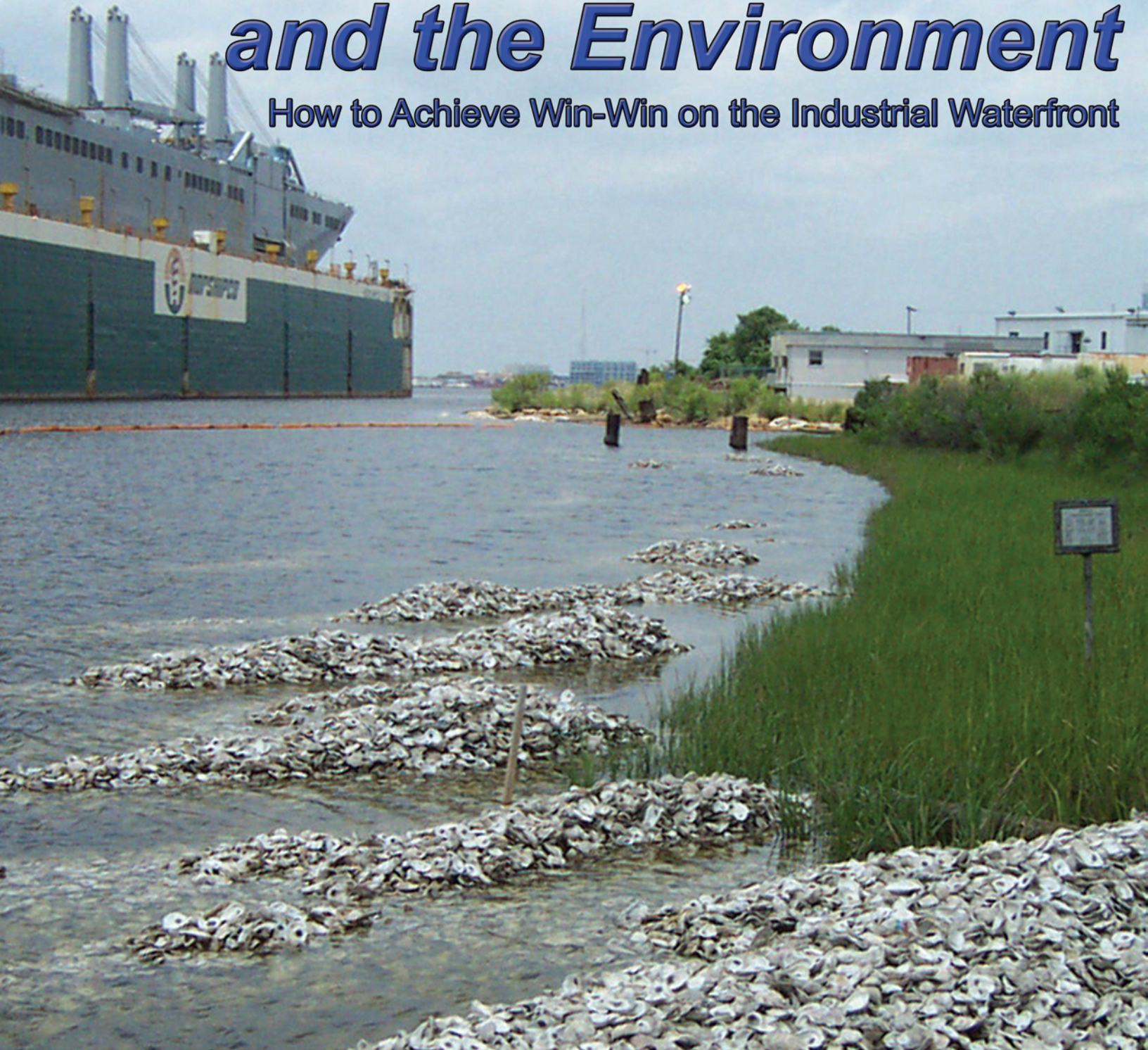


Balancing Industry and the Environment

How to Achieve Win-Win on the Industrial Waterfront



***A Guide to Sustainable Redevelopment Practices
by The Elizabeth River Project***

Prepared under contract to the U.S. Environmental Protection Agency, Region 3

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Prepared by:



The Elizabeth River Project
475 Water Street, Suite C103A
Portsmouth, Virginia 23704
Phone: 757-399-7487
www.elizabethriver.org

Prepared for:

US EPA Region 3
Brownfields Land Revitalization Branch
1650 Arch Street (3HS51)
Philadelphia, PA 19103-2029
Phone: 215-814-5000, Hotline for environmental questions

Cover photo: BAE Systems Norfolk ship repair (formerly NORSHIPCO) restored wetlands and oyster reefs.

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APM Terminals Virginia balances the economy and environment.

Executive Summary

“DOIN’ RIGHT BY THE RIVER” - WHAT’S IN IT FOR YOU?

“What is Sustainability? Sustainable development marries two important themes: that environmental protection does not preclude economic development and that economic development must be ecologically viable now and in the long run.”

– U.S. Environmental Protection Agency website,

<http://www.epa.gov/sustainabilitybasicinfo.htm>

The working waterfront is a fascinating world of modern industrial ingenuity, steeped in the ancient mystique of ships calling from foreign ports, juxtaposed with the call of seagulls, the rise and fall of the tide, the sight of an osprey diving and rising with a fish in its talons.

On the Elizabeth River in Southeastern Virginia, birthplace of maritime industry in America, we seek the power of balance between these forces. We at The Elizabeth River Project (www.elizabethriver.org) call our industries River Stars when they pass peer review for documented, voluntary achievements in pollution prevention and wildlife habitat restoration along our busy Norfolk-Portsmouth-Chesapeake harbor.

The value of pollution prevention to your business can be as simple as saving money. Pollution is the economic equivalent of throwing away your product. But this guidebook is also about a larger magic we have discovered in helping urban waterfront industries both help their bottom line, and help conserve the living waterways where they have located. While our program was developed for the Elizabeth River watershed, many of the practices and the benefits apply to your industry, too, if you are operating or planning to operate on an urban waterfront. We hope this guide also inspires other communities, agencies and environmental groups to consider the value of assisting and rewarding industries for their progress with environmental stewardship, versus the old model of blame and attack. The guidebook will explore five elements of voluntary environmental stewardship on the working waterfront:

CHAPTER 1 - PREVENTING POLLUTION, THE BASIC WIN-WIN. This is a primer for avoiding having any pollution to manage by not creating it in the first place. We will draw on the documented successes of River Star industries in the Elizabeth River watershed. Cost-savings, improved worker safety and morale, positive publicity and reduced liability are among the benefits awaiting you.

CHAPTER 2 - WILDLIFE HABITAT – MAKING ROOM ON THE URBAN WATERFRONT. No industry will have a greater opportunity to make a difference than yours if you have chosen the urban, industrial waterfront. More than likely, wildlife habitat is at a great premium all around you because it is so scarce. You may be surprised to find that you can do a lot to conserve or bring it back, even on the working waterfront. Discover industries that have created oyster reefs, restored wetlands and planted native forests among the drydocks and storage tanks of a major port. And learn the payoffs we’ve seen - from savings of \$16,000 a year on mowing to a company that landed three major construction contracts because of an article about its wildlife habitat. Bay Environmental and WPL, two environmental consultants in our area, helped us put together our technical advice here.

CHAPTER 3 - STORMWATER RUNOFF, THE BIG PAYOFF. Rain seems innocuous until it washes across your industrial yard and into the river, picking up your unintentional drips and drabs along the way. Then it becomes contaminated stormwater runoff, the No. 1 source of pollution on most waterways in the nation. Related both to pollution prevention and wildlife habitat restoration, efforts to address stormwater runoff provide a really big payoff for the health of your waterway. Here’s the latest in stormwater ingenuity for the industrial waterfront, with advice from our consultants Williamsburg Environmental Group and WPL.

CHAPTER 4 - REDEVELOPING THE CONTAMINATED SITE. Most sites that become available on the urban waterfront have been used before; generally heavily, often for centuries. Forging forward with rede-

velopment plans without first assessing and addressing prior contamination is taking the fast lane to problems, both for the river and for you. A systematic approach to first identify and then address the problems will pay off with improved land value and minimized environmental liabilities.

CHAPTER 5 - GREEN BUILDINGS FOR GLOBAL SUSTAINABILITY. If you are located near the ocean, no one stands to gain more from helping halt global warming than industries located on the waterfront. You're in the immediate path of rising sea water levels. Designing your buildings with energy efficiencies will provide dollar savings for you over the long-term and help reduce greenhouse gases. The University of Virginia School of Architecture's Phoebe Crisman and partner Michael Petrus were our advisors for a primer on sustainable building practices.

We conclude with three case studies of sites we have advised over the past several years to demonstrate the principles and practices described in this guidebook. Our case study on **Earl Industries**, a multi-state corporation that bought a shipyard, marina and undeveloped land on the Elizabeth River describes finding win-win for the 80 acres of waterfront property including nearly a mile of densely forested shore – despite plans to turn the shore into condos and office towers.

Our case study on **APM Terminals of Virginia** describes finding the path to a pro-active approach to doing right by the river despite plans for paving 230 acres to establish the largest private port terminal in the U.S.

Our case study of the **Southern Branch Corridor of the Elizabeth River** includes sites ranging from Atlantic Wood Industries, a Superfund site, to proposed plans for the world's largest ethanol plant, to a proposed public nature park and a condominium development. This corridor presents pretty close to the full range of challenges and opportunities we have identified in the search for balance between the environment and the economy on the working waterfront. At the end of the book, you will find further resources for “doin’ right by the river,” an approach that we hope will help your company’s bottom line, and give you the satisfaction of leaving the legacy of a healthy waterway for the next generation.

If you are a non-profit or other environmental organization like The Elizabeth River Project, we hope this guidebook shows you the power of working collaboratively rather than confrontationally with industries to help them discover this rewarding path.

The head of the environment for China once came to see why industries are so interested in working with The Elizabeth River Project to prevent pollution. The official had only a smattering of English and we knew no Chinese. Van White, the environmental manager at **NOVA Chemicals**, did his best to explain some of the company's inventive efforts as a River Star business participating with The Elizabeth River Project to “do right by the river,” our program slogan. Speaking through interpreters, Van explained that NOVA had, for instance, designed a steel mesh to cover the storm drains with holes just smaller than the polystyrene pellets it manufactured to capture spilled pellets before they entered the drains. The pellets were collected and re-used in the company's manufacturing process. Polystyrene, once washed into the river, would never have degraded. Giving the Chinese delegation a tour of NOVA on the Chesapeake, Virginia, shore of the Elizabeth River after Van's presentation, we were not sure our message had made it past the language barriers. Then our guest of honor bent beside a storm drain and picked up one of the pellets. “Money,” he said, summing things up perfectly.



Environmental protection does not preclude economic development. Photo by Van White.

INTRODUCTION

THE SATISFACTION OF FINDING THE BALANCE



Maersk proposed to build a \$400 million terminal, on 600 acres representing the largest habitat left on the Elizabeth River. Could the tradeoff be win-win for the river and the economy?

I was trespassing and I was scared. Not only had I not asked permission for my hike; of greater concern, Maersk, the colossal Danish shipping magnate, had proposed to build a \$400 million port terminal on the 600 acres of soybean fields, wetlands and rare Atlantic White Cedars where I was making my way along the farmer's dirt road and down a sandy shore. I picked a bouquet of wild Joe Pye weed, listened to the lap of the waves along the beach and thought about the consequences of the final recommendations we were about to submit on behalf of the non-profit conservation group, The Elizabeth River Project, to limit environmental impacts of this development. The site represented the largest open space left along the industrialized Elizabeth River, Virginia's busy commercial and military harbor. Maersk's subsidiary, APM Terminals, was pledging to offset dredging of 10 million cubic yards of healthy river bottom with a \$5.3 million mitigation payment – enough funds, we hoped, to

clean one of the most intensely degraded part of the river bottom a few miles away, where creosote from a series of spills and poor practices through the 1970s continues to leave a legacy of cancer in bottom-dwelling fish.

Would the trade-off really be win-win for the Elizabeth River and the local economy? Would APM Terminals also follow through on pledges to build a state-of-the-art facility with controls on stormwater far beyond the minimum required by law? Would they add maximum pollution prevention practices? Only such pro-active leadership on the company's part would limit the impacts to our urban river sufficiently for restoration to win the race with degradation. Meanwhile, for the company, willing cooperation with a prominent non-profit such as ours could help them move forward to construction without the resistance large port development plans were meeting from other port communities and regulators.



Giant Cement of Virginia established a now mow zone along the shores of Paradise Creek, creating habitat and saving money on mowing costs.

Four years later, I returned to the same shore by very different means. Tour buses shuttled almost a thousand dignitaries from parking lots that had replaced the farmer's fields to a circus-sized event tent, set among towering shipping cranes. Not only were the cranes electric, and thus would add no diesel fumes to the air, but APM also chose to make their 30 Rail-Mounted Gantry yard cranes electric, unheard-of on the East Coast, eliminating more diesel emissions. "Welcome to the most environmentally friendly port terminal in the world," our driver told the bus load of visitors on opening day.

In this guidebook, you will find a diagram for how APM Terminals indeed went beyond the minimum required by law to capture and treat its stormwater on the vast asphalt fields that have replaced the soybeans, and details of pollution prevention measures such as the electric cranes. "We want to be a terminal with a conscience. You inspired that" through Elizabeth River Project recommendations, Nick Taro, senior vice president during the terminal's development, told me over the asparagus tips and ham biscuits at the grand opening.

The non-profit Elizabeth River Project is pioneering a new premise on the East Coast of America, that waterfront industrial development can take place in cooperation with, rather than in opposition to, those of us who seek to champion and protect the environmental health of our waterways.

We believe that win-win is almost always possible. Part of it is a simple matter of commitment, the same kind you make when you decide to keep your room clean. When Ron Babski, APM's environmental manager, tells drivers not to leave their vehicles idling - an unnecessary source of emissions - he means it. "I tell people, if I find one of those vehicles, I'll take your keys and they'll be on my desk." Often win-win also requires thinking out of the box, as when we thought of offsetting the loss of the healthy river bottom at APM by asking the company to fund the clean up of degraded river bottom nearby. Typically win-win ends up surprising the companies with unexpected benefits to them as well as the river, from public approval, to cost-savings (pollution is often a product you no longer create and throw away), to the pure pleasure of knowing you are doing something good for the world.

"I feel like we benefitted more than we contributed."

- Van White, NOVA Chemicals

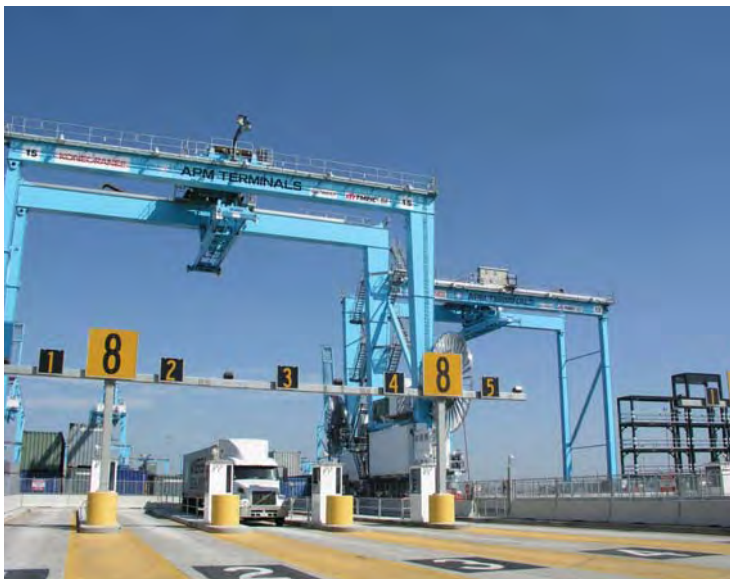
"I feel like we have benefitted more than we have contributed," said Van White, environmental manager of NOVA Chemicals, regarding its achievements with The Elizabeth River Project's "River Stars" program. The company became a River Star by planting an 11-acre wildlife habitat along Elizabeth's shore. That day's work wound up attracting 11 news articles including one that featured Nova Chemicals in the New York Times. Continuing on to become a guru of voluntary pollution prevention, Mr. White ended up in Thailand one year, welcomed by the Minister of the Environment for Thailand, to teach a seminar for businesses overseas on The Elizabeth River Project's model for cooperative pollution prevention.

Almost always, our brand of win-win has required an open mind on the part of the company, to consider a little different approach in develop-

ment or redevelopment of an urban waterfront site than the traditional one. Thus, we are pleased to provide this guidebook, made possible by the U.S. Environmental Protection Agency. EPA also saves time and money when industries “do right by the river” without the heavy hand of enforcement.

Our approach in Southeastern Virginia is organized through our River Stars program, a structured approach to assisting and recognizing voluntary industrial achievement. The Chesapeake Bay Program modeled its Businesses for the Bay effort after our approach. NOVA Chemicals reached the highest level of recognition in this program, becoming one of our Model Level River Stars, recognizing the best of the best, the exemplary leaders here in environmental stewardship. At this writing, 63 companies are recognized as River Stars by The Elizabeth River Project, based on peer review of their annual documentation of stewardship results.

Over the 10 years the program has been in existence, starting in 1997, the companies voluntarily have restored or conserved 818 acres of urban wildlife habitat – pockets of native plants in and among shipyard drydocks and along busy highways, that mean all the more because of the scarcity of habitat in this 250-square-mile, 90 percent developed watershed. Through waste and emission reductions, River Stars over



After development, the APM site included state-of-the-art approaches such as electric cranes.



Marjorie Mayfield Jackson, Executive Director, Elizabeth River Project, believes the only sustainable way forward is when the largest developers, as well as the smallest ones, seek out approaches that compliment the natural world. Photo: Bill Tiernan, The Virginian -Pilot.

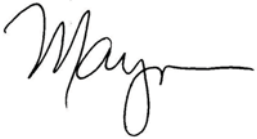
the same period have also reduced pollution the voluntary way by more than 180 million pounds. Each January these industries celebrate their progress together at an annual banquet.

Whether you are an on-going business or starting operations anew, you don't have to wait until someone else applauds you as a “star.” Wherever you are, if you are considering industrial development or redevelopment along an urban waterfront, you have a very special opportunity to achieve something extraordinary: a working waterfront that is also green and healthy. You begin with the magic of life along a busy harbor. Pam Boatwright, our River Stars Project manager, loves the harbor so much that she lives there, aboard her own trawler. She also loves the site visits where she puts on a hard hat and climbs, for instance, cement silos that will unload container carriers from foreign shores. When many property owners along an industrial shore are actively engaged in environmental stewardship, an energy is created that is unlike any other.

If you are a non-profit wondering how you can convince waterfront businesses to consider greener practices, we believe you can draw on the same resources, so long as you choose the collaborative path of believing win-win can be found.

“It is with subtlety and grace that Elizabeth River Project’s mission and programs have encouraged those of us in the maritime industry to look beyond the transportation and commercial fishing services that the river provides and into the depths of her marshes, oyster reefs and muddy bottom,” J. Robert Bray, Executive Director, Virginia Port Authority, wrote in a letter to The Virginian-Pilot. Bray said the voluntary approach has inspired port leaders “to understand that the river is the livelihood of our industries and as a result we should serve as her stewards.”

Don’t worry, I have only once trespassed in the pursuit of win-win, and only because I wanted to sit on that quiet beach at the proposed APM Terminal site alone, with the trees and tide, to decide if our unorthodox approach felt right even when applied to so very large a development: the proposed largest privately owned container terminal in the United States. At The Elizabeth River Project, we believe the only sustainable way forward in this modern world is when the largest developers, as well as the small ones, learn to seek out approaches that complement the natural world rather than destroy it. That the one is deeply more satisfying than the other hardly needs to be said.



**- Marjorie Mayfield Jackson, Executive Director
The Elizabeth River Project**

1

Preventing Pollution

The Basic Win-Win

Pollution prevention (P2), or the practice of avoiding pollution before it is created, is perhaps more important on the urban waterfront than for any other location. If harmful materials are spilled, they have little distance to travel to reach the fragile ecosystem of the river or harbor that is your host. Meanwhile, your urban waterfront is probably also already the home for a staggering load of pollution from industrial sites dating back many decades before anyone attempted to design for environmental protection.

Because how you chose to develop your site and design your processes will have an unusually critical role in conserving the remaining natural resources of your urban waterway, you have a leadership opportunity to prove that there is another way to do business on the waterfront – the win-win way for the environment and the economy.

When an 18-wheeler truck pulls into **APM Terminals of Virginia** to unload or load a container for overseas shipment, APM's goal is to have the truck on its way again inside of 30 minutes. A scanner reads a card in the driver's windshield to alert automated equipment regarding what the driver needs to load or unload, moving his truck as efficiently as possible through the terminal.

Two things are saved here: money and the environment. The cost of the driver's time is minimized, and so are emissions from the truck. It's a classic pollution prevention success story.

Not many waterfront sites will have the resources for the state-of-the-art efficiencies at APM. But preventing waste – wasted materials, wasted operating time, wasted fuel – generally equates to preventing pollution and saving money. On the Elizabeth River waterfront, this has proven true for both our largest and smallest facilities.

Naval Station Norfolk, the world's largest navy base, operates at the mouth of the Elizabeth River. One change alone in its processes to maintain ships saved the naval station \$285,000, and reduced fugitive dust emissions by 90 percent. The pollution prevention change was a switch to remove non-skid coating from submarines by water blasting instead of grinding. The naval station reports that pollution prevention efforts add up there each year to the tune of almost \$3 million in cost-savings.

NOAA Marine Operations Center – Atlantic is a tiny facility in comparison, totaling only a few acres on the waterfront and conducting no manufacturing or repair processes that might create significant pollution. Yet working with The Elizabeth River Project, NOAA designed an energy management program that saved the facility \$3,500 in the first two months over the prior year, while reducing greenhouse gases.

PLAN YOUR APPROACH

You will be most successful in the long-term if you approach pollution prevention systematically, with the development of a written plan that others can help you follow.

