

THE DIRTY HISTORY OF PORTLAND HARBOR

When scientists began looking closely at the sediments and at the bottom of Casco Bay beginning in the early 1980s, they confronted a pollution puzzle. Sediments taken from various locations throughout the Bay, and especially in Portland Harbor, held a wide variety of potentially toxic chemicals.

Until we know more about how these heavy metals, pesticides and other compounds affect marine life, it's hard to know what lasting impact the pollution in Casco Bay may have. But it was decided that the more we know about where those pollutants came from, the better chances we will have in preventing future problems.

The Casco Bay Estuary Project (now Casco Bay Estuary Partnership) commissioned environmental historian Edward Hawes to do some detective work, hoping that he could turn up some puzzle pieces from the watersheds that feed the Bay. The industrial legacy he found was a surprise to almost anyone who thinks they know the Portland area.

A Pollution Problem

When investigators began sampling Casco Bay's sediments in the 1980s, levels of pollution were found that merited additional attention. In 1991, the first systematic study was done to more clearly document the types and pattern of pollution that exist. What we all thought was a fairly pristine environment was in fact hiding a broad array of chemicals. Two areas of concern emerged;

The first involved areas where one or more contaminants had reached high enough concentrations that they might be toxic to marine plants and animals. At one sampling site, PCBs (polychlorinated biphenyls) were in this category. At another, PAHs (polynuclear aromatic hydrocarbons) reached this threshold.

The second area of concern was those sites where the concentrations of contaminants were high in comparison to other estuaries around the nation. PAHs again achieved this dubious distinction in a number of sites throughout



Early industry was limited by natural energy sources, like this tidal mill at Stroudwater. (courtesy: Sullivan Train & Photo)

Casco Bay. Lead, cadmium and mercury concentrations were comparatively high in Back Cove, as were lead and mercury in the inner Fore River. Lead was also relatively high in the Presumpscot River estuary.

Additional metals — nickel, silver, arsenic, chromium and zinc — were evident in lesser concentrations. This widespread contamination was a little mystifying. In this age of environmental regulation, how could so much pollution have landed in the Bay?

The next mystery was how the pollutants had reached heavier concentrations in some locations and lighter concentrations in others. The most powerful concentrations were found in the inner harbor. If there had been any doubt about the sources, this erased it. Some of these pollutants must have originated on land and been transported into the water, with some of them settling near their entry point.

And as history reveals, there was no shortage of tanneries, metal foundries and filling stations that might have generated just such pollutants. How these chemicals reached the harbor is a final puzzle. Although we now have environmental regulations to protect the environment, this was not the case during the time of early industry in the mid-19th century. It is quite possible that the wastes and spillage from

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these industries found their way into nearby streams or sewers, or were dumped straight into the Bay. Pollutants dumped inland may have worked their way down streams, or could even have been ferried by groundwater beneath the earth's surface, until they spilled out into Portland harbor.

What's in a Watershed

The Casco Bay Estuary Partnership decided to investigate further, knowing that watersheds, and the water that flows from them, are the key to pollution in the Bay.

Watersheds are created by hills and valleys that separate rainwater or melting snow into watery neighborhoods. A watershed can be tiny — a series of little left or right turns that a water drop makes as it rolls downhill. Or it can encompass a fan of rivers spread wide over hundreds of miles, all emptying into the Gulf of Maine. The watersheds examined for this study were moderate in size, roughly equivalent to a residential neighborhood. Because early industries tended to be situated near water, it is easy to divide the Portland Harbor region into areas that represent both watersheds and industrial clusters. Hawes calls these segments "historic development areas," or HDAs. (See "Home, Sweet HDA" on page 4.)

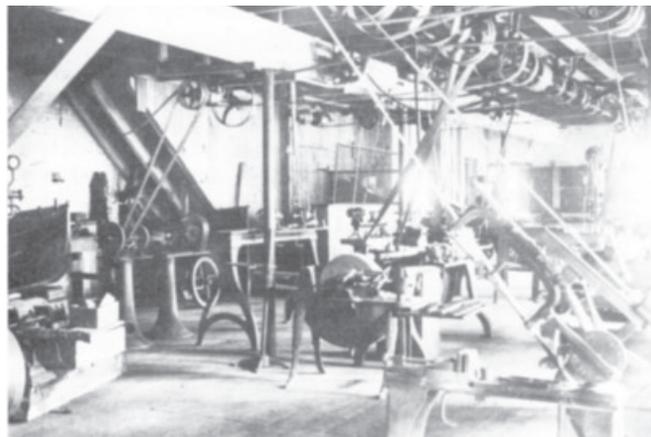
Until quite recently, each factory that sprouted along the streams, rivers, and inlets around Casco Bay produced its own brand of pollution, dumping it straight into the water, or onto the ground. The stream receiving lead as it passed the paint factory trickles down to join another stream — perhaps this one carries chromium and arsenic from a tannery. This stream might go on picking up lead, zinc, and copper from a foundry, then flow into a river laden with more arsenic leaking from a nearby cemetery.

By the time such a river reached the Bay, it would have collected a load of pollutants from all across the watershed. This chemical cocktail would swirl in the tidal currents, then settle to the bottom. The mix of pollutants changed with time

and industrial trends, and the route they took to the ocean altered somewhat with the advent of sewers in the 1890s. But the waste was always funneled through roughly the same watersheds and into roughly the same portions of the Bay.

