



**The Economic Impacts of  
the Hampton Roads Sanitation District (HRSD)  
and Sustainable Water Initiative  
for Tomorrow (SWIFT)**

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Strome College of Business  
Old Dominion University

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## 1. Executive Summary

The Hampton Roads Sanitation District (HRSD) engaged the Dragas Center for Economic Analysis and Policy in the Strome College of Business at Old Dominion University to conduct an Economic Impact Analysis (EIA) of its Sustainable Water Initiative for Tomorrow (SWIFT). SWIFT is an innovative approach to groundwater replenishment and treated wastewater discharge. The pilot SWIFT research center located in Suffolk, Virginia takes treated wastewater and through additional advanced water treatment produces drinking quality water. The resulting water is then added to the Potomac Aquifer. Currently, the pilot SWIFT plant treats approximately 1 million gallons of water daily with construction underway to expand this capacity to 50 million gallons of water daily.

Limiting the analysis of HRSD's efforts to only SWIFT, however, would understate the impact of HRSD. Prior to the development of SWIFT, HRSD was integral to the development of the Regional Wet Weather Management Plan (RWWMP), an effort to reduce unpermitted discharges and nutrient flows into Chesapeake Bay. HRSD's role in partially regionalizing the RWWMP avoided significant costs to ratepayers; reductions that would not be captured in an analysis that only focused on SWIFT. The semi-regionalization of services avoided approximately \$1,436.40 million in costs for ratepayers in HRSD's service area relative to the non-regionalized baseline.

The development and implementation of SWIFT also allowed HRSD to obtain loans at a reduced interest rate relative to prevailing markets. We estimate the present value of these savings to be \$321.6 million in 2024 dollars relative to the semi-regionalized approach. SWIFT saved ratepayers \$3,713.7 million in regulatory compliance costs and \$321.6 million in loan costs, for a total saving of \$4,035.3 million relative to the semi-regionalized approach. In total, HRSD's semi-regionalization and SWIFT saved ratepayers \$5,471.7 million relative to the non-regionalized approach.

Semi-regionalization's economic impacts include almost 7,500 jobs across Virginia with compensation equal to \$446.3 million. Semi-regionalization increased industry output by \$1,447.9 million and increased Virginia's GDP by \$924.5 million. SWIFT's economic impacts will include more than 21,000 jobs across Virginia with compensation equal to \$1,286.9 million. SWIFT will increase industry output across the Commonwealth by \$4,179.0 million and increase Virginia's GDP by \$2,669.0 million.

**In total, semi-regionalization and SWIFT will result in the creation of almost 28,500 jobs by increasing household income relative to the non-regionalized baseline. In other words, if HRSD had not undertaken semi-regionalization and SWIFT, there would be 28,500 fewer jobs across the Commonwealth. The total contribution of semi-regionalization and SWIFT to Virginia's GDP is \$3,593.5 million. Given the increases in construction and materials costs since the 2013 regionalization study, our estimates represent a lower bound on the economic impacts associated with semi-regionalization and SWIFT.**



## 2. Biographies and Qualifications

**Vinod Agarwal, Co-Principal Investigator**, is the Director of the Economic Forecasting Project in the Dragas Center for Economic Analysis and Policy and Professor of Economics in the Department of Economics in the Strome College of Business at Old Dominion University. His research interests are in applied economics. His articles have appeared in various journals such as *Cornell Hotel and Restaurant Quarterly*, *Journal of Travel Research*, *Economic Development and Cultural Change*, *Eastern Economic Journal*, *Economics of Education Review*, *Growth and Change*, *Journal of the American Real Estate and Urban Economic Association*, *Social Science Quarterly*, and *Southern Economic Journal*. He earned his doctoral degree from the University of California at Santa Barbara.

**Robert McNab, Co-Principal Investigator**, is the Director of the Dragas Center for Economic Analysis and Policy. He is a Professor of Economics and Chair of the Department of Economics in the Strome College of Business at Old Dominion University. His research focuses on topics in public finance, defense economics, and fiscal decentralization. He has worked at all levels of government on topics related to public budgeting and finance in more than 30 countries. He has published in *Applied Economics*, *Cornell Hospitality Quarterly*, *Defense and Peace Economics*, *National Tax Journal*, *Public Budgeting and Finance*, and *World Development*, among others. Professor McNab is a member of the Survey of Professional Forecasters of the Federal Reserve Bank of Philadelphia. He earned his PhD in Economics from the Andrew Young School of Policy Studies at Georgia State University.

**Old Dominion University (ODU)**, located in Norfolk, Virginia, is one of the eight colleges and universities in Hampton Roads. ODU is an accredited R1 research university offering 51 bachelor's degrees, 81 certificates, 59 master's degrees, and 29 doctoral degrees. Nearly 24,000 students were enrolled at ODU and nearly 30% of students had a military affiliation in 2024.

**The Dragas Center for Economic Analysis and Policy (Dragas Center)** undertakes a wide range of socio-economic, demographic, transportation, and defense-oriented studies. The Dragas Center produces the State of the Region Report for Hampton Roads and the State of the Commonwealth reports. The faculty of the Dragas Center have provided advice and assistance to numerous clients on economic impact analyses, regional economic development, and a wide range of public policy issues,

The views, opinions, and commentary expressed in this report are those of the primary authors and do not represent the official positions of the Commonwealth of Virginia, the Hampton Roads Sanitation District, Old Dominion University, or the donors of the Dragas Center for Economic Analysis and Policy.



### 3. Introduction

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Limiting the analysis of HRSD's efforts to only SWIFT, however, would understate the impact of HRSD. Prior to the development of SWIFT, HRSD was integral to the development of the Regional Wet Weather Management Plan (RWWMP), an effort to reduce unpermitted discharges and nutrient flows into Chesapeake Bay. HRSD's role in partially regionalizing the RWWMP avoided significant costs to ratepayers; reductions that would not be captured in an analysis that only focused on SWIFT. Relative to the non-regionalized baseline, the actions of HRSD and SWIFT will reduce ratepayer costs by approximately \$5.2 billion dollars in 2024 dollars through 2040. The avoided costs rise over time, from approximately 3.7% of the monthly average bill in 2026 to 39.1% of the monthly average bill in 2040. While ratepayers will have to pay more to comply with regulatory requirements, the actions of HRSD have significantly reduced future rate increases.

