

**Sea Level Rise, Stormwater Management,
and the National Flood Insurance Program**
How Norfolk's best management practices can
lower local flood insurance rates

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About the Author

Anna Killius, J.D. recently graduated with honors from William & Mary Law School where she served as Technical Coordinator for the Bill of Rights Journal and and Coordinator of the Constitutional Conversations adult education program. While a law student, she interned with the National Aeronautics and Space Administration and the Chesapeake Bay Foundation. In 2010, she graduated, magna cum laude, from the University of Dallas, Phi Beta Kappa, with a Bachelor of Arts in History and a concentration in Applied Mathematics.

About the Virginia Coastal Policy Clinic

The Virginia Coastal Policy Clinic (VCPC) at William & Mary Law School provides science-based legal and policy analysis of environmental and land use issues affecting the state's coastal resources and educates the Virginia policy making, non-profit, legal and business communities about these subjects.

Working in partnership with Virginia scientists, law students in the clinic integrate the latest science with legal and policy analysis to solve coastal resource management issues. Examining issues ranging from property rights to federalism, the clinic's activities are inherently interdisciplinary, drawing on scientific, economic, and policy expertise from across the university. VCPC has a strong partnership with the Virginia Institute of Marine Science (VIMS) and Virginia Sea Grant.

VCPC is especially grateful to the Virginia Environmental Endowment for providing generous funding to establish the clinic in fall 2012.

A Note from the VCPC Director

VCPC received funding from the Virginia Environmental Endowment to produce a series of white papers analyzing legal issues Virginia localities may face as they respond and adapt to increased flooding caused by sea level rise. To focus the students' analysis, we selected two Virginia jurisdictions—Norfolk and Poquoson—to analyze. The students utilized facts from published reports and press accounts to inform their work. Although we focused on these two jurisdictions, the issues raised are broadly applicable to similarly situated cities in Virginia. The reader should be aware, however, that the legal issues that county governments may face might be different from those in the city government context.

Future work is likely to involve interviews, additional analysis, and engagement with the broader policy community about some of the issues raised. Adapting to flooding and sea level rise is a complex area. We have not identified all of the possible legal issues that may arise. Nor have we necessarily answered every possible legal question as part of the analysis that was conducted. We hope, however, that our white papers begin to answer some of the threshold questions facing Virginia localities at this time. We also anticipate that they lay the groundwork for in-depth work and identify areas of needed discussion and additional research. We therefore welcome any feedback on our work.

Finally, a special thanks goes to Erica Penn, a rising third-year law student and Virginia Sea Grant Summer Fellow, for source-checking and editing this white paper. VCPC is also grateful to Virginia Sea Grant for funding the VCPC Summer Fellow program at William & Mary Law School.

Overview

Last year, Congress amended the National Flood Insurance Program (NFIP) to make it financially soluble in the face of expensive natural disasters like hurricanes Katrina and Sandy. While the amendments are good news for the future of the NFIP, they will soon have a striking impact on flood insurance policy owners around the nation. Some may see their premiums increase by as much as 25% per year until their rates reflect the actual, unsubsidized risk their properties face from flooding.

This is especially troubling news for the city of Norfolk, where over 12,000 flood insurance policy owners, the second most in the state of Virginia, will see their rates rise in the next few years. And as rates are rising, so too are the flood waters. Conservative estimates show the Hampton Roads area seeing 16 inches of sea level rise in the next 50 years, putting greater pressure on Norfolk's outdated stormwater management system.

Soon, one hundred year storms may come every twenty-five years, ten year storms every two.

But Norfolk is not without hope. In fact, it has already begun laying the groundwork. Norfolk has announced a four-fold strategy to control the effects of flooding through planning, preparation, mitigation, and communication. The city is also proposing several changes to its current floodplain regulations. Some of these changes include increasing setback requirements and lengths of freeboard (from one to three feet), prohibiting the construction of subgrade crawl spaces, and modifying the method of measuring structure height.¹

The city has even dedicated \$6 million per year for capital projects that promise to reduce flooding in the area. In May 2013, Norfolk was selected by the Rockefeller Foundation to participate in a project to develop a resilient urban stormwater infrastructure system. But as estimates for total stormwater improvements reach over \$560 million, Norfolk will need to approach this problem with an eye towards ensuring the most return on its investment.