Types of pollution prevention plans. Ideally your plan will take a look at all your processes to see where you could be using the principles of reduce, re-use or recycle. The size of your facility may dictate which of three planning approaches is best for you:

- **The pollution prevention plan is for smaller facilities.** Smaller facilities may want to develop a simple “pollution prevention plan” on your own,





BAE Systems Norfolk Ship Repair (shown above) along with Norfolk Naval Shipyard treat the stormwater runoff as well as washwater from drydocks. Photo by Van White.

although ideally with the help of an environmental consultant. On our working waterfront, an example of an industry choosing this route is Giant Cement of Virginia, a small cement transfer facility that as a result changed its cooling systems to prevent runoff. At The Elizabeth River Project, we provide companies with a pollution prevention workbook to get them started; also downloadable from our website, <http://www.elizabethriver.org/Publications/PDFs/ERPPubs/Polltion%20Prevention%20Workbook.pdf>. Other resources are available such as guidance from the Pollution Prevention Roundtable, found at <http://www.p2.org/>.

- **The Environmental Management System offers a more comprehensive approach** (see <http://www.epa.gov/ems/>). Larger facilities not interested in outside certification often find the development of a more formal Environmental Management System (EMS) to be more comprehensive and more useful as a dynamic tool for on-going environmental improvements in a facility with constantly changing processes. An EMS looks beyond environmental compliance and asks “which of our processes have the greatest impact on the environment, and what can we do about

it?” Because many environmental impacts arise from process wastes, useless byproducts, energy consumption, and excess materials, facilities often find that reducing environmental impacts and reducing costs go hand-in-hand. Examples of River Stars on our waterfront who use an EMS include Dominion Virginia Power’s Chesapeake Energy Center, a coal-fired power generation plant, and the Virginia Port Authority which developed the plan for its terminals.

- **International certification, or ISO 14001, offers third-party certification.** Internationally accepted standards can be pursued by facilities willing to go one step beyond an Environmental Management System to have their pollution prevention efforts certified by the International Standards Organization (ISO 14001). This can take several years and generally requires the guidance of consultants specializing in ISO certification. While time-consuming, the certification is recognized around the world and can demonstrate a high level of environmental commitment for companies conducting international commerce. Skanska, USA Civil Southeast, a River Star on the Southern Branch of the Elizabeth River owned by an overseas company, was the first heavy/marine/industrial contractor in the U.S. to be awarded ISO 14001 certification.

THE THREE R’S OF POLLUTION PREVENTION:

1. **REDUCE** - Reducing the sources of pollution is the top priority, through the design of environmentally friendly products, product or process changes and source elimination.
2. **RE-USE** - When sources of pollution cannot be reduced, re-use, or reclamation of waste materials is the next priority.
3. **RECYCLE** - When waste materials cannot be re-used, often they still can be recycled – the next level of priority.



KEYS TO SUCCESSFUL PLANS

Whichever of the three approaches you pick, common themes apply to all of them for helping you “star” in pollution prevention.

PUT TOGETHER THE RIGHT TEAM

- **Make the plan a company-wide effort, supported by top management.** Write down your company's environmental policy or goals regarding pollution prevention and share it with all company employees. It is important to encourage all employees to read and adopt this policy. At NOAA's Atlantic Marine Center, pollution prevention really gained momentum when a new commanding officer took a personal interest and assigned someone on his staff to develop goals and implement them, reporting to him directly on the progress.

Ford Motor Company's business on the Elizabeth River was assembling the F-150, a popular pickup truck. This required a large volume of paint, solvents and lubricants, none of it welcome in the waste stream or the Elizabeth River.

To reduce the volume of these potentially harmful materials, Ford pioneered “green purchasing” practices. Up to that time, “Ford purchased paint by the gallon. There was no incentive for suppliers to make the paint stretch,” says Pam Boatwright, River Stars Program Manager.

With paints, typically, “People don't think minimizing. They think extra.” But Ford figured out exactly how much paint and solvents they needed for each truck, then renegotiated with the suppliers to pay per truck unit. Then suppliers had a vested interest to be on site helping ensure that paint waste was at a minimum. This concept is known as Chemical Management Services (see <http://www.epa.gov/minimize/cms.htm> and <http://cmsforum.org>).

- **Identify one person who takes the lead in pollution prevention efforts.** Your champion could be called the pollution prevention facilitator, manager, coordinator, etc.
- **Provide a team format to encourage other employees to participate on a day-to-day level.** For instance, employees could form a Pollution Prevention (or “Green”) Team that identifies and evaluates potential pollution prevention opportunities. This team should be “cross-functional,” incorporating people within different areas of the company (i.e. engineering, operations, accounting, etc.).
- **The best place to get ideas for pollution prevention is often your employees.** Yes, a pollution prevention champion is important, but the greatest synergies and achievements can occur when many people get involved. The first line mechanics/craftsmen are generally in the best position to identify inefficiencies in processes and waste streams.
- **Incorporate a recognition or award program for employees who identify pollution prevention opportunities or promote environmental awareness and safety.** Norshipco, a large shipyard on the Elizabeth (now BAE Systems Norfolk Ship Repair), provided a special parking space for its Environmental Employee of the Month. Pro-active environmental initiatives earn employees a special ball cap from Virginia Port Authority at terminals on the river – inspiring workers to invent simple but effective new ways to store equipment and collect litter. Consider providing employees a share of the savings from the changes.

TOUCH ALL THE BASES

- **Identify all waste streams at your facility to assess their impacts and opportunities for reducing them.**
- **Set pollution prevention goals, based on your processes and waste streams.** Goals should be achievable, measurable, observable, flexible and demanding





The world's largest navy base, Naval Station Norfolk, saved \$285,000 by changing from grinding to vacuumed water-blasting when replacing non-skid coating on submarines. A classic win-win for the environment and the facility, the change reduced fugitive dust by 90 percent.

and should incorporate the following categories (if applicable):

- process wastes, inefficiencies and rework
- focus on each media (river water, ground water, stormwater, air) that may be impacted by discharges
- material, water, and energy consumption
- purchasing practices
- employee awareness and training
- stormwater runoff
- public relations/community involvement

KNOW IF IT'S WORKING

- **Determine the "baseline" performance for each goal so that progress can be measured.** For instance, if you decide to recycle a material, measure how much material is currently recycled and how much is currently disposed of as waste before implementing the recycling.
- **Publicize your efforts every chance you get, including through recognition programs.** The public really wants to hear about positive environmental efforts, especially when they are voluntary! On the Elizabeth of course, you might qualify for recognition as one of our River Stars. But there are also regional,

- **Include a method to track progress.** As with any company effort, you will want to document that the initiatives are worth your time. Document as specifically as you can all information about your successes with waste elimination, reduction, recycling, re-use and treatment, including types, volumes/amounts, and impacts, divided by process. Once recycling is implemented, measure how much each of those categories has changed. Other measurements could include disposal cost avoided, number of employee hours required to implement, training cost for implementation, etc.

How can this show up on your bottom line? **Christian Broadcasting Network (CBN)** saves \$1 million per year through creative reduction of its energy needs. **CBN's** approach includes using energy at night (off-peak time) to freeze water that supports the air conditioning during the day (peak time) by reducing the amount of cooling effort (energy) that is needed from the air conditioning units for proper climate control. This offsets both the costs of energy and the demand load on Dominion Virginia Power.

CBN also collects the water from this coolant process and reuses it in various other aspects of the operation, thus reducing the amount of water that the facility requires from the city. In addition, CBN made significant changes to its lighting system that involved changing three and four-lamp fixtures to two-lamp fixtures over the entire complex. The addition of mirrors within the fixtures actually increased the amount of useful light while requiring less energy to run.



national and even international recognition and award programs, varying by industry specifics. Three include EPA's ENERGY STAR program (<http://www.energystar.gov>), Performance Track program (<http://www.epa.gov/performance-track/>) and Businesses for the Bay (www.acb-online.org/b4b/index.cfm) here on the Chesapeake Bay. The publicity can also be shared with other facilities within the company.

- **Evaluate your plan periodically to ask yourself if it still meets your facility's needs.**
- **If you are a non-profit like The Elizabeth River Project, working to inspire partner industries to try pollution prevention, publicize and reward what companies achieve.** We hold an annual rec-

Nutrients and sediments: Too much of two good things. Nutrients sound like a good thing, since they are essential for the growth of all living organisms. But in waterways like the Chesapeake Bay, excess nutrients are the leading problem associated with poor water quality. Excess sediments are not far behind, as innocent as they may seem ("just dirt," right?). Here's why:

- Nutrients cause algae blooms which, in turn, deplete the dissolved oxygen essential for fish and shellfish to breathe, leading to fish and shellfish kills.
- Algae blooms also block sunlight to underwater grasses, preventing the growth of this critical form of habitat for aquatic life.
- Sediments washed off the land and into a waterway often carry with them excess nutrients as well as toxics. Causing further problems, the sediments smother bottom-dwelling plants and animals and cloud the water, preventing light from penetrating to the leaves and stems of underwater grasses. Sediments also clog navigation channels, making traffic difficult or hazardous, and requiring dredging.

ognition banquet for participants in our River Stars program and seek all the media coverage we can for their achievements. Industries find it easier to budget for voluntary environmental improvements when they receive public relations benefits for doing so. Friendly peer pressure, as pollution prevention becomes the "in" thing in your community, helps a lot also.

REDUCE: POLLUTION IS OFTEN A PRODUCT YOU THROW AWAY

Why create it in the first place, if you can figure out an alternative? You have achieved the most effective approach to pollution prevention when you re-design your processes or practices to avoid harmful wastes or emissions. Here's what some of our inventive River Stars did on the Elizabeth River.

BUY ONLY WHAT YOU NEED TO START WITH

At your site, think similarly. Order only what you need in terms of paints, epoxies and hazardous materials.

EQUIPMENT IS EVERYTHING

One of the easiest steps you can take to reduce your impacts on the environment - and save energy and operating costs - is to choose the most efficient equipment, appliances and vehicles. In spite of double-digit (12 percent) growth in container movement, Virginia Port Authority reduced air emissions by 30 percent when they purchased off-road vehicles that met on-road vehicle air emission standards, replaced eight-cylinder pick up trucks with four-cylinder models where practical, and implemented no-idle policies that direct equipment drivers to turn off vehicles during down times and all computer-controlled engines to shut down after 15 minutes of idling. When the Coast Guard Integrated Support Command in Portsmouth replaced older heating units with efficient, cleaner propane-burning units, it reduced air emissions from the station by 1,200 pounds per year. Earl Industries, another River Star, converted a boiler to natural gas, reducing air emissions by 2,600 pounds in one year.



COVERED STORAGE: DON'T WASH YOUR MATERIALS OUT WITH THE RAIN

If materials and wastes aren't properly stored, pollutants can leak or be washed out by rain water and carried into waterways. Cover stockpiled materials. Stockpiles of building and other materials such as lumber, metal products, topsoil, sand, gravel, compost, sawdust, and wood chips must be covered to prevent rain from carrying off pollutants such as sediment and nutrients.

SPILL PREVENTION: REDUCE LIABILITY AND POLLUTION

If you use paints, solvents, oils, gasoline, pesticides, or other materials that can spill, your business needs a spill control plan. This is true even if you handle materials that are normally considered harmless (such as food). In excess, anything can become a harmful pollutant. Food, for example, can contribute to excess nutrients in waterways, the leading cause of eutrophication (unwanted plant growth, decay and oxygen depletion) in the Chesapeake Bay.



When Skanska, a construction company, moves drums on the site like its Elizabeth River locations, this “drum dolly” not only makes the move easy, but provides secondary containment in case of a spill.

Examine your business for ways to reduce the chance of spills. Nearly every business uses liquids in its operations.

- Organize the delivery and unloading areas. Ideally, loading/unloading docks should have overhangs or door skirts that enclose the trailer end, and should be designed to prevent run-off of stormwater (for example, by being surrounded by a low berm).
- Use a funnel to transfer liquids from one container to another.
- Store materials where they won't be knocked over.

Prepare a clean-up plan

Any business that uses oils, gasoline, pesticides, or even bulk food products should prepare for possible spills. EPA links for spill prevention plans include <http://epa.gov/owm/mtb/spillprv.pdf> and <http://www.epa.gov/emergencies/content/frps/index.htm>. Generally, a clean-up plan includes the following elements:

- Describe the facility (including owner's name and address, activities, and types of chemicals used). Show chemical storage areas, storm drains, and what areas are sloped toward each drain. Also locate and describe spill control devices such as positive control valves.
- Establish who to notify in the event of a spill.
- Provide specific clean-up instructions for different materials handled on-site, safety requirements, and guidelines for evacuation.

Accurate Marine Environmental, an Achievement Level River Star on the Southern Branch of the Elizabeth River, installed stormwater inserts that filter sediment and hydrocarbons. The unique inserts also have a valve that can be closed in the event of a spill, which will prevent the spill reaching the river and make cleanup easier.



- Assign people to be in charge of spill clean-up, updating the spill control plan, training staff in clean-up procedures, testing the clean-up kit equipment, and maintaining the inventory.
- Prepare spill containment and clean-up kits which are easy to find and use. Include any needed safety equipment as well as clean-up materials appropriate to the type and quantity of material that could spill. In fueling areas, store absorbent materials in small bags for easy use and keep small drums for storing used absorbent rags.
- Post a plan summary (including clean-up contractors, location of clean-up kits, and who to contact) at appropriate locations.
- Clean up spills immediately. If a spill occurs, respond immediately according to your clean-up plan. Protect your safety and the safety of others. Contact regulatory authorities when required.
- Drain fluids such as unused gas, transmission and hydraulic oil, brake fluid, and radiator fluid from vehicles or parts kept in storage. Reuse, recycle, or dispose of these fluids properly. Leaking vehicles or parts kept on-site should be kept in a covered, bermed area.
- Fix leaks on equipment and vehicles. Maintain equipment properly and develop a system to report leaks promptly.
- Organize the work place to reduce the chance of spills. Use a funnel when transferring or diluting chemicals and place a tray underneath to catch spills. Place drip pans under the spouts of liquid storage containers. Immediately clean up any spills.
- Don't hose down your shop floor if the water can enter a storm drain. It's best to sweep it.

IMPROVE HOUSEKEEPING

Any residue (such as paint chips, metal shavings, or grease) on a surface that drains to a storm drain can be washed to waterways, often in violation of state and local laws. Disorganized work places increase the chance of spills.

- Keep surfaces that drain to the drainage system clean and organized.
- Keep toxic materials separated from non-toxic materials.
- Regularly sweep or mechanically remove outside wastes such as those found around the dumpster or on the parking lot. Don't hose the parking lot to clean it.
- Place a tarp on the ground during remodeling, painting prep work, sandblasting, or other operations that can create dust or debris.

For decades, the largest power plant on the Elizabeth River had little market for a large percentage of what it created: “fly ash,” a by-product of the coal it burned for power. A creative engineering team came up with a solution.

When Virginia's first Carbon Burn Out unit opened at **Dominion Virginia Power's Chesapeake Energy Center** in November 2007, the power plant began re-using, rather than land-filling, 360 million pounds a year of the fly ash, while addressing a national shortage of cement. The fly ash is now burned at the power plant to remove the last of the carbon with the heat captured and used at the plant – saving more than 15,000 tons of coal a year. The resulting powder is now suitable for resale as a cement alternative. This is a classic pollution prevention success story: the new approach reduces raw material usage, air emissions and landfill impacts while providing a revenue stream for the utility and reducing pollution from cement production.



EMPLOYEE TRAINING/AWARENESS IS CRITICAL TO SUCCESS

Many of the steps you can take to prevent pollution need to be followed on a daily basis. Therefore, continuing employee education is key to success. Consider incorporating the following into your training program:

- Select the applicable strategies.
- Include pollution prevention concerns in new employee orientations and in written procedures. Each employee should understand how the work he/she performs can create pollution and consume (or waste) energy and materials.
- Provide employees with proper disposal options.
- Conduct "worker right-to-know" training and have material safety data sheets (MSDS) available for easy reference. Show employees how they can identify the hazardous or toxic constituents of materials and let them know that finding less or non-toxic alternatives is a goal of the company.
- Discuss your company's P2 strategies and goals, including any equipment purchased, process changes, re-use and recycling efforts. Monitor workers to determine how effective the training program is. Provide daily feedback on observed behavior. Participate in other educational opportunities.
- Attend workshops and other relevant courses such as those sponsored by your trade association.
- Display signs and posters.
- Post an explanation of your pollution prevention strategies in areas where employees and customers will see them. For example, post the spill control plan or install a sign on the dumpster reminding staff to close the cover.

- Put pollution prevention issues/ideas/articles in staff minutes or a company newsletter.
- Publish successes around the facility and other facilities in the company.

REDUCE POLLUTION FROM YOUR VEHICLE

- Keep up maintenance for all vehicles including oil changes and tire pressure checks to minimize leaks, keep up fuel efficiency and reduce emissions.
- Recycle oil.
- In hot climates, tint vehicle windows to help increase fuel efficiency.
- Maximize the quantity for each material shipment to reduce deliveries to achieve savings in fuel and reduce emissions.
- Before purchasing vehicles, match the size vehicle to the job – does the facility need an eight-cylinder truck to drive around when a four-cylinder would do?



Dominion Virginia Power, Chesapeake Energy Center, reached Model Level River Star for improvements in its pollution and habitat conservation efforts.



- Reduce engine idling time.
- Consider reducing pollution from diesel engines through use of clean fuels such as low sulfur diesel fuel and retrofits of older diesel engines with pollution control equipment such as diesel oxidation catalysts or particulate filters.

These steps will reduce emissions of particulate matter, hydrocarbons, and carbon monoxide, improve air quality, and reduce asthma triggers.

REUSE: ONE MAN'S TRASH IS ANOTHER'S TREASURE

One way to help your bottom line while helping your local environment is to consider whether others could use your leftovers. Many times, there are other uses for those things that are considered waste. Used motor oil can be burned for heat in certain types of space heating equipment. A neighboring facility may be able to use leftover paint or other materials. Used furniture can be given to a charity or to employees. Scrap wood may be turned into mulch, and dirty solvent from one process may be clean enough to use in another process.

RECYCLE IS AN OLD FAVORITE

If you can't "reduce" waste or "re-use" the material, the third priority in the three R's of pollution prevention is the old standby of the environmental steward, to "recycle." This means to recycle waste material into a new product, still saving significant energy over creating the material from scratch – if not for you directly, for the planet.

The key to successful recycling: Separate wastes.

Keep your wastes in separate containers according to the type of product and keep records of the container contents (keep materials in the original container if possible). Combining different types of waste can prevent recycling and greatly increase disposal costs.

For example, uncontaminated waste oil can be recycled, whereas waste oil mixed with solvents requires a much more costly and complicated disposal process.

It's easy to start with simple office waste such as cans, paper and plastic. Seek out the recycling agency in your area for collection bins, instructions on what materials are accepted and any fees involved.

For waste fluids such as oil, antifreeze, transmission fluid and solvents, many industries buy their own equipment to recycle these fluids in-house, especially if they are working with large volumes. Waste contractors are also available to remove and recycle the fluids.

Steel and tin are valuable to metal scrap yards that often will pay to remove these waste materials from your site.



Wildlife Habitat

Making Room on the Urban Waterfront

2

THE SHORELINE:

THE CRITICAL ZONE

At The Elizabeth River Project, we have yet to discover an industry that needs every scrap of land at its waterfront for industrial use. Only a few water-dependent activities really require replacing the native vegetation with bulkheads and paving. Everywhere else, consider the fact that the last 100 feet along your shore are the most critical for conserving the health of the river through natural vegetation, especially native trees and shrubs, and on our tidal river, native marsh grasses and oyster beds as well.

We invite you to consider a new definition of what looks great along your shore. When you think mowed



Tom Epley, former president for BAE (Norshipco), the largest private shipyard on the Elizabeth River, finds room among the drydocks to restore a tidal wetland. Epley and his daughter were among volunteers making an outing of the Saturday planting.

The shoreline of the largest private shipyard in the Norfolk harbor and the center of ship repair for the East Coast, **BAE Systems Norfolk Ship Repair** might be the last place you would expect to find any opportunity for planting native trees, let alone restoring marshes and oyster reefs.

Nonetheless, has restored not one, but five wildlife habitat areas tucked between its mighty drydocks. On any given day, while shipyard workers are sandblasting paint from a destroyer or cruise ship, blue herons are fishing in two wetlands the workers restored on volunteer duty on Saturday mornings. A fox may be glimpsed in a patch of forest the crew replanted along the shore to absorb runoff and restore habitat value in an area where contaminated sandblast was voluntarily removed. At low tide, the waves may reveal a long stretch of oyster shell, hauled in and seeded with baby oysters at shipyard expense.

The shipyard is “committed to the proactive protection of natural resources beyond compliance,” says Michael Ewing, Environmental Manager of BAE (formerly NORSHIPCO), whose wildlife habitat results are featured on the cover of this guidebook.

All along the Elizabeth River, industries new and old are doing their part to bring back the natural shoreline that once filtered pollution and created habitat through a rich diversity of native marsh grasses, oyster reefs, shrubs, wildflowers and trees. For the health of the river, the shoreline is the most critical zone for restoration and conservation. For the industries, a greener shore lifts the spirits of the workers, who take pride in “doin’ right by the river” and may take to picnicking and bird watching in the new habitats. Customers take positive notice, too. “I like doing business with a green yard,” a ship captain told BAE’s president soon after a sign was installed at its headquarters about the habitat efforts.



When Earl Industries bought these 80 waterfront acres, the company agreed to preserve the forested shore (upper left) through a win-win design allowing for multi-story condos looking over the trees.

When **Earl Industries** bought 80 acres and more than a mile of shoreline on Scotts Creek, a tributary to the Elizabeth River, residential neighbors across the creek assumed in despair that they would lose their pastoral view of the densely forested shore. Instead, working with The Elizabeth River Project and innovative advisors from University of Virginia School of Architecture, Earl Industries decided that planned condos and office towers could gain a water view by looking across the trees from second and third stories – rather than cutting the trees down.