This study estimates the economic impact of HRSD and SWIFT from 2010 to 2040. To understand the impacts associated with HRSD and SWIFT, we first estimate the unmitigated and mitigated regulatory costs in 2024 dollars. Using data from HRSD, we also estimate past, current, and future capital expenditure pre- and post-SWIFT in 2024 dollars. We use these estimates as inputs into our EIA to obtain estimates of the economic impacts of HRSD and SWIFT on nonfarm payrolls (jobs), compensation, and Gross Domestic Product (GDP)

## 4. The Hampton Roads Sanitation District

On November 5, 1940, voters approved the creation of the Hampton Roads Sanitation District (HRSD) as a political subdivision of the Commonwealth of Virginia to ‘provide for the public health and welfare.’ In 1947, HRSD’s first treatment plant in Norfolk began operation, serving approximately 288,000 residents. Currently, HRSD’s service area encompasses approximately 1.9 million residents with the objective of reducing pollution, the construction of wastewater treatment facilities, and the installation of interceptors throughout HRSD’s service area.<sup>1</sup>

HRSD’s service area includes the independent cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Smithfield, Suffolk, Virginia Beach, and Williamsburg and the counties of Gloucester, Isle of Wight, James City, Mathews, Surry, and York. These independent cities and counties make up the Virginia portion of the Virginia Beach – Chesapeake – Norfolk Metropolitan Statistical Area (MSA)<sup>2</sup>, more commonly known as Hampton Roads. HRSD’s service area also includes localities outside of the Hampton Roads

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<sup>1</sup> <https://law.lis.virginia.gov/authorities/hampton-roads-sanitation-district-commission/>

<sup>2</sup> The three North Carolina counties in the Virginia Beach – Chesapeake – Norfolk MSA are Camden County, Currituck County, and Gates County. HRSD does not provide services to these counties.

MSA, including Accomack County (service areas are Onancock, Wachapreague, and Chincoteague), King William County (Service areas are Central Garage area, Town of West Point, and Mt. Olive), King and Queen County (No service area), Middlesex County (Service areas include Urbanna, Saluda, and Cooks Corner), and Northampton County (Service areas include Exmore and Nassawadox).

HRSD's geographical boundaries encompass approximately 5,000 square miles and include the political boundaries of the jurisdictions that are part of the district. HRSD's service area, which covers existing public sewer services or the ability to be served by public sewer services, is approximately 950 square miles. HRSD does not provide water, solid waste disposal, or stormwater management services. In addition to wastewater treatment services, in the counties of Accomack, King William, King and Queen, Mathews, Middlesex, Northampton and Surry, HRSD also provides collection and conveyance services which carry wastewater from industries, homes, apartments, and businesses to the HRSD's wastewater treatment system. In total, localities and HRSD operate more than 5,800 miles of gravity sewer, 1,100 miles of force main and almost 1,600 pumping stations. HRSD operates 14 sewer treatment plants (STPs) with a combined design permitted capacity of treating 225 million gallons per day (MGD).<sup>3</sup>

The HRSD service area is entirely within the Eastern Virginia Groundwater Management Area, an area of Virginia extending eastward from the Fall Zone (approximately along the I-95 corridor) to Chesapeake Bay. Groundwater in this region is primarily contained

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<sup>3</sup> HRSD operates 8 large sewage treatment plants at: Williamsburg, James River, York River, Boat Harbor, Nansemond, Army Base, Virginia Initiative Plant (VIP), and Atlantic. HRSD also operates six smaller plants operating in Onancock, West Point, Central Middlesex, Urbanna, King William, Chincoteague.

in aquifers (porous layers of sands, shells and gravels) that are confined by layers of impermeable soils (clays and silts). The layers of impermeable soil prevent rainwater from seeping into the ground to replenish these deeper aquifers. The largest of the aquifers in this area is the Potomac aquifer, located along the Virginia coast, which is several thousand feet thick and contains hundreds of trillions of gallons of pressurized water. With insufficient ability to recharge naturally, the water within the Potomac aquifer is a limited natural resource. As water is withdrawn, the pressure in the aquifer decreases. For more than 100 years, Virginians have been withdrawing water from this confined aquifer, significantly lowering the pressure. The reduced pressure has caused the aquifer to compact, resulting in land subsidence, and has also increased the potential for saltwater contamination.

## 5. Sanitary Sewer Overflows

Currently, localities and HRSD have no formal flow agreements that govern sewage flows delivered from the localities to the HRSD system. HRSD bills customers based on their water consumption. As the wastewater system has aged in Hampton Roads, wastewater collection system defects have formed (e.g., cracks, offset joints, leaking manholes, root intrusion) which allowed rainwater runoff, groundwater infiltration, and in some locations, substantial amounts of tidal inflow into the sewage pipes. During certain wet weather events, the additional external flow has exceeded the capacity of the existing wastewater infrastructure leading to Sanitary Sewer Overflows (SSOs). SSOs have occurred in localities' systems as well as HRSD's system.

Since early 2000, the Virginia's Department of Environmental Quality (VDEQ) and the U.S. Environmental Protection Agency (EPA) determined that the frequency and magnitude

of SSOs within HRSD's service area were likely to result in increased enforcement actions. HRSD and localities entered into Consent Orders (COs) with the Virginia State Water Control Board (SWCB), administered by VDEQ, for the reduction of unpermitted discharges from locality and HRSD sewer systems. The COs included a separate 2001 CO between the SWCB, the City of Norfolk and HRSD, and a 2007 regional CO between HRSD, the 13 other Hampton Roads localities, and the SWCB. HRSD and the 13 localities also entered into a Memorandum of Agreement (MOA) under which HRSD and the localities agreed to work cooperatively in developing and implementing a Regional Wet Weather Management Plan (RWWMP) to reduce unpermitted discharges from sewer systems.

HRSD, the U.S. Department of Justice (DOJ), and the EPA entered into a Consent Decree (CD) in 2010. While the 2010 CD was similar to the 2007 CO, HRSD was the only local signatory to the CD in contrast to the 2007 CO. The 2010 CD required HRSD to produce a RWWMP by November 26, 2013, extendable to July 31, 2014, if all parties to the CD agreed to the extension. The CD also provided for penalties should HRSD fail to meet the milestones and due dates specified by the document.

