of having a heightened focus on human activities, post-settlement, rather than on the features of the

Figure 17: Roharrt Ryder Long Island Sirvaide, c.1675, http://www.stonybrook.edu/libmap/nypath2.htm (Accessed April 9, 2013)
bay prior to settlement. Though much of Jamaica Bay was kept natural at this time, this practice stems from the small numbers of settlers rather than a wish to preserve. The wetland areas that were settled did end up being widely “improved upon” into grazing pastures.

Representations of Jamaica Bay are present in more comprehensive maps of New York and New England, created by professional cartographers, illustrators, and engravers, yet still show little understanding of the lay of the land in this area. As mentioned earlier, the lack of ecological respect also stems from a lack of scientific knowledge of wetland ecosystems. However, it must not be forgotten that the scarcity of knowledge stems from a lack of focus on these areas because of their aesthetic faults. Figure 18, an enlarged portion of a 1776 hand-drawn map that covered the southernmost portions of New York, and some of New Jersey, displays a rough outline of Jamaica Bay, despite its tile of “accurate”, the only specificities made being that it has “shallow water.” Even so, the Jamaica Bay ecosystem is more in visual focus than the previous century.

As the Dutch Flatlands settlements flourished, settlement extended to the marsh islands in the center of Jamaica Bay. By 1698, a census counted 2017 residents within Kings County. About half of these settlers were of Dutch origin, while the remaining half traveled from Germany, England, France, and Scandinavia, along with a large portion of slaves brought from Africa.\textsuperscript{17} A century later, the Revolutionary War brought American and British troops into conflict within the area, and after the colonists’ retreat in the Battle of Long Island in August of 1776, the area remained under British control through 1783.\textsuperscript{18} At this time, extensive alteration had begun to take place within Jamaica bay, in concurrence with a rise of truth to nature. Maps created at this time emphasize the heightened development of the area, rather than the layout of the ecosystem itself. It is clear that the Bay’s worth was determined by what it was being transformed into, rather than its ecological merits. The wetlands of Jamaica Bay fell under the negative connotations of wilderness under truth to nature values, and their use and representation mirrored this disdain. A New Jersey geologist indicated the Dutch aversion to the marshland in stating,

They are not only salubrious, but also comparatively non-productive in an agricultural point of view. The possibilities of these meadows when drained and the sanitary advantages of their reclamation, aside from the aesthetic setting, making a strong impression upon all who have seen the rich and beautiful polders of Holland.\textsuperscript{19}

The notion of the wetland as unproductive land contributed to its near decimation as New York continued to further industrialize.\textsuperscript{20} By the mid-nineteenth century, Jamaica

\textsuperscript{17} NY DEP, “Jamaica Bay Watershed Protection Plan”, 8.
\textsuperscript{19} Annual Report of the State Geologist for the Year 1895 (Trenton, NJ: John L. Murphy, 1896), xxvii.
\textsuperscript{20} Brash, \textit{Gateway}, 55.
Bay had shifted from being the center of a subsistence economy to a rapidly industrializing one.

**Rise of Photography in the nineteenth Century**

In the mid nineteenth century, Jamaica Bay was beginning to be scoped out as a hub of industrialization and transportation. John R. Pitkin a nineteenth century colonist and land developer proposed the idea of converting the New Lots area into a commercial center that would rival that of Manhattan, visualizing “instead of farms and quiet villages, a vast transportation center along the shore of Jamaica Bay.”

By 1878, the Secretary of War along with the city government of New York had petitioned to establish the bay as a major seaport. The 1865 construction of the Brooklyn and Rockaway Beach railroad in 1865 had ushered in sweeping changes to the Bay, and a booming tourism industry grew. Shellfish harvesting within the Bay began to take on a commercial character in the 1860s following the proliferation of seed oyster planting, and a ferry service began in Canarsie at roughly the same time.