Access for boating could involve a shared pier through the trees. As part of the site, Earl Industries was also purchasing a working shipyard. Even there, wetlands could be enhanced and trees planted wherever operations did not require direct water access. For more details on this innovative project, see the case study at the end of this manual.

lawn and concrete, we think harmful fertilizers and runoff. Try putting up a sign the way our River Stars do - “Wildlife Conservation Area” – to get positive comments on a wilder look. You may be rewarded by the song of birds and the entertainment of ospreys and kingfishers diving from your trees to fish off your healthier shore.

This chapter provides a menu of opportunities for practicing wildlife conservation along the industrial waterfront, while also making room for your business activities and addressing special problems like erosion.

DESIGN A HEALTHY SHORELINE BY LIMITING ENCROACHMENT

Wetland restoration and conservation: Tidal wetland grasses can be more productive ecosystems than rainforests. They protect your shore from erosion, filter polluted runoff from your site, and create a home for a rich array of fish, crabs, shrimp,

clams, wading birds and more. Site structures to avoid wetlands whenever possible, and design them to minimize impacts. Consider restoring wetlands along areas where you do not need access.

Forested buffers: Trees are unequalled in their ability to absorb runoff. A “forested buffer” of trees between your operations and the shore provides one of the simplest, most attractive and most effective means of protecting water quality. Protect and enhance your shoreline trees where you can.

Boat moorings: Boat moorings are necessary to secure vessels at rest. It is less environmentally damaging to tie up to a mooring or a piling than to bulkhead the shoreline for securing a vessel. If other access from shore can be obtained, such as with a pier, less habitat is disturbed.

Piers and boardwalks: Boardwalks, piers and observation decks can often be employed along a shoreline to provide community access and enjoyment of the shoreline, without physical disturbance to riparian buffers and wetlands. Piers and timber boardwalk structures should be supported with piles to reduce wetland disturbance and should be elevated sufficiently to minimize shading of wetlands underneath. A pier should have a minimum height of four feet between the decking and the wetlands substrate to allow more sunlight to reach the wetland plants. Another option in industrial settings to further minimize shading is a metal grated pier.

Flexible shoreline armoring (riprap revetments): In general, the use of rip rap to prevent shoreline erosion is preferable to a bulkhead because the rip rap provides habitat for crabs, shrimp, snails and oysters.

Hard structures combined with “bioengineered shorelines”: In some cases, a bulkhead landward of the “mean low water” limit may be more helpful for waterway health than rip rap because it may impact less wetlands and other habitat. If you do use hardened shoreline structures, such as groins, jetties, and bulkheads, consider combining them with softer, bioengineered shoreline pro-

Art, gardening and history are more normal education goals at the **Hermitage Foundation Museum**, but in 2006 the private museum took on a new role: as a premiere demonstration site on the Elizabeth River for “living shorelines,” a way to halt erosion using natural methods instead of bulkheads.

The Elizabeth River Project helped the museum and partners including the City of Norfolk obtain grant funding for this innovation, now being promoted throughout the bay. The Hermitage wanted to address an eroding historic wall along the shore, as well as poor habitat in an isolated tidal pool and the invasive foreign reed, “phragmites.”

After excavating the reed, partners and volunteers removed old rubble, re-graded and planted 5,300 wetland plants of various native species. A “marsh sill” of riprap stones at the farthest edge of the wetland was installed to help protect it and the wall from waves. The half-acre living shoreline is now the feature of ongoing museum and City education on wetlands and shoreline erosion.

tection methods to provide ecologically friendly shoreline stabilization and access.

MINIMIZE DREDGING: THE BOTTOM OF THE RIVER IS ALSO CRITICAL WILDLIFE HABITAT

Here’s a little known fact: about a sixth of all life can be found on the bottom of a waterway (the *benthos*). In fact, this “benthic” community of clams, mussels, worms, oysters, mud-burrowing fish and the like is considered a critical link in, the food chain for a river ecosystem. So generally, we would just as soon you dredge as little of the river bottom as you can. As

with preserving shoreline habitat, consider ways to partner with adjacent facilities to reduce the need to dredge for navigation access.

While sometimes dredging can have positive effects on the environment, as when the dredging removes sediments which contain harmful contamination, harmful impacts can include the removal of bottom dwelling organisms and the creation of a deeper water habitat which may have lower dissolved oxygen levels.

Shallow water provides critical habitat for many marine organisms and is highly productive. In addition, sediment suspended during dredging can change water quality through increased turbidity and the possible release of organic matter, nutrients or contaminants. Settlement of these suspended sediments can result in the smothering of bottom and/or nearby inter-tidal communities.

HALT EROSION WITH A “LIVING SHORELINE”

Living shorelines employ natural means to prevent shoreline erosion. Typically, wetland grasses and a line of shrubs and trees hold the soil in place. In areas subject to boat wakes and high winds, the wetlands may need the additional protection of an off-shore structure such as rip rap or an oyster reef to dissipate wave energy. Living shorelines should be designed to maintain or minimally disrupt normal coastal processes (such as the movement of sediment along the shoreline) and protection and restoration of wetlands.

If you have a failing bulkhead or erosion behind a stone wall, think about a living shoreline before you replace these structures with similar ones. The Chesa-



Before- A wetland at the Hermitage Museum in Norfolk, VA was eroding, threatening the historic wall and providing severely degraded habitat.



After- Community partners restored the wetland, and in one year's time, the marsh was thriving. Walter Priest, NOAA Restoration Center.

peake Bay Foundation offers excellent guidance at www.cbf.org/livingshorelines including this list of benefits of the living shoreline:

- Improves water quality by settling sediments and filtering pollution;
- Provides shoreline access to wildlife such as nesting turtles, horseshoe crabs, river otters and shore birds;
- Provides shade to keep water temperatures cool, helping increase oxygen levels for fish;
- Absorbs wave energy so that reflected waves do not scour the sub-tidal zone and hamper growth of under-water grasses;
- Is often less costly than bulkheads and rock walls;
- Looks natural rather than man-made and artificial.

There are regulatory permitting requirements for the creation of a living shoreline; however, it is fast becoming the preferred method of shoreline stabilization because it provides far greater overall environmental benefits than traditional “hard” stabilization methods.

Many environmental consultants are familiar with living shorelines as an alternative for control of erosion. Typically we recommend that our waterfront industries work with these experts to plan such a project, including providing cost estimates, assistance with permits, and construction and timing of plantings.

In some cases, fill needs to be brought into a site to create an area with the appropriate elevation for tidal marsh plants. At other sites, the existing beach can be contoured to the appropriate elevation. The amount of fetch (wave action due to wind) and boat wake (wave action due to boats) needs to be considered to determine if

something like a low rip rap or oyster shell sill is required to protect the new tidal marsh. The low sill is not intended to provide significant shoreline erosion protection; instead, it protects the marsh that protects the shoreline. Low wave energy areas may not need a sill at all.

CREATE A BIOENGINEERED SHORELINE

Bioengineering approaches use natural materials and plants to stabilize the shoreline. The first step towards using bioengineering techniques for shoreline stabilization is to create a stable slope for vegetation to grow: typically 3:1 slopes. “Serrated slopes” or terraces can also be created to stabilize slopes and create benches for the bioengineering materials. Examples of bioengineering techniques include:



Volunteers install coconut fiber logs along a shore at Hoffler Creek Wildlife Foundation to reduce erosion. The logs were planted with wetland grasses for added habitat value as well as providing added erosion protection.

- **Live staking** - sections of hardy woody plants that are cut into lengths and placed into the slope when dormant, which root easily and eventually grow into mature woody shrubs that reinforce the soil structure of the slope.
- **Fascine bundles** - long bundles of live woody vegetation buried in a stream bank in shallow trenches.
- **Pole plantings** - living plant cuttings from species that root quickly, such as willow and cottonwood. The plantings grow almost immediately and form a protective layer to help prevent soil erosion. This layer is a living root mat that stabilizes the soil by reinforcing and binding soil particles together and by extracting excess soil moisture. Pole plantings are similar to live stakes, but a bit larger (4-10 feet long, whereas stakes may be 1/5-4 feet long), and tend to survive longer. Sandy or silty soils are best suited for pole planting sites. After harvesting from the willow, cottonwood or other suitable tree, the poles should be soaked in water for 10 to fourteen days prior to planting.
- **Vegetated geogrids** - sometimes called a live soft gabion, vegetated geogrids consist of alternate layers of live branch cuttings and compacted soil with natural or synthetic geotextiles wrapped around each soil layer to trap sediment and reinforce the slope.
- **Biologs** - cylindrical rolls of packed fiber (coconut, etc.) bound together by natural twine. The logs usually come manufactured 12” in diameter and about 20 feet long; however, other sizes are available. Biologs protect shorelines by reducing wave energy and holding soil. Biologs are staked at the toe of the slope so that approximately 1/2 to 3/4 of the log is below normal pool elevation. Multiple biologs can be stacked on top of each other. Biologs trap sediment and nutrients from land runoff, which helps decrease sedimentation and eutrophication (too many nutrients which cause unwanted plant growth, decay and oxygen depletion). Additionally, the coconut fiber provides a medium for the estab-

ishment of aquatic vegetation, which is continually enhanced by trapped sediment and nutrients. Many types of plants can be used in biologs, creating an aesthetically pleasing shoreline stabilization application. Vegetated biologs benefit ecology by providing food, cover, and substrate for a variety of organisms. They tend to be less expensive and easier to install compared to bulkheads and rip rap.

CONSERVE OR RESTORE WETLANDS

Everyone knows that a rain forest is an amazingly productive ecosystem. Not as many people realize that a tidal wetland is even more productive, based on the variety of species that depend on wetlands for food and shelter. You can think of tidal wetlands as the grocery store of the marine world. Yet in urban areas like ours, wetlands for centuries have been destroyed as a matter of routine to make way for development, often unnecessarily. On the Elizabeth River, we work with industries and the community to bring back wetlands wherever practical, and to protect existing wetlands through long-term conservation agreements.

BENEFITS OF WETLANDS

There are two basic types of wetlands: tidal and non-tidal. Tidal wetlands provide vital nursery habitat for fish, crabs, shrimp and other aquatic life, as well as buffering shorelines from erosive waves and polluted runoff. Non-tidal wetlands provide flood buffering capacity, habitat for various plant and animal species, filter stormwater and absorb nutrients. A benefit of both types of wetlands that is often overlooked is the aesthetic improvement of shorelines and green space that the wetlands provide.

Industries in the Elizabeth River watershed have found additional benefits in creating, enhancing, or protecting wetlands on their facilities. Such “green” corporate policy lifts employee morale, especially when volunteer



Elizabeth River Terminals agreed to a two-acre wetland restoration along its shore in an area not needed for operations. Here, contractors visit the site to bid on design.

planting and maintenance activities are included. Businesses may be able to use created wetland areas to meet open space and stormwater management requirements. Areas overlooking wetlands also provide aesthetically pleasing break areas for employees. And conservation tax credits may be available for long-term preservation of larger wetland areas.

FACTORS FOR SUCCESSFUL

TIDAL WETLAND RESTORATION

There are three things to remember when considering a tidal wetland restoration or enhancement project: Location, location, location!

- The ideal tidal wetland restoration site is directly adjacent to tidal water, is already relatively low in elevation (to minimize the amount of excavation and grading), has tidal wetlands in the near vicinity, and is not an area planned for future development or use. Your city or county probably has a wetland representative who can visit your site to see if conditions are right for wetland enhancement.



RADVA, a manufacturer of packaging, added native plants to create a three-acre “buffer” along its Portsmouth shore.

- If conditions appear favorable, we generally recommend professional assistance including an environmental consultant for proper design including plant lists, cost estimates and permitting, and use of a construction firm specializing in shorelines to excavate and plant the wetland.
- Two criteria for a successful wetland restoration are daily tidal inundation (restoration elevations will need to fall between “Mean Low Water” and “Mean High Water”) and protection from erosion. If you have to excavate a channel to bring the tide to your site, you will need to consider the amount of flow that is needed to ensure that the water can come in and get out. This may require help from an engineer or a hydrologist.
- Another consideration is the amount of excavation that has to be completed to get the planting area between Mean Low Water and Mean High Water. Excessive excavation can make a site cost prohibitive, and disposing of the excavated material presents additional concerns.
- Other methods of restoring wetlands:
 - Remove invasive species where practical.
 - Remove debris that has floated or been dumped into the wetland area.
 - Protect the existing marsh with a low riprap or oyster shell sill.
 - Cease mowing or leave an un-mowed buffer between the upland and the wetland.
 - Enhance the area with additional plantings.
 - If you have a site that is technically feasible (has water, not too high in elevation), but there are future use concerns, consider modifying the use. For instance, if you need access to the water for a future use, do you really need a bulkhead along the entire shoreline, or would a pier suffice, thereby allowing wetland restoration along the remainder of the shoreline?

ADD OR PROTECT A VEGETATED BUFFER

A “Vegetated Buffer” Is So Important That for Us, It’s the Law. Because of the critical role that trees and shrubs play in filtering pollution along shorelines, in Virginia there’s a law – the Chesapeake Bay Preservation Act – that says the shore must be conserved with vegetation (trees preferred) for 100 feet back from the water. In some urban areas, a designation of “Intensely Developed Area” allows developers an exemption from this guidance. Encroachments into the buffer zone are also allowed for water-dependent features such as boat ramps. But the ecosystem will still benefit from any effort to keep the shore green. For questions in Virginia, contact your city or county’s planning department.

LANDSCAPE WITH NATIVE PLANTS

One of the most effective steps for restoring lost habitat in any ecosystem is to increase native plants in the landscape. In each region, a set of native plants has developed to live in harmony with each other to provide the wildlife specific to that region with food and shelter in the season it is needed. But the benefits of native plants are not just for the birds. Your company is likely to save costs on water, fertilizer and pesticides if you landscape with native plants. The native plants of your region have adapted to your climate. Once established, they need little human intervention.

And establishing your native plant habitat gives you an opportunity for employee volunteerism. Many industrial workers enjoy spending a Saturday morning with their family, planting a song bird or butterfly habitat in exchange for T-shirts and pizza.

Designing the Native Plant Landscape. Plants are considered native to a specific area if they occurred there before the arrival of European colonists. Plants are not

native if they were introduced into a region, intentionally or unintentionally, from distant countries or from another region of our country. Native plants are adapted to live in a particular geographic area according to the climate, soils, rainfall, and availability of pollinators and seed dispersers, and other influential components. Due to the fact that native plants are indigenous to a certain region, the level of maintenance is usually less, and they contribute to wildlife habitat and ecosystem stability. A good resource for helping businesses from across the country establish wildlife habitat and earn public recognition is the Wildlife Habitat Council, www.wildlifehc.org.

To identify native plants specific to your region, visit USDA’s National Resource Conservation Service, <http://plants.usda.gov>. The National Wildlife Federation offers resources and planting guides on a backyard level, <http://www.nwf.org/gardenforwildlife>. The local extension service can also offer assistance in identifying plants and trees that are best for your location. For example, trees for special situations can be found at the Virginia Cooperative Extension web site: <http://www.ext.vt.edu/cgi-bin/WebObjects/Docs.woa/wa/getcat?cat=ir-cgnl-tsls>.

Native Plants Can Offer a Complete Bird Habitat. Planting a variety of native plants that collectively provide a year-round source of berries and other food is the best way to provide for songbirds. A variety of native plants not only creates a reliable food source, but also forms the basis of habitat by providing places for the birds to carry out their daily activities. Birdfeeders are fine, but most species of songbirds won’t feed at feeders, and the birds that do cannot survive on these handouts alone. They need trees and shrubs not only to supply berries and insects, but also to provide shelter from predators, safe roosting at night, limbs for nests, and a perches for singing.

Invasive Plants – A Threat to Native Flora. Invasive plants and animals are fast becoming one of the leading causes of habitat loss. Since the arrival of European settlers to North America, European and Asiatic plants have been introduced for a variety of human purposes, includ-

ing agriculture, horticulture, erosion control and even wildlife habitat enhancement. Of the 4,000 non-native plants introduced to the United States that escaped cultivation, approximately 400, or 10 percent are invasive, meaning they are capable of invading and threatening native plant communities. Of these 400 invasives, half were introduced for horticultural interests.

Invasive plant species defeat native flora due to lack of natural controls such as insects and competitor plants. Some invasives are so prolific that they threaten entire plant communities, resulting in a loss of biodiversity. Even species native to other regions of the country can be invasive if placed in a different region. Saltmarsh cordgrass (*Spartina alterniflora*), the dominant and beneficial plant of Elizabeth River's tidal wetlands and native to the coastal wetlands of the East and Gulf coasts, became invasive when used for wetland restoration on the West Coast.

Because invasives are widespread and have a strong hold, you cannot assume that natural areas on your property consist of native plants, nor that areas left to turn into wildlife habitat will sprout a healthy configuration of native flora. Instead, you may end up with troublesome species such as China-berry (*Melia azederach*), Tree-of-heaven (*Ailanthus altissima*), Japanese honeysuckle (*Lonicera japonica*), English ivy (*Hedera helix*), Multiflora rose (*Rosa multiflora*), Autumn olive (*Elaeagnus umbellata*), Russian olive (*Elaeagnus angustifolia*), or Crown vetch (*Coronilla varia*), which smother or crowd out native flora. These plants are just a few of the invasive alien species introduced to the U.S.

The most effective way to control invasives is through prevention. Don't include them in your landscape design to begin with. If you find them on your site, identify and control them before they take over.



Algae blooms covered much of the Main Stem of the Elizabeth River in late summer 2007. Excessive nutrients often come from fertilizer use and lead to algae blooms, which in turn deplete dissolved oxygen that is needed for aquatic life to thrive. Steve Earley, The Virginian-Pilot.



Kinder Morgan Southeast Terminals (formerly ExxonMobil Refining and Supply) install an osprey platform to benefit the once-threatened fish hawk. These raptors have made a dramatic comeback on the East Coast.

REDUCE PESTICIDES AND FERTILIZERS

Natural Pest Control. Insects provide many beneficial uses including pollination. However, some are considered pests. Pick a pest and you can usually find a natural control for it; one that won't poison you or your employees. Natural pest control is less expensive than buying and applying pesticides, and it's safer for your habitat and the environment.

The easiest way to control nuisance insects on your property is to discourage them from coming in the first place. In other words, a healthy habitat is the best defense.

- Pull out and dispose of any weak plants, as they may be infected. If allowed to remain, they will attract predators.
- Build healthy, organic soil by using natural composting methods, mulching, or topping your soil with compost or natural fertilizer is the best way to develop strong, vigorous plants.

- Seaweed mulch or spray contains trace elements such as iron, zinc, barium, calcium, sulfur and magnesium, which promote healthy development in plants. Seaweed fertilizer in mulch or spray form will enhance growth and give plants the strength to withstand disease and it also repels slugs.
- Minimize nuisance insect habitat by keeping the area clear of debris and weeds which are breeding places for insects. Use clean mulch.
- Water early so foliage will be dry for most of the day. Wet foliage encourages insect and fungal damage to your plants.
- Disinfect your tools if you've been working with infested plants.

Use Nature's Fertilizer. By composting, you can recycle vegetative scraps, generate rich fertilizer, and reduce your dependence on chemical fertilizers. Compost is created when bacteria, fungi, protozoans, centipedes, earthworms and other organisms break down plant material. The finished product looks and feels like fertile garden soil – dark, cool, crumbly, and earthy-smelling. Compost can be spread over the top of planting beds or worked into existing soil where it will naturally provide plants with plenty of essential nutrients. You can recycle yard waste by using it as mulch.

Mulch enriches the soil by decomposing in the same manner as compost. Good mulching materials include pine straw, shredded dry leaves, grass clippings, straw, wood chips, or shredded hardwood mulch. Mulching with stones has a number of drawbacks. Stones are not as cool for plants during the summer as other mulches. Also, stones do not decompose or hold moisture, so you miss out on the benefit of soil enrichment.

Applying mulch in planting beds and around trees has several benefits. Because mulch covers otherwise exposed soil, it reduces erosion and runoff of soil. Mulch also slows evaporation of important moisture needed by plants.

CONSIDER HABITAT NEEDS SPECIFIC TO OUR AREA

Helping Bring Back the Oyster and the Osprey. On the Elizabeth River, a tidal estuary of the Chesapeake Bay, the Eastern oyster (*Crassostrea virginica*) was once so abundant that the reefs were navigational hazards. Their filter-feeding ability is so great that the oyster population once filtered the entire volume of water in the bay in a few days. Early settlers reported oysters the size of dinner plates, and the “Norfolk oyster” was a celebrated delicacy. Today disease and over-harvesting have reduced Virginia oyster population by 99 percent but our River Star industries are in the forefront of restoring manmade reefs, seeded with tiny oysters, to bring them back. Our River Stars are also putting up osprey nesting platforms to help bring back this majestic fishing raptor; nearly decimated by the 1970s before the ban of the pesticide DDT. Call environmental groups in your area to find out about habitat needs specific to your waterway.

Resources for Oyster Growing. In Virginia, information on how to create an oyster reef is available from the Virginia Marine Resources Commission in Newport News, 757-247-2200. Information on oyster gardening, or growing young oysters in floats, is available throughout the Chesapeake Bay from the Chesapeake Bay Foundation (Norfolk office, 757-622-1964).

Further South on the Elizabeth River, workers at the **Kinder-Morgan Terminals** oil transfer station now focus one of their security cameras on a welcome visitor – one they built a wooden platform to attract.

To do their part as a River Star industry creating habitat, Kinder Morgan installed an **osprey platform** offshore.

Now the staff in the headquarters building enjoy their own “Osprey Cam,” each spring watching a pair of osprey hatch their eggs on the platform.

River Star industries such as **Lyon Shipyard** on the Elizabeth River are helping reverse the decline in the native oyster here, caused by disease and over-harvesting.

Many waterfront industries do what Lyon did; participate in a four-hour “**oyster gardening workshop**” with The Elizabeth River Project and Chesapeake Bay Foundation.

Participants receive thumbnail-sized “seed” oysters and build a floating “cage” to protect them while they grow. The oyster floats are suspended from the participant’s dock for about a year, and then the participant has the opportunity to help transplant them onto a restored reef in the river.

Tom Beacham, Environmental Manager of Lyon Shipyard, expanded the education benefits of becoming the first shipyard on the Elizabeth to participate in oyster gardening by including a quiz about the Eastern oyster in paychecks distributed to all employees.

