OF MUDDY WATERS AND PRESIDENTIAL MEMORIALS: EROSION AND SEDIMENTATION IN THE POTOMAC RIVER WATERSHED

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1 ABSTRACT

This paper tells two paired stories of erosion and sedimentation in the Potomac River basin in the nineteenth century. It describes deforestation and erosion due to iron production in the Shenandoah Valley, the largest area of cleared land in the watershed, and it chronicles the resultant build-up of sediment downstream in Washington, impacting navigation and commerce in the capital. George Perkins Marsh's Man and Nature identified these conditions as part of a long, historical pattern of human impact on the environment, and it galvanized the public, leading to significant conservation of forestlands. Less documented is the response to the sediment that built up in many cities and ports downstream. Tying the two stories together illuminates a larger story about human impact and agency in the environment, showing environmental impacts of human settlement but also showing positive consequences of focused stewardship and design.

1.1 Keywords

Forest history, erosion, sedimentation, Potomac River, Theodore Roosevelt Memorial, George Washington National Forest.

. 2 INTRODUCTION

In December of 1901, just three months after becoming president in the wake of William McKinley's assassination, Theodore Roosevelt submitted a proposal to Congress for a new national forest in the southern Appalachian Mountains. (Roosevelt, 1902; Morris, 2001) There were no federal lands in the east that he could simply designate as a forest reserve, so he sought Congressional approval to purchase privately owned lands and create the first eastern national forest. Just two weeks earlier in his first Annual Message to Congress, the equivalent of today's State of the Union address, he had outlined a bold new conservation agenda, and this forest proposal was among his first tangible steps toward implementing it. (Morris, 2001) Creating a national forest would protect the southern Appalachians from destructive logging, and equally important, would prevent severe erosion of the steep mountainsides and damage to the rivers downstream due to excessive sedimentation.

A month after submitting that proposal, the President and First Lady Edith Roosevelt made their way across the White House lawn to the newly-built Corcoran Museum and reviewed the Senate Park Commission's proposal for "The Improvement of the Park System of the District of Columbia," more commonly known as the McMillan Commission Plan. (Morris, 2001; Senate Park Commission, 1902) The plan established a new vision for the various parks and landscapes of the capital, but its highlight was a bold design for the National Mall extending well beyond the Washington Monument to the newly reconfigured shoreline of the river. This new larger mall would include land that had recently been created by dredging the main channel of the river and filling in mudflats that had formed in the broad shallows at the foot of the Washington Monument. According to the plan, the mall would culminate at its western end in a classical memorial to Abraham Lincoln with a site for a second memorial across the new Tidal Basin that in time would become the Jefferson Memorial. Both these sites had been under water when Pierre L'Enfant first laid out the streets and avenues of the capital city.

These two seemingly unrelated events early in Roosevelt's presidency are tied to one another at a sedimentary level, literally, since each can be seen as a response to a heavy build-up of sediment in the Potomac River over the course of the nineteenth century. Each ultimately led also to the cultivation of a commemorative presidential forest, an indication of the changing role of forests in the American imagination. Roosevelt's call for a national forest inspired numerous national forests in the East, including the George Washington National Forest, which was instrumental in reforesting the headwaters of the Potomac River and mitigating erosion. Downstream, the accumulated sediment in Washington, DC would come to influence the design and ecology of a future memorial to Theodore Roosevelt himself, a forested island in the Potomac, wild in character and in notable contrast to its classically inspired brethren on the National Mall. The Senate Park Commissioners did not propose the island as a site for a presidential memorial, but they did envision it as one of a pair of natural forested islands in the river, a foil to the formal geometry of the Mall. Each of these islands was formed in whole or in part by sediment building up in the river.

This paper examines the history of deforestation, erosion and sedimentation in the Potomac River basin by telling the stories of two specific sites within the watershed: Catherine Furnace in the headwaters of the Shenandoah River and the shallows of the Potomac Flats in the heart of Washington. Grounding the combined problems of deforestation, erosion and sedimentation in specific geographic locations shows how specific actions impacted and degraded the environment, but it also shows the positive and ameliorative impacts of other actions such as reforestation and re-forming the accumulated sediment. It is too easy to condemn humans as the source of environmental harm without also recognizing the positive impacts of human agency in response to environmental damage. Pairing these two specific stories allows for the negative and positive impacts of human agency to be paired as well.

The stories themselves are not new, and this paper draws upon previous histories as a means of identifying sources of erosion, which need to be gleaned from the previous accounts. The paper draws upon histories of the Shenandoah Valley focused on clearing and settlement as well as other documentary and geographic evidence (surveys, maps and photographs) that tie those stories to specific sites. It also combines history of the sedimentation of the Potomac River with detailed maps showing contours of the river bottom to give geographic specificity to the story of the sediment. Retelling and combining these two stories with a focus on these two sites allows the land itself to be an active player in the stories, if not a willing agent, and allows the story of the soil to come to the surface. Furthermore, linking the stories along the gradient of the watershed allows for a different reading, a larger story that shows the connection between actions upstream and downstream and shows the role of human agency in the changing role of forests within the watershed and the nation.

3 EROSION IN THE SHENANDOAH VALLEY

The Potomac is not a particularly large river, but in three hundred miles upstream from Washington, it flows from its source at Fairfax Stone, West Virginia through all the major geologic provinces of the Appalachian region. (Stanton, 1992) As a result, its watershed is surprisingly complex. As early colonists settled in this diverse territory, they cleared the forests, even on mountainous terrain, and much of the soil on that land eroded into the region's rivers and streams, eventually flowing downstream and settling as mudflats in the heart of the capital.

It is difficult to find direct evidence of erosion, even though it was likely ubiquitous when lands were newly cleared, because erosion rarely attracts attention unless it leads to mudslides, sink holes or other dramatic loss of soil. Therefore, constructing a history of erosion is largely a matter of reading between and across scant pieces of evidence, in this case, existing histories of settlement and land use, land surveys, and photographs.

Much of Washington's sediment probably eroded from the rolling lands immediately upriver of the capital in the piedmont district of Maryland and Virginia because there were fewer places where it could settle out before it reached Washington. (Chappell, 1973) However, the greatest amount of cleared land in the watershed was farther upstream in the Shenandoah Valley of Virginia and its less famous counterpart, the Cumberland Valley of Pennsylvania and Maryland. Being more renowned, the Shenandoah has attracted more attention from historians and offers more clues to past sources of erosion.