Norfolk needs to make smart decisions that put each dollar to work in more than one way. Right now, city planners have the opportunity to choose mitigation options that qualify as credited activities under the National Flood Insurance Program (NFIP). In fact, several of the stormwater management efforts Norfolk currently practices under the Virginia Pollution Discharge Elimination System (VPDES) may be an untapped source for credit it already deserves. The city could also potentially earn additional credits if its current proposal to update floodplain regulations is approved. Although this paper focuses primarily on stormwater management activities, by preserving wetlands and open space, Norfolk can also minimize flooding risks and earn credits under the NFIP. These options will be discussed in future white papers. In short, through coordinated actions, the city can conserve its resources while simultaneously address flooding, and insurance rates, and even non-point source pollution – good news in the face of rising waters.

Things to Know

- Norfolk should plan for 16 inches of sea level rise in the next 50 years.
- Norfolk's 12,000 flood insurance policy owners may see rates increase by as much as 25% per year.
- Norfolk can reduce flood insurance rates by lowering its Community Rating System (CRS) rating.
- CRS credits can be earned through stormwater management projects.

Understanding the Risk

Sea Level Rise

Of the ten most significant storms in the history of Hampton Roads, six have occurred in the last 15 years.² Two in the past decade have reached water levels that should only occur once every one hundred years.³ The increased frequency of major flood events is startling but not a surprise. Since 1933, the relative sea level measured at Sewell's Point off the coast of Norfolk has risen by 14.5 inches. But scientists from the Virginia Institute of Marine Science (VIMS) recently released a cautionary report—coastal sea levels are now rising more rapidly than previously anticipated.⁴ For a century, sea level rise at Sewells Point was 50% greater than other mid-Atlantic locations.⁵ But in the last decade, the rate of sea level rise has ballooned to 1.5 times its previous level.⁶

To complicate the problem, as the seas continue to rise, the land subsides. Because of its proximity to the Chesapeake Bay impact crater, Hampton Roads is sinking more than half an inch per decade.⁷ Consequently, VIMS scientists warn that in the next 20 to 50 years, the Hampton Roads area could see relative sea levels (the combination of rising waters and sinking land) rise by 1.5 feet.⁸ By 2100, our region could experience sea level rise anywhere between 1.5 and 7.5 feet.⁹ Their recommendation: Virginia needs to prepare for at least 16 inches by the year 2050.¹⁰

The dangers of sea level rise extend beyond moving shorelines and disappearing beaches. Rising tides increase the size and devastation of storm surges. With only one foot of sea level rise (six inches below the suggested planning level), one hundred year flood events will occur three times as often, or approximately once every thirty-three years.¹¹

An Outdated Stormwater Management System

Norfolk's aging drainage infrastructure could quickly intensify the problem. Despite over 1,800,000 feet of pipes, 28,000 structures, 260,000 feet of ditches, 10 pumping facilities, and one pump station, the Norfolk drainage system is simply not equipped for the increased frequency of destructive flood events.¹² Much of Norfolk's stormwater system is over 60 years old. Originally, it was designed for the type of rain storm that occurs once every two years.¹³ In 2000, it was retrofitted to handle the ten year storm – a ten year storm that may now occur every three years.¹⁴

Additionally, Norfolk risks finding many of its storm drain outlets, or outfalls, underwater as the sea levels continue to rise. This phenomenon is called tail water. When outfalls are partially or completely submerged, stormwater is unable to travel out of the city, increasing the level and duration of floods.¹⁵ Fugro, a Dutch engineering firm contracted to research the effect of tailwater on flooding in the Hampton Roads area, estimates that with six inches of tail water rise and one foot of sea level rise 100 year storm surges could occur once every 25 years, 10 year storm surges every 2 years.¹⁶