And it might still be. Even though the foundries are long gone, their toxic legacies may remain in the soil. The hundred-plus filling stations that once circled the Portland peninsula are gone, but some of their forgotten underground storage tanks may still be seeping gas and oil. Slow-moving groundwater traveling beneath the Earth's surface could still be collecting these chemicals and carrying them down through the watershed.

It is even possible that today's development could unleash fresh plumes of those old pollutants to contaminate the Bay. In the process of preparing a building foundation, for example, a backhoe operator could unknowingly unearth an old brickyard-turned dump. This might open a virtual time capsule of industrial wastes, which could begin their delayed journey down the watershed.



UNION STREET: Metal working, at this Union Street machine shop and others, was probably one of the industries that built Portland — but it probably released metal particles and other pollutants to the Bay. (courtesy: Sullivan Train & Photo)



Many of the filling stations that ringed Portland disappeared with the Studebaker. But their underground storage tanks may still be releasing pollutants to the watershed. (courtesy: Sullivan Train & Photo)

Small Industries, Small Problems

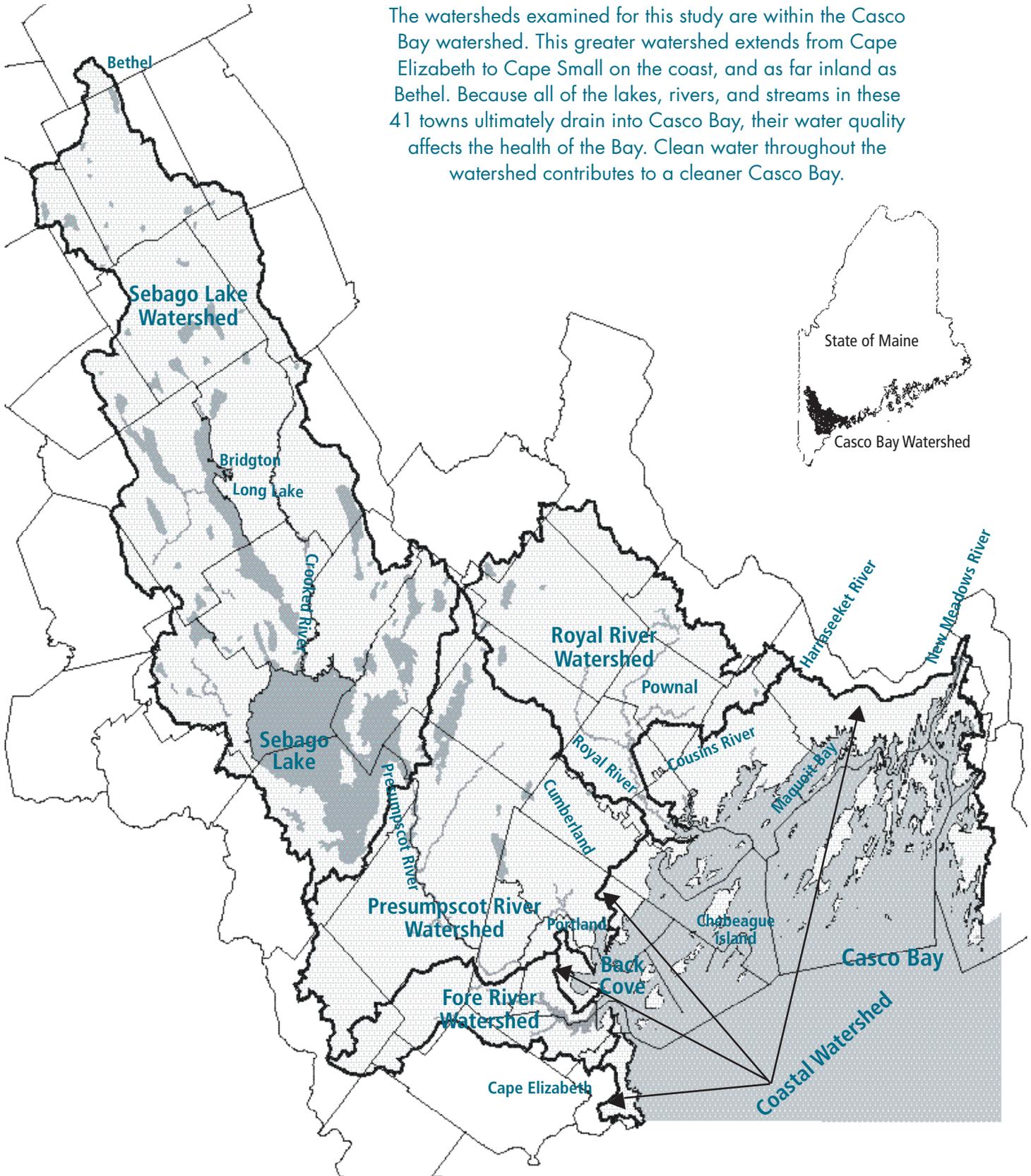
Digging through old maps, directories, and local histories, Ed Hawes discovered that Casco Bay's dirty history begins in the mid-1800s. Until that time, there simply was little industry. There were a few mills scattered along the rivers, taking advantage of whatever water power they could harness. These mills were likely to process grains or logs rather than dirtier products like iron or paints. The waste products they discharged into rivers were biodegradable and were likely short-lived. Whether these early mills used the energy from rivers or tides, the size of their operation was limited by the natural energy supply. So even if an early factory dabbled in chemicals, the small scale of the operation would have minimized the pollution that was released.