The Shenandoah Valley had a robust and diversified economy that developed during the eighteenth and nineteenth centuries, but its primary cash crop was wheat. With fertile limestone soils and with rivers and railroads linking it to Washington and other mid-Atlantic cities, wheat farming prospered in the valley, earning its Civil War era moniker "The Breadbasket of the Confederacy." (Koons and Hofstra, 2000) Clearing the extensive forests for farmland and steep stream banks for mill sites would have led to substantial soil loss across much of the terrain, though little of that is directly documented in histories of settlement. (Koons and Hofstra, 2000) More notable at the time was the erosion of mountainsides that were logged for timber, fuel wood, and especially for iron mining and charcoal production.

In addition to wheat farming, the Shenandoah Valley was an important iron-producing region through the early decades of the nineteenth century and again during the Civil War. Iron production was less widespread than farming, but it devastated the forests and mountainsides surrounding the numerous iron furnaces, and this led to remarkable erosion. The combination of heavy impacts to the forests, steep mountains, and steady flowing streams in narrow valleys was a recipe for substantial loss of soil and increased sediment load in the rivers.

A well-documented example is Catherine Furnace on Cub Run in the Massanutten range, a fifty-mile long set of parallel ridges that rise up in the center of the valley and split the Shenandoah River into its North and South Forks. *(Rappleye, 1981)* At its southern end, the ridges are tightly spaced yet broken by enough gaps that Cub Run weaves several parallel valleys into a collective watershed before emerging from a small gap in First Mountain and flowing into the South Fork of the Shenandoah. Catherine Furnace was located right in that gap.

Iron making required several key resources: iron ore, limestone, a steady flow of water, and extensive forests to make charcoal, and these were all readily available in the Cub Run watershed. (U.S. Dept of Agriculture, Forest Service, n.d.; Rappleye, 1981) Like many of the mountains that define the Shenandoah Valley, Massanutten is comprised of ridges of folded bedrock with different strata meeting the surface at different elevations. At various locations in the mountains, layers of iron ore were at or near the surface, and these were the quest of iron speculators, who cleared the forests, stripped the overburden, and sent the soil and surface rock down the slope in an initial erosive act. The ore itself was strip mined and carted downhill to the furnace for smelting. (U.S. Dept of Agriculture, Forest Service, n.d., Cooper, 1991)

Iron ore was smelted in a stone furnace adjacent to Cub Run, the waters of which powered the bellows to stoke the fire. The heat source was charcoal which consumed tremendous quantities of wood but had advantages within the local economy. Compared to coal, which was being used in England, charcoal made a more malleable iron with fewer impurities, and this made it more easily worked by local blacksmiths so it fit well within the decentralized rural economy of the Shenandoah Valley. (Williams, 1989) But charcoal production devastated the forested mountains because many thousands of acres of trees were needed to create enough charcoal to support a single furnace.

Making charcoal involved tending a controlled fire that charred tightly stacked wood without actually burning it up. The skill of the charcoal maker, or collier, was in stacking wood into a dense mass and limiting the supply of oxygen. Too much oxygen would make a "live" fire and consume the wood, but too little would put it out entirely. Colliers packed four-foot logs vertically in three tiers to make a broad shallow dome of nearly solid wood, and the whole structure, except for a narrow central chimney, was covered with dirt and leaves to prevent air from infiltrating the mass of wood. (U.S.D.A., Forest Service, n.d.) Green wood was needed so it wouldn't too burn too quickly, and although some trees made better charcoal than others, colliers and iron masters weren't picky. Woodchoppers cut every living tree in tracts of up to 1000 acres, leaving only deadwood, brush, and trees too small to harvest. It took twenty to twenty-five years for the forest to regenerate and be ready to be cut again, and therefore about 20,000 acres of forest were needed to support a single iron furnace. (U.S.D.A., Forest Service, n.d., Cooper, 1991)

Although mining the ore took a heavy toll on the mountainsides, making charcoal destroyed far more of the forests and their soils. Fires were especially destructive, sweeping the mountainsides in the wake of clearing, sometimes escaping from the charcoal hearth itself. With just dead wood and brush remaining, fires spread rapidly, destroying whatever was left of the forest and stifling its ability to regenerate. The effect of all this mining, cutting and fire devastated the land.

> The mountains were criss-crossed with roads, covered with test-pits and mining operations. Repeatedly wildfires occurred from the charcoal operations, repeatedly burning the young forest. The roads were left to erode and wash away. Conservation was unheard of at that time. Even before the decline of the charcoal iron industry [after the Civil War], a growing population was making demands on the timber, water, and wildlife resources of the forest. By the early 1900s, the forest was in poor condition from overuse and misuse." (U.S.D.A., Forest Service, n.d., p. 13-14)

Catherine Furnace was developed in 1837 at the height of iron production in the valley but shut down in the 1850s along with many other furnaces because the lack of good rail connections to bigger markets crippled production. The outbreak of the Civil War provided a new market, and Joseph Anderson of Tredaker Ironworks in Richmond encouraged all the furnaces to go back into production to supply the Confederacy with iron for rails, cannons, and other wartime needs. (Rappleye, 1981) By the late 1870s, the furnace was closed again when Jedediah Hotchkiss, an engineer from the Board of Immigration, surveyed the whole iron plantation to assess its viability as a place to direct new residents.

> The location of the furnace is an excellent one in reference to raw materials, for iron ore, limestone, and charcoal can all come to it by gravity; the outcrops of the ore and limestone begin within a hundred yards of the furnace mouth, and a dozen square miles of the forest lands of tract "A" are readily accessible, largely by roads already constructed through the numerous parallel and transverse valleys that have their natural outlet by way of this furnace. … The timber resources of this tract are ample to supply perpetually a large charcoal furnace and forges." (as cited in Rappleye, 1981, p. 34)

Since Hodgkiss surveyed the land forty years after iron production began, it is surprising that his assessment of the forest is so positive. Perhaps the intermittent history of iron production had allowed forests to recover enough to resist fires, or that he was exaggerating the case for reopening it. A second survey by foresters in 1912, more than three decades later, described very different conditions. (Clark and Volkmar, 1912) No mention is made of specific additional cutting or degradation of the land in the interim, but they do acknowledge that fifteen to twenty years earlier "the mountains supported a fair stand of timber" which suggests that not all the damage to the forest was due to mining and charcoal production directly. In any case, according to their report the forests were devastated, erosion was rampant, and the land seemed to be in continued decline rather than recovering. And all of this had severe impacts on Cub Run as well.