Norfolk Becomes Proactive

Faced with this growing risk, Norfolk has begun to prepare for sea level rise and increased flooding. The city has a four-fold strategy, including efforts to plan for, prepare for, mitigate the effects of, and communicate about flooding.¹⁷ In order to plan for flooding, Norfolk has contracted studies by Fugro, Timmons Group, and Moffat & Nichol.¹⁸ These firms have identified the city-wide flood risk and assessed potential mitigation efforts for four vulnerable communities: The Hague, Pretty Lake, Mason Creek, and Spartan Village.¹⁹ These mitigation efforts include infrastructure, land use regulations, building regulations, and property purchases.²⁰

The Timmons Groups completed a City-wide drainage study evaluating the need for and cost of stormwater drainage improvements.²¹ The engineering firm estimates it will cost \$561,645,000 to update Norfolk's stormwater drainage and roadways, not including changes to the existing outfalls.²² In response, the city of Norfolk has set aside \$6 million per year to flood mitigation capital projects, including stormwater management improvements.²³ Additionally, the city is attempting to reach out to and inform the public through a citizen input group and a flooding website.²⁴

The city of Norfolk has taken crucial steps on the path towards flood preparation and mitigation, including the current proposed changes to its floodplain regulations. Despite these efforts, there is clearly much more to do. Recognizing this, the city is currently proposing significant changes to its floodplain regulations. The pronounced gap between estimated total cost and the funds allocated so far is a sign of the amount of work ahead. But public funds are not all that is at stake. With recent changes to the National Flood Insurance Program, residents will see the impact of higher flood risks reflected in their own rising insurance policies.

Rising Waters and Rising Rates: the National Flood Insurance Program

The city of Norfolk has a total of 12,360 flood insurance policies, the second highest in the state of Virginia.²⁵ This means over twelve thousand residents could face higher flood insurance premiums as frequent flooding becomes increasingly expensive to address. While Norfolk cannot completely insulate policy owners from these rising rates, it can take steps to secure higher discounts for its residents, easing the burden.

The National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) was created in 1968 to “mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally backed flood insurance protection for property owners.”²⁶ Owners of pre-existing structures were grandfathered in to the program, protected from having to comply with new ordinances and urged to participate in the insurance program with subsidized rates lower than the actual risk.²⁷ The grandfathering and subsidizing policies continued to insulate existing properties, despite changing risk assessments, making the program financially unsound.²⁸

In 2012, Congress amended the NFIP to “eliminate some artificially low rates and discounts which are no longer sustainable.”²⁹ According to the Federal Emergency Management Agency (FEMA), “[m]ost flood insurance rates will reflect full risk, and flood insurance rates will rise on some policies.”³⁰

Under the new Flood Insurance Reform Act of 2012, existing primary residences will keep their subsidized rates until the property is sold, the policy is allowed to lapse, the property suffers severe or repeated flood loss, or the property owner purchases a new policy.³¹ For all other properties, insurance rates will experience a phased increase until they reflect the actual flood risk.

As of January 1, 2013, policy rates for non-primary residences (insured or insured’s spouse inhabits property less than 80% of the policy year) increased annually by 25%.³² On October 1, 2013, properties that experience severe or repeated flooding and business properties in Special Flood Hazard Areas will also have insurance rates increase by 25% annually.³³ Finally, in 2014, if the local community updates its Flood Insurance Rate Map (FIRM), all discounts will be phased out by 20% each year for five years.³⁴ Norfolk’s current FIRM map was adopted in 2009.³⁵ According to the NFIP’s FloodSmart.gov website, Norfolk may see a new FIRM map in May of 2015, triggering higher rates for all property owners.³⁶

Flood Insurance Reform Act (2012) Changes to the National Flood Insurance Program*

Year	Properties Affected	Increase
Jan 1, 2013	Non-primary residences	25% annually
Oct 1, 2013	Severe or repeated flooding properties in Special Flood Hazard Areas	25% annually
2014	All properties in communities with updated Flood Insurance Rate Maps (FIRM)	20% annually for five years
May 2015	All Norfolk properties if new FIRM adopted	20% annually for five years

**Note: Rates for primary residences will remain at the subsidized level until the property is sold, the policy lapses, the property suffers severe or repeated flood loss, the property owner purchases a new policy, OR a new FIRM is adopted for the community.*