Though increasingly developed, the bay was also increasingly represented within maps, and as photography became popularized, it became the focus of aerial surveys and scientific photography. Photography, by being able to cover the entire area, unfortunately, made available not an appreciation for the environment, but rather provided a basis for regions to develop. The use of aerial photography provoked the sense of mastery over the environment, and the Jamaica Bay continued to be “improved.” With the invention of photography, residents, politicians and policy-makers

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now had the ability to create accurate visual representations of their environments, and riding on the coattails of truth to nature representation, mechanical objectivity began to flourish. As truth to nature values battled in opposition to those of mechanical objectivity, a similar conflict was demonstrated in the struggle between further development of the Bay and the wish to preserve it. Directly following a period of time in which humans held sole jurisdiction over nature, the marshes of Jamaica Bay were not seen as ecologically important but rather as “distinctly favorable to the growth of commerce… the land being for the greater part salt marsh, is perfectly flat.”

The islands of Bergen and Mill were filled and expanded to join together and connect to the mainland. Likewise, the Canarsie shoreline also underwent extensive filing until many biological formations and creeks disappeared. An 18 feet deep by 500 feet wide channel was dredged from the Entrance to the Bay to Mill Basin in 1912, in effort to transform Jamaica Bay into “the port of entry for a considerable amount of domestic commerce”25, expanding upon Pitkin’s original fantasy for the Bay’s economic future. As a result, what is not Broad Channel Island is comprised of what were formerly Big Egg Marsh, Goose Pond Marsh, Rulers Bar Hassock and Goose Creek Marsh.26 The channels within and around the bay would continue to change over the next century, as a result of a lack of knowledge of ecological principles of conservation and the impact of physical and chemical alterations on the health of coastal ecosystems. And, as the policy of “no net loss” was not enacted until 1989, the bay continued to be widely transformed and developed throughout the twentieth century.

24 Department of Docks and Ferries, “Report on Jamaica Bay Improvement”, (April 20, 1910), 28
26 Ibid.
By the early twentieth century, just as Central Park was becoming a celebrated design achievement that “synthesized” city and nature, Jamaica Bay had been degenerated to a point of polluted dumping ground for the industrial factories overpopulating the area, a distinction that bears truth to the exception of wetlands from the new notion of wilderness as sublime. By 1917, fifty million gallons of raw sewage were being discharged daily into the bay. What is now Gateway National Park and the Jamaica Bay Wildlife Refuge was nothing more than a “place where it is said that nothing green could live and the smell would sicken at a distance of two miles.” Thus, its perceived lack of ecological productivity continued to provide ideological grounds for its transformation into a grand futuristic fantasy—a “megaport” — that would destroy the entirety of the remaining wetlands within the bay. (Figure 19.) The announcement of the megaport plan in 1907 coincided with the collapse of the local fishing and oystering industries due to contamination by industrial pollution. By 1912, dredging for the 40 square mile megaport was underway. An 18 feet deep by 500 feet wide channel was dredged from the entrance to the Bay to Mill Basin, expanding upon Pitkin’s original fantasy for the Bay’s economic future. As a result, what is now Broad Channel Island is comprised of what were formerly Big Egg Marsh, Goose Pond Marsh, Rulers Bar Hassock and Goose Creek Marsh. However, as construction of the harbor became increasingly difficult, dreams of the “Great World Harbor” waned, in favor of “America’s Greatest Airport”. The second quarter of the twentieth century represents a time period where the proliferation of technological advancements such as that of

27 Brash, Gateway, 57.
28 Ibid., 63.
29 Ibid., 57.
31 Ibid.
32 Brash, Gateway, 58.
motorized flight could enhance and change scientific imagery forever, but in order to progress within this field, environmental sacrifices were often made.