In early 2012, HRSD proposed a regionalization of services to reduce capital and operational costs and comply with the terms of the 2010 CD. The regionalization of services would allow for a more effective integration of services, economies of scale in the provision of services, and improved rehabilitation of existing systems, regardless of jurisdictional boundaries. The Hampton Roads Planning District Commission (HRPDC) hired consultants to complete a Regionalization Study to evaluate the issues and make a recommendation to HRSD and the localities on whether regionalization would be beneficial to the customers.

HRSD and the EPA subsequently negotiated a schedule modification to the 2010 CD that allowed schedule relief to complete the Regionalization Study. EPA agreed to the extension for the RWWMP from November 2013 to July 2014, as specified in the existing CD. This modification also allowed for an extension of the RWWMP to April 2015 if the Regionalization Study did not recommend consolidation; October 2015 if the Regionalization Study recommended consolidation but the localities or HRSD decided against it; or October 2016 if regionalization was agreed to by the localities and HRSD. As a part of a comprehensive program to mitigate the occurrence of SSOs, HRSD and localities began to work on a two-pronged approach; a rehabilitation program to reduce the peak wastewater flows by reducing infiltration and inflow, and a RWWMP to convey and treat the peak flows to meet an agreed-upon level of service (LOS).

The CD modification required submission of the Regionalization Study by August 31, 2013. This document included an economic evaluation to identify the total costs associated with rehabilitation (i.e., reducing infiltration/inflow (I/I) into the wastewater collection system) and capacity improvements required post-rehabilitation to meet the LOS as well as a recommendation about regionalization. The cost estimates in the study were stated in 2013 dollars. While the study identified projects, the study did not establish a schedule or list of priorities. The study established that HRSD and localities would have to make substantial investments in the regional sanitary sewer system and HRSD would also need to make substantial additional investments for the RWWMP.

Table 1 displays the cost estimates to meet the requirements of the 2010 CD with a non-regionalized approach in 2024 dollars. HRSD would have to spend \$887.9 million to

implement the RWWMPs by increasing the capacity of HRSD infrastructure to handle peak flows. Localities would have to expend \$453.2 million to improve local capacity. In addition, localities and HRSD would have to spend \$2,634.7 million to rehabilitate existing capacity, that is, fixing locality gravity sewer pipes to abate leakages. Further, approximately \$389.5 million would be allocated for private sewer laterals coming from homes or commercial shopping areas. In total, the Regionalization Study estimated costs would be approximately \$4,365.4 million in 2024 dollars. Table 2 contains a summary of the estimated capital costs HRSD and the localities would have to incur to meet 2010 CD requirements.

HRSD and localities, however, also agreed to evaluate the possible regionalization of the sanitary sewer system. A regionalized approach would derive cost estimates based on each treatment plant's service area instead of jurisdictional boundaries. These costs remain broken out by "Regional Wet Weather Improvements" for comparative purposes between approaches and include improvements to upstream lift stations, gravity collection systems (not currently owned by HRSD), and terminal pumping stations (not currently owned by HRSD). As there would be only one entity, presumably HRSD, the costs are presented at the system-wide level. The implementation period for the regionalized approach is assumed to be 20 years. Table 3 shows the total estimate capital improvements costs associated with the regionalized framework in 2024 dollars.

While full regionalization did not happen, as localities did not agree to transfer their sewer assets and operations to HRSD, a regional approach was undertaken for the RWWMP. HRSD assumed full regulatory and financial obligation to comply with the 2010 CD and for regional wet weather capacity into the future. For localities, this meant their sewer rates

could be customized to meet the needs of their individual Management, Operations and Maintenance (MOM) programs, their only remaining regulatory component of the 2007 CO. These MOM programs essentially meant localities needed to focus on operating and maintaining their sanitary sewer systems to eliminate significant defects and transporting sewage to HRSD. Table 4 illustrates that, relative to the non-regionalized approach, semi-regionalization saved rate payers \$1,436.4 million in 2024 dollars.

## 6. Stormwater Overflows

In addition to the costs required to comply with the 2010 CD, HRSD and localities were also required to deal with issues related to stormwater overflows and pollutants discharged in Chesapeake Bay. The EPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) for Nitrogen, Phosphorus, and Sediment, a historic and comprehensive "pollution diet", on December 29, 2010. This TMDL included rigorous accountability measures to drive actions to restore clean water in Chesapeake Bay and the region's streams, creeks, and rivers. TMDL was based largely upon Watershed Implementation Plans (WIPs) prepared by Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia.

The Chesapeake Bay TMDL applied to all localities having a Municipal Separate Storm Sewer System (MS4). This system is a network of drainage systems, including pipes, ditches, and other conveyances, designed to carry stormwater runoff directly to nearby streams, rivers, and other bodies of water. MS4s are distinct from sanitary sewers, which carry sewage and industrial wastewater to treatment facilities. Individual or Phase I Permits were issued to localities with populations over 100,000. These localities had to implement policies to control the discharge of pollutants from their storm sewer system to the maximum extent

practicable in a manner that protects the water quality in nearby streams, rivers, wetlands and bays. Phase II permits applied to smaller municipalities, typically those with populations between 10,000 and 100,000 and other operator entities not covered under Phase I. Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach received Phase I MS4 permits, and Poquoson, Suffolk, Williamsburg, James City County and York County received Phase II MS4 permits.

MS4 permittees were required to develop and implement comprehensive stormwater management plans. These plans detailed strategies to control and mitigate the impacts of stormwater runoff on water quality. MS4 programs included measures to regulate and manage runoff from construction sites to prevent soil erosion and the transport of sediment and pollutants into storm drains as well as the long-term maintenance of stormwater infrastructure, and the implementation of measures to minimize the impacts of development on water quality. All MS4 permittees, as a Special Condition of their permit, were also required to develop and implement a TMDL Action Plan. TMDL Action Plans ensured MS4 permittees addressed all pollutants of concern for which the permittee has been assigned a Waste Load Allocation (WLA) under an approved TMDL.

The TMDL Action Plan for the Chesapeake Bay TMDL requires that MS4 permittees reduce the portion of the nutrient load associated with urban developed land use. These nutrients enter local waters and Chesapeake Bay via stormwater runoff from impervious surfaces such as roads, parking lots and buildings. Nutrient reductions are achieved through the implementation of Best Management Practices (BMPs) that have identified nutrient removal benefits per Chesapeake Bay Program and state guidelines.