In anticipation of the much higher flood insurance rates, FEMA is reaching out to the public with suggestions on how to lower their rates. “Federal officials are encouraging homeowners in flood-prone communities to consider elevating their homes and increasing their deductibles to cut down on the sticker shock from rising insurance premiums.”³⁷ One foot of elevation alone could result in hundreds of dollars in savings.³⁸

What property owners should not do is allow their policies to lapse – mortgage companies may still require property owners to purchase private flood insurance more

expensive than the NFIP.³⁹ Edward Connor, a FEMA deputy associate administrator, warns that relying on disaster assistance is also ill-advised as it is unlikely to cover actual flood damages.⁴⁰ And while property owners mitigate their own rates through individual actions, communities can also act to lower premiums for their residents.

Community Rating System (CRS)

Communities can participate in the NFIP’s Community Rating System (CRS) by implementing measures that lower their flood risk. The CRS has three goals:

1. Reduce flood damage to insurable property;
2. Strengthen and support the insurance aspects of the NFIP, and
3. Encourage a comprehensive approach to floodplain management.⁴¹

Communities are awarded credit points (between 0 and 4,500+) for up to 18 activities across 4 categories: public information, mapping and regulations, flood damage reduction, and flood preparedness.⁴² A community with 0-499 points receives a rating of 10; residents of a class 10 community receive no reduction on their flood insurance premiums.⁴³ For every 500 additional points, communities move up one class, and properties in Special Flood Hazard Areas receive a 5% reduction on their premium.⁴⁴ Property owners not within Special Flood Hazard Areas receive a total reduction of 5% for classes 9 through 7, and 10% for classes 6 through 1.⁴⁵

Community Rating System (CRS) Class Levels and Insurance Rates	Class	Credits	Rate Reduction
	1	4,500+	SFHA - 45% Other - 10%
	2	4,000-4,499	SFHA - 40% Other - 10%
	3	3,500-3,999	SFHA - 35% Other - 10%
	4	3,000-3,499	SFHA - 30% Other - 10%
	5	2,500-2,999	SFHA - 25% Other - 10%
	6	2,000-2,499	SFHA - 20% Other - 10%
	7	1,500-1,999	SFHA - 15% Other - 5%
	8	1,000-1,499	SFHA - 10% Other - 5%
	9	500-999	SFHA - 5% Other - 5%
10	0-499	All - 0%	

The city of Norfolk, with over 12,000 flood insurance policies, is currently within CRS class 9.⁴⁶ All policy owners currently receive a 5% reduction on insurance premiums, with an average savings of \$46 per household per year.⁴⁷ FEMA has warned community officials that changes in the 2013 CRS Coordinator’s Manual make it “likely that some communities with marginal CRS Class 9 programs will have to identify new CRS credits in order to remain in the CRS.”⁴⁸

Recommendations: Improving Norfolk’s CRS Rating

Many of the CRS credited activities mimic the stormwater management requirements Norfolk may already be meeting for the National Pollutant Elimination System (NPDES). Therefore, Norfolk may be entitled to more credit for actions it is already taking to reduce flooding risks by improving stormwater management. If not, Norfolk’s stormwater management and CRS programs may be able to work cooperatively in choosing activities that cost once but count twice.

This paper identifies three areas within NPDES permitting and three CRS activities that offer Norfolk the opportunity to count stormwater system improvements towards its CRS rating. If fully implemented, the maximum credit for these activities could place the city in CRS Class 7, lowering policy owners rates below current levels. Although this paper focuses primarily on CRS credits earned through stormwater management activities, there are several other ways Norfolk can earn CRS credits by preserving wetlands and open space, which will be discussed in future white papers.⁴⁹

National Pollutant Discharge Elimination System (NPDES)

As Norfolk looks towards flood preparation, stormwater management offers an excellent focus point for mitigation efforts for two important reasons. First, the outdated stormwater system threatens to intensify the strength and duration of storm surges within the city. Record flooding could occur up to five times as often.⁵⁰ Secondly, stormwater management is already a regulated area carrying national and state requirements regarding the health and efficiency of stormwater programs.⁵¹ Since Norfolk is already required to maintain and improve its stormwater management program, these requirements could be a significant source of CRS credits – both earned and yet to be earned.