> At present … there is practically no mature timber left, except a very few culled patches of 5 or 10 acres, or less, where for one reason or another, a clear cutting was not made. This timber has at present little commercial value, and serves only to show the character of the original forest. Mature trees, which are either defective or of inferior species, are scattered widely over the entire tract. The best stands of second growth are found in the coves and on the lower slopes. The ridges are

> often bare of tree growth. … Through overcutting, slopes and ridges have been left bare, and no attempt has been made to dispose of the brush. Fires have inevitably followed the cutting, and have swept over the slopes and ridges, killing most of the young growth. Bare rock and thin soil have as a consequence, been left exposed. …
>
> The removal of the timber and the repeated burnings have materially affected the stream flow. Farmers living near the tract say that during the wet seasons the streams are much higher, and floods are more numerous than they were fifteen to twenty years ago, when the mountains supported a fair stand of timber. Logging roads through the gaps, have been washed so badly by floods, that they are will nigh impassable. In the dry seasons of summer and early fall, springs and wells of the vicinity, which never failed before the timber was removed, now go dry. (Clark and Volkmar, 1912, pp. 5-7)

4 SEDIMENTATION IN WASHINGTON, DC

Regardless of whether soil loss originated from subtle but persistent erosion off of farmland or the dramatic loss of mountainsides, all the eroded soil in the upper watershed had to go somewhere, and the inevitable collecting point for much of it was Washington, DC. Like other cities of the mid-Atlantic, Washington straddles the threshold between two geological provinces, the Piedmont and the Coastal Plain. As the Potomac flows out of the rolling uplands of the Piedmont and onto the flat Coastal Plain, it changes from a relatively narrow and fast moving river to a broad, shallow tidal river, a brackish mix of fresh and salt water. That geologic boundary may not be as sharp as a line on a map, but the threshold is surprisingly evident when the river reaches Georgetown, the area's original port city and the oldest part of Washington. Just upstream, the fresh water of the upper Potomac tumbles over its last set of rapids and joins the tidal ebbs and flows of the Chesapeake estuary. For early settlers, this was the point where fresh, drinkable water met tidal, navigable water, and it was an ideal place to settle, as others had also found in Philadelphia, Baltimore, Richmond, and numerous smaller settlements of the mid-Atlantic. (Spirn, 1984)

But the same conditions that made for good settlement also made for lots of sediment. As eroded soil from farms and mountainsides tumbled down the rapids of the Potomac, the speed of the river kept it moving until it reached the Coastal Plain. At Georgetown the river turned sharply, divided into two channels around Mason's Island, and then broadened to nearly a mile wide, slowing down tremendously and dropping its sediment in the shallow, slower-moving water and gradually accumulating as mudflats that blocked navigation. (Chappell, 1973)

Although erosion in the upper watershed may have gone largely unnoticed and elicited little comment, the buildup of sediment in Washington occurred in plain view, filling up the broad shallows of the Potomac River right at the foot of the Washington Monument. From day to day, the river would not have been noticeably different, but engineers and ship captains were aware of changes in the depth and navigability of the river. All of this weighed on engineers, planners and lawmakers who needed to address the sediment and its impacts on commercial shipping in the capital. (Chappell, 1973)

The accumulation of sediment happened slowly over decades, but the changes are evident in a series of maps of the city that show the channels of the river and the shallower waters between them. (Miller, 2002). As early as 1791, when Pierre L'Enfant proposed his plan for the central mall and radiating avenues of the new capital, sediment evidently was already building up in the river. Andrew Ellicott's modified version of L'Enfant's plan indicates the Potomac's three prominent channels and gives evidence of changes in their flow. (Figure 1) The Virginia channel is shown flowing down the west side of Mason's Island (also known as Analostan Island) and then hugging the Virginia shoreline; the Georgetown channel flows down the east side of the island and then down the center of the river; and the Washington channel flows right along the edge of the city itself, continually scouring at the banks of the new capital and making a good deep harbor along its southwest waterfront. (Chappell, 1973) All three channels converge by the time they reached the southern tip of the city where they are joined by the waters of the Anacostia River flowing in from the east. The current in these channels kept them open for navigation, but between the channels are shallows, perhaps already filling with sediment since settlers upstream were already clearing the forests upstream for agriculture, mills, mining and charcoal production.

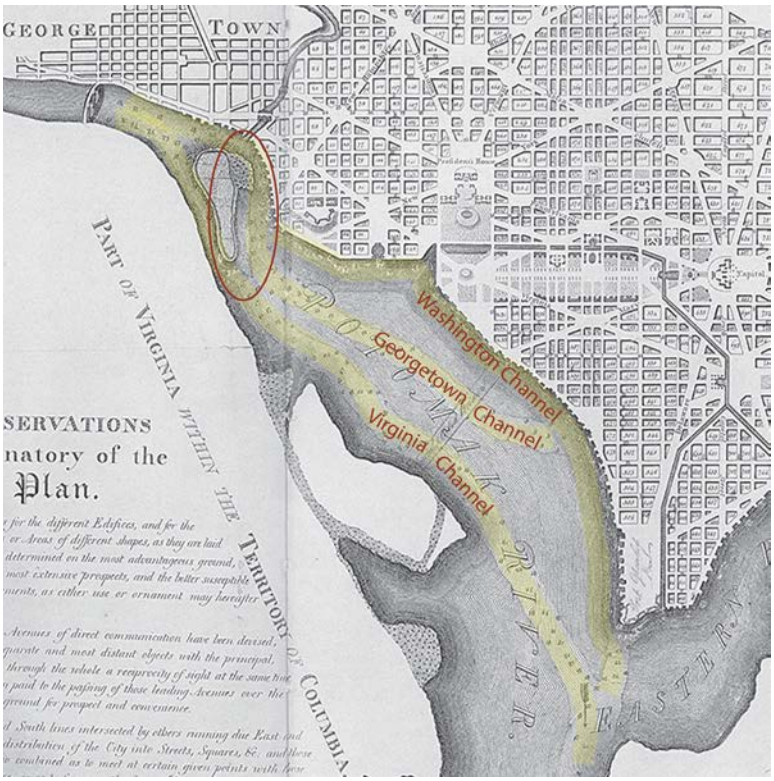

Figure 1. Andrew Ellicott, Plan of the City of Washington (1792), detail.
Colorized by author to show three original channels and sediment on Mason's Island.
Public domain map, Library of Congress, Geography and Map Division, G3850 1792.L4 Vault

In Ellicott's engraving two details at Mason's Island hint at changing conditions of the river. Swampy lowland has established on its northeast shoulder, and immediately adjacent to it downstream, tidal mudflats are visible along the eastern side of the island. This suggests that sediment was already building up even before the city was planned, and it also shows that the island cast a shadow of slower current allowing extra sediment to collect along its eastern edge.