In the case of Jamaica Bay, the sacrifice was made on behalf of the construction of Idlewild Airport, an environmental nightmare in favor of the growth of one of the world’s most influential cities. Built under the jurisdiction of Mayor Fiorello LaGuardia, the construction of Idlewild was devised under a plan to transform New York City into the international heart of air transportation. Beginning construction in 1942 and

reaching completion in 1948, its construction occurred within the WWII period.\textsuperscript{33} Originally planned to cover only 1,200 acres of land, it now covers over 5000 acres of land along the northern shores of Jamaica Bay, a process that took 55,000,000 square yards of hydraulic fill to create the land platform which now stands.\textsuperscript{34} The site was “originally marsh land at about high tide elevation with three to five feet of interlaced organic mat covering a variable depth… [the remainder composed of] clay or mud.”\textsuperscript{35}

While it is clear that the construction of Idlewild international significantly altered the natural landscape of the coasts of Jamaica Bay, it is important to recognize the social, political, and ecological costs and benefits of its structure. Though ecologically costly the proliferation of motorized flight and correspondingly aerial photography were supported by its construction, offering new potential for cartography, and a scientific understanding of the Bay and its interactions with the surrounding urban area. However, the placement of Idlewild also opened doors for future expansion, and as the need for air transport capacity grows over the years, a new sacrifice must be made—either risk environmental degradation in favor of expansion, or accept a sub-par airport in exchange for a strong (yet decidedly degraded) ecosystem. The problem lies in the fact that as the scientific and general public becomes more aware of anthropogenic environmental impacts through advancements in visual mapping and technology, further advancements become limited by this knowledge. This is a problem being faced in urban wetland ecosystems worldwide, and the decisions made, and being currently made in Jamaica Bay can serve as a model for future issues.

\textsuperscript{35} Brash, Gateway, 40.
Since the early twentieth century, this conflict has been ever-present in Jamaica Bay, and interestingly enough, Mayor LaGuardia, the very person who proposed and propagated the construction of Idlewild also proposed the bay’s first environmental restoration plan in 1938, 10 years before the completion of Idlewild Airport. LaGuardia understood the importance of Jamaica Bay as not only a recreational and economic resource, but also as an ecological unit, whose natural functions may benefit human needs as much as its developmental potential. The struggle between these two needs can be kept in balance as long as demands remained moderate, but as the area surrounding the bay became increasingly urbanized, these demands intensified. Floyd Bennett Airport, constructed in 1941, but whose construction commenced in 1928 paved the way for Idlewild, providing city officials with early insight into the impact that a large-scale dredging and air travel operation has on the environment. (Figure 20a & 20b)

Nevertheless, however detrimental the effects at the time, the science was not yet advanced enough to predict the future impact, nor could they quite predict the scale of the future expansion of the air travel industry.

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36 USGS, “Geology of National Parks.”
In the decades following the completion of Idlewild (renamed John F. Kennedy International after Kennedy's death in 1963), air traffic within the area multiplied, and surrounding areas that were previously vacant land have become packed with housing.
This has led to mass contamination of the Bay’s waters, and leads one to question what the future holds for such an environment. While politicians, policy-makers, and scientists were in constant interaction with these issues, scientific imagery was not yet in the public domain at this point in time, and the hundreds of thousands of people living within the vicinity of JFK and Jamaica Bay, while contributing to these issues, were commonly uninvolved in decisions on how to remediate them. Public incorporation in environmental decisions did not become a key facet to the management of Jamaica Bay until the 1960s, at the conjunction of the rise of the Jet Age, Space Age, and satellite remote sensing.

**Satellite Imagery and the Conflict Between Environment and Development**

Robert Moses was prophetic in his 1938 complaint that “Jamaica Bay faces the blight of bad planning, polluted water, and garbage dumping. Are we to have another waterfront slum?” Aerial photography, though at the time only able to provide straight photographs and not much else played the role of placing Jamaica Bay in the wider context urban surroundings, perhaps prompting the city’s first conservation efforts by Robert Moses and Mayor LaGuardia in the 30’s. Satellite imagery took it a step further and moved entirely outside of the subjective, bringing humans together with their impact rather than their mere presence. In an ecosystem that has long been intertwined with the urban jungle surrounding it, the distinction between integration and impact is difficult to make. For this reason, as well as the fact that it happens to be within a growing urban environment with a constant flux of newcomers, changes often go unnoticed unless being constantly tracked. Satellite imagery provides a medium for ceaseless monitoring,

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and its visual nature allows changes to be accounted for instantaneously. Under this paradigm, images produced via satellite remote sensing have been widely used in conjunction with aerial photography to uncover patterns of wetland loss and alteration within Jamaica Bay. Below is a time series of aerial satellite images taken in Jamaica Bay, displaying the mass losses that marsh islands were subjected to between 1974 and 1999. (Figure 21.)