Stormwater discharges are a significant source of pollution because they allow unfiltered precipitation to flow out of the community and into nearby bodies of water.⁵² To reduce pollutant discharge, municipal separate storm sewer systems (MS4s) like Norfolk must receive discharge permits under the National Pollutant Discharge Elimination System (NPDES).⁵³ These permits are mandated under the Clean Water Act and overseen by the Environmental Protection Agency (EPA).⁵⁴ However, the EPA has authorized Virginia, specifically the Department of Conservation and Recreation (DCR), to issue its own NPDES permits within the state.⁵⁵

To receive a discharge permit, Norfolk must implement best management practices (BMPs) that reduce pollutant discharge to the maximum extent practicable.⁵⁶ These BMPs should address thirteen areas of concern.⁵⁷ At least three of these elements have analogs within the CRS credited activities: structural stormwater controls,

development and redevelopment controls, and public education efforts.

Structural BMPs are engineered devices that attempt to reduce pollutants, protect downstream bodies of water, and reduce flooding.⁵⁸ The most common BMPs include vegetated filter strips, infiltration trenches, permeable pavement, and ponds:⁵⁹

- *Filter strips* “capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting the filtered water in an underdrain, and then returning it back to the storm drainage system.”⁶⁰
- *Infiltration trenches* temporarily retain stormwater runoff, allowing the soil to permeate the soil and absorb pollutants.⁶¹ This not only reduces the concentration of pollutants in the runoff but also lowers the amount of runoff that ever enters the drainage system.
- *Permeable pavements* allow stormwater to filter through the surface into a stone reservoir underneath, slowing its flow into drains and encouraging infiltration.⁶²
- *Ponds* store water for longer periods of time to encourage particulates to settle and to reduce stress downstream.⁶³

To institute post-construction development and redevelopment controls, municipalities can pass ordinances that “guid[e], regulat[e], and control the design, construction, use and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land.”⁶⁴ The goal for these controls are to reduce the amount of stormwater runoff caused by the impervious surfaces associated with development, limiting pollution, erosion, and flooding.⁶⁵

Public education and outreach focuses on changing individual actions.⁶⁶ This includes messages regarding littering, trash disposal, pet-waste disposal, fertilizer use, car washing, and the use and disposal of household chemicals.⁶⁷

Each of these required elements are already addressed in Norfolk’s current MS4 permit, a potential source for CRS activities for which Norfolk may not already be receiving credit. Additionally, Norfolk’s MS4 permit is due to expire in June, 2013.⁶⁸ As Norfolk revises and implements its new permit, it can align its stormwater management efforts with CRS credited activities, meeting national NPDES requirements while lowering insurance premiums for the city’s homeowners.

CRS Stormwater Management Activities

Three CRS activities allow Norfolk to transform MS4 stormwater requirements into credited programs: Stormwater Management (Activity 450); Drainage System Maintenance (Activity 540); and Outreach Projects (Activity 330). If completely implemented for the maximum available credit, these activities could account for 1,675 credits, placing the community within CRS Class 7. Insurance policy owners in Special Flood Hazard Areas would receive a 15% discount while those outside of these areas would receive 5%.

**Community
Community Rating
System (CRS) Credit
Activities Related
to Stormwater
Management Best
Management
Practices (BMPs)**

Activity	Credits	Stormwater BMP
450 – Stormwater Management	755	Structural stormwater controls; Post-construction development and redevelopment controls
Stormwater management regulations	380	
Watershed Master plan	315	
Erosion and sedimentation controls	60	
540 – Drainage System Maintenance	570	Structural stormwater controls
Inspecting and maintaining channels	200	
Problem sites	50	
Capital Improvements	70	
Stream dumping regulations	30	
Inspecting and maintaining storage basins	120	
Coastal erosion protection measures	100	
330 – Outreach Projects	350*	Public education and outreach
Outreach Projects	200	
Flood response preparations	50	
Program for Public Information	80	
Stakeholder delivery	50	
Total	1,675	

**Activity 330 is capped at 350 credits though its components could reach more than 350.*

Because Norfolk participates in the CRS program at Class 9, it is already taking several steps to mitigate flooding. Many of these steps may already qualify under the activities listed below, and Norfolk may be receiving credit. Therefore, the following is not simply a roadmap for what more the city should do, but also a rubric by which to assess what it has done. Norfolk needs to critically assess both its stormwater management program *and* its CRS rating, *together*, to identify how much credit it should be receiving before identifying how much more it can do.