By the early 1800s more sediment was building up below Mason's Island, so engineers constructed a dam connecting the island's northwest corner to the Virginia shoreline. This forced all the water to the east side of the island in the hope that the added current would keep the upper Georgetown channel open and retain access to the Georgetown wharves. (Chappell, 1973) The dam is visible in William James Stone's 1841 map of the "Head of Navigation of the Potomac River," and also visible is a long mudflat along the eastern side of the island. (Figure 2) A second, equally large mud bar has formed along the opposite shore, cutting off the head of the Washington Channel. Each of these mud bars is labeled "Dry at Low Water," but each is just a tip of a larger mud bar below the surface of the river and extending farther downstream. The lower part of the Georgetown Channel had nearly filled in by 1840, and even the lower Virginia channel appears less navigable than in Ellicott's map.

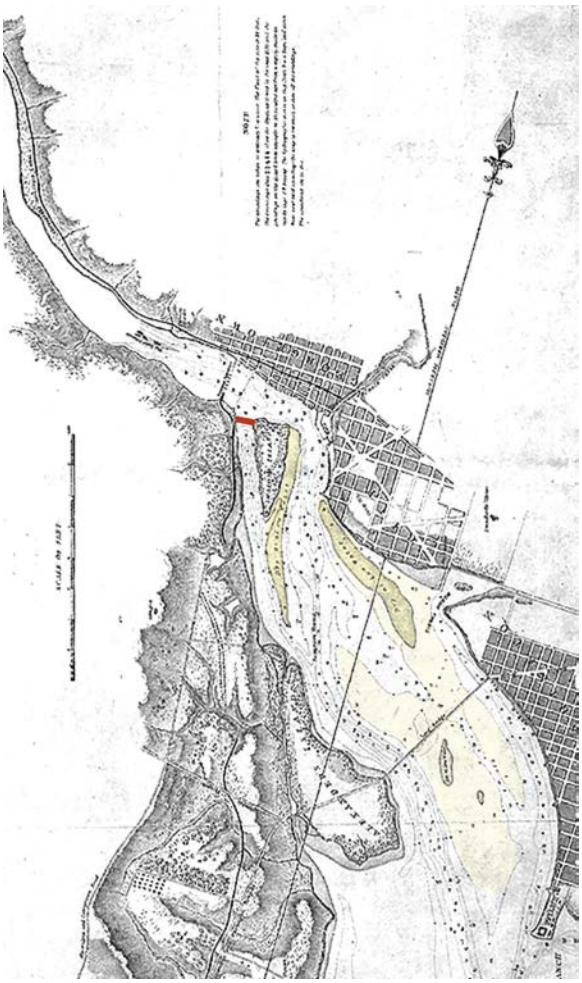

Figure 2. William James Stone, Chart of the Head of Navigation of the Potomac River (1841), detail. Colorized by author to showing new mudflats and dam at northwest corner of Mason's Island. Public domain map, Library of Congress, Geography and Map Division, G3851 P55 1838 .S7

By the start of the Civil War, the entire center of the river was less than four feet deep, and ship captains could no longer navigate directly from the Washington waterfront to Georgetown without sailing downriver first and then returning upstream via the other channel. (Chappell, 1973) This is visible in A. Boeschke's 1861 "Topographical Map of the District of Columbia" which shows an enormous tongue of sediment filling the entire middle of the river with depths marked as shallow as one foot deep. (Figure 3) Major Nathaniel Michler of the U.S. Army Engineer Bureau described the condition of the resultant mudflats.

> At low water the soil is entirely uncovered and has become so firm as to support the weight of a man. This development, unless effected by high freshets or other strong natural causes, will continue more rapidly from year to year; the vegetable matter becoming more firmly rooted, will materially aid in checking any floating matter, and cause the material to be deposited in the river. (as cited in Chappell, 1973, p. 15)

Michler proposed dredging the main channel along the Virginia side to keep it open all the way to Georgetown and also dredging the Washington channel to maintain access to its wharves. He proposed using the dredged material to fill the newly formed "Potomac Flats" so it wouldn't wash back into the deeper water.

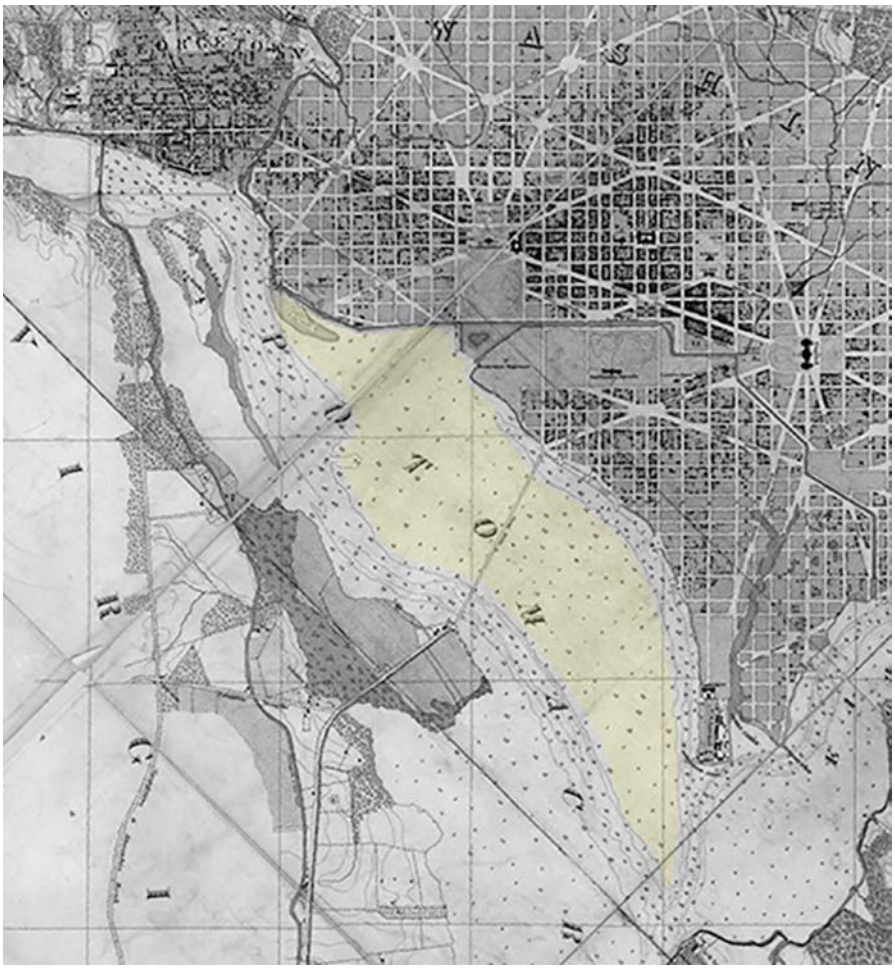

Figure 3. A. Boschke, Topographical Map of the District of Columbia (1861), detail. Colorized by author to show tongue of sediment filling the center of the river. Public domain map, Library of Congress, Geography and Map Division, G3850 1861 .B6 Vault