Building an Osprey Platform. Ospreys will readily nest in dead trees (called snags) as well as man-made structures such as channel markers, power poles, duck blinds, and lighthouses. A properly constructed osprey platform can relocate ospreys away from human disturbance or man-made structures with conflicting purposes. Osprey platforms should be located near favored fishing areas and with good visibility (if placed near the shore it should be taller than the surrounding vegetation). A permit is often required.

Contact your local planning department. Osprey platform designs and a comprehensive guide to native plants and their wildlife benefits in Southeastern Virginia is provided in The Elizabeth River Project’s 142-page *Wildlife Habitat Guide for Restoration and Landscaping in the Elizabeth River Watershed* (757-399-7487).

CONSERVE YOUR HABITAT FOR THE LONG-TERM

Conservation Easements Provide Tax Benefits. Conservation easements are legal documents that landowners use to voluntarily place restrictions on their property that will legally bind the actions of present and future landowners of the property. They are one of the most powerful and effective tools available for the conservation of private lands and are often used to protect large tracts of lands from development. The high sensitivity/value of urban waterfront property creates an opportunity for much smaller parcels to be protected that may be just as valuable to wildlife.

Depending on the specific characteristics of the site, the environmental benefits may include protecting water quality, conserving wildlife habitat, preserving open

space, buffering public lands, and maintaining landscapes for tourism.

Benefits to the property owner start with federal tax deductions for easements granted in perpetuity. For example, subject to a few limitations, individuals and corporations may deduct the full fair market value of their gifts of land or easements to a non-profit on their federal income tax returns.

Alternatively, the Internal Revenue Service allows estate tax exclusions. Additional state tax deductions vary. In Virginia, a generous state tax-credit program provides for state income tax credits of up to 40 percent of the fair market value of the donation up to \$100,000. As with the federal tax benefits, the unused portion of the credit may be carried forward for a maximum of five consecutive tax years. Consult your tax advisor for recommendations specific to your situation.



Southern States Cooperative-Chesapeake Fertilizer Plant agreed to long-term conservation of 16 acres of pristine wetlands in support of river conservation. The plant was recognized as a Model Level River Star.

To protect land with a conservation easement, a qualified third party must hold the easement for conservation purposes. The holder may be a state agency, local government, land trust, or conservation organization (The Elizabeth River Project offers this service for our watershed). Since a conservation easement is a real-estate transaction, the deed of easement must be recorded in the court of the locality where the property is located. Because a conservation easement affects the land in perpetuity, it is important for the landowner to consult a lawyer while working with the holder on the terms of an easement. More information about easements can be found at www.lta.org/conserve. Information pertaining to Virginia

is available at www.virginiaoutdoorsfoundation.org and at www.dcr.virginia.gov/land_conservation.

Land Conservation Understandings – A Non-Binding Alternative. Despite the tax benefits of conservation easements, many facilities are unable to place land in such a legally binding long-term agreement because of foreign parent companies, legal obstacles and uncertainty regarding future plans. With the Elizabeth River Project, River Star industries have the alternative of signing a “Land Conservation Understanding,” a non-binding gentleman’s agreement to leave undeveloped land in its natural state for five years. So far no River Star signing the agreement has had to reverse it.

The Elizabeth River Project’s

Land Conservation Understanding for “River Star” Industries

[Name of facility] and The Elizabeth River Project wish to state an understanding in which the [description of facility] intends to set aside [# of acres] acres of natural habitat [description of habitat, i.e. wetlands, riparian buffer] located along [geographic landmarks or water body], for a minimum of five years for the purpose of promoting and supporting The Elizabeth River Project’s efforts to restore the environmental quality of the Elizabeth River.

This understanding is memorialized between The Elizabeth River Project and [Name of facility] for the period from [date] to [date], renewable every five years thereafter.

During the period indicated, [Name of facility] intends to maintain the property in native vegetation through active conservation and stewardship. The [description of facility] intends to make no structural improvements in the conservation area, other than any which may be recommended by The Elizabeth River Project for conservation enhancements.

This understanding is not intended to represent a legally binding obligation on either party. Abiding by the terms of the understanding entitles [Name of facility] to ongoing public recognition by The Elizabeth River Project as a participating River Star “do-in’ right by the river,” so long as other criteria of the River Stars program are also met.

Signed and dated by The Elizabeth River Project and the facility.

3

Stormwater Runoff

The Big Payoff

Marjorie Mayfield Jackson was caught in a rainstorm on her bicycle one Sunday afternoon, riding home from the gym. Although she'd been Executive Director of The Elizabeth River Project for a decade, not until then did she really experience first-hand how something as innocent as rainwater can have become the No. 1 source of pollution in America's waterways.

The storm had been underway only a few minutes before she was steering the bike through water over her ankles. The Norfolk four-lane highway had been transformed into a virtual river itself, a strong current diverted only by storm drains. She watched the rain water seethe and churn against culverts she knew would dispatch an instant "toxic soup" straight into the Elizabeth River with no filtering of the oils, grease and metals absorbed by the rain from the street; the chemical fertilizers and pesticides applied to her neighbors' lawns; and the stray liquids and process materials on nearby industrial pavements.

"You don't really understand the sheer volume of stormwater that's not being absorbed because of paving until you are sloshing through it without the separation of a nice dry car; up close and personal on a city street," she said.

The amount of hard, or "impervious," surface your site presents to the rain – roof, sidewalk, parking lot, road, tank or other structure – is directly related to the amount of stormwater runoff likely to head for your local river or bay, picking up pollution along the way. Before development, your site absorbed and filtered most of this rain. That was when it was covered with native trees, shrubs and grasses.

A site solely consisting of natural ground cover will allow 50 percent of the stormwater to absorb into the soil. Another 40 percent will evaporate, leaving 10 percent to



In urban cities like Norfolk, most storm drains send untreated runoff directly to waterbodies like the Elizabeth River, with no filtering of the toxic soup of pollution collected off streets and other surfaces. here, consultant Bill Hunt, North Carolina State University, takes a close-up view of the situation.

run off. Conversely, a site consisting of almost all impervious cover will allow only 15 percent of the stormwater to soak in, while 30 percent evaporates and 55 percent runs off.

Traditional stormwater approaches may not get to win-win with your waterfront site. The old "pipe it to a retention basin" approach can be costly and less efficient than emerging approaches. This chapter provides a



Education is one way to address the problem of polluted runoff. A student at Old Dominion University marks a storm drain to remind others that only rain should go down such drains.

brief menu of effective approaches to consider, from rain gardens to stormwater wetlands and mechanical devices. We suggest you incorporate as many of them as you can into your design concept, and hire a stormwater engineer familiar with these approaches to modify them for your specific site conditions.

PRINCIPLES FOR REDUCING POLLUTED RUNOFF:

- **Design your site to reduce hard (impervious) surfaces.** Design buildings, drives, walks, and parking areas to their minimum sizes to increase the amount of permeable surface (surface that can absorb rain) and reduce drainage problems. Reduce over-wide roads and use parking decks and on-street parking instead of parking lots. Reduce the footprint of buildings by designing them up, stacked in stories, instead of out. Consider porous paving material and “green roofs” – vegetation on the roof to absorb runoff and provide insulation.

- **Consider the mighty tree.** Restore and conserve trees, shrubs, and naturalized areas, especially along the shoreline. Trees are super stars at run-off control with a combined effectiveness worth much more than the cost of planting or protecting them. Fairfax County, Virginia, estimates it would cost \$742 million to construct stormwater facilities that provide the same level of service as the countywide tree canopy.
- **Preserve existing native vegetation.** Native vegetation (see Chapter 2), is already succeeding in absorbing runoff and controlling erosion at your site. Preserve all of it you can and save the cost of new plantings. During construction, protect existing vegetation with well-marked limits of disturbance.

At **APM Terminals Virginia**, Ron Babski, General Manager of Safety, Security and the Environment, is so confident of his stormwater treatment system, despite an enormous volume of paving – 230 acres for the largest private port terminal in the United States - “when I did my quarterly inspection, I drank it,” he said of his treated rain water.

The new terminal, opened in July 2007, incorporates several approaches we recommend. First, all of the paving is gently graded so that rainfall runs backward, away from the Elizabeth River, to travel by trench toward two aerated retention ponds, one with vegetation.

Four “oil-water separators” filter the runoff at strategic points. As a final treatment, the outfall leading back to the Elizabeth River has a “level spreader” to slow and disperse the water a final time before sending it through rocks for more aeration and final pollution removal.

Your site is unlikely to approach the size and complexity of APM Terminals. A more typical example is presented by Earl Industries, the mixed-use site described in the case study in the final pages of the guidebook.

- **Limit soil disturbance.** During development, your construction equipment could compact your soils, reducing their ability to absorb runoff. Limit disturbance and construction traffic where possible. When it is not possible to limit clearing, grading, or construction traffic, enhance the soils after construction by tilling and incorporating sand, compost, and other organic sources.
- **Slow down and dissipate the stormwater.** Slow the rate at which the stormwater will flow across your site, maximizing the time it has to infiltrate into the soils. Grade for minimal slopes with just enough vertical angle to carry water away from buildings and other site elements.
- **Re-use stormwater with rain barrels and cisterns.** The world is experiencing a crisis in the shortage of fresh water – yet Americans still design their sites to get rid of rain water as quickly as possible. Rain barrels and cisterns are simple ways to capture runoff from your roof making it available for re-use for irrigation of your landscaping, reducing your water bill and your stormwater treatment costs.
- **Analyze your site holistically to plan your stormwater management in relation to your specific conditions and development plans.** Important factors will include the depth of your water table, the topography, soil characteristics, available land, potential contamination and existing natural features. In our region, a shallow water table makes it difficult to have treatments units of any depth.



Elizabeth River Project staff install a rain garden with the City of Portsmouth to filter an acre of runoff into Paradise Creek. Planting projects like this one can be fun volunteer outings for industry employees.

- **Direct stormwater to existing or enhanced natural filters,** such as vegetated groundcover, forested areas, leaf litter / naturalized areas, and wetlands.
- **Eliminate curbs and gutters** to allow runoff to flow naturally into grassy areas, while saving construction costs. Some local codes still do not allow this basic sustainable development approach, but more and more localities are modifying codes to promote more natural stormwater treatments.

MENU OF EFFECTIVE PRACTICES FOR RUNOFF CONTROL

- **Consider the lovely “rain garden.”**

Prettier and more important for the ecosystem than the traditional stagnant stormwater pond, the rain garden looks like a landscaping amenity. It’s a shallow depression planted with native plants in soil amended with gravel, sand or other components to absorb and filter stormwater. Also called “biofiltration” or “bioretention basins,” rain gardens can be sited in medians, parking lot islands, at edges of parking lots, and adjacent to existing drainage swales.

Gravel typically is placed at the bottom of a basin to allow for a larger storage volume of water. The pit is filled with an amended soil mixture designed to be highly permeable and supportive of native plants, which also provide wildlife habitat. Soils should have a sandy loam, loamy sand, or loam texture. An outlet, usually in the form of a pipe, can be placed near the boundary between the soil amendment layer and the gravel layer. The outlet allows water to pass out of the system in large storms.

Plantings should consist of a diverse mixture of native trees, shrubs, and herbaceous ground cover.

Rain gardens can provide phosphorus removal efficiency of 50-65 percent (Virginia Stormwater Handbook, Virginia Department of Conservation and Recreation). The level of removal is dictated by the surface area and storage capacity. Rain gardens are also effective for treating total suspended solids, as they are effective at capturing the important “first flush” of pollutants that occurring in the first few minutes.

- **If you have room, incorporate a stormwater wetland – and watch your landscape come alive.**

This beautiful ecosystem can be an effective stormwater control and a more vibrant addition to your landscape, but it does need more space than a retention pond. Wetlands come alive with aquatic birds and fish and can include flowering wetland plants.

Typically, a constructed stormwater wetland has three main components, high marsh, low marsh, and deep pools. The phosphorus removal efficiency is estimated at about 30 percent (Virginia Stormwater Handbook). When combined with additional elements such as “aquatic benches” (see Take the Traditional Stormwater Pond to Another Level, below), the wetland is an especially effective way to treat water quality as well as provide flood storage capacity.



Trees are super-stars at runoff control, absorbing nitrogen at a lower cost than artificially constructed devices. At the Chesapeake Arboretum in the Elizabeth River watershed, thick forests on both sides up the treatment value of a stormwater conveyance receiving runoff from 1,200 acres of residential and commercial areas.



When Naval Medical Center Portsmouth decided to replace traditional sidewalks and access roads with “pervious” pavement to reduce runoff into the Elizabeth River the creative design included a “star” pattern. Space between the paving stones allows rain to seep into the ground for filtering.

- **Restore or conserve a strip of vegetation along your shoreline.**

Consider a “buffer strip” or linear strip of vegetation positioned just in front of the water body being protected. A strip of vegetation from 15 feet to several hundred feet wide should consist of trees, shrubs and perennials. Non-concentrated, sheet flow through the filter strip is essential for maximum effectiveness. Vegetated buffers or filter strips can provide approximately 10 percent phosphorus removal efficiency (Virginia Stormwater Management Handbook) when constructed properly. In many cases, filter strips can be enhanced by the addition of compost amended soils. By amending the soils, storage capacity, groundwater recharge and pollutant removal efficiency are increased.

- **Use paving material that allows water to trickle through.**

Known as “permeable” pavement, these modern approaches reduce stormwater runoff while providing treatment through either porous surface for water to infiltrate across the entire surface of the material (grass and gravel

surfaces, porous concrete and porous asphalt), or impermeable blocks separated by spaces and joints through which the water can drain. Permeable pavement does not require “new” space to be made available; it can replace existing or planned pavement, if vehicular use is light, infrequent or absent.

- **Combine several practices in a “treatment train.”**

A treatment train combines practices to channel and filter the stormwater as much as possible before it reaches a protected body of water. On its way, stormwater is slowed down to allow time for pollutants to drop out as well as to reduce potential for erosion, and processed for a variety of pollutants. This method distributes the water and pollutant loads over greater areas, in contrast with the dated practice of piping all of the site’s stormwater to a costly detention/retention facility.

- **Incorporate grassed “swales,” or grassy natural channels for the rain.**

Install a grassed swale, an extremely shallow ditch planted in turf, to gently collect and direct stormwater to

other downstream treatments. This almost unnoticeable component in the landscape will direct water but still allow for other activities. Grassed swales can be used to connect multiple treatment practices together, making up the treatment train described above, or to direct runoff to relief flow locations during larger storm events. The turf will help to filter and retain larger pollutant particles before they are carried too far down the treatment train. Turf should be allowed to grow to several inches prior to being cut. This will enhance its ability to filter particles, allow the root system to extend deeper into the soil, and will cut back on lawn maintenance costs. The phosphorus removal efficiency of grassed swales is approximately 15 percent (Virginia Stormwater Management Handbook) when constructed properly.

- **Slow the flow with “level spreaders.”**

These constructed elements, made of wood, concrete, masonry or plastic, are strategically placed in areas where water is expected to concentrate. The level spreader is long and installed so the top is perfectly level. The water spills evenly over this element, dispersing its energy and slowing its velocity.

TAKE THE TRADITIONAL STORMWATER POND TO A MORE EFFECTIVE LEVEL

Sometimes space or design constraints will still indicate the need for a traditional “retention basin,” or pond, to collect and filter runoff. Take the basin to another level of effectiveness by enhancing it as a stormwater wetland, described earlier, and/or by adding enhancements such as “aquatic benches,” “sediment forebays” and the planting of a vegetated buffer around the perimeter.

Use Aquatic Benches to Create Vegetated Areas of the Pond. One common method of enhancing pollutant removal in retention basins is to create aquatic benches or wetlands along the perimeter of the basin, or benches and

islands within the basin where aquatic plants can grow. The vegetation on the bench increases the filtering and settling of sediments and biological uptake of nutrients. Aquatic benches are often planted with select vegetation to provide a diverse plant community, but the planting of aquatic benches for large basins using plugs and container plants can be prohibitively expensive. For large basins, it may be practical to seed some aquatic benches with emergent plant mixes instead of planting with plugs and container plants.

Try Sediment Forebays to Mimic Nature. Sediment forebays, or settling basins generally located where the runoff enters the pond, are generally included in retention basins to promote settling of pollution and capture of trash and debris. The location near the pond entry provides maintenance access. Forebays provide effective pretreatment, removing the more easily settled particulates and solids and allowing the remainder of the basin to focus on removing finer particulates and dissolved nutrients. Creating aquatic benches or wetlands in sediment forebays may be more practical than creating wetlands throughout the basin, since the volume and area in forebays are only a fraction of the total basin area. In nature, wetlands exist in the headwaters and fringes of tidal and



Norfolk Environmental Commission used volunteers to install this attractive pattern of bricks for its permeable, or rain-absorbing, sidewalks around the Ernie Morgan Environmental Action Center.



A plastic container is recycled to collect rain water at NOAA's Atlantic Marine Center in Norfolk. Rain barrels are a preventive measure not only for runoff pollution, but for water scarcity, an emerging global issue.

non-tidal water bodies, where they serve a similar function to the forebay. By creating wetlands in the forebays, the basins mimic nature in form and function.

Plant and Manage Vegetation Along Pond Edges.

“Vegetated riparian buffers,” or plantings on the perimeter of basins, can enhance stormwater runoff quality by filtering pollution before the runoff reaches the basin. The vegetation also helps to stabilize the banks and protect them from erosion. Riparian buffers provide habitat for a diversity of wildlife, while reducing the attractiveness of the basin to nuisance species, such as resident Canada geese that prefer cleared banks with open views of approaching predators. Note that vegetated riparian buffers can pose some risk for other stormwater structures included in the treatment area, but the risk can be managed. If the basin is created by an earthen embankment, then woody material should not be allowed to grow on the embankment or at the abutments, where it could lead to premature failure of the dam. While the vegetation can control shoreline erosion, it may also attract burrowing animals that can destabilize the banks, and falling trees and shrubs along the shoreline can also cause bank erosion. Debris and deadfall from the buffer can block hydraulic control structures, as can beaver activity within and around the pond. Many of the negatives resulting from vegetated riparian buffers can be addressed through periodic maintenance to remove fallen debris and dead-

fall, keep hydraulic structures clean, and repair bank erosion caused by burrowing animals and fallen trees. Like wetlands created in forebays, riparian buffers can help ponds fit in with the natural environment. They need not be used around the entire shoreline, and can be designed to accommodate passive recreational uses and access to the basin for recreation as well as maintenance.

Southern States Cooperative, Chesapeake Fertilizer Plant on the Elizabeth River collects about 150,000 gallons of stormwater a year and reuses it in its processes. The rainwater is pumped from the stormwater pond to a converted rail car that acts as a rain barrel. This reuse saves the plant money from not having to buy water and reduces the amount of nutrients it must add to the fertilizer. This reuse also helps the river, since virtually no stormwater runoff leaves the site.

CONSIDER MECHANICAL DEVICES TO SOLVE URBAN CHALLENGES

The urban waterfront presents special challenges such as limited land and elevated risks from oil and grease in runoff. Under these circumstances, the following approaches should be considered.

- **Oil/water separators** are devices used to remove oils and greases (and sometimes solids) from stormwater and can be important for sites with a high volume of paving and vehicle traffic. There are several styles to separate oil from water including gravity separation, filters, coagulation/flocculation, and flotation.
- **Sand filters** take up little space and can be used on highly developed sites and sites with steep slopes. A typical sand filter system consists of two or three chambers or basins. The first is the sedimentation chamber, which removes floating debris and heavy sediments. The second is the filtration chamber of sand, which removes additional pollutants. The third



Beach Marine Services' oil/water separator not only protects the river, but also houses tree frogs.

is the discharge chamber, either through an under-drain system, to a storm drainage system, or directly to surface waters.

- **Proprietary ultra-urban devices** have become a popular means of stormwater treatment in dense urban areas due to tight space constraints. Several technologies are employed to remove sediment and other debris from stormwater runoff, including filtration and separation.

BIG IDEAS THAT COULD CHANGE THE WORLD

Harvest Your Runoff for Reuse. Experts say a world-wide fresh water crisis is coming that will soon equal the crisis over oil. “The world is running out of fresh water, and the fight to control it has begun,” wrote William Finnegan (“Leasing the Rain,” *The New Yorker*, April 8, 2002). “There’s water everywhere, of course, but less than three percent of it is fresh, and most of that is locked up in polar ice caps and glaciers, unrecoverable for practical purposes. Water demand, on the other hand has been growing rapidly—it tripled worldwide between 1950 and 1990—and water use in many areas already exceeds nature’s ability to recharge

supplies. Meanwhile, more than a billion people have no access to clean drinking water. There are businessmen in Alaska who believe that the state’s earnings from fresh water will eventually dwarf its earnings from oil.”

Yet daily, we throw fresh water away through our storm systems. Consider the stormwater approach of the future: capture and store your runoff for later use in irrigation and other activities. The practice of rainwater harvesting is gaining increasing momentum as its application continues to decrease the demand on the potable water supply. On-lot cisterns and rain barrels not only reduce your costs of stormwater controls, but provide a source of water for irrigating your landscaping, or for fountains and other water features.

Install a Rain Barrel System. If you have a roof with exterior gutters, you can use a rain barrel system to collect and re-use the rain. The Elizabeth River Project offers a how-to guide: Everybody needs a rain barrel, downloadable from our website, www.elizabethriver.org. The basic elements of connecting a rain barrel system to a roof include:

- A barrel, cistern or tank
- Gutters
- Gutter screens for keeping out leaves
- Downspouts from the gutter into the tank

Some other elements that may be needed:

- Hardware to connect spout to tank (elbows, pipes, PVC cement)
- A tank overflow pipe to direct water away from your foundation
- A faucet for the bottom of the tank
- A tight-fitting removable cover to keep mosquitoes out and allow access for cleaning
- Hose to get water from faucet to wherever it is needed

Convert Your Roof into a Garden, or “Green Roof.”