The Stroudwater area of Portland was the site of some of this low-impact industry. Old maps show a tidal-powered grain

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Casco Bay Watershed and subwatersheds — Home to the work of the Casco Bay Estuary Partnership

The watersheds examined for this study are within the Casco Bay watershed. This greater watershed extends from Cape Elizabeth to Cape Small on the coast, and as far inland as Bethel. Because all of the lakes, rivers, and streams in these 41 towns ultimately drain into Casco Bay, their water quality affects the health of the Bay. Clean water throughout the watershed contributes to a cleaner Casco Bay.



mill and warehouse at Stroudwater Crossing. The falls were harnessed as well, for sawing logs into lumber, clapboards, and lathes.

In the 1800s, there were two leather tanneries in Stroudwater. However, the existence of a bark mill nearby indicates that the tanneries relied on tannin extracted from bark. Unlike the toxic chromium and arsenic used in the “mineral” tanning process, the wastes from a bark-based operation would have decomposed rather quickly in the environment.

Portland’s Industrial Revolution: 1840 — 1900

Then the industrial revolution arrived with steam power that came to town in the 1840s, making factories independent from water power, and requiring the import of fossil fuels from elsewhere. Electrical power followed in the 1880s.

Bigger industries began to produce large quantities of human-made compounds that were new to the ecosystem. This new brand of pollution was the type that biodegrades slowly — or doesn’t break down at all. The production of coal gas at the Portland Gas Company on West Commercial Street, for example, yielded coal tars containing potentially carcinogenic polynuclear aromatic hydrocarbons (PAHs). The manufacture of paints on Munjoy Hill relied heavily on white lead. The foundries, rolling mill, and other metal works throughout the area introduced their own metallic by-products to the area.

Dilution, which did a reasonable job of handling the area’s early waste problems, would have been hard pressed to handle these larger quantities and heavier concentrations.

Six new industries would have had the biggest environmental impact during this time. They were the tanneries, paint and varnish manufacturing, shipbuilding yards, metal foundries, railroad yards, and the coal-gas plant.

Home, Sweet HDA: A Neighborhood History

When environmental historian Edward Hawes began the detective work to discover where pollutants in Casco Bay might have come from, he discovered two patterns on the land that overlapped.

One was watersheds, topographical neighborhoods that funnel water into tiny streams, then creeks, then small rivers, eventually emptying into the Bay.

This system of watersheds surrounding Casco Bay coincides with a second pattern. Historic development essentially mirrors the watershed, because early industries were dependent on nearby sources of water. Even when sewers were installed, they had little effect on land use patterns, because these human-created watersheds tended to mimic the natural ones — in some cases, the streams themselves were taken underground with the sewer.

Hawes mapped these distinct neighborhoods and named them Historic Development Areas, or HDAs.

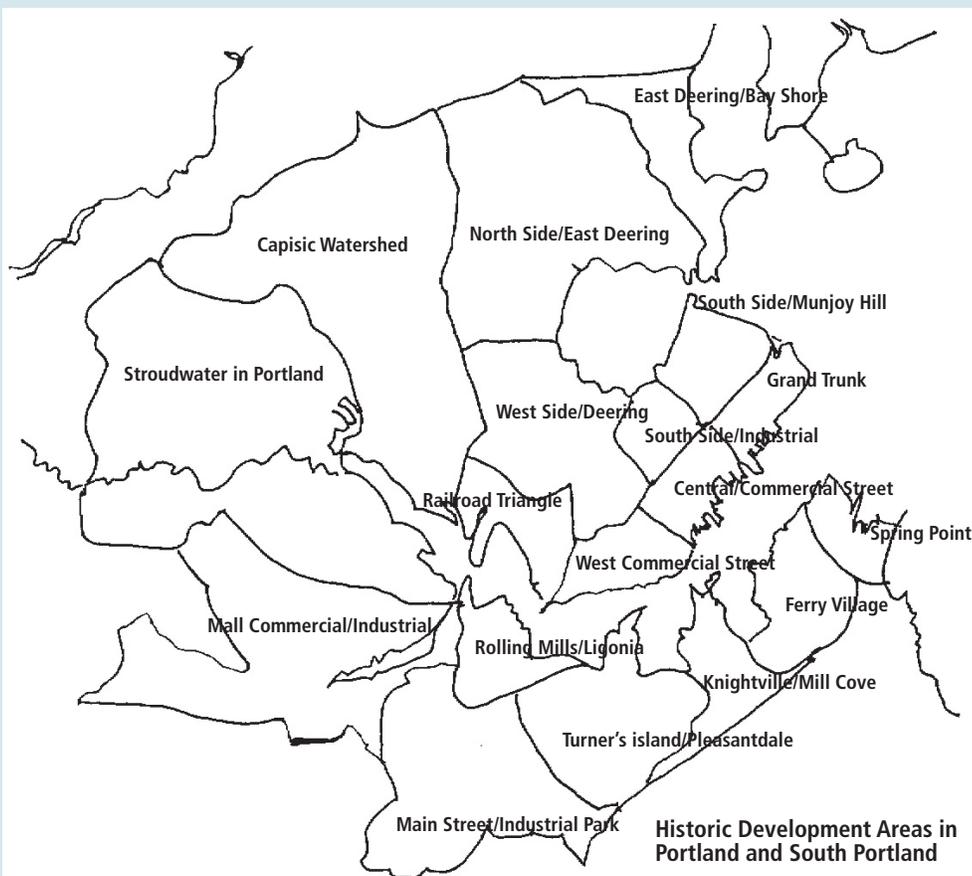
Listed here are the major polluting industries that Hawes identified in each HDA in Portland or South Portland. Consult the map to locate the HDAs in

which you live, work, or go to school. Then see the list below to learn which industries were present in years past.