![Salt Marsh Conversion in Jamaica Bay on Elders and Duck Point](http://www.dec.ny.gov/lands/5489.html) (Accessed April 6, 2013)

As resources such as satellite imagery became more readily available and the disturbing ecological state of Jamaica Bay came to public attention, conservation efforts Jamaica Bay became more intensive. In 1972, Gateway National Recreation Area was established as one of two national parks in a distinctly urban setting (the other being Golden Gate National Recreation Area in San Francisco.) Encompassing 26,607 acres across the New
York-New Jersey coast, enveloping Staten Island, Sandy Hook, and Jamaica Bay, it supports 22 million residents within the tri-state region, and accommodates more than 8 million visitors annually. As a federally designated park adjacent to one of the world’s largest metropolitan regions, it is socially and physically intertwined with the politics, culture, and infrastructure of Greater New York. Now, as data and imagery of the Jamaica Bay ecosystem is readily available and used by the public, there is increased public effort to protect the bay. As the ideas of wilderness transformed from that of wasteland to one of spiritual reverence, perceptions of the bay similarly transformed from a location for improvement schemes to a location of cultural significance. The new objective perspective that satellite imagery provides on large-scale land alteration within the bay provides a basis for the need of preservation. Now, as the general public becomes ever more connected with political and scientific decisions, and issues such as sea level rise and climate change become more pertinent, the Bay, and other United States wetlands have entered an era of conservation. In 2005, New York City responded to the marsh loss crisis by developing a comprehensive Jamaica Bay Watershed Protection Plan, in an effort to preserve the bay for future generations. As similar endeavors are taken on worldwide, it has become clear that the public perception of coastal wetlands has indeed completed its transformation into a socially and ecologically beloved environment.

**Conclusion**

A gradient of land and water, political jurisdiction, and social, ecological, and infrastructural contexts—both historical and modern—Jamaica Bay is a site of complex politics. The conflicting management needs for Jamaica Bay are not just a local problem,

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but may be used as an archetype of the numerous problems of environmental
management, control, restoration, and conservation that are faced within many densely
populated coastal environments nationwide. For much of the twentieth century, the bay
has served as a “fringe experiment” for the city’s centralized development,
manufacturing, and capital-intensive projects. Its current restoration and future use will
highlight a shift to an integrated landscape and community-based approach to wetland
use.\textsuperscript{40} Prompted by an increasing scientific knowledge of wetland environments that has
spread to the public sphere via increased interconnectivity and objective visual
representation, Jamaica Bay now serves as a pilot project on urban ecology, mobilizing
stakeholders, park ranger, politicians and scientists alike to create much-needed change
in wetland use in a human dominated environment. Jamaica Bay, like all other urban
wetland environments in the United States must now strike a balance between urban and
natural, community-based and ecologically dependent. This requires a new ethical,
psychological and political agenda. Though still in a sorry state of ecosystem health,
Jamaica Bay’s transformation presents an ideal example of wetland changed from
natural, to industrially dominate, to an appreciated landscape as its visual representation
evolve

\textsuperscript{40} Ibid., 62.
Conclusion

It is only by awareness of the intimate, intricate and varied links among wetlands, human culture, biological diversity and wider environmental characteristics, that it is possible to appreciate fully the complexity of possible future as well as current management perspectives.

—Edward Maltby and Tom Barker, *The Wetlands Handbook*¹

Roderick Nash, in his analysis of the social role of nature to humans claimed “Wilderness does not exist. It never has. It is a feeling about a place… Wilderness is a state of mind.”² The evolution of wetlands from sordid waste to respected ecosystem supports this notion that the American relationship with nature is relative. Indeed, the idea of wilderness is a human construct, developed on the basis of analysis shaped by subjective opinion. Now, in the time of environmental crisis, it has become increasingly necessary to separate ourselves from our subject-minds and engage with the otherness of wilderness. Through analysis of the evolution of visual representation of wetlands, it becomes clear that changes in depiction impelled the process of wetland appreciation.