The magnitude of the load reductions within the urban areas of Hampton Roads would have required Hampton Roads localities to implement costly urban stormwater controls in heavily developed communities. These retrofits, according to Hampton Roads Planning District Commission (HRPDC) were originally estimated to cost localities \$1,807.0 million over 15 years in 2017 dollars or \$2,312.5 million in 2024 dollars (Table 5).

## 7. Watershed and Compliance Costs

Virginia's strategy for meeting the overall nutrient reductions required by the Chesapeake Bay TMDL is documented in its Watershed Implementation Plan (WIP). The most recent version of the WIP, the Phase 3 WIP, incorporated Virginia's Enhanced Nutrient Removal Certainty Program (ENRCP) which identified nutrient reduction targets for all of the HRSD facilities that discharge into the lower James River. The costs associated with implementing this level of control at each individual facility owned by HRSD are detailed in Table 6.

A summary of costs required to comply with SSOs by localities and HRSD, costs required to comply with Chesapeake Bay TMDL MS4 retrofits by localities, and costs required of HRSD to reduce nutrient loads per TMDL requirements are summarized in Table 7 in 2024 dollars. Compliance costs to comply with all requirements were estimated to be approximately \$8.2 billion in 2024 dollars if localities and HRSD were to work on these requirements individually. However, if one entity under a regionalized approach, HRSD, took responsibility for administering and complying with all requirements, costs would have been reduced to \$6.8 billion, a saving of approximately \$1.4 billion dollars or 17.4 %. As stated earlier, while full regionalization did not happen, the RWWMP was regionalized and HRSD assumed

full regulatory and financial obligation to comply with 2010 Consent Decree (CD) and for regional wet weather capacity into the future.

## **8. Sustainable Water Initiative for Tomorrow (SWIFT)**

In 2016, HRSD announced the launch of its Sustainable Water Initiative for Tomorrow (SWIFT) at its York River Treatment Plant in Seaford, Virginia. This program offered the opportunity to address multiple compliance challenges throughout the region for the same investment dollars, representing lower compliance costs for the communities served by HRSD. The multi-year initiative was to take already highly treated wastewater that would otherwise be discharged into the Elizabeth, James or York rivers and purify it through additional rounds of advanced water treatment to produce drinking-quality water, SWIFT Water®. In March 2017, HRSD broke ground on the new SWIFT Research Center (SRC) that later opened in May 2018 at its Nansemond Treatment Plant in Suffolk. The SRC can purify one million gallons of water per day using advanced treatment processes and then recharge the depleted Potomac aquifer via specially designed wells.

In developing the SWIFT initiative, HRSD worked closely with leading agencies and experts such as the Virginia Department of Health, Virginia Department of Environmental Quality, and a panel of scientific experts to help oversee the project. SWIFT has also benefitted from positive engagement with the Chesapeake Bay Foundation, the U.S. Environmental Protection Agency and the United States Geological Survey. With this insight from diverse leaders, the SWIFT initiative focused on a process that provides high-quality, purified water to sustain a growing population, improve local ecology, and create positive economic returns in long run.

HRSD broke ground for its first full-scale SWIFT facility at the James River Treatment plant on July 21, 2022 in Newport News. This facility is expected to be in operation in 2026 and will be able to replenish the Potomac aquifer with up to 16 million gallons of drinking-water quality SWIFT Water® per day using advanced treatment processes. The project also includes advanced nutrient reduction improvements for the James River Treatment Plant.

The EPA had approved HRSD's Integrated Plan (IP) in August 2021. This plan comprises measures that involve other Clean Water Act programs, including the (MS4) programs and TMDLs relevant to HRSD's Wastewater Treatment Facilities. In addition to SWIFT, the managed aquifer recharge program was permitted under the Safe Drinking Water Act's Underground Injection Control program. The inclusion of SWIFT also prioritized work intended to counter risks of sea-level rise and inundation ahead of additional SSO-related work required by the Clean Water Act. The Integrated Plan also identifies efficiencies from separate wastewater and storm water programs to prioritize capital investments and achieve EPA's human health and water quality objectives. As a requirement of the Chesapeake Bay TMDL, Hampton Roads MS4 Localities are required to achieve 100% of their required nutrient reductions from storm water runoff by 2028. HRSD, through SWIFT, is able to provide the necessary credits to localities at no cost. Had this not been done, localities would have been required to implement costly urban stormwater controls in heavily developed communities in order to meet this deadline. New capital costs associated with the Integrated Plan replace costs needed to meet all regulatory requirements of localities as well as HRSD (SSOs and TMDL) and are shown in Table 8.

In August 2024, HRSD broke ground for its second full-scale SWIFT program at the Nansemond Treatment plant in Suffolk. This facility is expected to be in operation in 2029 and will be able to replenish the Potomac aquifer with up to 34 million gallons of drinking-water quality SWIFT Water® per day using advanced treatment processes. The project also includes advanced nutrient reduction improvements for the Nansemond Treatment Plant. The implementation of SWIFT at each of these two facilities, James River and Nansemond, in addition to Tertiary SWIFT at Virginia Initiative Plant (VIP), represent Phase I SWIFT. The VIP Tertiary SWIFT project will add the initial stages of advanced water treatment (tertiary filtration) to achieve phosphorus reductions and set the stage for a future full-scale SWIFT facility at VIP. Full implementation of Phase I SWIFT, which supports compliance with Virginia's Enhanced Nutrient Removal Certainty Program, will reduce nitrogen discharge by more than 70% and phosphorus discharge by more than 50% from their 2021 levels in the lower James River basin.

The residents of Hampton Roads send approximately 145 million gallons of sewage water for treatment to HRSD each day; approximately 100 million gallons flow into Chesapeake Bay (87 million in James River and 12 million in York River in 2024), the remaining 44 million gallons of treated water go into Atlantic Ocean). HRSD cleans this water to exacting standards and returns it safely to area waterways. The cost of cleaning water is rising as new stricter regulatory requirements, like more nutrient removal, are implemented to address environmental issues that continue to be further refined.