A green roof is planted in vegetation to absorb runoff, extend the life of the roof and reduce energy costs. A green roof can capture and retain up to 75 percent of the stormwater that otherwise would run off. This presents



Succulent plants and engineered soils now filter runoff and extend the life of roofs on several of its smaller buildings at NOAA Marine Operations Center Atlantic in Norfolk, VA. Here, Pam Boatwright, River Stars program manager, and Doug Smith, NOAA work with volunteers on installation day.

a tremendous benefit to the overall site plan because it reduces the amount of stormwater to be treated at ground level.

At 10 square acres, the largest successful green roof in the United States is on the Ford Motor Company's Dearborn River Rouge plant. However, green roofs have proven successful in every climate in the United States at a variety of sizes, from residential homes in Miami to Chicago's City Hall.

Components of a green roof include plants, a growing medium, a drainage component, and a membrane that separates the building from this system. Some systems can be installed on roof tops never intended to support plant material, while other systems rely on architects and structural engineers to complete the design with a green roof in mind.

Spin Off Benefits of a Green Roof. A properly installed green roof can extend the life of a roof by protecting it from the elements. In urban areas, the heat island effect is reduced by minimizing surface area that absorbs and radiates the sun's heat. The vegetated layer acts like a layer of insulation to reduce energy costs. The water that does make its way through the roof drainage system can be diverted to cisterns where it can be reused for irrigation. This application will reduce or eliminate the costs associated with tapping into municipal water supplies for irrigation needs.

Newer Designs are as Light as a Normal Roof. There are two kinds of green roofs: extensive and intensive. Intensive roofs are generally grass on top of a thick bed of dirt that requires beefed-up building structure, while extensive roofs, a more recent invention, are generally sedum type plants in a two-inch deep bed of dirt that is no heavier than the typical dead load to which structural engineers currently design. Nearly all green roofs currently built are the more economical and successful extensive type.

In the Elizabeth River watershed, the first green roof was installed on the office of **Hanbury Evans Wright and Villatas, Architects**. Although the four-story building was originally built in 1891, it was retrofitted in 2004 with a 4,300-square-foot green roof that cost \$98,000 but will reduce the urban heat island effect and save building energy costs in addition to capturing and treating stormwater.

Soon after, **NOAA Marine Operations Center Atlantic**, a Model Level River Star, used volunteer labor to install two green roofs on several of its smaller buildings as a pilot project to promote the practice.

Now **Earl Industries** and **Old Dominion University**, two more River Stars, have committed to install green roofs in the Elizabeth River watershed.

4

Redeveloping The Contaminated Site

The urban industrial waterfront probably presents less likelihood for pristine land than anywhere else you could choose to locate in America. While this has its advantages, you can expect that your urban waterfront site probably has been used before, maybe heavily, and probably before any regulations or practices were in place to control pollution.

Welcome to the world of the “brownfield,” previously used manufacturing, industrial, commercial, petroleum storage, or retail sites with real or perceived contamination issues.

Benefits Are Tantalizing. A brownfield often offers many redevelopment benefits:

- Typically, brownfields are the largest, least expensive sites available for purchase on an intensely developed



Often the only available waterfront in an urban area is also a “brownfield,” posing cleanup challenges along with redevelopment potential. Here, developer chose to pursue Belharbour Station, proposing upscale condominiums, a marina and retail stores, for re-use of the shoreline after addressing residual contamination.

urban waterfront such as the Elizabeth River waterfront.

- Brownfields may mean lower costs of infrastructure and utility construction, as these may already be in place.
- Land costs may be lower due to perceived contamination issues.
- Returning the land to productive use will increase the tax base for the municipality or county, which in turn may offer incentives to encourage you to redevelop the property.
- Building on a previously developed site reduces urban sprawl, preserving your urban watershed’s vanishing greenspace and farmland.
- Redevelopment of previously contaminated land reduces public exposure to potential health risks.
- Redevelopment and reuse will create employment opportunities for residents in local communities.
- Federal and state funds and assistance are available to help address environmental contamination on brownfield sites.

Environmental Studies Are an Essential Up Front Investment. When considering redevelopment of a brownfield, the only prudent way to steer clear of regulatory, environmental and human health quagmires is to be sure you start with a clear understanding of the extent of contamination and are prepared to take steps to protect future users of the site, to not exacerbate the problem caused by the contamination, to cover the cost of appropriate cleanup, and/or remediation. As the potential purchaser, we advise you ALWAYS to spend the money up front to complete environmental studies

that will determine these issues for you, potentially offering some level of protection against future regulatory liability.

The federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) outlines studies and approaches that can help limit the environmental liability of a potential purchaser, beginning with Phase I and, if indicated, Phase II “Environmental Site Assessments.”

CONDUCT “ALL APPROPRIATE INQUIRY” TO REDUCE YOUR LIABILITY

Often, a brownfield has been abandoned for many years due to perceived contamination issues and related fear of regulatory liability. In 2006, EPA instituted a rule for how to conduct Environmental Site Assessments that have the potential to limit the future liability of a brownfields buyer. If your studies comply with the EPA rule, then you have completed “All Appropriate Inquiry” into the history of the property, and have some



A legacy of creosote tanks from a former operation created a challenge to revitalization of the Money Point peninsula on the Elizabeth River. EPA stepped in to excavate soils saturated with the creosote, allowing the revitalization to move forward.

protection under CERCLA law for future actions related to any contamination existing prior to your purchase of a site. In addition to helping to limit a buyer’s site liability by meeting “All Appropriate Inquiry,” these initial studies can help quantify the amount of soil or groundwater contamination on a site, identify costs and approaches for remediation, and help in the decision making process of whether a proposed use for a site is appropriate given the level of existing contamination.

We recommend you hire a qualified environmental consulting firm to conduct your assessment in compliance with the federal rule, as well as consult with your attorney.

TASKS OF A TYPICAL PHASE I

ENVIRONMENTAL SITE ASSESSMENT:

- Perform a site reconnaissance of the property to look for surface indications of past and present hazardous substances and petroleum products use and/or storage. Inspect for evidence of dumping or material stockpiling and for use or storage of hazardous substances or petroleum products.
- Make inquiries with selected State and Federal regulatory agencies to collect data concerning past or present environmental concerns on the subject site or on adjoining properties. Federal databases typically reviewed include Federal, State, and local lists of environmental items such as Superfund sites or registered underground storage tanks.
- Review all available fire insurance maps of the site.
- Perform a reconnaissance of selected areas around the subject site to verify the location of listed facilities that handle hazardous substances. The studies should evaluate the potential for environmental impact on the site based on readily visible nearby land uses.
- Review background and historical information. A review of available aerial photographs and public

records helps to identify historical uses of a site that may have used or stored hazardous materials or petroleum products.

- Review title binders regarding the chain of property ownership of the subject site for at least 60 years (although industrial use in many parts of the country, especially the East Coast, can go back much further), as well as a listing of any liens or encumbrances on a site.
- Interview selected individuals who may have knowledge of past or present environmental concerns associated with the subject site or adjacent property, such as the property owner(s), occupant(s), and/or the key site manager(s).
- Summarize observations, findings, and conclusions.

If a Phase I Environmental Site Assessment identifies “Recognized Environmental Conditions” that appear to have the potential for impairment to the soil or groundwater on the subject site, recommendations are typically made for further assessment through the completion of a Phase II Environmental Site Assessment.

The Phase II Environmental Site Assessment consists of sampling soil and/or groundwater for suspected contaminants based on the former uses, spills, or dumping on the site.

CLEAN UP TO LEVELS APPROPRIATE FOR YOUR USE

Repirements Vary By Intended Use. Once you know what, if any, contamination a previously used site may have, you need to determine what the appropriate level of remediation will be for your proposed use. For instance, if you are purchasing a former dry cleaner facility that has solvent contaminated soil and groundwater, and you are planning to use the site as a day-care facility with a playground, the legally required

level of remediation is likely to be higher than if you were proposing to use the site as a commercial warehouse. Your environmental consultant should be able to help determine the appropriate level of remediation required by relevant environmental regulatory agencies, and related costs.

Some Regulatory Programs Provide Funding Assistance. In Virginia, unless the site is being overseen by the Environmental Protection Agency as a “Superfund” site, three programs address contaminated land: Resource Conservation and Recovery Act (RCRA) closures, Petroleum Program, and the Voluntary Remediation Program. RCRA closures are completed to reuse sites that have had RCRA permitted activities on the site. An example is the redevelopment of a site in Hampton, Virginia that was formerly a RCRA-permitted chrome plating facility. Soil and groundwater contamination are undergoing remedial activities at the site, so that the facility can be reused for another commercial operation not related to the chrome plating. Sites closed in this fashion can receive a closure letter from the Virginia Department of Environmental Quality stating that no further remedial activity is warranted.



Money Point peninsula revitalization at a former creosote facility by US EPA.

The second program addresses all things related to petroleum, including spills, underground and aboveground storage tanks, and soil and groundwater with petroleum contamination. In Virginia, the Petroleum Storage Tank Fund provides money to site owners for assessing and remediating petroleum contaminated soil and groundwater related to leaks from petroleum storage tanks or supply lines. Petroleum contaminated sites are typically less expensive to remediate than sites contaminated with hazardous materials, and have the added bonus of the potential of reimbursement for some of the remediation costs.

Third is Virginia's Voluntary Remediation Program, overseeing cleanup of contamination that is not otherwise regulated. Typical are sites contaminated with heavy metals or solvents. Cleanup activities are voluntary; however, on satisfactory completion, the state will consider issuing a letter indicating completion of satisfactory remediation.

At the federal level, the EPA Brownfields Program and other land revitalization programs provide funding and technical assistance for assessment, cleanup and redevelop-



Hess planted native poplars to take up PAH contamination through the natural process of “phytoremediation” on the Elizabeth River at Money Point.

opment. More information about EPA's technical assistance and funding opportunities is available at www.epa.gov/brownfields.

Look for Synergy. Consider whether you have the opportunity to address contamination while achieving another redevelopment goal at your site. For instance, if you must excavate contaminated soils from an area, you may consider placing your stormwater management pond in that location if all of the contamination is to be removed, as you may need to excavate a pond for stormwater management anyway. You may consider paving a portion of your site as a cap to the underlying contaminants to prevent exposure to occupants or visitors to the site. A risk assessment is helpful in determining which contaminated areas need to be removed and which can be left on the site.

TRY PUTTING PLANTS TO WORK PHYTORMEDIATION

Phytoremediation involves the use of plants to clean up pollution in the environment by removing harmful chemicals from the ground as their roots take in water and nutrients from polluted soil, streams and groundwater. Once inside the plant, chemicals can be stored in the roots, stems, or leaves or changed into less harmful chemicals within the plant. Grasses used for phytoremediation may need to be extracted and disposed of; however the volume of hazardous material for disposal is likely to be much lower than the volume of contaminated soil prior to remediation. Phytoremediation takes advantage of natural plant processes, requires less equipment and labor, can make a site more attractive, and can be significantly less expensive than mechanical cleanup methods. One challenge can be the time required – phytoremediation can take significantly longer.

Indian Mustard is being used to remove heavy metals, such as lead and cadmium, in New Jersey, and Duckweed and Parrot Feather are being used to remediate explosive wastes in Tennessee groundwater. EPA has used ferns to remove arsenic in soil at a site in Virginia.



After the US Navy and Atlantic Wood removed contamination from a lagoon and transformed it into a natural wetland, scientists caught multiple species of fish from the restored area. Below: Close up of the catch.



Faced with a site impacted with dark creosote from prior operations as a wood treatment facility, **Hess Corporation**, current owner, began experimenting with native poplar and other trees to draw up the pollution through the roots.

The facility on the Elizabeth River's Southern Branch found the "phytoremediation" practice so effective with a test plot that it went on to plant 1,200 trees. The trees began removing PAH laden groundwater from the site in 2005-2006, significantly reducing the risk of contaminated groundwater and contaminated runoff discharging to the Elizabeth River.

The trees provide an inexpensive, low-tech component of a comprehensive, voluntary remediation effort that snared River Star recognition for Hess from The Elizabeth River Project. Hess has also removed over 90,000 gallons of creosote from the groundwater in one well.



5

Green Buildings for Global Sustainability

“The aim of sustainable design is to support contemporary needs without compromising resources for the future.”

- Nancy Rottle, American Society of
Landscape Architects

If you have chosen to build on the waterfront, your investment will be first in line for risks from rising sea levels. The mainstream scientific community now accepts the reality of sea levels on the rise across the planet from global warming. In our region, the Chesapeake

Bay watershed, sea levels have already increased a foot in the last 100 years, swamping islands and eating up prime shore property; with an expected increase to at least two more feet by 2100 (University of Maryland).

To help keep your site from disappearing under water in coming decades and help prevent other predicted disasters, consider being part of the solution. “Green buildings” use technologies that, among other environmentally sustainable approaches, reduce greenhouse gases associated with global warming by improving



Old Dominion University built Virginia's first LEED (Leadership in Energy and Environmental Design) certified higher education building, housing Engineering and Computational Sciences. The building maximizes natural daylight. Office lights turn on and off by motion sensors.

energy efficiency. Another “win-win” benefit: your utility bills also go down. EPA has a number of programs that provide resources where you can learn more about the components of green building and how to incorporate green building concepts into different types of buildings. Green building information is available at www.epa.gov/greenbuilding.

ENERGY EFFICIENCY: FOR BIG SAVINGS

Phoebe Crisman, our advisor at the University of Virginia School of Architecture, tells us the one area where building owners spend money most needlessly involves energy efficiency. “This is usually because inefficient, ineffective heating, cooling and lighting systems are less expensive in up-front costs and engineering,” says Crisman. But over the life cycle of the building, “enormous amounts of energy and sums of cash are used up” by these inefficient decisions, she says. For example, providing windows to give workers the benefit of daylight is more expensive up front than fluorescent lights, but the windows will more than

In 2007, **Earl Industries** began final design of a “green” office building on the Scotts Creek tributary to the Elizabeth River. The Model Level River Star plans to construct the largest green roof (see stormwater chapter) in the Norfolk area, 9,100 square feet, to absorb runoff from this building.

The new office will also feature a series of sustainable practices to conserve energy and water, including glazed, double paned glass, integrated roller window shades, zero to low VOC paints, waterless urinals, low-flow toilets and automated faucet controls.

Elevators will be energy efficient through electric traction. Parking lots will feature rain gardens. Wetlands plantings will be incorporated into the stormwater retention basin.

pay for themselves. Crisman has won numerous awards for her work at the university and with building design to incorporate sustainable principles. She and Michael Petrus, her partner in the architectural firm of Crisman + Petrus in Charlottesville, Virginia, served as our technical advisors for guidance provided in this chapter.

Building Placement: Work with Sun and Wind to Cool Your Building.

- To reduce cooling costs, place your building to avoid exposure to the hot mid-afternoon sun. The long direction of the building should be east-west, tipped 10 to 12 degrees east to avoid overheating in the afternoon.
- Orient the building to allow breezes to flow through the building during temperate months. Check NOAA data to show the direction of prevailing winds by month.

DESIGN AS A “SYSTEM” AND REDUCE OVERALL COSTS

The least cost-effective approach to designing a green building is to pick a few well-meaning, energy efficient features simply because they fit a line-item budget. More effective for your wallet will be designing the building as an integrated system of features that work together to optimize energy and water use, yet provide a comfortable, well-lit environment for a company to operate.

Here’s an example. Designed as a system, a green building may include high performance, operable windows that are more expensive than ordinary units. Yet the building may be less expensive overall because these windows make possible the use of lower capacity heating and cooling units and reduce costs of energy to run them. Similarly, a green roof (covered with living plants to absorb runoff; see chapter on stormwater) is more expensive to install than an ordinary roof. However, the green roof reduces or eliminates the costs of stormwater systems and provides insulation to reduce energy costs.



Earl Industries plans a “green building” complete with a large green roof as its new headquarters on the Elizabeth River (see Chapter 3 regarding green roofs). Green roofs are planted in vegetation to absorb runoff while reducing energy costs and lengthening the life of the roof.

The U.S. Green Building Council has established a relatively easy way for building owners to understand and control the process of constructing a green building. The LEED rating system (Leadership in Energy and Environmental Design), provides a checklist-based tool for evaluating whole building environmental performance over a building life cycle. It provides an owner with a menu of choices of how green to make a building, from bronze (basic), to silver (moderate) and platinum. Achieving a silver rating involves costs similar to conventional building. Meeting platinum standards involves using technologies beyond ordinary construction, such as solar panels, but is cost-effective over the building life cycle.

EarthCraft House provides guidelines for constructing energy efficient, earth friendly housing (both single family and multiple family) specifically applicable to our climate. However, many of these guidelines are applicable to any construction project. They also give one-day training for builders interested in learning more about earth friendly construction. Technical guidelines and information on training sessions can be found on the EarthCraft of Virginia web site <http://www.earthcrafthouseva-sf.org/index.html>. Habitat for

Humanity is committed to using EarthCraft construction practices. South Hampton Roads Habitat for Humanities Virginia Beach Covenant built the first EarthCraft certified house in Virginia in the Spring 2007.

MAKE SUSTAINABLE BUILDING MATERIAL CHOICES

For true global sustainability, every material that is brought to a building site should be considered in larger terms. Is it toxic? Were toxins made in its production? What happens to it when we’re finished with it?

Toxic end products versus toxic by-products. While many building materials are relatively safe or inert in their final state, the making of those materials at a factory may involve the production of dangerous by-products. Choosing materials that are ecologically safe in their production leads to sustainable building at a global level.

Ecological footprint, embodied energy, or what does it cost our planet to build a new warehouse? Although that sounds like a daunting question, thinking simply and intelligently about the source of each material that goes into a building goes a long way towards minimizing the impact of construction at both local and global levels. When you order building materials, such as plywood, think about how much energy is expended for plywood to arrive at your site. How much oil does it take for plywood to arrive from foreign countries versus South Carolina? Plywood from foreign countries might be less expensive to you, but it has cost the planet more in terms of green house gas from burning fossil fuel. Also consider the effects of your new building on how land is treated far away from your site. How much mining goes into your building or does your wood come from new growth or old growth forests? Substituting fly ash for newly mined materials for concrete, for example, has become a popular and inexpensive practice, while demand for new-growth forest lumber has become the norm. Green construction practices are catching on as conscientious builders force the marketplace to supply sensible materials.

SUSTAINABLE BUILDING MATERIALS

Thinking from the ground up, the following building materials are inexpensive or no-cost, easily available alternatives to conventional, less sustainable materials. Where additional costs are involved, payback times are very short – eight years or less.

Foundation. Concrete: The substitution of fly ash for 20 to 35 percent of Portland ready-mixed cement has become a common practice in the past few years. The environmental advantages of using this byproduct of coal combustion are diversion of materials from the waste stream and reduction of virgin, mined material. Fly ash also offers the benefit of improved concrete performance. A longer discussion of this topic can be found at: <http://www.greenbuilder.com/sourcebook/Flyash.html>.

Concrete Formwork. Two possibilities that reduce waste and improve insulating performance are wall-form materials made from expanded polystyrene (EPS) that remain in place after the foundation is poured and re-usable rubber formwork. Both of these offer the advantage of eliminating waste disposal of plywood formwork. The insulative value of the wall-form materials will also augment energy use over the life of the building and easily pay for itself.

As with all building products, a powerful ecological benefit can be realized by making sure that wood products are sourced as close to the building site as possible. Buying trusses from a local supplier who also receives his materials locally avoids the environmental impact of burning fossil fuels in long-distance shipping. However, it is worth making sure that your supplier is using locally grown resources.

Many pressure treated lumber products used over the past decades have proved to be highly toxic, both in their production and on site. Chromated copper arsenate (CCA) has been used extensively in this country as a wood preservative. CCA is composed of copper, which acts as a fungicide; arsenate, a form of arsenic, which is

an insecticide; and chromium, which binds the ingredients to the wood. These toxins and endocrine disruptors are particularly dangerous to children and those who spend more time on the ground. These chemicals are leached into the ground, particularly by sawdust generated during construction.

Alternatives to CCA treated lumber include:

- Plastic “lumber” made from recycled products. Plastic lumber, which is most frequently composed of high density polyethylene (HDPE), does not release hazardous materials into the ground. An additional benefit of using this material is that it is often manufactured with recycled plastic. Therefore, using plastic lumber conserves natural resources. In addition, plastic lumber usually requires less maintenance.
- Composite lumber is wood and plastic combined into one lumber product. Wood-plastic composites generally exhibit low moisture absorption and high resistance to decay, insect, and UV ray damage. The wood component provides the composite with greater dimensional stability than plastic lumber, but not as much as wooden lumber. Like plastic-only lumber, wood/plastic composite lumber is often made with recycled materials.
- Lumber pressure-treated with non-arsenic wood preservatives is available in the marketplace. Many of these wood preservatives are copper-based such as ACQ compound (ammoniacal copper quaternary) or CA (copper azole). A simpler process uses Borates to treat lumber.

Insulation. Insulation materials play a primary role in achieving high energy efficiencies in buildings. There has been concern over the health impacts of the material constituents of insulation ever since the problems associated with asbestos became apparent, followed by the banning of urea formaldehyde based insulation.

Cellulose insulation is made from recycled newsprint. A large amount of newspaper is diverted from a landfill by using cellulose insulation to insulate a home. The

amount of energy needed to produce cellulose insulation is many times less than required for fiberglass or rock wool insulation. Many report (e.g., www.greenbuilder.com) that cellulose insulation contains printers' inks, which can possibly outgas formaldehyde into a home. Greenbuilder.com states that if there is any release of gas from inks, it should fall well below levels irritating most people.

However, an environmentally-sensitive person should be careful in selecting cellulose and install a vapor retarder between the insulation and the living space. (Note that the vapor retarder can exacerbate mildew problems if humidity levels in the house are high.) Homepower.com reports that most researchers have concluded that cellulose insulation does not pose a health risk to the occupants of a home (http://www.homepower.com/view/?file=HP111_pg44_Anderson)

Rigid board insulations employed as sheathing on homes have played an important role in achieving high R-values. However, the use of CFCs in many of these materials has caused increased release of chlorine molecules into the atmosphere, contributing to ozone depletion. HCFCs outgas a lesser amount of chlorine molecules, however the severity of the ozone depletion situation has led to the recommendation to avoid both types of insulation blowing agent. Alternatives in rigid board insulation are available that do not use CFCs.