Getting full credit for these activities is by no means easy – it demands much from city planners and residents in order to mitigate potential flood damage. But higher insurance premiums make these efforts all the more necessary as sea levels continue to rise.

Activity 450: Stormwater Management

The CRS manual includes credits for stormwater management activities as increased impermeable development can increase stormwater runoff, “causing more frequent flooding, greater flood depths, and longer lasting floods.”⁶⁹ Additionally, sediment pollution can damage drainage systems, further preventing adequate flood mitigation.⁷⁰

Categorized within “Mapping and Regulations,” Stormwater Management offers 755 credits, maximum, for participating communities.⁷¹ Up to 380 credits can be earned for stormwater management regulations that “require the peak runoff from new development to be no greater than the runoff from the site in its pre-development condition.”⁷² Requiring best management practices such as filters, infiltration trenches, pervious pavement, and ponds can help developers meet this “no-net-increase” goal. These regulations must apply to property of at least 5 acres or development that will add at least 20,000 square feet of impervious area.⁷³ Additionally, the developments must manage at least a 10-year storm event.⁷⁴

If a community has received credit for stormwater management regulations, it can earn up to 315 points by creating a watershed master plan.⁷⁵ This plan must manage future flows to remain at current levels, and manage runoff for up to at least a 25-year storm event.⁷⁶

Regulations controlling erosion and sedimentation for all construction sites can add up to 40 points.⁷⁷ Regulations that require best management practices by developers are eligible for a 20 point credit.⁷⁸

Activity 540: Drainage System Maintenance

A community can receive up to 570 credits for inspecting and maintaining “natural and manmade watercourses, conduits, and storage basins that collect rainfall and convey flood flows.”⁷⁹ These include natural channels, storm drains, ditches, and retention basins.⁸⁰ Debris and sediment build up in these watercourses, conduits and basins can reduce storage and flow capacity and encourage flooding.⁸¹

To qualify for channel debris removal credits, the community must inspect channels and conveyances annually, upon receiving a complaint, and after all major storms.⁸² An additional 50 points may be earned if the conveyance inspections identify and pay special or more frequent attention to “choke points,’ chronic dumping sites, obstructions to flows, or sites with erosion or sedimentation problems.”⁸³

A community can also earn credits for a capital improvement plan and program “that make permanent, structural changes within the drainage system to reduce flood problems or maintenance problems.”⁸⁴ Norfolk dedicates \$6 million per year towards capital stormwater management system improvements. Possible future capital improvement projects providing permanent changes could include raising outfall heights or installing backflow gates. Tideflex valves prevent backflow through stormwater outfalls during storm surges and reduce obstruction by sediment accumulation and debris.⁸⁵

Thirty credits are available for communities that have regulations prohibiting littering or dumping within streams, explicitly including materials such as “brush, fill, and items normally not covered in littering ordinances.”⁸⁶ Preventing and regulating illegal dumping in stormwater management systems is also a requirement of the VPDES MS4 permitting process.

Should the community have regulated the public maintenance of required facilities under Activity 450, it can also earn 120 credits for annually inspecting and regularly maintaining retention, infiltration, and other storage basins.⁸⁷

Activity 330: Outreach Projects

Public outreach projects and flood response preparations can earn up to 350 credits.⁸⁸ Outreach projects must be done annually and must include a message concerning the availability of flood insurance.⁸⁹ The number of points earned depends on the types of media used, prevalence of the messages and if the messages were delivered by non-government stakeholders.⁹⁰

Available topics are limited (six total) but broad, and they can include such messages as “Don’t dump in the storm drains; they drain to the bay” and “Keep debris and trash out of the streams and ditches,” messages that would qualify under the VPDES MS4 permit public education requirement.⁹¹ Flood response preparations are messages concerning public information needed during a flood that has been prepared in advance.⁹² These messages can include “mitigation opportunities during repairs, and information on mitigation grants,” both of which can include encouraging best stormwater management practices.⁹³

Conclusion

While Norfolk’s stormwater management program is a significant weakness in its flood preparation, it also offers an important opportunity for city. Good stormwater management can both alleviate flooding from sea level rise and storm surge events, and protect water bodies from pollutant discharges.