Taking water out of the ground at the current rate has led to sinking of land, or land subsidence, in some parts of eastern Virginia. This makes us more vulnerable to rising sea

levels and the associated impacts. Replenishing the aquifer with HRSD's SWIFT Water® can help slow or even reverse the sinking of land due to withdrawal. Scientists believe that overuse of the aquifer causes about 25 percent of the sinking of land in parts of eastern Virginia. Replenishing our overdrawn aquifer can improve the environment and help our communities adapt to rising sea level, contributing to the resiliency of our region. Restoring the health and productivity of Chesapeake Bay largely depends on reducing the amount of nutrients and sediment that enter Chesapeake Bay waters. According to HRSD, Virginia has met the sediment reduction goals and MS4 permittees no longer have to demonstrate any further reduction in Total Suspended Solids. Virginia's focus is now on reductions in Nitrogen and Phosphorous. HRSD's Phase I SWIFT program is projected to effectively eliminate nearly 50% of HRSD's discharges to Chesapeake Bay. This will significantly reduce the total amount of nutrients, such as phosphorus and nitrogen reaching the receiving streams, and ultimately, the Bay.

## 9. Comparison of Alternatives

Table 9 summarizes costs required to comply with regulations with a Non-Regionalized Approach, a Semi-Regionalized Approach, and costs with SWIFT Integrated Plan in 2024 dollars. Costs associated with SWIFT Integrated Plans are much lower (\$3.1billion) than costs associated with non-regionalized approach (\$8.2 billion) or the semi-regionalized approach (\$6.8 billion). Regional collaboration reduced costs by \$1.4 billion (17.4%). The SWIFT Integrated Plan reduces costs by an additional \$3.7 Billion (45.4%) relative to the semi-regionalized approach.

If we accept the non-regionalized approach as the base case (do nothing case), then the semi-regionalized approach avoids approximately \$1,436.4 million in compliance costs relative to the base case. SWIFT avoids approximately \$5,150.1 million from the base case and \$3,713.7 million from the semi-regionalized case. The question is one of perspective. Localities and HRSD were facing \$8,238.8 million in potential costs in 2024 dollars and found that regionalization (or semi-regionalization) would reduce outlays. After agreeing to embark on semi-regionalization, the parties then explored how to further reduce costs, ultimately embarking on SWIFT. If one starts with the base case, avoided costs are about \$5.15 billion. If one starts with a semi-regionalized case, avoided costs are about \$3.7 billion. Regardless of the prospective, SWIFT initiative has saved localities and rate payers from having to make significant capital outlays.

In summary, through a collaborative effort, led by HRSD, rate payers in Hampton Roads were able to avoid about \$5.15 billion in costs associated with regulatory requirements. Total estimated savings due to semi-regionalization were \$1.44 billion and remaining \$ 3.71 billion can be attributed to the SWIFT initiative led by HRSD.

## 10. Economic Impact Methodology

This section briefly discusses the modeling approaches, assumptions, and the measures of economic impact. We first define direct, indirect, and induced economic impact. We then discuss different measures of economic impact. The section concludes with a discussion of the inputs for the generation of economic impacts.

**Total economic impact** consists of three measures: direct economic impact, indirect economic impact, and induced economic impact. Quantifying the **economic impact** of HRSD and SWIFT in satisfying regulatory requirements is an important element in local, regional, and state economic development efforts. Capital investment and the mitigation of costs to ratepayers contributes to the growth in jobs across the region and state. The task of this study is to estimate **how much** HRSD and SWIFT increases economic activity across the Commonwealth of Virginia and **how many** more jobs exist in Virginia because of HRSD and SWIFT in complying with regulatory burden.

While the term **economic impact** is generally used to present estimates of the influence of an activity, organization, or policy on economic impact, there are actually several measures of economic impact to consider. The most straightforward measure of economic impact is **employment**, which is typically measured in terms of nonfarm payrolls (jobs) or individual employment (people). **Earnings** or **compensation** is a measure of wages, salaries, and benefits associated with employment impacted by the activity, organization, or policy. In this case of this study, we estimate the change in nonfarm payrolls (jobs) associated with increases in household income because of HRSD and SWIFT.

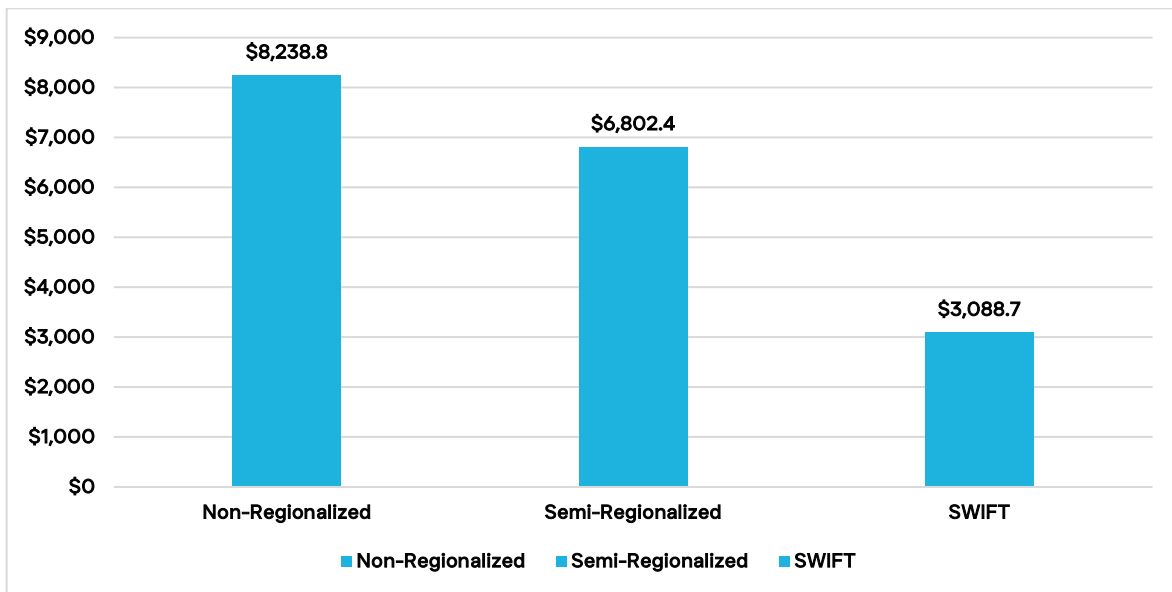
**Value added** or **Gross Domestic Product (GDP)** is a measure of the value of final goods and services in the study area for a given period of time. Value added is net of the cost of **intermediate inputs**, that is, goods and services used to produce the final product or service in question. Value added represents the level of economic activity in an area. Why is it important not to include the value of intermediate inputs? If a manufacturer in Virginia Beach buys \$1 million in goods from outside the area and uses these goods to create final products for sale worth \$3 million, we want to capture the additional value created by the manufacturer. In other words, economic activity increased by \$2 million (the value added) not \$3 million (the value added and the value of intermediate inputs).