> In this way the water would be confined to the main channel; the flats, now so detrimental to the city, would be reclaimed, and the material taken out could be employed to some useful purpose, instead of being deposited in the river, as had hitherto been the case, to one side or the other, only to be washed back by the current in some succeeding freshet. (as cited in Chappell, 1973, p. 16)

Michler's proposal was not adopted, and instead the Virginia and Washington channels were conventionally dredged in 1874 and 1875 with the dredged material simply moved to the side where it could wash back into the channel. Just two years later in 1877, the largest flood up to that date deposited up to six feet of new sediment and "undid virtually all of the work that had been done to improve navigation on the river." (Chappell, 1973, p. 19)

The flood of 1877 made it necessary to dredge again, immediately, but it also made it clear that a definitive plan for the river was needed. In addition to Michler, several engineers had proposed plans for the river, and in 1882 an Army Corps of Engineers commission approved a composite of several of them. (Figure 4) The plan proposed filling in the eastern half of the river, giving it a new shoreline with a long, gentle 'S' curve, culminating in a long peninsula along the flats that would keep the Washington Channel open. The peninsula would protect the channel from new sedimentation, and a tidal basin at its head would wash it clean with every change of tide. (Chappell, 1973) As the tide rose, water would fill the basin through

its southern gate, dropping its sediment in the basin's still waters, and then as the tide fell, clear water would flow out the eastern gate to keep the channel clear and navigable.

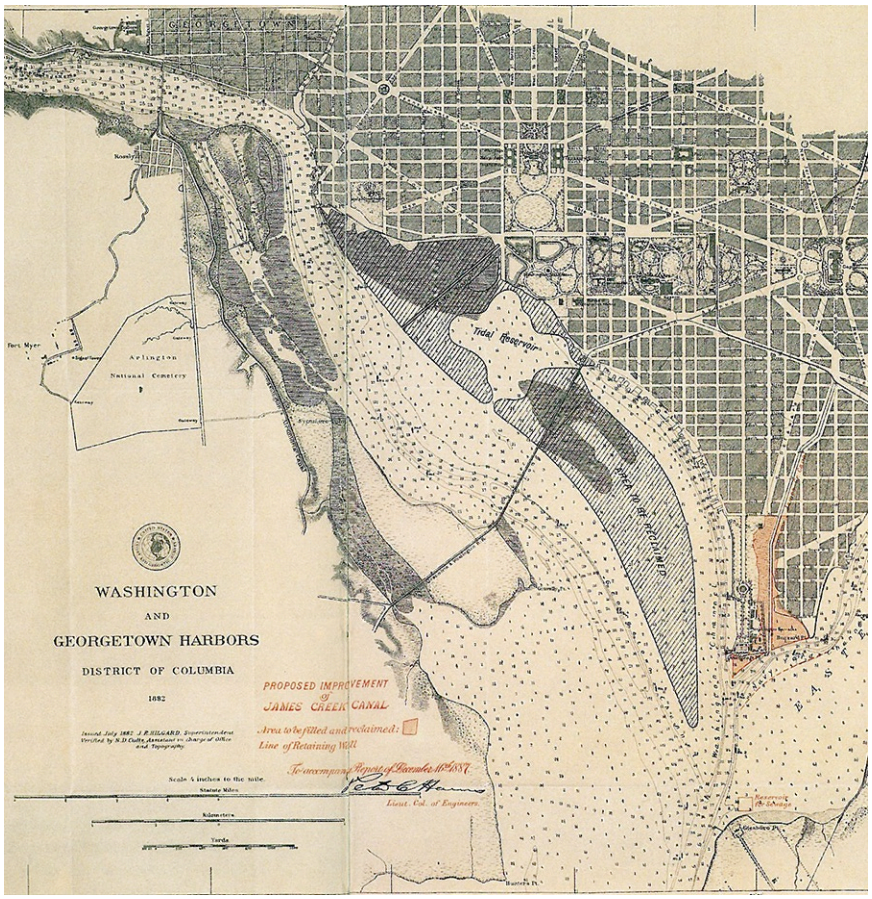

Figure 4. J. E. Hilgard, Washington and Georgetown Harbors, District of Columbia (1861), detail. Proposed areas to be filled with dredged material, original coloration. Courtesy of The George Washington University Museum, Washington DC, AS 551, The Albert H. Small Washingtoniana Collection

Of course lines on a map do not instantly translate into firm ground under foot, and it would take nearly thirty years before the river was dredged and the new land had been completely filled as shown in the plan. At first, contractors used clamshell dredges that would take a bite out of the bottom of the river, place it on a waiting barge that would dump it next to a newly built railroad trestle. From there, it would be dredged again and put into a railroad car that hauled it to the fill zone. This was slow and expensive, so contractors developed a new system of hydraulic dredging that was much quicker and cheaper. A huge vacuum-like hose could suck up soil and water from the bottom of the river and pump it directly to where they wanted to place it. The outflow was mostly water, so riprap walls were built to contain it while the water drained off and the mud settled. The whole process was quicker and cheaper, and the suction left a smoother river bottom. (Chappell, 1973)

The contractors filled above the high tide point, achieving a rough draft of the new waterfront, but the question remained of how high to build the land. At the start of dredging, the plan was to fill to a level three feet higher than the flood of 1877, but in 1889 the largest flood on record elevated the river three feet higher than in 1877 so the final elevation of the filled lands was raised yet another three feet. New sea walls were constructed along the earlier riprap ones, and this gave a more formal, vertical edge to the river. All of this refinement took much longer than the initial dredging, and twenty-one years later in 1911 the long peninsula along the Washington Channel, the last piece of dry, solid land to be finished, was turned over to the Office of Public Buildings and Grounds. (Chappell, 1973)