Industries are grouped by century, but many activities begun in the 1800s

continued into the 1900s. Some continue to this day.

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The tanneries which were west of Back Cove and in the Morrill's Corner area, probably relied on the "mineral process," which involved toxic and potentially carcinogenic chromium and arsenic.

Four paint factories appeared in the Portland Harbor watershed, too. On Munjoy Hill there was a sizeable paint factory that may also have produced white lead. The white lead was used as a pigment base in the paint, and the coloration was achieved by adding other metals, including red lead, zinc, cadmium, and coal tars. Lead can cause nerve damage, as well as genetic mutations and cancers. Mercury, an infamous neurotoxin, was added to the paint-making process in this century, as were synthetic solvents, which would include some potentially carcinogenic petrochemicals.

Foundries and metal works pop up on old maps of Portland as frequently as restaurants do now! Metal works of all sorts were scattered from the waterfront to the Back Cove area and out to Morrill's Corner, where a handful of shops

produced pewter and Britannia metal. Everything from rolling metal to casting, machining, and galvanizing were done here.

The wastes that they produced were equally diverse. Early foundries handled copper, zinc, tin, and lead. With the rapid development of steel alloys in this century, the list of metals used grew to include: chromium, cobalt, manganese, molybdenum, and nickel. These were accompanied by powerful acids, phenols, and PAHs, cyanide and arsenic, used for everything from cleaning to sand-molding of metal parts. Dirtied wash water, solvents, metal particles and acids would have been disposed into nearby water bodies or sewers.

The railroad facilities represented a similar conglomeration of grubby undertakings. They incorporated a machine shop and a painting operation, along with the traditional maintenance and fueling facilities. The maintenance shops would have produced lead from machining and painting. The coal ash itself contained traces of mercury. As railroads

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Home, Sweet HDA: A Neighborhood History *continued*

Stroudwater, Portland

1800s: Two tanneries (probably "tannin bark" process, which is cleaner than "mineral" process).

Capisic Watershed

1800s: Pewter and Britannia metal shops, tannery, two brickyards, several cemeteries. 1900s: Many filling stations.

Railroad Triangle

1800s: Several railroad yards with machine shops, two slaughter houses, soap factory, brick yard. 1900s: Filling stations and garages, petroleum storage and distribution facilities, trolley and bus depots.

West Back Cove/Deering

1800s: Four tanneries, varnish and paint factory, foundry, stoneware factory, brickyard. 1900s: Substantial fill, dump, filling stations, and garages.

North Back Cove/East Deering

1800s: Pewter and Britannia metal shops, two tanneries, book bindery, can factory, galvanizing and plating shop, possible brickyard. 1900s: Substantial fill at Back Cove, dump, numerous filling stations.

South Back Cove/Munjoy Hill

1800s: Tannery, dump, fill at East Promenade. 1900s: Dry cleaners.

South Back Cove/Industrial

1800s: Considerable filling of the cove, railroad repair yard, Portland Stove Works, numerous machine shops and metalworking facilities. 1900s: Radiator works and machine shop, junk yard, culvert company, numerous gas stations and garages.

Grand Trunk Area

1800s: Smelter, cemetery, shipyard, rail yard with machine shop, metal shops, numerous metalworking facilities, major foundry, lead paint factory. Second major foundry, printer.

Central Commercial Street

1800s: Paint factory, canneries, many machine shops and small foundries, galvanizing operations, boat landings. 1900s: Filling stations, junk yards, six printing shops.

West Commercial Street

1800s: Match factory, sugar refinery, railroad yards, gas works, hat factory, petroleum storage and distribution facility. 1900s: Filling station.

Spring Point

1800s: Military bases. 1900s: Considerable filling of mudflats, shipyards, pipelines, off-loading facilities, petroleum tank farms, metal working with machine shops and foundries, truck repair, canneries.

Ferry Village

1800s: Shipyard, metalworking facilities. 1900s: military base with machine shops, cannery, marina.

Knightville/Mill Cove

1800s: Dry dock, brewery, and shipyards. 1900s: Two dumps, rug factory, many gas stations, dry cleaning, electrical plant.

Turner's Island/Pleasantdale

1800s: Heavy landfilling, cemetery, rail yard and repair facility. 1900s: Tank farm and off-loading facilities

Rolling Mills/Ligonias

1800s: Substantial landfilling, two cemeteries, large iron rolling and fabrication facility, acid chemicals plant, kerosene refinery, paint and varnish factory. 1900s: Numerous tank farms, petroleum storage and distribution facilities, gas stations.

Main Street Industrial Park

1900s: Two landfills, railroad yard repair facilities, cemetery, steel fabrication works, truck repair, metals salvage.

Mall Industrial/Commercial

1900s: Numerous filling stations, car dealerships, car washes, electronic components manufacturing.