Norfolk is already improving its stormwater management system through capital improvement projects and its updated MS4 permitting process, and many of these programs may already fit within the credited CRS activities rubric. Now, the city needs to take credit for the good work it has already done and that which it plans to do. Moreover, the city needs to make every effort to coordinate its future stormwater and flooding projects so as to get the most benefit for its investment.

The future of flood preparation in Norfolk is coordinated, comprehensive action. Norfolk can implement a flood mitigation strategy that reduces risk, includes stormwater management BMPs, and earns CRS credits. Not only will this protect the city from costly expenditures after natural disasters, but it can also save local residents money on flood insurance through the NFIP, critical in the wake of rising insurance premiums under the Flood Insurance Reform Act.

Acknowledgement

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Notes

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- 5 American Public Works Association, SEA LEVEL RISE, *supra* note 1.
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- 8 VIRGINIA INSTITUTE OF MARINE SCIENCE, RECURRENT FLOODING STUDY, *supra* note 3, at 2-3, 111-12.
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- 11 Fugro, *City of Norfolk City-wide Coastal Flooding Study* (May 31, 2012).
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- 13 *Id.*
- 14 *Id.*
- 15 Fugro, *City of Norfolk*, *supra* note 10. Tide gates are often installed to close these outfalls when sea levels rise too high. Outfalls without gates allow sea water to travel up stormwater pipes, resulting in saltwater intrusion in already oversaturated areas. San Francisco Bay Conservation and Development Commission, ADAPTING TO RISING TIDES VULNERABILITY AND RISK ASSESSMENT REPORT, 13-8 (Sep. 2012). Tide gates prevent Bay water from traveling into the city, but they also keep flood water from draining into the Chesapeake.
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50 Fugro, *City of Norfolk*, *supra* note 10.

51 See *infra* notes 50-54.

52 *National Pollutant Discharge Elimination System: Stormwater Program*, ENVIRONMENTAL PROTECTION AGENCY (Apr. 15, 2013, 2:13pm) http://cfpub.epa.gov/npdes/home.cfm?program_id=6.

53 *National Pollutant Discharge Elimination System: Stormwater Discharges From Municipal Separate Storm Sewer Systems (MS4s)*, ENVIRONMENTAL PROTECTION AGENCY (Apr. 15, 2013, 2:13pm) <http://cfpub.epa.gov/npdes/stormwater/munic.cfm>.

54 *National Pollutant Discharge Elimination System: Stormwater Frequently Asked Questions*, ENVIRONMENTAL PROTECTION AGENCY (Apr. 15, 2013, 2:15pm) http://cfpub.epa.gov/npdes/allfaqs.cfm?program_id=0#107.

55 *National Pollutant Discharge Elimination System: Authorization Status for EPA's Stormwater Construction and Industrial Programs*, ENVIRONMENTAL PROTECTION AGENCY (Apr. 15, 2013, 2:15pm) <http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm>; *Virginia Stormwater Management Program Permits: Stormwater management*, VIRGINIA DEPARTMENT OF CONSERVATION & RECREATION (Apr. 15, 2013, 2:17pm) http://www.dcr.virginia.gov/stormwater_management/vsmp.shtml#ms.

56 *Virginia Stormwater*, *supra* note 53.