**Economic output** or **industry output** is equal to the sum of value added and intermediate inputs. For analyses focused on a specific industry, output captures the impact of a spending or policy change on industry activity. Output is typically considered the total value of production and is equal to the sum of intermediate inputs and value added. As output includes the value of intermediate inputs, it encompasses parts of the value of other industries' outputs.

We are limited in our ability to compare capital expenditures across the different scenarios. The non-regionalized and semi-regionalized approach estimates were developed in 2013 and did not include the schedule of expenditures. While we have actual and projected expenditures for SWIFT, the lack of detail regarding the non-regionalized and semi-regionalized estimates requires us to compare aggregate expenditures for each alternative in 2024 dollars.

Graph 1 presents the regulatory compliance costs for each approach in million of 2024 dollars. The non-regionalized approach would have cost ratepayers \$8,238.8 million in 2024 dollars while the semi-regionalized approach would have cost ratepayers \$6,802.4 million in 2024 dollars. We note that these estimates are likely a lower bound on the cost of these plans as construction and material costs have increased at a faster rate than the overall pace of inflation since 2013. SWIFT's total regulatory compliance costs are equal to \$3,088.7 million in 2024 dollars.

**Graph 1**  
**Regulatory Compliance Costs**  
**Millions of 2024 Dollars**



*Source: Authors' estimates.*

From an economic impact perspective, we need to estimate the **marginal benefit** of the semi-regionalized and SWIFT approaches. The marginal benefit, or reduction in costs to ratepayers, captures the avoided costs due to a policy change. The marginal benefit of the

semi-regionalized approach represents the change in regulatory compliance costs relative to the non-regionalized approach, or \$1,436.4 million (\$8,238.8 million - \$6,802.4 million). In other words, because of the implementation of the semi-regionalized approach, ratepayers in HRSD service area avoided \$1,436.4 million in costs relative to the non-regionalized baseline. Table 10 contains these estimates.

The development and implementation of SWIFT also allowed HRSD to obtain loans at a reduced interest rate relative to prevailing markets. We estimate the present value of these savings to be \$321.6 million in 2024 dollars relative to the semi-regionalized approach. SWIFT saved ratepayers \$3,713.7 million in regulatory compliance costs and \$321.6 million in loan costs, for a total saving of \$4,035.3 million relative to the semi-regionalized approach. In total, HRSD's semi-regionalization and SWIFT saved ratepayers \$5,471.7 million relative to the non-regionalized approach.

We model the avoided costs of each approach as an increase in household income for ratepayers in HRSD's service area. The avoided costs in Table 10 represent the present value of historical and future costs in 2024 dollars. In other words, ratepayers "saved" \$1,436.4 million because of semi-regionalization. The development and implementation of SWIFT will save ratepayers an additional \$4,035.3 million relative to semi-regionalization.

We do not, however, have information on the distribution of ratepayers by income decile. We assume that the distribution of ratepayers by income can be proxied by the distribution of households by income decile in the Virginia Beach - Chesapeake - Norfolk MSA. We obtain 1-year estimates from the U.S. Census 2024 American Community Survey (ACS) on the distribution of households by income in the past 12 months.

As we use IMPLAN to estimate the economic impacts associated with the avoided costs, we must map the 2024 ACS income categories to the IMPLAN income categories. In some instances, there is a direct correspondence between the ACS and IMPLAN income categories. In other cases, we assume the household distribution is constant within categories by each \$1,000 of income and map ACS to IMPLAN categories accordingly. We then distribute the avoided marginal costs for semi-regionalization and SWIFT to each of the IMPLAN income categories based on the percentage of Virginian households in each income category. We treat the avoided costs, displayed in Table 11, as an injection of household income which, in turn, is spent in the economy according to the spending patterns of each income category.

Table 12 presents the estimates of economic impact for semi-regionalization, SWIFT, and the total economic impacts associated with both approaches. We note that the economic impacts are for the economy of Virginia and likely represent a lower-bound on the impacts associated with semi-regionalization and SWIFT as the costs have increased since the 2013 regionalization study.

Semi-regionalization's economic impacts include almost 7,500 jobs across Virginia with compensation equal to \$446.3 million. Semi-regionalization increased industry output by \$1,447.9 million. Semi-regionalization also increased Virginia's GDP by \$924.5 million. SWIFT's economic impacts will include more than 21,000 jobs across Virginia with compensation equal to \$1,286.9 million. SWIFT will increase industry output across the Commonwealth by \$4,179.0 million. SWIFT will increase Virginia's GDP by \$2,669.0 million.

In total, semi-regionalization and SWIFT will result in the creation of almost 28,500 jobs by increasing household income relative to the non-regionalized baseline. In other words, if HRSD had not undertaken semi-regionalization and SWIFT, there would be 28,500 fewer jobs across the Commonwealth. The total contribution of semi-regionalization and SWIFT to Virginia's GDP is \$3,593.5 million. As we noted previously, given the increases in construction and materials costs since the 2013 regionalization study, our estimates represent a lower bound on the economic impacts associated with semi-regionalization and SWIFT.