Stroudwater River, Westbrook Minimal industry

Gorham — Minimal industry

THE CONCENTRATION GAME: Sewers and Dumps

The job of drawing a straight line between the pollutants in Casco Bay and the long-departed factories on land is difficult enough. Add sewers and dumps to the mix, and it is truly a puzzle. Both sewers and dumps collect pollutants from a wide variety of sources, but with differing results.

Just as the web of streams and rivers had once gathered the waste of industry, in the 1890s, sewer systems began to do the same. Wastewater from far-flung corners of Portland and South Portland traveled toward the Bay, with new flows of water branching in along the way. By the time the sewer reached its outfall point at the harbor, it might be carrying pollutants from ten different industries, and numerous households, all swirling together.

There are dozens of these outfalls around the harbor, and many of them still come into play on rainy days. Because the region's sewer system does double duty as a storm water system, heavy rains swell the sewage flow to more than the treatment plants can handle. In that case, the excess raw sewage and water divert to the old outfalls. And as they always have, each outfall empties a concentrated load of pollutants into its segment of a river, a cove, or the Bay.

Why, then, does pollution show up in sediments throughout the Bay, and not solely beneath these outfalls? A sound answer depends on further study. But waves, tides, and currents hold one key to this complex riddle. Sewers and streams don't empty into a calm pool of water, but rather, into a flowing river or a railing, rushing ocean. Depending on the tides and currents, pollutants might have been whisked up and carried out to sea, or conversely, pushed deep into the harbor to settle.

The sea may not be satisfied with this first settlement of pollutants. Changing currents may be uncovering old deposits right now, and burying others deeper still.

Dumps and landfills represent another version of concentrated pollutants. Portland's Commercial Street and much of South Portland's harbor frontage were created by extensive filling of mudflats. Back Cove once extended into a system of inlets and wetlands, which are now filled. Old brickyards and quarries were likewise inviting places to dispose of all sorts of waste.

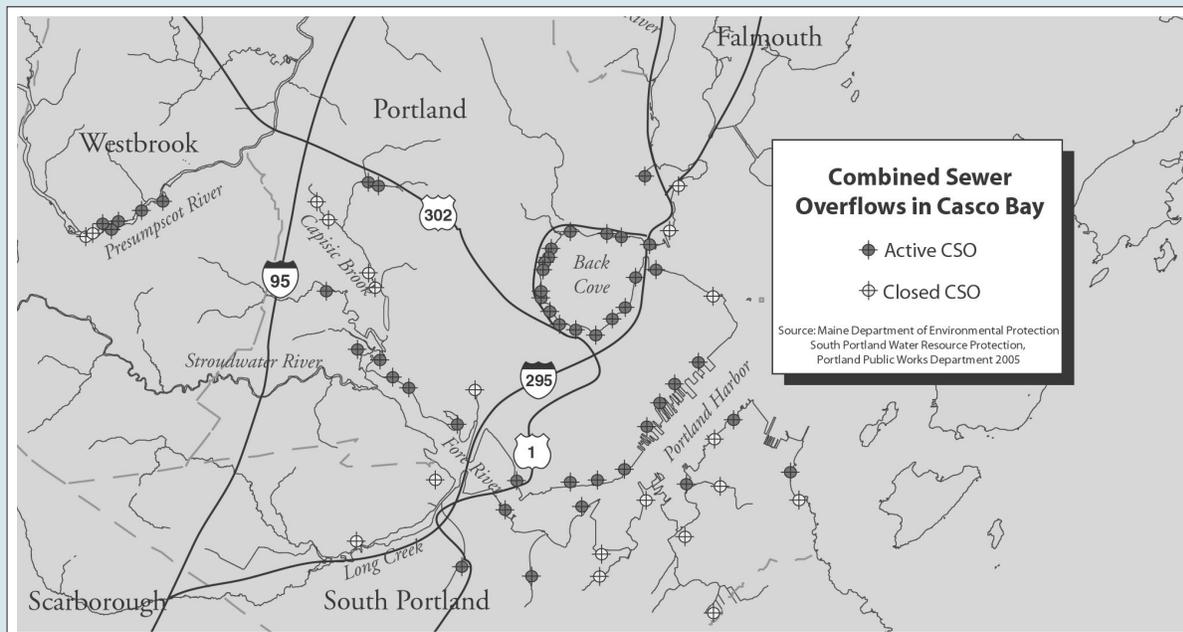
In recent history, many of these dumps have become overgrown, forgotten, then reborn as building sites. But the question of their contents remains.



East End dump with Bulldozer: The attempt to trace one marine pollutant to one source on land is confounded by dumps and sewers, which gathered together wastes from numerous sources. (courtesy: Maine Department of Environmental Protection)

We know now that landfills — even modern, lined ones — leach pollutants slowly into the groundwater that flows past them. Although it may be a creepingly slow process, the soluble contents of these old landfills may be moving toward the Bay. The stones at the base of the Eastern Promenade near the sewage treatment plant, for example, have been stained a lurid rust color from leachate emerging from a large old landfill there.

The journey these hidden pollutants take may be hastened if we're not careful. Because many dumps are forgotten, they are vulnerable to being disturbed by excavation and development. It's possible this could release long-dormant wastes into the watershed.



evolved in this century, maintenance generated used cleaning solvents, along with the metals and other contaminants that they removed, as well as spillage, leakage and washing residues of any chemicals that were transported in tanker cars. Diesel fuel also introduced PAHs.