As Thoreau affirmed, “A howling wilderness does not howl: it is the imagination of a traveller that does the howling.” This insight makes possible a transfer from human destructiveness to a nearly opposite order of motive and interpretation of an environment. Through this perspective, the dangers of wetlands have receded, and wetlands have re-emerged as a herald of ecologic health. The ways that we as a culture choose to represent (or, in the case of wetlands, avoid representation of) our wetland

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surroundings bare witness to the way that they as a landscape are appreciated and utilized socially. As for American wetlands, most of their relationship with the American public has been spent “under the radar”, in terms of both visual representation and land use: consistently overlooked visually, and destroyed or transformed physically. How then did it happen that wetlands became one of the most appreciated and preserved environments in the contemporary era? As visual practice became increasingly objective as it progressed from illustration to satellite imagery, the relationship with nature began to shift from one that encouraged intervention and transformation, to one that rejected it in favor of preservation.

My approach in this thesis was to look at three distinct eras of scientific representation and trace the epistemic virtues and cultural attitudes towards nature that followed. The first was conventional cartography, the illustrated maps that dominated the seventeenth through mid-nineteenth century. The second was the rise of photography and aerial photography/surveying. The third era was the “space age”, with the rise of satellite imagery within environmental science. Each phase had a distinct set of scientific values and ecological ethics that corresponded with them. For illustration—truth to nature; for photography—mechanical objectivity; and satellite remote sensing—trained judgment. These modes of thought provide means to assess the conception of an image, the image of wetlands, because in order to understand the alterations to landscape use and representation, we must consider the greater forces at work in the culture as a whole. On a broader scale, the work done within this thesis can be expanded to consider the evolution of the pervasive nature/culture binary in Western thought.

Up until the nineteenth century, illustrated maps were the dominant form of landscape representation, and truth to nature as an epistemic virtue was the prevailing
modality of scientific thought. It sought to represent not an array of specimens or environments, but, on the contrary, display an “ideal form”, in which a naturalist must extract the universal from the particular. Under this set of values, the “ugly” was an imperfect form, and it was up to the human hand and mind to tame an unruly landscape. Wetlands fell under the title of unruly wilderness, associated with a physical immersion in evils. As long as the characteristic image of the wetland alluded to the negative, their status remained under the control of powerful cultural and theological associations. Wetlands in the seventeenth and eighteenth century thus belonged in the category of “out there”, and were accordingly shunned. Because of the pervasive view of wetlands as wasteland, tangled and impure, wetlands at this time were increasingly transformed for other uses. As so, they were largely excluded from public representation, and their lack of depiction led to the perception that they were disposable landscapes.

In the nineteenth century photography rose to prominence in the United States, its use spanning social, political, and cultural boundaries. Mechanical objectivity developed alongside photography, seeking to counterbalance the pervasiveness of the subjective. The urge to achieve objectivity predated its invention, and the arrival of photography as a scientific medium became a crucial part in this tradition. Truth to nature objectivity became an active practice, and Mechanical objectivity sought to be passive, to allow nature to speak for itself, for only then would the scientific object emerge in its purity. The inventions and innovations of photography influenced the way scientists observed. It restructured the hierarchy of observation, and its use prompted a new scientific culture in which seeing and knowing were inextricably linked. When aerial photography emerged in the early twentieth century, expanding the scope of what could be seen and exposing a detailed depiction of the environment from a God’s-eye view,
two distinct responses occurred. The public exposure to nature was altered through
graphy, in some cases, providing a new view of majestic environments that
prompted an “urge to preserve”, while in other cases, such as that of wetlands, only
furthered their position as dirty tangled wilds. Aerial photography simultaneously
provided incentive for both preservation and destruction, wetlands receiving the short
end of the stick. Aerial photography remained the dominating way of representing the
earth through the mid-twentieth century, and wetlands were accordingly destroyed until
this time, when satellite imagery emerged and revolutionized scientific imaging
technology.