Cementitious insulation material is a cement-based foam used as sprayed-foam or foamed-in-placed insulation. One type of cementitious, spray-foam insulation is known as Air-Krete. It contains magnesium silicate and has an R-value of about 3.9 per inch. With an initial consistency similar to shaving cream, Air-Krete is pumped into closed cavities. After curing, it's similar to a thick pudding. Cementitious foam costs about as much as polyurethane foam. It's also nontoxic and nonflammable. Cementitious foam is made from minerals (like magnesium oxide) extracted from seawater. (See http://www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11510). This type of insulation is considered very benign from an indoor air quality standpoint.

Perlite insulation is in a loose form suitable to fill the cavities in building block. Perlite can be bound into other materials and used in sheet form. It is commonly used in commercial roofing material and can be used as an aggregate in concrete. It is non-flammable, lightweight and chemically inert.

Although rockwool insulation is considered an old-fashioned alternative, it is worth including in this list. Rockwool is recycled steel slag (a landfill/waste material). It is available as blow-on wall insulation (a starch binder is used) and as loose blow-in attic insulation. It offers very good energy performance, will not burn, and is chemically inert.

Decking and sheathing. While you might imagine that there might be plywood made from recycled wood products, there are none in the marketplace. There are plywoods made with bamboo, a more renewable resource than pine, although it tends to be a finish grade rather than sheathing grade. There are also plywoods made with non-formaldehyde based glues, but at the moment are difficult to find. This will change in the future, but the moment, the best sustainable plywood and sheathing practice is to be sure that your sheathing is manufactured from locally sourced wood. If your supplier is unsure of the plywood's origin, see if it has an APA (American Plywood Association) stamp. All APA rated plywood is manufactured in the United States and can be traced by codes in the stamp.

Exterior finish materials. For industrial or commercial buildings, concrete planks are hard to beat for economy and ecological sustainability. Steel siding possesses a high rate of embodied energy and requires repainting which has ecological problems of its own. Terra cotta plank systems are becoming more popular for commercial buildings, and have fairly low embodied energy, although they are fairly expensive compared to concrete.

In residential construction, an example of the building industry gravitating toward sustainable materials is the use of cementitious siding, one of the most ecologically sustaining siding materials available today. It also happens to be very economical and low-

maintenance. While vinyl, steel and aluminum siding are terrible for the environment due to mining or toxins released in production, cementitious siding production is non-toxic and has a low non-renewable resource impact. Although it is sourced from some non-renewable materials (sand, cement), its life span is much greater than renewable siding materials such as wood.

Roofing. Whether the roof material chosen is asphalt, rubber, wood, plastic (shingles), clay tile or slate, the lightest possible color should be chosen for two related reasons. Dark roofs absorb solar radiation and heat up adjacent interior spaces, increasing air conditioning loads, and act as frying pans that contribute to the urban heat island effect. The heat island effect may not be much at the scale of one house, but when 1,000 house roofs are cooking in the sun, the effect on the local climate is high. Flat-roofed industrial or commercial buildings can also avoid internal solar heating and the urban heat island effect by using white rubber roofs instead of black, or light colored gravel when a ballasted roof is desired.

Flooring. When carpet is used, ask the same questions as you would about paints: “What toxins are used



Atlantic Associates installed a green roof on its office building in downtown Norfolk.

in manufacture, and what materials are going to off-gas after installation?” Many carpet companies are aware that they need to produce carpets that reduce indoor air pollution, and have adjusted their manufacturing processes to meet this need. Search them out. For wood floors, many sustainable choices are now available at costs competitive with non-sustainable woods. An internet search will turn up countless locally sourced renewable resource woods. One of the most renewable choices is bamboo, purpose-grown and rapidly replenished.

Interior finishes. Like carpets, paints and wall coverings can off-gas toxins years after their installation. Safe interior finish materials cost little and manufacturers are aware of the market demand for safer products. It is no longer difficult to find these products. All it takes on the architect’s or builder’s part is to spend the time researching this aspect of performance, just as they would for durability.

Energy and Equipment choices. Use EnergyStar certified equipment whenever available. The following are also low or no cost alternatives to conventional systems:

- **Heating and cooling**
 - With the rising price of carbon-based fuels, energy use is no longer only an ecological issue but an economic one for building and home owners as well. The way a building is insulated and the combination of insulation and vapor barriers used is very specific to various climates. Great care should be taken to tailor the exterior envelope to the climate. Proper ventilation, by means of fans and vents, should change the air in a building frequently for health reasons.
 - In the case of large volume buildings such as warehouses or manufacturing buildings, much of the building does not really need to be heated at all. It’s the people working inside that do. Recent innovations in heating manufacturing buildings include the targeting of populated areas of large volume buildings, where heated or cooled air is directed by ducts or blowers only to where the building is occupied. This is an example of how teamwork on the part of all consultants can provide an optimum level of comfort while making economic and ecological sense.

- Alternative, energy efficient heating and cooling strategies should be explored. These might include heat pumps, thermal floor systems, ground source heating and cooling loops, passive solar gain, or natural ventilation strategies for temperate seasons. None of these systems is expensive, but they need to be thought out with care to be effective.
- **Lighting.** Recently there has been a great deal of media attention on low wattage light bulbs, an important consideration. More importantly, however, daylighting buildings with windows so that no electric lighting is needed during the day can be easily accomplished by careful consideration of window size, placement and orientation to the sun.
- **Kitchen and bathroom fixtures.** The average American home uses 300 to 400 gallons of potable water per day. The largest water savings to which a builder can contribute is in low water usage fixtures, such as 1.5 gallon per flush toilets, are now common and practical, and 2.5 gallon per minute showerheads have become the norm.
- **Water conservation outside the building:** Rain water from roofs can be harvested for the irrigation of plant material in above or below-ground cisterns (see stormwater chapter for these and other stormwater controls).
- **Water Conservation inside the building:**
 - Capture, filter and re-use of water used in manufacturing processes
 - Use low flow (1.5 gal/flush) toilets
 - Include waterless urinals, a proven technology
 - Use infrared sensors at bathroom hand sinks
 - Incorporate composting toilets
 - Explore dry-pipe options for fire protection (sprinkler) systems.

6

Case Study 1

Earl Industries: A Shipyard Conserves the Shore and Models Modern Stormwater Controls

"There is much that is both unusual and commendable about the cooperation taking place on the banks of Portsmouth's Scotts Creek... Everyone - even the river - comes out ahead."

-Editorial, *The Virginian-Pilot* (12/6/2006)

The dense trees went on for more than a mile of shore, just around the bend from downtown Portsmouth and Norfolk, Virginia. In fact, the site represented the largest undeveloped land left on the downtown harbor of the Elizabeth River. "I want to do the right thing for the river," said the new owner, Jerry Miller, president of Earl Industries. He also wanted to redevelop the 22 acres into condominiums and office high-rises, complimenting a large naval repair yard and pleasure boat marina he had also purchased on an adjacent 68 acres.

The challenge to find "win-win" in this plan seemed unusually daunting. The front porches and backyards of hundreds of homes looked across the water to the peaceful shoreline about to be redeveloped along Scotts Creek, a tributary to the Elizabeth. The neighborhoods had struggled with City Hall and prior would-be developers for decades regarding the future of this land.



Earl enlisted The Elizabeth Project and the community to develop a Master Plan to not only preserve the forested shore shown here, but also model state-of-the-art practices for reducing pollution.

Lessons Learned:

1. The commitment of the developer, from the top, is key.
2. If a proposed redevelopment will significantly affect residential and environmental interests, bring these stakeholders to the table early and give them meaningful roles in the planning process (really listen to them, don't just invite them for show).
3. A steering committee of key interests can be a useful way to discover a development plan that works for all – residential, environmental and developer. Such a plan then is easier to implement than one that creates opposition.
4. Find the funds to invest in the best available technical help. We benefited from both cutting-edge engineering and an architect savvy on land-use planning.

"We need some expert help here," we responded to Mr. Miller. Within six months, The Elizabeth River Project and Earl Industries had landed a \$40,000 grant from Virginia Department of Conservation and Recreation to use the site as a model for Low Impact Development approaches to stormwater control. Earl committed to match the grant 1:1 with implementation of the recommendations. The Elizabeth River Project invited the neighborhoods, the City, the developer and other interests to sit on a Steering Committee for the project, and hired two advisors: Williamsburg Environmental Group, a specialist in emerging stormwater strategies, and Phoebe Crisman, who specializes in sustainable urban design at the University of Virginia, School of Architecture.

Fast-forward two years. Now when Earl Industries customers from across the East Coast arrive at the ship-





One of Earl's first projects was this rain garden or bioretention area that is landscaping that filters and reduces stormwater runoff at the shipyard's headquarters.

yard headquarters building on Scotts Creek, the welcome sign is a diagram of the native trees and shrubs, biofiltration elements, swales and a rain barrel that were installed around the building to absorb and filter runoff. Three more of the Low Impact Development approaches have been implemented. The blueprint for the planned office high-rise includes the largest "green roof," a roof planted in vegetation to absorb runoff (see stormwater chapter), in Southeastern Virginia. And the forested shore? It's there to stay. Residents of the condominiums will view the creek by looking over the trees from their second and third stories. They will have the benefit of a hiking trail along the shore.

Ed Giles, whose house faces this shoreline from across Scotts Creek in Portsmouth's West Park View neighborhood, for years had put off improvements to his front porch, for fear the peaceful panorama would be ruined when a developer finally purchased the forest. Once Earl Industries agreed to the Master Plan, Giles at last invested in his porch; confident his quality of life would be protected by a responsible industrial neighbor. That's win-win.

A DIVERSE COMMITTEE AGREES ON GUIDING PRINCIPLES

The Elizabeth River Project facilitated a Steering Committee of about 15 members in reaching consensus on "guiding principles" for how the 80 waterfront acres purchased by Earl Industries should be redeveloped in a way that would be acceptable to the community, the developer and the environment. The Steering Committee included representatives of Shea Terrace; West Park View and Park View neighborhoods; as well as the umbrella group, Friends of Scotts Creek, Miller as CEO and other lead staff for Earl Industries; two staff from Elizabeth River Project; representatives of the City of Portsmouth and the Virginia Department of Conservation and Recreation.



Scotts Creek from the West Park View neighborhood.



Agreement on the Guiding Principles provided the win-win breakthrough. The technical team fleshed out a Master Plan of concepts in keeping with the principles. The Elizabeth River Project held two Community Listening Sessions, with a professional facilitator, to present the approach to the community and obtain further input. Earl began implementing the concepts during the planning year and continues today to pursue elements, most recently completing architectural designs for a “green roof” on its proposed office building.



Retrofit in progress at Earl Industries.

Guiding Principles for Win-Win Redevelopment, North Shore of Scotts Creek

By consensus of Elizabeth River Project’s Scotts Creek Low Impact Development Steering Committee

Win-Win in the 22 Undeveloped Acres

The western portion of the 80-acre site included 22 acres of forested shore and open meadow.

- **Preserve a 100-foot vegetated buffer along the full length of the undeveloped shoreline.**
 - Preserve the stand of trees currently along the shore (possibly thin out invasives).
 - Enhance the trees within the 100-foot buffer where practical with native, mostly low-growing, non-deciduous (evergreen) trees and shrubs. This allows for an unobstructed view over (low) trees from upper stories of any new homes/businesses, while screening new development from neighbors on the opposite shore (W. Park View etc). It also filters runoff and provides vital habitat.
 - Consider creating a low-impact bike path through the buffer.
 - Consider a Conservation Covenant with any future occupants to ensure that conservation objectives for the buffer are valued and honored (preserving the trees, keeping vegetation native, not using pesticides/fertilizers.)
 - Consider a common pier for residents, with access limited to one or two common boardwalks through the forested buffer.

- **Consider commercial space facing Harper Avenue. Immediately behind, consider a compact plan of two and three story condos, preserving open space and providing for parking between the condos and the commercial space, as well as a possible office complex further east between the condos and the shipyard.** (If and when construction resources become available, and to the extent practical given soil/contamination/zoning constrictions.)
 - Seek zoning change from heavy industry to mixed use.
 - Second and third stories offer the advantage of a water view that does not require removing the forested buffer.
 - Conduct a marketing survey to determine viability of commercial /residential mix.
- **Implement Low Impact Development strategies** prescribed by Williamsburg Environmental Group and Crisman+Petrus Architects to limit polluted runoff and sedimentation from reaching Scotts Creek (as redevelopment projects are constructed).

Win-Win in the 58 Partially Developed Acres

The remainder of the site included an existing repair yard for naval ships and an existing marina, with plans for one or more new office buildings.

- **Implement Low Impact Development (LID) strategies** throughout the site (shipyard, office complex, marina), as prescribed by Williamsburg Environmental Group/Crisman+Petrus Architects, to reduce pol-





Volunteers of all ages plant more than 500 native trees and shrubs to further enhance the buffered shoreline along Scotts Creek. Neighbors once worried that Earl would industrialize the shore, but Earl committed to preserving the forested riparian buffer.

luted runoff and sedimentation from reaching Scotts Creek -- as resources become available.

- Kudos to Earl Industries for committing \$40,000 to implement a large demonstration of LID practices around Earl's headquarters building on Scotts Creek! The LID was designed by Williamsburg Environmental through a grant to The Elizabeth River Project and will have educational signage to explain benefits to Earl's visitors from across the Eastern Seaboard.

THE CONTROVERSIAL UNDEVELOPED 22 ACRES

What Earl Industries did with the existing shipyard was of much less concern to all involved than what would be built on the long stretch of open shore, the target of redevelopment dreams in Portsmouth for decades. The win-win concept came from the two architects advising the project. Phoebe Crisman and



her partner, Michael Petrus, sketched the basic concept: upscale condos and commercial buildings should cluster along the road, leaving room for the trees.

The water view would still be there if the buildings were multi-story. Says Crisman: “Although the continuous, 100-foot wide riparian buffer along the river’s edge functions as a planted water and pollution filter to reduce the flow of excess nitrogen, phosphorous and other pollutants into Scotts Creek, it is incorporated into the strategic plan as a linear park, open to the public with walking and bicycle trails that may connect this neighborhood to the opposite side of Scotts Creek in the future.”

Assuming rezoning for mixed-use, the plan proposes a rich mix of uses. Three building types across the 22 acres promote the idea that this is a busy neighborhood with residents and working people occupying the area at all hours:

- Five, four-floor multi-family residential buildings with corner store retail create a strong street edge and distinct identity for the site. Each apartment receives natural light and ventilation from at least two directions, thanks to the narrow building width. Onsite parking (1 1/2-2 spaces) is provided for each unit per the City of Portsmouth requirements, and the corner-store retail has on-street parking. The proposed plan provides 125 dwellings, 45 of which are single-family houses.
- Four, 4-floor buildings contain 112,000 square feet of commercial office space and light retail, such as small restaurants and corner stores. The two easternmost

buildings provide parking on ground level with some retail, and four floors of office above. The 450 parking spaces meet city requirements.

- Two-story, single-family or duplex dwellings along the buffer relate to the smaller scale of the creek and preserve views for the higher buildings along the street. Parking (two per dwelling) is located in planted courtyards defined by the higher buildings

The strategy includes these general concepts:

- Preserve/enhance a continuous 100-foot wide riparian buffer protected by conservation covenant
- Incorporate a bike path/trail system into ‘linear park’
- Create more street use by adding retail and commercial uses
- Maximize views by increasing building heights adjacent to Scotts Creek
- Orient narrow-footprint buildings to prevailing winds for natural cooling in summer
- Collect rainwater for landscape watering or on-grade filtration and release into the river
- Provide a habitat for all species: human, animal and plant
- Create a “neighborhood” with rich mix of uses and building types (not a “development”).

**See page 60 for a summary of strategies in progress at Earl Industries.*



ADDRESSING STORMWATER: LOW IMPACT DEVELOPMENT STRATEGIES

While the architects concentrated on the open land, Williamsburg Environmental Group took the lead in developing recommendations for Low Impact Development (LID) strategies (a relatively new approach to absorb rain where it falls rather than creating runoff) for Earl to implement as the opportunity arose throughout the 80-acre site.

Location on Earl Site

Strategy & Implementation Progress

22-Acre Open Land

Strategy: As mixed-use development proceeds, implement soil amendments, biofilters, tree box biofilters, pocket wetlands, and buffer preservation/revegetation to absorb runoff.

Progress: Tree planting conducted December 2005; mixed-use development not yet underway.

Planned Office
Building/Parking

Strategy: Green roof; treatment pockets; tree box biofilters.

Progress: Earl is in final design (2007) for a “green” office building with a 9,100 square foot vegetated green roof. The building will also feature glazed, double pane glass, integrated roller window shades, zero to low VOC paints, waterless urinals, low-flow toilets and automated faucet controls. Elevators will be energy efficient through electric traction. Parking lots will feature rain gardens and wetlands plantings will be incorporated into the stormwater retention basin.

Area 2:
Administration Building

Strategy: Filter strips; bioretention; amended soils; tree box biofilters; rain barrel.

Progress: Implemented Summer 2006 – showcase LID landscape includes rain garden with bioengineered filtration, native plants throughout, rain barrel, and educational signage.

Piers 1 & 2

Strategy: Install biofilters at the foot of each pier for water treatment and for stabilization of shoreline

Progress: Implemented Spring 2008 – LID includes bioretention with native landscaping.

Area 3:
Paint and Blast Facility

Strategy: Wetland pocket; buffer re-vegetation; stream stabilization.

Progress: Implemented Spring 2008 – LID includes a “wet land ditch” that will be landscaped with native plants.



6

Case Study 2

APM Terminals Virginia: Seeking Sustainability on a Mega Scale

Few projects have challenged the “win-win” principle of balancing economy and environment on the Elizabeth River more than a proposal by APM Terminals Virginia (APM) to build the largest privately-owned container terminal in the U.S.

The Danish-based subsidiary chose the largest parcel of undeveloped land left on this industrialized river; its 600-acre shore an oasis of sandy beach, wetlands and rare Atlantic White cedars, its offshore shallows harboring some of the Elizabeth’s healthiest and most productive bottom populations of clams, fish and other species.

However, at upwards of \$400 million, the development would be the largest private investment in the history of the region and provide a windfall for economically stressed Portsmouth, Virginia.



APM’s state-of-the-art stormwater system collects runoff from the wharf in this trench where it is then sent through oil-water separators, detention ponds that are aerated and finally over a level spreader for final polish before discharging to the river.

Over the course of five years, The Elizabeth River Project, APM, regulators and many other stakeholders struggled to find the balance of win-win for the environment and industry.

A month after APM Terminals Virginia opened at the site in 2007, Ron Babski, the terminal’s general manager for safety, security and environment, gave The Elizabeth River Project a tour. “We have a zero tolerance mindset when it comes to environmental mishaps,” Babski said. Everyone who gets a permanent badge for entry to his terminal – vendor, client, and employee - must sit through his hour-long training, ending with the instruction to call him and security at the number on the back of the badge the moment they see any questionable environmental risk.

Win-win at this mega site has turned out to include a combination of precedent-setting regulatory mitigation, aggressive stormwater controls, a new standard for operation efficiencies that also prevent pollution and a pro-active on-going commitment to environmental stewardship.

THE PRECEDENT-SETTING REGULATORY MITIGATION

To provide today’s mega ships with deep-water access to the terminal, APM Terminals Virginia proposed to dredge 10 million cubic yards of sediment from the bottom of the Elizabeth River - the largest dredging project in Virginia history.

Meanwhile, The Elizabeth River Project, in a plan adopted by the Commonwealth of Virginia, had identified restoring healthy river bottom as the highest priority need for the Elizabeth River. Much of the rest of the river floor is laced with contamination, reducing the health and diversity of life at the bottom of the food chain. But the bottom sediments off-shore of the APM site were rela-





This new port is setting world-class standards for its efficiency and environmental stewardship including electric gantries that reduce air emissions and precedent-setting mitigation.



Lessons Learned:

1. Any developer can identify win-win for the environment and the economy, if both interests cooperate and are willing to think outside the box.
2. Large impacts to a healthy river bottom matter, and can be offset.
3. Operations efficiency can equal pollution prevention.
4. Leadership commitment is essential.

tively healthy, as well as shallow, the most productive kind of bottom habitat. Scientists on a seining trip there caught large fish feeding off this important “benthic” or bottom community. The dredging would convert this to deep-water habitat, a permanent loss of shallow water habitat.

Nonetheless, no regulatory precedent existed for requiring the company to “mitigate” or replace this loss of river bottom habitat. Dredging damages are a hidden environmental cost occurring out of the public eye. How to offset them presented a considerable challenge.

This is the win-win proposed by The Elizabeth River Project, accepted by the developer and the regulators and now underway: APM could not create new river bottom at its site to replace the loss, but the company could set aside enough funds to pay for clean-up of one of the most polluted areas of the river, a few miles away.

APM Terminals Virginia placed \$5.3 million in a trust as mitigation for impacts to river bottom habitat from dredging. The Elizabeth River Project set up a trust fund, the Living River Restoration Trust, to manage the funds. The Trust’s projects and spending are overseen by the U.S. Army Corps of Engineers and the Virginia Depart-

ment of Environmental Quality. While the dredging was underway, the first \$300,000 was spent in 2005 for a 13-acre oyster reef at the mouth of Scotts Creek on the Elizabeth to help restore the native oyster. The remaining \$5 million is being used by the Trust to clean up sediments contaminated from a wood treatment plant that operated at Money Point in the early 1900’s, about seven miles upstream from APM, in Chesapeake. Returning this non-functioning river bottom to life is intended to offset the dredging impacts.

To mitigate for wetland impacts (a more routine regulatory requirement), APM created 17 acres of tidal wetlands at four locations surrounding the facility, hand-planted more than 199,000 plants, and purchased over 13 acres of non-tidal wetlands credit from a wetlands bank. In addition, APM placed over one million native clams in a broodstock sanctuary to offset potential impacts to shellfish resources associated with dredging and placed a 110-acre forest and associated non-tidal wetlands in permanent conservation.