5 A WIDER ENVIRONMENTAL PROBLEM

Deforestation of the upper watershed and the build-up of sediment in Washington were not unique to the Potomac River or even to modern times. George Perkins Marsh's best-selling book of 1864, *Man and Nature, Or Physical Geography as Modified by Human Action,* described this as a recurring phenomenon throughout the newly settled regions of the United States and with precedents dating back to classical times. (Marsh, 1864; Lowenthal, 2000a) A native Vermonter, Marsh witnessed the clearing of his home state's forests during his childhood in the early 1800s and the resulting erosion of soil into the region's rivers. Later, as a foreign minister in Turkey, Greece, and Italy in the mid-1800s, he found the same problem had beset cities in the eastern Mediterranean after ancient Greeks and Romans had cleared their mountains of forests. Rivers silted in, and cities struggled to keep their harbors open. (Lowenthal, 2000a)

In *Man and Nature,* Marsh synthesized his personal observations in Vermont with historical information from the eastern Mediterranean and contemporary scientific research, and he identified and articulated the link between deforestation, erosion and sedimentation.

> With the disappearance of the forest, all is changed. The face of the earth is no longer a sponge, but a dust heap, and the floods which the waters of the sky pour over it, hurry swiftly along its slopes, carrying in suspension vast quantities of earthy particles which increase the abrading power and mechanical force of the current, and, augmented by the sand and gravel of falling banks, fill the beds of the streams, divert them into new channels and obstruct their outlets. The rivulets, wanting their former regularity of supply and deprived of the protective shade of the woods, are heated, evaporated, and thus reduced in their summer currents, but swollen to raging torrents in the autumn and in spring. From these causes, there is a constant degradation of the uplands, and a consequent elevation of the beds of watercourses ... The channels of great rivers become unnavigable, their estuaries are choked up, and harbors which once sheltered large navies are shoaled by dangerous sandbars. (Marsh, 1864, 186-7)

Marsh's warnings were not abstract ideas observable only in distant places or in past time periods but were very evident in the immediate landscape. Farmers downstream from Catherine Furnace complained of dangerous floods and their wells running dry after the forest had been destroyed on Massanutten, and in Washington the problem of sedimentation clogging the harbors was plainly evident. The record setting floods of 1877 and 1889 occurred when the watershed was at the peak of deforestation and not long after Marsh's book was reprinted, and the immediacy of such events probably contributed to the success and impact of the book. Like Rachel Carson's *Silent Spring,* published ninety-nine years later, it galvanized the population, and combatting deforestation became the leading environmental cause of the late nineteenth century. (Lowenthal, 2000a) As stated in the beginning of this paper, Theodore Roosevelt's proposal for a national forest in the southern Appalachians and the Senate Park Commission plan for the park system of Washington are direct responses to the environmental consequences of deforestation in the watershed and sedimentation in Washington.

Roosevelt's national forest proposal was clearly influenced by Marsh's writing. To make the link between deforestation, erosion, flooding and sedimentation, it paired images of erosion on steep deforested mountainsides with images of rivers and farms severely damaged by flooding and sedimentation. With language reminiscent of *Man and Nature* the report plainly described these conditions in the accompanying text.

> The soil, once denuded of its forests and swept by torrential rains, rapidly loses first its humus, then its rich upper strata, and finally is washed in enormous volume into the streams, to bury such of the fertile lowlands as are not eroded by the floods, to obstruct the rivers and to fill up the harbors on the coast. More good soil is now washed from these cleared mountain-side fields during a single heavy rain than during centuries under forest cover." (Roosevelt, 1902, p. 4)

The southern Appalachians were the likeliest location for a new eastern national forest. They are the largest mountainous region in the east and are blanketed with the most substantial deciduous forests in the nation, forests that were still largely pristine and unlogged when Roosevelt took office. The

combination of steep mountains, narrow valleys and heavy rainfall made them particularly susceptible to devastating erosion if logged irresponsibly, and the devastation would be especially severe in the agricultural valleys downriver from the mountains and all the way to the harbors at the mouths of the rivers. (Roosevelt, 1902)

Roosevelt's proposal, drafted by Secretary of Agriculture James Wilson and his assistant Gifford Pinchot, aimed to protect the forests and mountains from the uncontrolled industrial logging that was encroaching upon the region. In keeping with Marsh's argument, it stressed that deforestation would devastate the rivers flowing out of the mountains, as well as the adjacent farmland and the harbors downstream. As Roosevelt made clear in his introduction, the relationships between mountains, forests, rivers and farmland pointed to "the necessity of protecting through wise use a mountain region whose influence flows far beyond its borders with the rivers to which it gives rise." (Roosevelt, 1902, p. 3)

For all of the strength of its argument, Roosevelt's proposal was not adopted during his presidency, however ten years later Congress passed the Weeks Act in 1911 authorizing the purchase of lands within designated boundaries from willing sellers for the creation of numerous eastern national forests. (Satterthwaite, 1991) Part of one such proposed forest, the Shenandoah National Forest, were the lands of the Massanutten range, and in 1912 one of the very first purchases of eastern forest land was a 17,000 acre property near the southern end of Massanutten, land that had been devastated by iron mining and charcoal production for Catherine Furnace. (Satterthwaite, 1991)

Simply purchasing the land was not enough to protect the forest and restore the watershed, however. As evidenced in the Forest Service's 1912 survey of the property, the forests and mountainsides were not regenerating, and appeared to be in further decline thirty-five years after iron production stopped. (Clark and Volkmar, 1912) It would take significant effort to restore forests on the eroded mountainsides. After purchasing the property, the Forest Service implemented a series of management practices that amounted to continuous acts of cultivation of the forest, including fire suppression, erosion abatement, and planting of seedlings. Massanutten was the pioneer district with regard to several key management and restoration practices. It was the first district to receive fire towers to spot fires and aid in suppressing them, and during Franklin Roosevelt's presidency, the first camp of the Civilian Conservation Corps was established on Massanutten, appropriately named Camp Roosevelt. Its workers constructed erosion control structures and planted seedlings across the newly acquired Forest Service lands. (Satterthwaite, 1991) Due in large part to these efforts, Massanutten is blanketed with forest today, and its soils no longer erode dramatically into the Shenandoah River and down the Potomac to Washington.