Shipyards have always been part of the Bay's industrial mix. Dotting the waterfront in Portland and South Portland, their lead and copper bottom paints had a very brief journey to reach the harbor waters. With the advent of metal ships, many of the pollutants associated with metal works were brought to the yards, as were fuel spills.

The Portland Gas Company extracted the energy from coal and coke in the form of gas, which was then piped throughout the city. But in past years the plant generated large quantities of coal tar, in addition to ammonia and sul-

fur compounds that would have filled the air with a distinct eggy perfume.

Pollutants from major industries were augmented by innumerable smaller sources. Brickyards were often transformed into dumps when they closed, leaving pockets of contamination scattered through the area. Cemeteries are located in every neighborhood, and they may continue to release the arsenic that was once used as an embalming agent. A stoneware and pottery factory located where the Back Cove shopping center is now located probably used glazes with lead and other metals. A hat factory near the waterfront used mercury in its processes. For a time there was a kerosene refinery, a source of PAHs, near where the Veteran's Bridge originates in South Portland.

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RAIL ARRIVES: Heavy Industry Follows

Portland industries secured a very early toehold on Munjoy Hill's harborside flank. The collection of brick buildings beneath where Fore Street rises to the Eastern Promenade can only begin to evoke how the scene must have appeared a century ago.

The Grand Trunk Railroad got things started in the 1840s, when it built a rail line to Montreal. At the corner of Commercial and India Streets, the railroad built a passenger depot, plus a rail yard with a car-building operation, repair facilities, and a roundhouse. It then added facilities for ocean shipping; in effect, Canada's winter port.

This railroad complex would have produced a number of metal wastes, from machining and metal forming, in addition to PAHs from lubricants. The coal ash would also have contained mercury.

At the same time, the Portland Company moved into the east of the Grand Trunk. This foundry built locomotives for the new railroad, then fueled the area's industrial revolution with steam engines and other heavy machinery. This was one of the area's biggest foundries, encompassing several forges, a machine shop, and a rail car painting shop, with its attendant lead pollution. The Portland Company underwent several expansions in its 100-year life, producing everything from cannons and shells to jet engine parts.

In the 1890s, another foundry, the Thomas Laughlin Company, moved to the neighborhood from a small site on Commercial Street. It began a rapid expansion, making tools and marine hardware, using several forges, machine shops, and a galvanizing works.

These three heavy hitters were accompanied by smaller businesses, including many small foundries and machine shops, the first Burnham & Morrill cannery, a smelter at the entrance to Back Cove, and a shipyard. The metal pollutants generated in this area must have been considerable, with the shipyard adding copper and lead from bottom paint, a printer contributing solvents

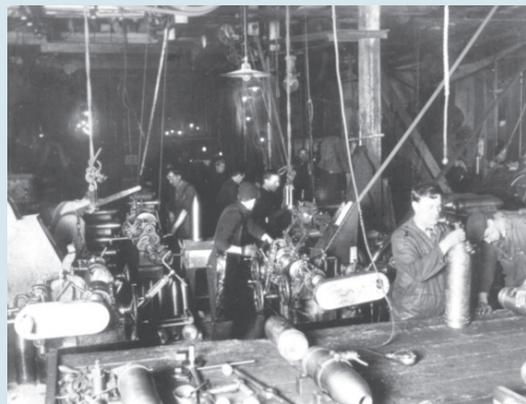
and various metals, and a cemetery bringing arsenic (from embalming) into the mix.

This part of the harbor must have been irresistible to heavy industry. The deepwater port didn't freeze, allowing ships from Chile to deliver the copper they needed. And the rail line was ready to carry finished goods to Canada and other markets. And of course, there was plentiful water, for both processing metals and flushing wastes into the Bay.

Various forces combined to sweep heavy industry out of the Grand Trunk area. Time had made some of the heavy industries obsolete, and buyouts had shaken the stability of others. A general de-industrialization took place even before the Clean Air Act and Clean Water Act of the early 1970s took force.

Laughlin closed in the early 1980s. The Portland Company sold its name and several divisions in 1970, but closed a few years later. Now even the rails that lured these giants to the waterfront are gone.

The only thing that continues to pour pollution into the Bay from the Grand Trunk neighborhood is a combined sewer overflow (CSO) near Commercial and India Streets. Like a souvenir from an earlier era, this old sewer line overflows on rainy days to remind us how this thriving waterfront must have once looked (and smelled) every day of the year.



Portland Company Wartime Production: The early availability of rail transportation on East Commercial Street led to a boom in heavy industry, including numerous foundries. Workers at the Portland Company on Fore Street make shells for World War I. (courtesy: Maine Historical Society)

All of this rumbling, steaming, smoking industry must have been an impressive sight, and much of it would have been impossible without the rich water resources all around. Even after fossil fuels freed industry from dependency on water power, industry depended heavily on water. Some plants needed water to cool machinery or wash their products; others needed it as an ingredient in their manufacturing process. And they all needed flowing water to carry away their waste.

Steeped as we are in the modern notion of treating waste water, it's hard to imagine what early sewers looked like. Some factories discharged their filthy water, sludges, and biological wastes through a pipe that ran straight to Back Cove or into Portland Harbor. Others poured their pollution into nearby rivers, ponds, or streams-turned-sewers that flowed to the Bay. The concept of removing the pollutants before returning the water to Nature was unheard of, and it has left an invisible legacy that will haunt Casco Bay for generations to come.