57 *Id.* According to the Department of Conservation and Recreation, MS4 programs like Norfolk must:

- Operate and maintain structural stormwater controls.
- Control discharges from areas of development and significant redevelopment.
- Operate and maintain public streets, roads and highways.
- Identify, monitor and control discharges from municipal waste treatment, storage or disposal facilities.
- Control pollutants related to application of pesticides, herbicides and fertilizers.
- Implement an inspection program to enforce ordinances, which prohibit illicit connections and illegal dumping into the MS4.
- Screen the MS4 for illicit connections and illegal dumping.
- Implement standard investigative procedures to identify and terminate sources of illicit connections or discharges.
- Prevent, contain and respond to spills that may discharge into the MS4.
- Limit the infiltration of sanitary seepage into the MS4.
- Identify, monitor and control discharges from municipal landfills; hazardous waste treatment, storage, disposal and recovery facilities; facilities subject to EPCRA Title III, Section 313; and any other industrial or commercial discharge the permittee determines to be contributing a substantial pollutant loading to the MS4.
- Control pollutants in construction site runoff.
- Conduct public education on stormwater.

Id.

58 *Non-Proprietary BMPs*, VIRGINIA STORMWATER BMP CLEARINGHOUSE (Apr. 15, 2013, 2:24pm) <http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html>.

59 *Id.*

60 VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, VIRGINIA DCR STORMWATER DESIGN SPECIFICATIONS NO. 12: FILTERING PRACTICES, 1 (Mar. 1, 2011).

61 VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, VIRGINIA DCR STORMWATER DESIGN SPECIFICATIONS NO. 8: INFILTRATION PRACTICES, 1 (Mar. 1, 2011).

62 VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, VIRGINIA DCR STORMWATER DESIGN SPECIFICATION NO. 7: PERMEABLE PAVEMENT, 1 (Mar. 1, 2011).

63 VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, VIRGINIA DCR STORMWATER DESIGN SPECIFICATION NO. 15: EXTENDED DETENTION POND, 1 (Mar. 1, 2011); VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, VIRGINIA DCR STORMWATER DESIGN SPECIFICATION NO. 14: WET POND, 1 (Mar. 1, 2011).

64 ENVIRONMENTAL PROTECTION AGENCY, NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES): ORDINANCES FOR POST-CONSTRUCTION RUNOFF, available at <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=92&minmeasure=5>.

65 *Id.*

66 *National Pollutant Discharge Elimination System (NPDES): Public Education and Outreach on Stormwater Impacts*, ENVIRONMENTAL PROTECTION AGENCY (Apr. 15, 2013, 2:28pm) http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=1.

67 *Id.*

68 ENVIRONMENTAL PROTECTION AGENCY, WATER DISCHARGE PERMITS (PCS) DETAILED REPORTS (Nov. 12, 2012) available at http://oaspub.epa.gov/enviro/pcs_det_reports.pcs_tst?npvalue=1&npvalue=2&npvalue=3&npvalue=4&npvalue=5&rvalue=12&npvalue=6&npvalue=7&npvalue=9&npvalue=10&npvalue=11&npdesid=VA0088650.

69 FEDERAL EMERGENCY MANAGEMENT AGENCY, CRS COORDINATORS MANUAL, 450-2 (Mar. 2013).

70 *Id.*

71 *Id.* at 110-6.

72 *Id.* at 450-4-5.

73 *Id.* at 450-5.
74 *Id.*
75 *Id.* at 450-14.
76 *Id.* at 450-15.
77 *Id.* at 450-18.
78 *Id.* at 450-20.
79 *Id.* at 540-3.
80 *Id.* at 540-2.
81 *Id.*
82 *Id.* at 540-5.
83 *Id.* at 540-11.
84 *Id.* at 540-13.
85 VIRGINIA PORT AUTHORITY, 2040 MASTER PLAN EXECUTIVE SUMMARY, Ex-10 (Dec. 2008); *Stormwater/Wastewater Collection*, TIDEFLEX TECHNOLOGIES (Apr. 15, 2013, 2:31pm) <http://www.tideflex.com/tf/index.php/content/view/228/368/>.
86 FEDERAL EMERGENCY MANAGEMENT AGENCY, CRS COORDINATORS MANUAL, *supra* note 67 at 540-16.
87 *Id.* at 540-18.
88 *Id.* at 330-1.
89 *Id.* at 330-2-3.
90 *Id.*
91 *Id.* at 330-4.
92 *Id.* at 330-9.
93 *Id.* at 330-9.

Cover Image: Flooding in the Hague neighborhood of Norfolk. ©Skip Styles/Wetlands Watch

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