Roosevelt's national forest proposal was a direct response to the erosion in the Potomac watershed and others like it along the eastern seaboard. The Senate Park Commission plan for the park system of Washington is a less obvious response to the erosion, but it was motivated at least in part by the need to decide what to do with the newly filled land in the heart of the city. While the land's fate as part of the National Mall seems inevitable from today's perspective, it was far less obvious in the late 1800s as dredging was still creating the new waterfront of the capital. Railroad companies wanted the land for new rail yards, developers wanted to expand the city's core, and President Grover Cleveland thought it would be good for use as vegetable farms to grow food for the city's residents. But in the end he signed Congressional legislation to make it parkland. (Chappell, 1973)

Architect Daniel Burnham and landscape architect Frederick Law Olmsted, Jr., were the lead planners on the commission, reprising the role played by Burnham and Olmsted, Sr. in the design of Chicago's World's Columbian Exposition in 1893. The baroque grandness and neo-classical architecture of that exposition were an important influence on the proposal for the mall with its white limestone museums and monuments, but so was the presence of another feature of the Chicago fair. In the midst of all the architectural splendor of the fairgrounds, Olmsted, Sr. had included a small forested island, the Wooded Isle, as a natural respite in the heart of the fairgrounds. The island became the site of the Japanese pavilion, which fit traditional Japanese architecture among the trees and still served as a respite in clear distinction from the neo-classic architecture of the rest of the constructed lagoon. (Howett, 1993)

While the fair was in full swing and attracting thousands to the "White City," and while dredgers were filling the future grounds of the national mall, Mason's Island, now called Analostan Island, was gradually accumulating sediment along its eastern side and also downstream in the quieter water protected by the island. In the Senate Park Commission plan, Olmsted, Jr. proposed Analostan Island to be a forested island in contrast to the neo-baroque splendor of the mall, much like his father had proposed the Wooded Isle at the Chicago World's Columbian Exposition. In the plan, a second island, separated by a narrow

channel and created entirely through sedimentation, extends Analostan Island downstream, so that it would form the backdrop to views of the Lincoln Memorial and the National Mall. (Figure 5)

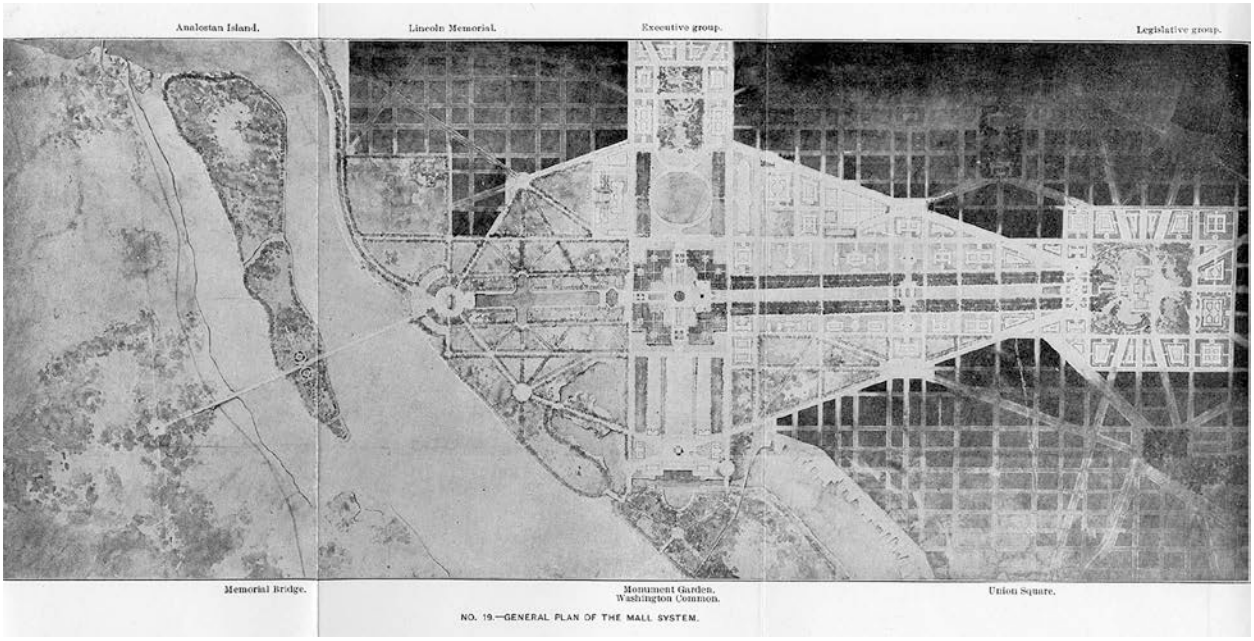

Figure 5. Senate Park Commission, General Plan of the Mall System, (1902). Showing Analostan Island enlarged and extended with sediment. Public domain map courtesy of U.S. Commission of Fine Arts.

As with the forest on Massanutten, the woods of Analostan Island needed cultivation. The island had once been a plantation and summer home of George Mason IV, the son of a founding father, who used the island to help develop suitable agricultural plants for the new nation. Mason abandoned the island in 1833, and afterward it had been used for a variety of purposes, including military training for African American troops in the Civil War, and its vegetation had apparently been frequently and variously disturbed throughout the nineteenth century. (National Park Service, 2010) Simply put, the vegetation was not a rich forest as depicted in the Senate Park Commission's plan.

In 1932 the island was rechristened Theodore Roosevelt Island as a living memorial to the former president known for his conservation agenda and his various exploits in the wild lands of the Adirondacks, the Dakotas and beyond. Frederick Olmsted, Jr. developed a plan for reforestation that included removal of undesirable vegetation and planting of species that would grow into a typical forest of the mid-Atlantic coastal plain and piedmont. His plan included an open lawn on the southern end of the island with a low retaining wall acting as a plinth to the forest itself. The wall's proposed inscription identified the island as a memorial to Roosevelt: "This island is given to the people as a living memorial to Theodore Roosevelt President of the United States Lover of Nature Leader of Men." (Olmsted Brothers, 1947) Although Olmsted's full design was not built, during the 1930s workers from the Civilian Conservation Corps cleared and planted the island following his plan, redirecting its path of succession. Other disturbances, including frequent flooding of the lowlands, construction of an interstate highway bridge across the island, and construction of an architectural monument to Roosevelt in the middle of it, have continued to alter the vegetation, yet the trees still have established and grown into a surprisingly diverse forest overall. Mature upland woods grow on the original high ground, and floodplain forest and open marshland cover the sedimented lowlands. And it does indeed serve as a bit of a respite from the city as envisioned by Olmsted, Jr. (National Park Service, 2010)

That same year, 1932, was George Washington's 200th birthday, and as one of the many acts of commemoration, the Shenandoah National Forest was renamed the George Washington National Forest, in part to distinguish it from the newly created Shenandoah National Park along the adjoining Blue Ridge. The name change was also likely seen as a fitting commemoration of Washington, whose associations with

trees and forests were being celebrated as part of his bicentennial. Working with the George Washington Bicentennial Commission, the American Tree Association called upon Americans to plant ten million trees in Washington's honor and included detailed instructions on the selection and planting of trees to commemorate Washington.