AGGRESSIVE STORMWATER CONTROLS

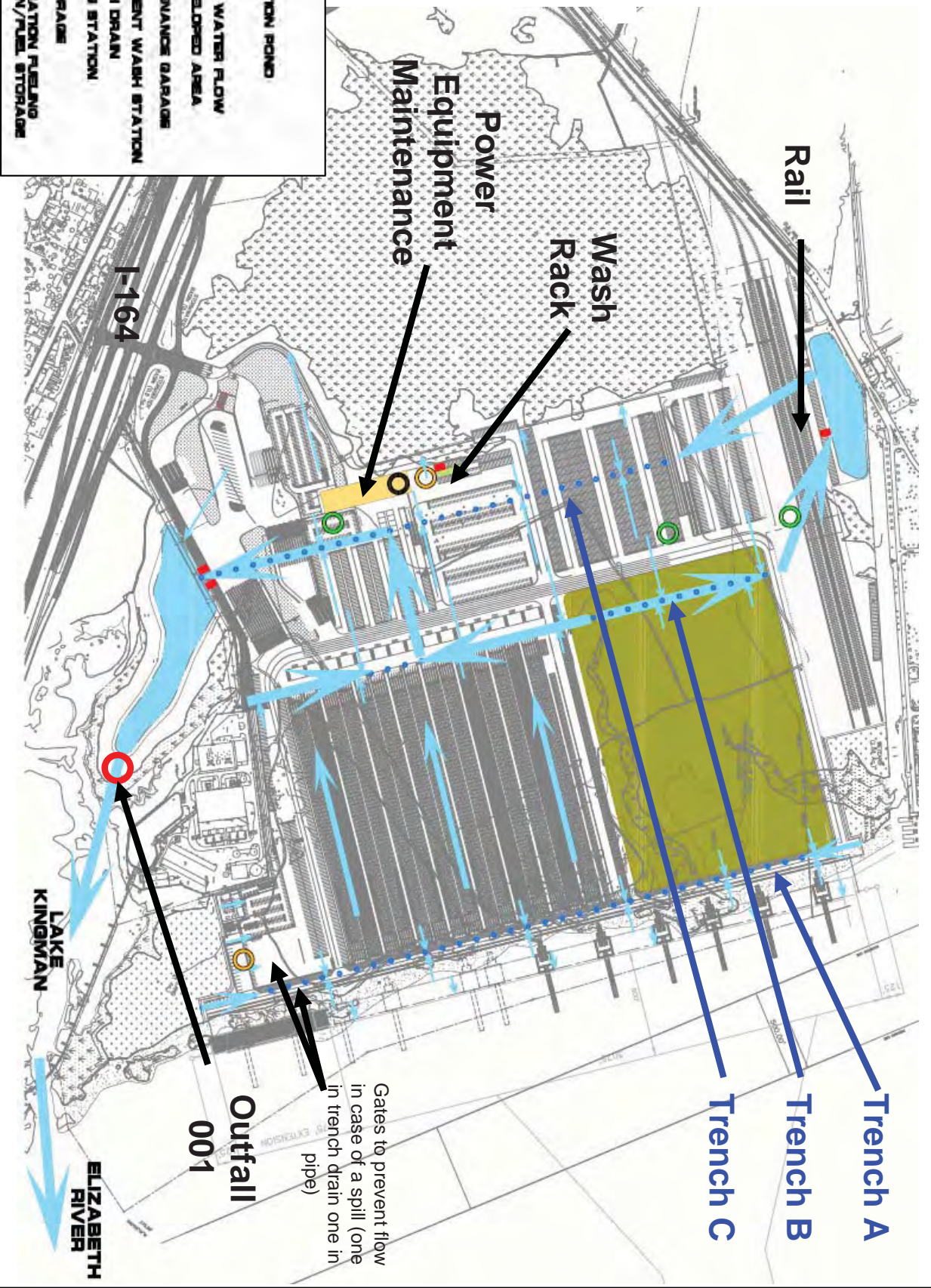
The new terminal called for 291 acres of new pavement traveled by a high volume of industrial trucks, with the potential for large water quality impacts from contaminated runoff. An aggressive stormwater design at the site seeks to capture and treat all runoff except in major storms and along a small margin of the 4,000-foot wharf. Paved areas slope away from the river, so that stormwater drains backward, not over the wharf edge and into the river but into three trenches running parallel to the wharf. From here, the stormwater must navigate a long system that includes three oil/water separator/grit removal chambers (see stormwater chapter on mechanical devices) to remove oils; two retention ponds enhanced with wetland benches; and a last scrub system in a small natural lake, before runoff is delivered to the Elizabeth.

As shown on the diagram (on page 64), Trenches A and B empty into the North pond, which releases into Trench



LEGEND

- RESTRICTION POND
- OWS
- STORM WATER FLOW
- UNDEVELOPED AREA
- MAINTENANCE GARAGE
- EQUIPMENT WASH STATION
- TRENCH DRAIN
- FUELING STATION
- OIL STORAGE
- CONSERVATION FUELING STATION/FUEL STORAGE



APM Terminals Virginia Site Drainage Map

May 2007

Figure 2-1



C and the South pond to allow additional treatment time before all flow is consolidated to a single discharge point into Lake Kingman, before release into the Elizabeth. At the final discharge point, a “level spreader” (see storm-water chapter) slows and disperses the water a final time, then sends it through rocks for more aeration and final pollution removal. A fourth oil/water separator, near the container inspection dock and heavy equipment wash rack, discharges contaminated stormwater to the sanitary sewer system. The overall system is designed to handle drainage from relatively large “25-year” storms, versus the more typical 10-year storm design level.

“RAISING THE BAR” - OPERATION EFFICIENCIES THAT ALSO PREVENT POLLUTION

The Portsmouth facility is setting the standard for terminal efficiency, reported The Journal of Commerce (September 2007). “The automation that APM has built into its new terminal could increase pressure on other U.S. terminals to adopt similar efficiencies. ‘The opening of the APM terminal has raised the bar,’ says Bill Coffey, a port consultant.”

Efficiency equals less waste; equals less pollution in the Elizabeth River.

The APM Terminals Virginia facility achieves this through technological advances that minimize air emissions and minimize the footprint of the development.

- The terminal uses all electric ship-to-shore cranes (six of them) and rail mounted gantries (30 of them on site), eliminating diesel emissions. The savings in air emissions is estimated at up to 45 tons per year of nitrogen oxides - a precursor to smog – compared to diesel cranes and gantries.
- Truck emissions are also minimized because APM is the first port terminal anywhere to combine four specific technologies that maximize efficiency of cargo movements, minimizing truck queue and idle times.

The technologies: “Radio Frequency Identification” window stickers identify in-bound trucks as soon as they enter the terminal gate. “Optical Character Recognition” technology allows longshoreman to track the trucks and cargo from computer screens inside terminal headquarters. Specially designed shuttle trucks, and the electric rail-mounted gantry cranes, provide a streamlined tracking system to get the right cargo container headed for the right truck (or ship) as quickly as possible. “As the systems mature, we expect a substantial reduction in the amount of time it historically has taken for trucks to go from gate-in to gate-out,” Babski said regarding the time trucks remain on the vast site. Speed and efficiency on a cargo container terminal not only reduce emissions, but minimize the land footprint needed to handle a high container volume.

- In addition, all 62 off-road vehicles meet the stricter emission standards for on-road vehicles.

A PRO-ACTIVE COMMITMENT TO STAYING CLEAN

Every vehicle – even a pickup - at APMT VA carries a “spill kit,” to respond immediately to any spill of any size. Stationary 65-gallon spill kits are located in seven



North pond of APM’s stormwater system also features aeration.



different places across the site. In a related move, Bab-ski's cell phone, as environmental and safety manager, is on the back of every ID badge on the site.

APM also incorporated building energy efficiencies. Office needs are consolidated into a single three-story building. Floor-to ceiling windows allow natural light, and revolving doors minimize the amount of climate-controlled air that escapes as people enter and exit the building. Motion-sensors turn out lights when they are not needed. The company even handed out fluorescent bulbs to employees to encourage them to take their commitment to environmental practices home.



Case Study 3

Southern Branch Corridor, Elizabeth River: Seeking Synergy Across Multiple Sites

As The Elizabeth River Project considered possible case studies for this guidebook, we realized that nowhere on our waterfront could we hope to make more of a difference for the environment and the economy than along the Elizabeth's Southern Branch corridor -- a hot-bed of contamination, pending big-dollar cleanup efforts and uncoordinated, often competing redevelopment plans.

Could our "win-win" approach be applied successfully to more than a dozen sites at once, even when the more than 500 acres included the most controversial private redevelopment projects of the day, as well as a heavily-contaminated Superfund cleanup site?

Our answer so far is a qualified yes. The effort focused our attention where it was most needed, resulting in important environmental protection of critical areas of the Elizabeth River. But with multiple developers and interests involved, the work was so resource-intensive that a small non-profit like ours was at times stretched too thin to develop the relationships and the out-of-the-box solutions needed to achieve the other half of win-win: an economic development project that was balanced enough to move forward.

A locality might be in a better position to work with multiple sites in what amounts to forward-thinking land-use planning. We still have hopes that the economic and environmental revitalization potential of this section of the Elizabeth River, some 750 acres of available land with rare deep-water access to a major port, will be more effectively tapped when the cities of Portsmouth and Chesapeake, Virginia, agree to a common plan for marketing available waterfront, with complimentary zoning, land-use planning and environmental standards.

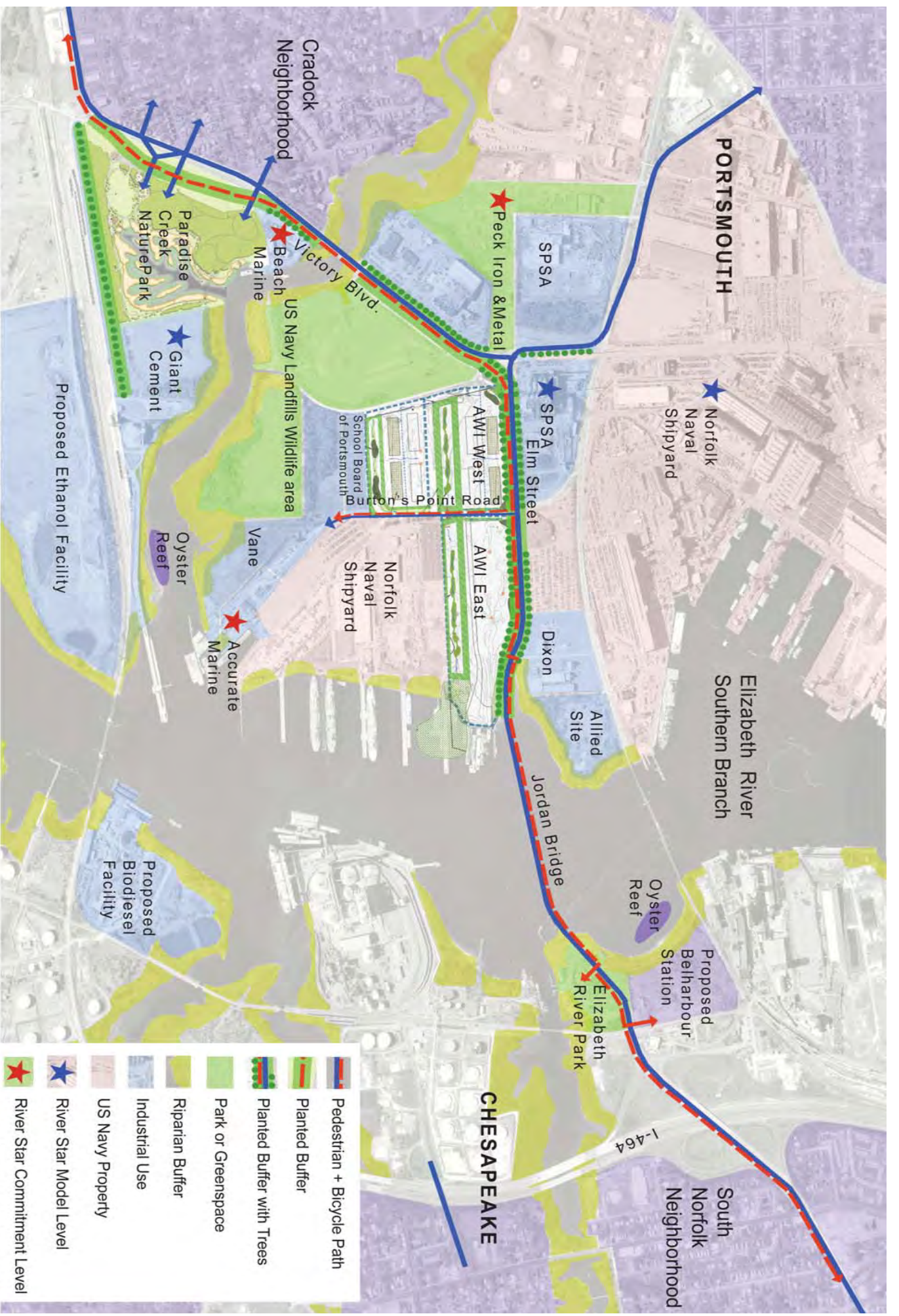
So far our contribution has been a set of guiding principles for the Southern Branch Corridor, agreed on by a stakeholder steering committee; and intensive recommendations for four specific sites there:

Lessons Learned:

1. Stakeholders can set influential guidelines for sustainable redevelopment of an urban waterfront. Developers may find it easier to obtain permits when they are willing to work within these guidelines.
2. Often an urban watershed will offer multiple, nearby sites with similar redevelopment challenges and opportunities. Working on them as a whole offers the best opportunity for win-win.
3. Working with multiple sites at the same time can be unwieldy and resource intensive, diluting the depth of effort that can be devoted to achieve the difficult challenge of win-win.
4. Redevelopment opportunities that cross multiple jurisdictions can clash unless a regional approach is found.

- Atlantic Wood, a 48-acre wood treatment facility designated a Superfund cleanup site by the EPA since 1990;
- International Biofuels Virginia's proposal to build one of the world's largest ethanol distilleries on 97 acres less than a mile south of Atlantic Wood;
- Smiling Earth's proposal to build a large biodiesel facility across the river from International Biofuels Virginia (IBE), and
- Belharbour Station, a \$200 million condominium development proposed adjacent to the Smiling Earth site.





Conceptual Design Recommendations for the Green Corridor
 Prepared for the Elizabeth River Project - Sustainable Development Steering Committee

A Steering Committee for the 750-acre Atlantic Wood corridor agreed on general guiding principles including: planting trees along edges of roads, preserving buffers, maximize stormwater and pollution measures, and create a positive merge of environment and industry.



Conceptual Design Recommendations for the Green Corridor
 Prepared for the Elizabeth River Project - Sustainable Development Steering Committee

Crisman+Petrus Architects 8.1.07
 Williamsburg Environmental Group

Suggestions for Atlantic Wood include: redeveloping the Western part of the property as a small industrial park, planting a buffer along the street, and integrated stormwater practices.

Each developer's responsiveness to the guiding principles proved to be pivotal in determining whether the planned project moved forward or was stalled by public opposition.

STAKEHOLDER GUIDING PRINCIPLES: A PIVOTAL STEP

It's our experience that win-win can be found only when the chief competing interests are at the table to discover it. The Steering Committee for this guidebook, listed in the back of the book, has been our attempt to provide such a win-win forum for sites in the Southern Branch corridor, as well as for proof-testing the guidebook's more general recommendations. The committee included representatives of environmental advocacy groups and developers; economic and environmental protection arms of local governments, as well as our team of technical experts.

The two other case studies in the guidebook, Earl Industries and APM Terminals Virginia, were single sites where The Elizabeth River Project had completed most of its work in seeking win-win with the developers prior to beginning the guidebook. The Southern Branch corridor, in contrast, presented an open book to the Steering Committee with large redevelopment projects still in early formulation.

Over several meetings in 2007, the Steering Committee agreed on general guiding principles it considered appropriate for the redevelopment of all properties in the 750-acre stretch. In addition to the four sites mentioned, other properties included:

- the Dixon property – 11 acres; owner actively pursuing redevelopment;
- the Allied site – 16.5 acres;
- Paradise Creek Nature Park – 40 acres, envisioned as an education center for the win-win principle of marrying industry and environment;

- Peck Iron and Metal – 33 acres, PCB contamination and;
- St. Julian's Creek – 489 acres, Navy site slated for redevelopment.

Nearby facilities not slated for redevelopment but participating in The Elizabeth River Project's River Stars program for industrial stewardship were asked to do their part with achieving the guiding principles for the Southern Branch corridor. These included the Norfolk Naval Shipyard, Giant Cement, RADVA Corp., and Southeastern Public Service Authority's Refuse Derived Fuel Plant.

GUIDING PRINCIPLES – SOUTHERN BRANCH CORRIDOR

- **Plant trees as hedges along edges of roads to provide connected habitat, aesthetics and a screen for industrial activity.** Giant Cement committed to planting native trees such as Eastern Red Cedar and Wax Myrtles along the half mile entrance to the plant; the Naval Shipyard is considering a buffer planted along Elm Avenue; SPSA is considering a significant planting along its Victory Boulevard property; and the proposed IBE ethanol facility proposed to enhance the line of trees between its site and Giant Cement.
- **Protect and enhance 100-foot buffers** of vegetation between development and the river. The IBE facility proposed to conserve its 100-foot buffer.
- **Create a positive merge of environment and industry.** This is the heart of the plan.
- **Maximize stormwater treatment at all sites**
- **Maximize developable property**
- **Maximize cleanup.** Where prior contamination was suspected, The Elizabeth River Project recommended



comprehensive environmental study and maximum cleanup.

- **Adopt aggressive pollution control measures.** The Elizabeth River Project provided extensive recommendations to IBE for controlling pollution at its proposed ethanol facility, anticipated to be a major source of air emissions.
- **Provide an odor free environment.** The Elizabeth River Project also focused on recommendations to IBE for control and objective measurement of odor at the proposed ethanol facility.
- **Improve traffic access.** How to improve access was a topic of much discussion, via the aging Jordon Bridge and bottleneck, narrow roads such as Burton’s Point Road.
- **Seek better connection between of the two cities and the neighborhoods.** Bike paths and mass transit were proposed along with improvements or replacement to the Jordan Bridge, an aging, two-lane infrastructure crossing the Elizabeth River between the proposed Belharbour site in Chesapeake and Atlantic Wood/Allied sites in Portsmouth.
- **Minimize footprint on the land.**

- **Minimize carbon footprint.**
- **Identify all possible incentives.**
- **Consider making this corridor an Enterprise Zone.**
- **Coin an identity for the corridor** – Southern Corridor, Elizabeth River, was suggested.
- **Share consolidated water access ports** – The IBE concept demonstrated this, with plans to share port facilities with adjacent Giant Cement. A similar concept is recommended where possible with other facilities.
- **Consider collective parking and down the road, mass transit.**
- **Use greenways that connect the river to habitat** – This is the key concept developed by the technical team for the Atlantic Wood site.



The Belharbour Station shore will soon be a living shoreline with wetlands and oysters.

APPLYING THE PRINCIPLES: BELHARBOUR PROPOSED CONDOMINIUMS

Belharbour Station is a proposed \$200 million mixed-use development in the South Norfolk neighborhood of Chesapeake, to include as many as 600 upscale condos and a marina. The previously contaminated site was originally zoned for industrial use. In meetings with The Elizabeth River Project, Truxton Development representatives incorporated several sustainable redevelopment concepts into the plans, including:

- A commitment to incorporate Low Impact Development strategies to treat stormwater runoff close to the source. Bioretention, or rain gardens, were incorporated in the landscape design to augment treatment, allowing for a less extensive, less expensive stormwater pond



- The near-shore edge of the marina was moved further away from the shore into deeper water and boat slip locations were shifted to reduce the amount of dredging required, saving costs and shallow-water habitat.
- A “living shoreline” is planned (see habitat chapter) in the shallow water area to include oyster shells as a berm.
- In the vicinity of an existing oyster reef restored by the Elizabeth River Project in 2004, the developer plans to place pilings at a relatively close spacing to prevent boats from approaching the reef.
- Signage on the pilings and/or the floating dock may also provide an educational opportunity about the living shoreline, oyster reef, etc.

As of the end of 2007, the project has been approved to move forward by the City of Chesapeake, and the environmental clean-up of the development site has begun.

APPLYING THE PRINCIPLES: SMILING EARTH PROPOSED BIODIESEL SITE

A California developer, Smiling Earth Energy, proposed a large biodiesel facility on a 44-acre brownfield site along the Southern Branch, within sight of Atlantic Wood across the river. The \$532 million facility would produce 320 million gallons of biodiesel per year, which would make it the largest biodiesel facility in the United States. The Elizabeth River Project offered recommendations for sustainable development. The majority were agreed to verbally by the developer and many were included as stipulations in a conditional use permit granted by the City of Chesapeake.

After meetings with The Elizabeth River Project, the developer agreed to these recommendations:

1. Conduct a detailed assessment of environmental and community impacts of this development, and identify

comprehensive measures and objective standards that will be employed to minimize impacts.

2. Reduce encroachment into the Chesapeake Bay buffer. Original development plans included structures, tanks and roads within a few feet of the shore. The developer agreed to pull development out of the immediate shoreline for 50 feet.
3. Delineate and conserve/restore wetlands. After originally finding no wetlands on the site, the developer eventually agreed to place a two-acre wetland site under a long-term conservation easement.
4. Conduct an investigation and, as needed, clean up of likely upland contamination from prior use. The developer completed initial investigations.
5. Minimize impervious surfaces and provide maximum stormwater treatment.
6. Incorporate the highest level of pollution prevention on site.
7. Use native plants in all landscaping.

In October 2007, the project was approved by the City of Chesapeake; however, financing difficulties have precluded moving forward.



Proposed conceptual design of a biodiesel plant.



APPLYING THE PRINCIPLES: IBE PROPOSED ETHANOL SITE

In the same vicinity, IBE proposed the largest ethanol facility in the world, a 216 million gallon facility immediately south of Elizabeth River Project’s Paradise Creek Nature Park, Giant Cement and the Cradock neighborhood of Portsmouth. Through the summer and fall of 2007, IBE drew headlines and angry crowds at public meetings, from a community fearful of impacts similar to those of an ethanol plant that was shut down in St. Paul for odor, as well as ethanol plants inspiring EPA concerns for air emissions in the early 2000s. Most ethanol facilities have been located in rural areas because of potential impacts on citizens.