The Petroleum Age: 1890 — 1970

When the 20th century dawned over Casco Bay, the industrial landscape underwent another significant transformation. Mass production and a national distribution network for goods brought in some new industries, and rendered others obsolete, among them the tanneries, the hat factory, the acid plant, and the kerosene refinery.

The new steel alloys, on the other hand, were readily adopted by the foundries already here. Alloys arrived in the first decade of the century, introducing molybdenum, magnesium, and other metals that would find their way to the Bay. In the 1920s, more lead entered the ecosystem through the leading of gasoline. The infamous PCBs were added to the lubricant inside electrical transformers. In the 1940s, war production pushed manufacturing efficiency far ahead of waste management concerns, as shipyards strained to produce a military fleet.

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HISTORY OF SHIPBUILDING: South Portland's Maritime History

The shipbuilding business along South Portland's waterfront got a very early start. The former South Portland Shipyard on Front Street in Ferry Village dated to the 1850s, as did its marine railway. This early boat building and repair enterprise was a relatively clean undertaking, with pollution coming mainly from the copper and lead in the bottom paints.

It was war that brought a major shift in South Portland's nautical history, along with a new and complex family of chemical pollutants.

For more than a year before the United States entered World War II, the "East Yard" at Spring Point was turning out coal-fired steel liberty cargo ships for the British government.

In preparation for war, the "West Yard" and the naval base were built across the harbor from the Grand Trunk property, largely on fill that was dumped in the mudflats in front of Preble Street. Throughout most of the war, this yard built oil-fired Liberties for our own naval effort, and when the East Yard had satisfied the British contract, it too went into production for the U.S. The only remaining operational U.S. Liberty ship

to participate in the landing at Normandy, in fact, was built in South Portland.

The urgency of this wartime production eclipsed any consideration of environmental effects, and it's likely that all the pollutants associated with metal working — a wide range of toxic metals along with solvents — were plentiful, along with PAHs from lubricants and fuels, and possibly hazardous wastes in the filled flats.



Long a center for building, South Portland became a virtual assembly line for steel "Liberty Ships" in World War II. Production would have taken precedence over preventing metal particles, solvents, and toxic bottom paints from entering the environment. This photo shows the East Shipyard at Spring Point. (courtesy: Sullivan Train & Photo)

Shipbuilding has maintained a solid presence in South Portland; in fact, the boat yard and marine rail in Ferry Village are in operation still. From 1959 to 1982, boat building and maintenance would have entailed use of the extremely toxic tributyl tin in bottom paint. And these days, the marinas, Coast Guard station, and boat yards may contribute to the release of PAHs into the ocean in small fuel leaks and spills.

Ferry Village and Spring Point had their share of heavy industry, too, and from very early on. In the 1850s, one of the biggest foundries in the area opened there, and remained until the 1980s. Several canneries were clustered on the shores, using lead to solder their cans until the 1920s. And the Turner's Island railroad yard, along with its machine shops and maintenance facilities, operated from the 1850s to the 1930s.

South Portland has long played host to the petroleum industries, with tank farms and the Portland Pipeline facility that delivers oil to Montreal for refining. Unlike years ago, strict environmental standards now exist to prevent oil from entering the harbor.

Now the maps reveal South Portland evolving into a port city in its own right, with military bases and shipyards, along with metal-working and machining, in the Spring Point area. In the 1960s and 1970s, high-tech manufacturing became important.

In terms of pollution in this century, however, there were four new industries that stood out: canneries, electrical power generators, petroleum storage and distribution facilities, and the dozens of filling stations that clustered at “gasoline gates” to the city.

The fish, vegetable, and meat canneries produced copious biological waste, but it was the cans themselves that had a lasting effect on the Bay. It wasn't until the 1920s that this industry began moving away from lead solder; until then, the toxic metal would have been in plentiful supply at these waterfront factories.

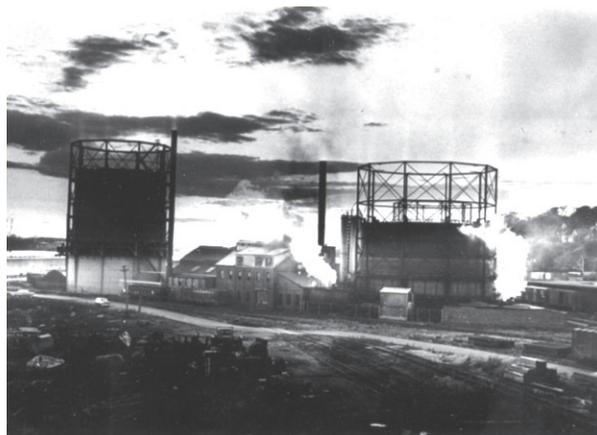
The electrical generating facilities were partly responsible for the introduction of PCBs in the 1920s, as were hydraulic systems in everything from bulldozers to foundry presses. This extremely toxic chlorinated compound shows up in disturbingly heavy concentrations at some locations in Casco Bay.

The early petroleum industry may be responsible for some of the PAH pollution that is common in the sediments. The tank farms that were established in the 1920s, eventually formed a regional hub for transportation of petroleum from Portland Harbor to Montreal. PAHs are a large family of hydrocarbons, a number of which are also carcinogenic.