> The most fitting of all memorials is a living one – a tree. Every individual can plant a tree. Boards of Trade, civic organizations, women's clubs, men's clubs, boys' clubs, can plant groups of trees or avenues of trees. National organizations can conduct sectional planting of groups of trees and of forests. Towns can plant town forests, states can further extend and plant state forests. In a word trees and forests are the type of memorials, which not only appeal to everyone, but which the father of our country himself would doubtless declare the most fitting memorial. (Pack, c. 1930, preface)

The group's charge to plant trees invoked Washington's personal connections with trees and forests but also his patriotism and desire for national self-sufficiency.

> As a lumberman, a woodsman, and a surveyor, Washington knew the value of trees. He would be surprised could he now see what tremendous depletion of our forest resources has taken place in 200 years. As a statesman, with the future of his country ever in mind, he would be a most earnest advocate of the restoration of our forests wherever economically possible. He would realize that the nation must become forest minded. (Pack, c. 1930, preface)

On the back cover of the guide to planting commemorative trees, the American Tree Association invoked Theodore Roosevelt, under the heading "The Part of Good Citizens", to stress the importance of planting trees.

> A people without children would face a hopeless future; a country without trees is almost as helpless; forests which are so used that they cannot renew themselves will soon vanish, and with them all their benefits. When you help to preserve our forests or plant new ones you are acting the part of good citizens. (as cited in Pack, c. 1930, back cover)

Roosevelt's quote underscores the links between these presidential forests, up and downriver in the Potomac watershed, and they signal an important change in the role of forests in the national landscape. Less than one hundred years earlier, forests were being cut rampantly on steep mountainsides, which were eroding and filling up waterways with sediment. By 1932, these same forests had regenerated due in part to conscious human cultivation and were deemed to be of enough value to commemorate beloved presidents. Being consecrated in this manner gave the forests added stature, stamping them with a seal of approval that testified to the changing perception of forests in the American imagination, and the numerous acts of cultivation and conservation that revived the forests as part of the watershed. No longer a resource to be exploited, they were valued for their role in protecting the watershed and as larger symbols of our nation, including right in the heart of the capital.

6 A RIVER RUNS THROUGH IT

As individual tales, the story of deforestation, erosion and reforestation of the Massanutten range and the sedimentation, filling and transformation of the Potomac Flats into the extension of the National Mall are compelling accounts of environmental change. But pairing them upstream and downstream from each other within the watershed offers a wider geographic perspective and yields different insights. Specifically, it allows the extension of the national mall in Washington to be equated with the reforestation activities upstream as responses to a particular environmental problem, and consequently it sheds different light on the important roles of human agency in modifying the environment.

George Perkins Marsh wrote in a time when he could assume that most of his fellow citizens would feel a sense of stewardship to the land, at least in part due to a shared religious belief that man's role was to exert dominion over the earth. (Lowenthal, 2000b) Until he published *Man and Nature*, most people assumed that human impacts improved the earth or were at least benign, and perhaps the greatest significance of his book was in disproving that assumption. According to Marsh's biographer, David

Lowenthal, (2000a) many Americans still felt a responsibility to steward the earth, and this led to significant steps toward restoring and preserving forests and planting trees. This included the inauguration of Arbor Day in 1872; creation of the Adirondack Forest Preserve in 1885 with Marsh acting as an important advocate for its preservation; the founding of many eastern national forests and implementation of reforestation practices after the passage of the Weeks Act in 1911, and the call in 1930 by the American Tree Association to plant ten million trees in honor of Washington's 200th birthday.

All these ameliorative acts are part of the stewardship response by people at all levels of citizenry in light of a pressing environmental problem. It would be easy to leave the story there, but following the sediment downriver to Washington, as Marsh himself had done, leads to a different component of the problem and a different outcome. In Washington, amelioration was not an available response unless the sediment were to be hauled back upriver to the headwaters. By contrast, filling the flats and extending the mall were creative and inventive acts making new land and eventually new national landscape from the literal spoils of the deforestation upriver. In a different era, that new land might have been developed as fully commercial waterfront, or instead the sediment may have been formed into a set of forested islands and braided channels instead of extending the mainland. Such alternatives point to the creativity involved in forming the river into its current S-shaped profile.

It is important to see this creative agency as part of the response to the problem of deforestation, and that is the benefit of pairing these stories up and downriver. Just as Marsh's wide geographical lens showed that the impact of human modification of the earth was cumulatively destructive and not benign, a wider lens in the Potomac watershed joins the ameliorative and creative responses to the problem of deforestation. Acknowledging the creative response is important because it counters the more modern legacy of *Man and Nature* that finds *only* negative impacts of human actions on the environment. (Pollan, 1991) Marsh himself did not lose his optimism, according to Lowenthal, but it is harder to find similar optimism today in the face of such pressing issues as climate change and mass extinction of species. Although these seem like overwhelming global issues today, so too did the problems that Marsh identified in his time. (Lowenthal, 2000b)

This is not to suggest that all creative acts are good simply because of their creative agency; the filled lands of the National Mall have their own set of environmental problems (continued settling of fill, a vertical hard edge with little habitat value, etc.) and with rising sea levels it's possible that the entire filled area could one day become part of the river again. But those environmental problems do not discredit the meaning to the nation that the new land has added as a site of national commemoration, public demonstration, individual grieving at war memorials, and recreation along the river, including the respite offered at Theodore Roosevelt Island.

What the creative agency affords is the possibility of inspiring new attachments to the land and to the forest, attachments which invite people to care more about the environment. As Lowenthal puts it,

To be valuable enough to care for, the environment must feel truly our own, not merely a commodity but integral to our lives. Like our forebears and our heirs, we make it our own buy adding out own stamp, now creative, now corrosive. The environment is never merely conserved or protected; in Marsh's terms, it is modified – both enhanced and degraded – by each new generation. We should form the habit of lauding, not lamenting, our own creative contributions to the environment. Learning to praise, we become more apt to makes changes that we and our successors feel worthy of praise. (Lowenthal, 2000b)

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