**Table 1 - Non-Regionalized Approach Capital Costs for Localities and HRSD**

Millions Of 2024 Dollars

Jurisdiction	Regional Wet Weather Improvements Plans	Locality Capacity Improvements	Locality /HRSD Rehabilitation	Private Property I/I Abatement	Total Capital Costs	Implementation Schedule Years
Chesapeake		\$65.0	\$365.9	\$0.0	\$431.0	30
Gloucester		\$10.3	\$10.1	\$0.0	\$20.4	25
Hampton		\$63.4	\$209.6	\$0.0	\$273.0	25
HRSD	\$887.9	\$0.0	\$233.4	\$389.5	\$1,510.9	10/20*
Isle of Wright		\$0.0	\$0.2	\$0.0	\$0.2	25
James City Service Area		\$26.9	\$85.7	\$0.0	\$112.6	20
Newport News		\$72.4	\$169.4	\$0.0	\$241.8	25
Norfolk		\$22.0	\$572.3	\$0.0	\$594.3	25
Poquoson		\$1.8	\$18.9	\$0.0	\$20.6	25
Portsmouth		\$72.3	\$333.2	\$0.0	\$405.5	30
Smithfield		\$0.0	\$5.1	\$0.0	\$5.1	20
Suffolk		\$20.1	\$39.5	\$0.0	\$59.6	15
Surry		\$0.0	\$0.0	\$0.0	\$0.0	
Virginia Beach		\$93.5	\$470.8	\$0.0	\$564.2	30
Williamsburg		\$5.5	\$22.9	\$0.0	\$28.4	20
York		\$0.0	\$97.6	\$0.0	\$97.6	25
<b>TOTAL</b>	<b>\$887.9</b>	<b>\$453.2</b>	<b>\$2,634.7</b>	<b>\$389.5</b>	<b>\$4,365.4</b>	

*Source: Comparative Analysis Report prepared by Brown and Caldwell, August 2013, page xiii. Data displayed includes Norfolk's estimated \$425 million in 2013 dollars for rehabilitation costs related to their individual Consent Order, which are not covered by the 2007 Regional Order and not included in the Comparative Analysis capital improvements estimates. HRSD Rehab and private property I/I Abatement Plans had a 10-year implementation schedule and the RWWMP schedule was assumed to be 20 years. All estimates in this table have been adjusted to reflect costs in 2024 dollars.*



**Table 2 – Compliance Decree: Non-Regionalized Scenario Capital Costs**

Millions of 2024 Dollars

Locality	Capacity Improvements	Rehabilitation	Private I/I Reduction	Total CIP Cost
Locality Total	\$453.2	\$2,401.2	\$0.0	\$2,854.5
HRSD	\$887.9	\$233.4	\$389.5	\$1,510.9
<b>TOTAL</b>	<b>\$1,341.2</b>	<b>\$2,634.7</b>	<b>\$389.5</b>	<b>\$4,365.4</b>

*Source: Regionalization of Sewer Systems Study, Final Report August 2013, page ES-8, Prepared by HDR and McGuire Woods for Hampton Roads Planning District Commission. This table includes Norfolk's estimated \$425 million in 2013 dollars for rehabilitation costs related to their individual Consent Order, which are not covered by the 2007 Regional Order and not included in the Comparative Analysis capital improvements estimates. All estimates in this table have been adjusted to reflect costs in 2024 dollars.*



**Table 3 - Compliance Decree: Regionalized Scenario Capital Costs**

Millions of 2024 Dollars

Locality	Locality Rehab	Private I/I Reductions	Regional Wet Weather Improvements	Upstream Capital Improvements	Total CIP Cost
HRSD	\$1,353.7	\$283.5	\$855.3	\$436.5	\$2,929.0

*Source: Regionalization of Sewer Systems Study, Final Report August 2013, page ES-8, Prepared by HDR and McGuire Woods for Hampton Roads Planning District Commission. "Upstream Capacity Improvements" mean larger/additional infrastructure in the locality systems required to handle peak flow. All estimates in this table have been adjusted to reflect costs in 2024 dollars.*



**Table 4 – Capital Costs for Non-Regionalized and Semi-Regionalized Scenarios**

**In Millions of 2024 Dollars**

	<b>Non-Regionalized</b>	<b>Semi-Regionalized</b>	<b>Savings in Dollars</b>	<b>Savings in Percentage</b>
Rehabilitation	\$2,634.7	\$1,353.7	\$1,281.0	48.6%
Regional Wet Weather Improvements	\$887.9	\$855.3	\$32.7	3.7%
Locality/Upstream Capacity Improvements	\$453.2	\$436.5	\$16.7	3.7%
Private Property I/I Abatement Program	\$389.5	\$283.5	\$106.1	27.2%
<b>Grand Total</b>	<b>\$4,365.4</b>	<b>\$2,929.0</b>	<b>\$1,436.4</b>	<b>32.9%</b>

*Source: Comparative Analysis Report prepared by Brown and Caldwell, August 2013, page xiv. Includes Norfolk's estimated \$425 million in 2013 dollars for rehabilitation costs related to their individual Consent Order, which are not covered by the 2007 Regional Order and not included in the Comparative Analysis capital improvements estimates. All estimates in this table have been adjusted to reflect costs in 2024 dollars*



**Table 5 - Estimated MS4 Retrofit Costs Over 15 Years**

Millions of 2024 Dollars

	Millions of 2024 Dollars
Chesapeake	\$326.3
Gloucester County	\$42.2
Hampton	\$253.4
Isle of Wight Conty	\$51.2
James City County	\$111.3
Newport News	\$286.7
Norfolk	\$358.3
Poquoson	\$17.9
Portsmouth	\$160.0
Suffolk	\$139.5
Surry County	\$9.0
Virginia Beach	\$413.4
Williamsburg	\$23.0
York County	\$120.3
<b>TOTAL</b>	<b>\$2,312.5</b>

Source: HRPDC November 2017.

<https://www.hrpdcva.gov/DocumentCenter/View/6567/Chesapeake-Bay-TMDL-Update-PDF>  
and Consumer Price Index for All Urban Consumers: All items in U.S. City Average (1982-84=100)



**Table 6 - Estimated Costs to Be Incurred by HRSD to Upgrade Its Plants**

Millions of 2024 Dollars

<b>Plants Owned and Operated by HRSD</b>	<b>Millions of 2024 Dollars</b>
Army Base Plant in Norfolk (AB)	\$80.4
Williamsburg Plant (WB)	\$80.4
Virginia Initiative Plant in Norfolk (VIP)	\$160.8
York River Plant (YR)	\$26.8
James River Plant (JR)	\$293.7
Boat Harbor Plant (BH)	\$576.7
Nansemond Plant in Suffolk (NP)	\$342.0
<b>TMDL Compliance by HRSD</b>	<b>\$1,560.9</b>

*Source: HRSD internal estimates based on previous upgrades. These costs would have appeared in their capital program as budgetary planning numbers. Estimates in this table have been adjusted to reflect costs in 2024 dollars*