The post-war period integrated the development of military technologies with
information theory and environmental science. The 1950’s brought new technological
innovations, machines with the computational and display potential to mark a re-birth in
data visualization. As satellite remote sensing became the primary medium for
representing the world’s landscapes, the public image of wetland shifted completely. This
mode of visualization prioritized the geographic, and privileged objectivity over a social
experience of a landscape. The epistemic virtue of trained judgment followed in suit,
allowing heightened interpretation of an image in comparison to mechanical objectivity,
thus creating a pathway for the observer to engage with the objective properties of their
personal landscape. Satellite imagery represents “a technology that relies on the social
practices of establishing truth through a particular seeing of space, while on the other
needing to hide those social practices of production to maintain that truth.”

By being removed from the picture through satellite imagery, the human role as a negative

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4 Ibid.
influence on the environment has been re-established, because it is literally all that can be seen.

Now, in the twenty-first century, wetlands have emerged as crucial towards helping society to adapt and moderate the direct and indirect consequences of climate change. Unfortunately, climate change can also exacerbate adverse anthropogenic impacts on wetland areas.\(^5\) As a plethora of environmental problems continues to reveal to us that our current relationship with the environment is inadequate, it is crucial to look to the integrated nature of ecological processes for a new wisdom to sustainability in a continuously expanding human world. For this reason, among others, the future of wetlands is dependent on finding a way of incorporating sustainability into economic and political decision-making. Jamaica Bay, in its transformation from garbage dump to designated national recreation area, and the still increasing conservation focus that this area is receiving provides an example of modern wise use of wetlands, a practice that can be extended to other urban wetland ecosystems worldwide.

Advancements in the mapping and representation of coastal wetlands can been one of the most influential technological improvements in wetland science. Wetland science and management have become further integrated through the use of this technology, and new technological paradigms help to place wetland functioning in the context of current climate change. The onset use of new imaging technology has the potential to identify how wetlands can change with, or adapt to climate current and future change. These changes in perspective include: a wider recognition of the consequences of wetland degradation, recognition of the role of wetlands within policy frameworks, opportunities for wetlands to deliver improvements in the welfare of

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communities, and a scientific focus on wetlands in the conservation movement. The competing needs of wetland preservation and urban development have been a central problem of the modern world. Because the environment is a public resource, increasing public awareness of the changing environment is a necessary precursor of the inevitable adjustment society must make between escalating demands, and the environment’s limited capacity. Wetland imaging can serve as a valuable resource for heightening public mindfulness, and encouraging conservation.

Because seeing is normatively construed as a physiological practice, highlighting the historical construction of these converging visualization practices offer insight into how the social imaginary of wetlands has changed, and shapes relations between observers, and the observed landscape. While it is well known that cultural practice influences visual representation, just the opposite is just as common: representation impacts culture. Henri Lefebvre once stated “every society produces a space, its own space.”6 As society has evolved, the space we have created for ourselves in utilizing nature has shifted and evolved. Now, as technology further advances, what new possibilities and prohibitions exist in how we see and relate to space? In this modern era, in which the observer easily chooses where in the world to look and at what scale through something as simple as a mobile devise or personal computer has given rise to a generation that interacts with their environment in a different way than ever before. The world is now quite literally at our fingertips. This, in conjunction with the rising pressures of global climate change and an increasingly industrialized world could either provoke a relationship to the environment in which the heightened access to the “global

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"view" instills a closeness to nature, or, it could prompt just the opposite, at which point visual interaction with entire world becomes so accessible that people become desensitized to it. American wetlands, in their unique role as sentinel of land and sea, will be fundamentally impacted by whatever path we choose to take. As time progresses, our society will face a difficult choice: to change our wetlands, or to change our culture.

I see what to say: this marsh that hold me
Is the climax of a lake, shallowing, dying,
Filled with he best endeavors of pondweeds,
The exploring and colonizing shapes of a world
Too good at living for its own good,
But in this man-made silence, while wrens and kinglets
Decide what I am and slowly excuse me
For being a moving object with much less use
Than a stump, I learn why I came here
Out of order: in order to find out how to belong
Somewhere, to change where all changing
Is a healing exchange of sense for sense.  

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