The Elizabeth River Project sought to develop recommendations for the developer and City of Chesapeake in keeping with the guiding principles for the Southern Corridor. Additional concerns included the in-direct effect of an anticipated increase in corn farming on the Chesapeake Bay to supply the ethanol facility. Corn farming is a leading source of nitrogen runoff, the No. 1 problem with the health of the bay. In November 2007, the Chesapeake City Council denied a conditional use permit for the facility, citing community concerns to shelve the project.

These were some of The Elizabeth River Project’s key recommendations:

1. Prepare a comprehensive analysis of environmental and human health risks for the benefit of decision-makers, at a level of detail that would be required of a project of this magnitude under federal scrutiny.
2. Meet the highest criteria for minimizing air emissions and impacts to human health and the environment, and offset unavoidable impacts. The developer incorporated some state-of-the-art controls into designs but discussions remained unresolved regarding appropriate technologies and emission limits.
3. Maximize stormwater treatment. The developer made a verbal commitment to consider Low Impact Development strategies.
4. Reduce the use of fresh water by planning and re-use of sewage treatment plant effluent. The plant was proposed to use 1.4 million to 2.1 million gallons of fresh water per day, the equivalent of a small city.
5. Guarantee 95 percent-plus efficiency in the control of odor and noise, and bench-test untried technology. Olfactory meters are available that provide objective odor measurement and other localities have developed standards. The Elizabeth River Project recommended modeling of the impact area, daily monitoring and a compliance level of 1 odor unit above ambient conditions. Debate continued over whether an appropriate compliance level and monitoring could be established.
6. Purchase corn only from distributors who require farmers to document recommended conservation practices. Help fund conservation education and cost-share incentives for farmers to get started with these practices. The unprecedented demand for corn as raw material for the ethanol could pose grave risks to the health of the Chesapeake Bay and other waters, unless farm conservation practices are required of suppliers. The Elizabeth River Project recommended that the developer, at a minimum, provide funding to help the bay states pay for incentive programs for farmer to use conservation tillage, winter cover crops, nutrient management and restoration of riparian buffers. The developer responded that these approaches were impractical.
7. Implement additional maximum pollution prevention practices to limit risks of devastation from the spill of large volumes of flammable and or toxic materials, especially during hurricanes.
8. Document financial stability and environmental compliance.
9. Maximize conservation of the shoreline buffer area, incorporate native plants and complement adjacent



public park area. The developer agreed to protect the 100-foot buffer, in one of the more positive environmental approaches at the site.

The City of Chesapeake's Planning Department incorporated some of these recommendations into a long list of proposed stipulations for IBE – more than three times the amount of stipulations ever proposed by the department for a developer. In November 2007, the conditional use permit was denied by City Council due to concerns from the surrounding residential neighborhoods and the adjacent City of Portsmouth on the potential for significant impacts and the uncertainty surrounding the developer's proposals to mitigate those impacts.

APPLYING THE PRINCIPLES: ATLANTIC WOOD SUPERFUND SITE

A small fish, the mummichog, exhibits as much as 65 percent pre-cancerous lesions alongside the 48-acre Atlantic Wood Industries facility. Location of a former wood-treatment facility, the site has been listed since 1990 on the EPA's "Superfund" or National Priorities List of the nation's most serious uncontrolled or abandoned hazardous waste sites. From 1926 to 1992, a wood-treating facility operated at the site using both creosote and pentachlorophenol (PCP). The site was contaminated from the treatment operation, storage of treated wood and disposal of wastes. Sediments in the Elizabeth River contain visible creosote.

The ground water and soil at the site are also heavily contaminated with creosote. Creosote contamination previously migrated into a storm sewer and discharged to an inlet of the Elizabeth River at the northeast corner of the site near the Jordan Bridge. Polycyclic aromatic hydrocarbons (PAHs), PCP, dioxins and metals contamination (mainly arsenic, chromium, copper, lead and zinc) have been detected in soils, ground water and sediments. A number of these compounds have also been detected in stormwater runoff from the site. Currently, Atlantic Wood operates a pre-stressed concrete products manufacturing facility at the site.

In 2004, Atlantic Wood, the adjacent Norfolk Naval Shipyard, The Elizabeth River Project and other partners received White House recognition for a breakthrough clean-up of an inland area of the site, resulting in a restored wetland (Coastal America Award). In 2006-2007, the EPA began serious planning for remediation of the off-shore contaminated sediments, resulting in a December 2007 Record of Decision that describes the clean-up actions.

The Steering Committee for the guidebook, with help from the technical team, focused on potential redevelopment of the Atlantic Wood site as a catalyst for sustainable development of neighboring properties. Recommendations included:

Master Plan for Atlantic Wood Redevelopment

- While the Atlantic Wood site is currently zoned for heavy industrial use, the Steering Committee suggested redeveloping the western part of the property as a small industrial park to support the surrounding industries while also promoting the redevelopment of other brownfields in the vicinity of the site.
- A continuous vegetated buffer was suggested along Elm Street (between Jordan Bridge and SPSA conveyor) to provide a physical barrier and to screen the



Atlantic Wood and Norfolk Naval Shipyard restored a toxic dump into a thriving wetland.





Paradise Creek Nature Park will be the 40-acre keystone of the corridor, featuring an education center, mature forest and restored wetlands, as well as permeable paving, “rain gardens,” canoe and kayak launch, and over two miles of trails.

Atlantic Wood site consisting of a wax myrtle hedge and American Elms. This buffer would be one of the largest vegetated areas along the corridor and provide more habitat connectivity in the industrialized landscape for wildlife movements. The buffer would not only provide much needed habitat to the area but it would reduce traffic speed.

- Provide a continuous sidewalk integrated with stormwater management practices and vegetated buffer along Elm Street and Victory Boulevard from the Jordan Bridge to the Paradise Creek Park. There was some discussion of connecting with the existing sidewalk on the North side of the Jordan Bridge; however there was no consensus that biking across the bridge would be safe.
- Grass pavers or vegetated storage areas for a portion of the materials storage areas at Atlantic Wood (dependant on access, types of materials, loads, etc.) would help to reduce large amounts of stormwater runoff by allowing stormwater to be absorbed by the native soils. Although the remedial options for the site call for a semi permeable cap, these pervious areas could be strategically placed in areas of the site

that do not contain high levels of contamination. A plus for reducing impervious areas results in less area needed to treat the stormwater runoff.

- Design infrastructure and parcel dimensions at Atlantic Wood and nearby sites to accommodate light industrial and associated office or storage uses. Encourage tenants to use marine shipping and/or rail and limit heavy truck traffic to reduce air pollution and traffic congestion.
- Recommend green roofs (see stormwater chapter) to significantly reduce stormwater volume and reduce urban heat island effects (when cities produce their own weather because of the amount of heat radiating from the impervious surfaces). Most impervious, or hard, surfaces trap heat and give it off over long periods of time. If green roofs are not determined feasible, then roof rainwater collection systems should be suggested.
- Encourage sustainable building practices (see Green Buildings chapter), such as locating structures to optimize solar orientation, passive ventilation and natural day lighting.



Wetlands as Green Space and Stormwater Treatment

- The Southern Corridor concept includes creating a powerful central green space to provide multiple functions including organizing the future industrial park on the western Atlantic Wood parcel, controlling runoff, and providing a beautiful habitat connection to the river (in alignment with existing Atlantic Wood Industries east tidal wetland). This habitat would support vegetation that is reliant on both fresh and brackish waters. The vegetation in the headwaters would consist mostly of freshwater wetland species. They would filter out stormwater runoff from the site while also providing wading bird and fish habitat. The central design of this wetland and stormwater treatment train would minimize the volume of stormwater ponds needed for the site while providing high quality habitat linked to the river. This wetland would also extend into the eastern portion of the site, and this part of the wetland would feature more tidal vegetation. The design calls for a forebay to collect and hold sediments in the stormwater runoff. The forebay would be placed at a location easily accessible for maintenance. Note that further geotechnical analysis is needed to determine the most functional/practical treatment method for the “wetland forebay”.
- Connect the central wetland forebay with a network of distributed stormwater practices that work in concert with new access roads. North South swales are suggested to convey water along Burton’s Point Road, along with detention/retention basins collecting water at the North and South edges of the site. If this element is not constructed, the existing wetland may fill in from sediment transport and allow invasion of *Phragmites australis*, a non native reed grass.
- Observe a minimum 50’ (100’ preferred) building setback along the river and wetland areas. This area provides critical transitional habitat from water to uplands. The trees and bushes in these areas will filter out sediments and contaminants before they enter the river.
- Add native hardwood trees to enhance the eastern area of the Atlantic Wood site, adjacent to the recently restored wetland area (winner, Coastal America award) for at least 50 feet landward to provide a vigorous buffer for the wetland. The buffer would provide a natural limit for site operations to prevent negative impacts on the restored wetland. This buffer would also add a positive aesthetic backdrop for workers. Trees and bushes should be considered that might provide phyto-remediation of PAH contaminated soils. At nearby Hess, poplar trees proved successful with reducing PAH contamination in the soils.



Resources

General

The Elizabeth River Project, www.elizabethriver.org, 757-399-7487 – River Star program for industries, Wildlife Habitat Guide, Everybody Needs a Rain Barrel. Education materials are free to the public, but The Elizabeth River Project only provides site-specific assistance to industries in the Elizabeth River watershed with a significant potential to reduce environmental impacts.

Chapter 1 – Preventing Pollution, The Basic “Win-Win”

National Pollution Prevention Roundtable - <http://www.p2.org/>

EPA Energy Star - <http://www.energystar.gov/>

Business for the Bay - www.acb-online.org/b4b/index.cfm

Chapter 2 – Wildlife Habitat, Making Room on the Urban Waterfront

Native Plant References

eNature - http://www.enature.com/native_invasive/

Shoreline Restoration

Shoreline Erosion Advisory Services, Virginia Department of Conservation and Recreation -

http://www.dcr.virginia.gov/soil_&_water/seas.shtml

Virginia Marine Resources Commission - <http://www.mrc.virginia.gov/>

NOAA Restoration Center - <http://www.nmfs.noaa.gov/habitat/restoration/>

Chesapeake Bay Foundation Guide to Living Shorelines - <http://www.cbf.org/landscaping>

Conservation Easements

Land Trust Alliance - <http://www.lta.org/conserv>

Conservation Science at The Nature Conservancy - <http://www.nature.org/tncscience/?src=l10>

Conservation Easements in Virginia

The Virginia Outdoors Foundation - <http://www.virginiaoutdoorsfoundation.org>

Virginia Dept of Conservation and Restoration, Office of Land Conservation -

http://www.dcr.virginia.gov/land_conservation

Chapter 3 – Stormwater Runoff, The Big Payoff

Green Roof Resources

Green Roofs for Healthy Cities - <http://www.greenroofs.net/index.php>

EPA Heat Island Effect - <http://www.epa.gov/hiri/strategies/greenroofs.html>

Center for Green Roof Research at Penn State - <http://hortweb.cas.psu.edu/research/greenroofcenter/>

Low Impact Development Center - http://www.lid-stormwater.net/greenroofs_home.htm

Greenroofs 101 - <http://www.greenroofs.com/Greenroofs101/index.html>

International Green Roof Association - <http://www.igra-world.com/home/index.html>

Stormwater Pollution Prevention Plans for Construction Activities -
<http://cfpub.epa.gov/npdes/stormwater/swppp.cfm>

Chapter 4 – Redeveloping the Contaminated Site

EPA Brownfields - <http://www.epa.gov/brownfields/>

EPA Land Revitalization - <http://www.epa.gov/landrevitalization/index.htm>

Chapter 5 – “Green Buildings” for Global Sustainability

Sustainable Urban Development and Architecture

EPA Green Communities - <http://www.epa.gov/greenkit>

EPA Smart Growth - <http://www.epa.gov/livability>

EPA publication called “Using Smart Growth Techniques as Stormwater Best Management Practices,” at -
http://www.epa.gov/livability/pdf/sg_stormwater_BMP.pdf

Smart Communities Network - <http://www.smartcommunities.ncat.org/>

National Center for Appropriate Technology focused on “Helping People by championing small-scale, local, and sustainable solutions to reduce poverty, promote healthy communities, and protect natural resources.” Good links to other useful sources.

EPA Green Buildings - <http://www.epa.gov/greenbuilding>

Whole Building Design Guide - <http://www.wbdg.org/>

The National Institute of Building Sciences website: a Gateway to Up-To-Date Information on Integrated 'Whole Building' Design Techniques and Technologies.

U.S. Green Building Council - <http://www.usgbc.org>

“The U.S. Green Building Council (USGBC) is the nation’s foremost coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work. Council members work together to develop LEED® products and resources, the Greenbuild annual International Conference and Expo, policy guidance, and educational and marketing tools that support the adoption of sustainable building. Members also forge strategic alliances with key industry and research organizations and federal, state and local government agencies to transform the built environment.” The US GBC has a local chapters, such as:

Virginia’s James River Green Building Council - <http://www.jrgbc.org/>

Virginia Sustainable Building Network (VSBN) - <http://www.vsbn.org>

VSBN is “the only statewide organization that brings together representatives from diverse sectors who are interested in building healthy, energy-efficient, environmentally friendly buildings and sustainable communities.”

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Guidebook Steering Committee, Elizabeth River Project:

- Art Kirkby, Virginia Department of Conservation and Recreation
- Brewer Moore, Portsmouth Citizen
- Brian Ballard, City of Chesapeake Planning
- Charles Wilson, U.S. Navy Chesapeake Bay Program.
- Chris Moore, Chesapeake Bay Foundation
- Christy Everett, Chesapeake Bay Foundation
- Dave Harper, Atlantic Wood Industries
- Dwight Dixon, landowner
- Ed Giles, Friends of Scotts Creek
- George Brisbin, City of Portsmouth Planning
- Heather Mantz, Virginia Port Authority
- John Blandin, Wetlands Watch
- John Deuel, Norfolk Environmental Commission
- John Ponton, TetraTech
- Ken Bailey, TetraTech
- Kristie Fragoso, Giant Cement of Virginia
- Landon Wellford, City of Portsmouth Planning
- Mike Nickelsburg, Elizabeth River Project
- Mujde Etal Unal, Old Dominion University School of Engineering
- Paylor Spruill, Belharbour Station

- Randy Sturgeon, U.S. Environmental Protection Agency
- Richard Broad, City of Chesapeake Public Works
- Ron Ritter, Earl Industries
- Ross Worsham, Atlantic Wood Industries
- Thomas Reese, Portsmouth Economic Development

Technical Team:

- Bay Environmental, Inc.
- Crisman+Petrus Architects
- The Elizabeth River Project
- Williamsburg Environmental Group, Inc.
- WPL Landscape Architects, Land Surveyors and Civil Engineers

River Stars 2008

River Stars 2008, The Elizabeth River Project

The Elizabeth River Project's River Stars program recognizes facilities that voluntarily prevent pollution or increase wildlife habitat in the Elizabeth River watershed -- and document their success by peer review. The program offers three levels of recognition.

★★★Model Level

Exceptional pollution prevention and wildlife habitat results while mentoring others as community leaders in environmental stewardship.

- APM Terminals Virginia
- BAE Systems Norfolk Ship Repair*
- Dominion Virginia Power, Chesapeake Energy Center*
- Earl Industries, LLC
- Giant Cement of Virginia, Inc. *
- HRSD
- Hermitage Foundation
- Hoffer Creek Wildlife Refuge
- Mitsubishi Chemical America, Inc.
- Naval Medical Center, Portsmouth*
- Naval Station Norfolk
- NOAA Marine Operations Center – Atlantic
- Norfolk Environmental Commission*
- Norfolk Naval Shipyard*
- Old Dominion University
- Southern States Cooperative – Chesapeake Fertilizer Plant
- SPSA – Waste to Energy Facilities, Refuse Derived Fuel Plant
- Tidewater Community College
- US Coast Guard, ISC Portsmouth
- Virginia Port Authority*

★★Achievement Level

Significant results in pollution prevention and wildlife habitat, relative to size and nature of organization.

- Accurate Marine Environmental
- BASF Corporation
- Beach Marine Services
- Chesapeake Arboretum
- Christian Broadcasting Network
- Citgo Petroleum Corp.

*Honored for Sustained Distinguished Performance. Represents completion of a significant new initiative by the River Star.

- Hampton Roads Regional Jail
- Hampton Roads Rowing Club
- Izaak Walton League of America–Norfolk Chapter
- Kinder Morgan Southeast Terminals
- Larchmont Branch Library
- Lyon Shipyard
- Metro Machine Corp.
- PETA
- Portsmouth–Stormwater Division*
- RADVA Corp.
- SIMS Metal Chesapeake
- Skanska USA Civil
- U.S. Maritime Administration, South Atlantic Region

★ Commitment Level

Significant results in either pollution prevention or wildlife habitat enhancement.

- Atlantic Associates
- Amerada Hess Corp. – Chesapeake Terminal
- Cape Henry Audubon Society – Weyanoke Wildlife Sanctuary
- Christ and St. Luke's Church
- Colonna's Shipyard
- Dismal Swamp Canal Trail – City of Chesapeake
- Elizabeth River Terminals, LLC
- Great Bridge Lock Park
- Hampton Roads Behavioral Health
- Island Properties/Island Estates
- Lafarge North America Cement – Chesapeake Plant
- Marine Repair Services – Container Maintenance Corp.
- McLean Contracting
- Norfolk's Business Partners for Clean Water
- Peck Land Co.
- Perdue, Inc.
- Portsmouth Boating Center
- Sadler Materials Corp.
- Saint Paul's Episcopal Church
- Southern Aggregates, LLC
- Virginia Beach – Eastern Branch Greenway
- Virginia Zoological Park
- Volvo Penta of the Americas, Inc.
- Waterway Recycling

*Honored for Sustained Distinguished Performance. Represents completion of a significant new initiative by the River Star.

State of the Elizabeth River 2008

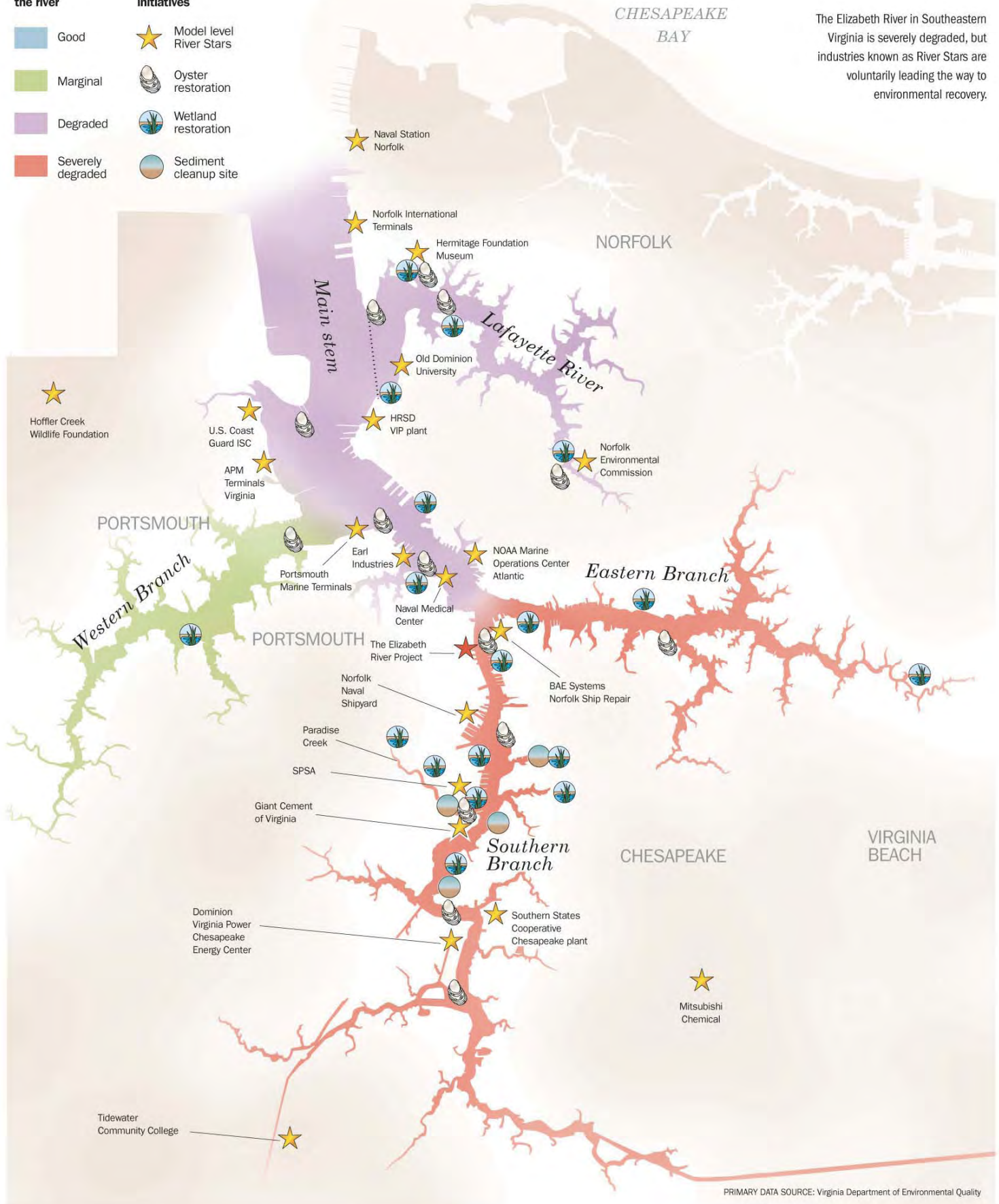
Health of the river

- Good
- Marginal
- Degraded
- Severely degraded

Restoration initiatives

- Model level River Stars
- Oyster restoration
- Wetland restoration
- Sediment cleanup site

The Elizabeth River in Southeastern Virginia is severely degraded, but industries known as River Stars are voluntarily leading the way to environmental recovery.



PRIMARY DATA SOURCE: Virginia Department of Environmental Quality