**Table 7 - Consent Decree and Chesapeake Bay TMDL Capital Costs**

**Millions of 2024 Dollars**

<b>Compliance Costs</b>	<b>Non-Regionalized Approach</b>	<b>Semi-Regionalized Approach</b>
TMDL Compliance by HRSD	\$1,560.9	\$1,560.9
MS4 Compliance by localities	\$2,312.5	\$2,312.5
CD Compliance by HRSD and localities	\$4,365.4	\$2,929.0
<b>TOTAL</b>	<b>\$8,238.8</b>	<b>\$6,802.4</b>

*Source: Authors' estimates.*



**Table 8 - Estimated Capital Costs of SWIFT (Integrated Plan)**

**Millions of 2024 Dollars**

<b>Capital Costs</b>	<b>Millions of 2024 Dollars</b>
Army Base Plant in Norfolk (AB)	\$0.0
Williamsburg Plant (WB)	\$1.5
Virginia Initiative Plant in Norfolk (VIP)	\$306.7
York River Plant (YR)	\$2.3
James River Plant (JR)	\$729.3
Boat Harbor Plant (BH)	\$489.6
Nansemond Plant in Suffolk (NP)	\$1,139.4
<b>TMDL Compliance</b>	<b>\$2,668.7</b>
<b>MS4 Compliance</b>	<b>\$0.0</b>
<b>CD Compliance</b>	<b>\$420.0</b>
<b>TOTAL</b>	<b>\$3,088.7</b>

*Source: HRSD CIP Plan Budget Estimates and HRSD's SWIFT Budget. Estimates in this table have been adjusted to reflect costs in 2024 dollars.*



**Table 9 - Regional Regulatory Burden of the Three Approaches**

Millions of 2024 Dollars

<b>Capital Costs</b>	<b>Non-Regionalized Approach</b>	<b>Semi-Regionalized Approach</b>	<b>SWIFT: Integrated Plan</b>
Army Base Plant in Norfolk (AB)	\$80.4	\$80.4	\$0.0
Williamsburg Plant (WB)	\$80.4	\$80.4	\$1.5
Virginia Initiative Plant in Norfolk (VIP)	\$160.8	\$160.8	\$306.7
York River Plant (YR)	\$26.8	\$26.8	\$2.3
James River Plant (JR)	\$293.7	\$293.7	\$729.3
Boat Harbor Plant (BH)	\$576.7	\$576.7	\$489.67
Nansemond Plant in Suffolk (NP)	\$342.0	\$342.0	\$1,139.4
<b>TMDL Compliance by HRSD</b>	\$1,560.9	\$1,560.9	\$2,668.7
<b>MS4 Compliance by localities</b>	\$2,312.5	\$2,312.5	\$0.0
<b>CD Compliance</b>	\$4,365.4	\$2,929.0	\$420.0
<b>TOTAL</b>	<b>\$8,238.8</b>	<b>\$6,802.4</b>	<b>\$3,088.7</b>



**Table 10 - Regulatory Compliance Costs and Marginal Change in Costs**

Millions of 2024 Dollars

	<b>Regulatory Compliance Cost</b>	<b>Reduction in Ratepayer Costs</b>	<b>Reduction in Loan Costs</b>	<b>Total Reduction in Costs</b>
Non-Regionalized Approach	\$8,238.80	---	---	---
Semi-Regionalized Approach	\$6,802.40	\$1,436.40	---	\$1,436.40
SWIFT	\$3,088.70	\$3,713.70	\$321.57	\$4,035.27
<b>Totals</b>		<b>\$5,150.10</b>	<b>\$321.57</b>	<b>\$5,471.67</b>

*Source: Authors' estimates. The reduction in ratepayer costs represents the marginal reduction in costs relative to the previous approach. The reduction in ratepayer costs for the semi-regionalized approach is relative to the non-regionalized approach while the reduction in ratepayer costs for SWIFT is relative to the semi-regionalized approach.*



**Table 11 - Distribution of Income and Avoided Costs**

Household Income Past 12 Months	Distribution of Virginia Households	IMPLAN Household Income Categories	Distribution of Virginia Households	Avoided Costs Semi-Regionalization Millions of 2024 Dollars	Avoided Costs SWIFT Millions of 2024 Dollars
Less than \$10,000	4.30%	Less than 15k	7.0%	\$100.55	\$282.47
\$10,000 to \$14,999	2.70%	15k-30k	7.8%	\$112.04	\$314.75
\$15,000 to \$24,999	5.10%	30k-40k	5.7%	\$81.40	\$228.67
\$25,000 to \$34,999	5.40%	40k-50k	5.9%	\$85.23	\$239.43
\$35,000 to \$49,999	8.90%	50k-70k	11.8%	\$168.92	\$474.55
\$50,000 to \$74,999	14.70%	70k-100k	15.2%	\$218.91	\$614.98
\$75,000 to \$99,999	12.30%	100-150k	18.0%	\$258.55	\$726.35
\$100,000 to \$149,999	18.00%	150k-200k	11.1%	\$159.44	\$447.92
\$150,000 to \$199,999	11.10%	200k or Above	17.5%	\$251.37	\$706.17
\$200,000 or more	17.50%				
<b>Totals</b>	<b>100.00%</b>		<b>100.00%</b>	<b>\$1,436.40</b>	<b>\$4,035.27</b>

*Source: U.S. Census, 2024 American Community Survey, 1-Year estimates and authors' estimates. The reduction in ratepayer costs represents the marginal reduction in costs relative to the previous approach. The reduction in ratepayer costs for the semi-regionalized approach is relative to the non-regionalized approach while the reduction in ratepayer costs for SWIFT is relative to the semi-regionalized approach.*



**Table 12 - Economic Impacts of Semi-Regionalization and SWIFT**

	<b>Employment</b>	<b>Labor income Millions of 2024 Dollars</b>	<b>Value Added Millions of 2024 Dollars</b>	<b>Outputs Millions of 2024 Dollars</b>
Semi-Regionalization	7,480	\$446.3	\$924.5	\$1,447.9
SWIFT	21,013	\$1,286.9	\$2,669.0	\$4,179.0
<b>Totals</b>	<b>28,492</b>	<b>\$1,733.2</b>	<b>\$3,593.5</b>	<b>\$5,626.9</b>