The petroleum business also brought more lead to the area, first as an additive to oils (1900), then to gasoline (from 1922 to the 1970s). Lead and PAHs could have spilled in ship-to-shore transfers, or leaked from tank farms, under ground storage tanks at filling stations, and even from the vehicle parked in a residential driveway.

Shipbuilding continued to thrive, and foundries expanded, generating metal particles and solvents. Numerous other dirty industries took root as the economy matured as well. Commercial laundries and dry cleaners flushed away copious cleaning solvents and perhaps even heavy metals washed from the clothes of laborers.

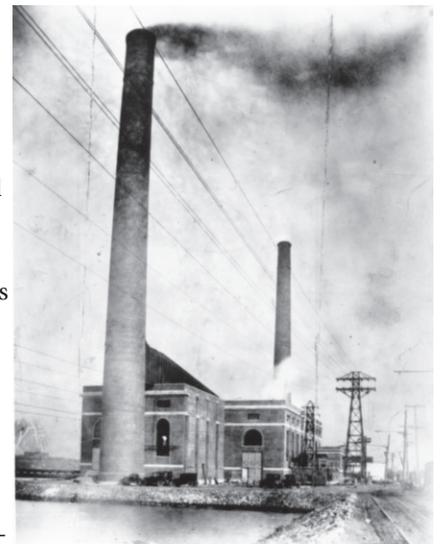
Manufacturers of electronics produced a mix of pollutants similar to that of laundries. Plastics industries dealt in solvents, as well, including toxic phenols.



Fossil fuel technologies boomed in this century, powering further industrial development. But electrical generators introduced dangerous PCBs to the environment, and this coal-gas plant, formerly located next to the Fore River north of the Casco Bay Bridge, produced prodigious quantities of potentially carcinogenic coal tars. (courtesy: Portland Press Herald)

Not surprisingly, many of these industries remained reliant on a nearby supply of water. The shipyards, of course, hugged the ocean, as did the canneries and petroleum tank farms.

Although Portland's economy now appears to be mostly service-oriented, it was only quite recently that the heavy industry abated. The coal-gas works held on until the 1960s; the Portland Company metal works on Fore Street closed at the end of the decade. Two remaining foundries closed in the 1980s, along with Portland Stove Works near Marginal Way.



CMP STATION: Environmental regulations have reduced the amount of pollution released by industries and power plants like this one near the South Portland waterfront. But the legacies of the unregulated years may remain hidden in the soil, traveling in groundwater toward the harbor. (courtesy: Maine Historical Society)

A Clean Site

After a century and a half of absorbing the effluvia of human industry, things began to look up for Casco Bay in the 1970s. An environmental awakening swept across the country, and people began to pay attention to the planetary consequences of their behavior.

Congress passed the National Environmental Policy Act in 1970, and followed it with the comprehensive acts to protect the air, land, and water. The Clean Water Act has radically changed the way industries dispose of their wastes. Solid wastes have to be buried or burned in accordance with strict regulations. And waterborne pollutants often must be removed from wastewater at the industry's expense. In other cases, the factory must seek a permit to release specific toxins, and it must report those releases to an agency with enforcement powers. Straight pipes are gone, as is the quiet dumping into a handy sewer.

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However, the toxic evidence from the days of our environmental innocence remains, buried in old brickyards, hidden in underground storage tanks, and layered in the telltale sediments of Casco Bay.

The question, though is what this evidence can tell us about the future.

It is tempting to point to the Bay's accumulation of lead and say, "Ahh! That lead is a direct result of the old paint factory on Munjoy Hill!" But there's little point to that. First of all, it is currently difficult to trace any one pollutant in the Bay to any one source on shore. Not only does mixing occur where the rivers and sewer outfalls dump pollutants into the harbor, but they're further stirred by wave action, tides, and currents.

Even if culpability could be assessed, the paint factory is long gone, leaving no pollution abatement fund behind. In the days when many of these pollutants entered the Bay, people little understood the dangers of the chemicals they released. They certainly couldn't appreciate the subtle biological effects they might have on marine ecosystems.

There are some useful lessons buried beneath Casco Bay, however. The most pointed testimony from the contaminated sediments is that pollution is long-lasting. While we see no trace of the biological wastes from the old slaughterhouses and fish canneries, some pollutants remain unchanged after 150 years, and will remain so for the foreseeable future. Lead, cadmium, arsenic, copper, and many of the other potential toxins in the Bay are

elements, vulnerable only to chemical reactions. Fresh sediments will wash down the rivers to cover them, perhaps, but they will be there, ready to be brought back to the surface by biological activity or dredging.

There are further lessons for people who work with the land around Casco Bay. Land-use planners and developers should take note that they may not be working with virgin soils. The ground the bulldozer breaks today may have been the site on which a foundry sat a century ago, releasing its metals, solvents and acids into the earth. Not only can these buried surprises trigger lawsuits and expensive clean-ups, they may also release pollutants that have long been held at the site.



Many of Portland's industries were located on the water. While a waterfront location made shipping and receiving easier, it also brought pollution to the shore. This photo shows the old Brown Sardine Cannery in South Portland. (courtesy: South Portland/Cape Elizabeth Historical Society)

There is a lesson in Casco Bay for anyone who cares about this beautiful, vital resource. Every watershed eventually empties into the ocean, and each of us lives in a watershed. Each drop of rain that lands on each lawn is an empty vessel, ready to carry contaminants down through the watershed. That drop may gather up pesticides from the roses, motor oil from the driveway, or pet waste from the sidewalk. While wastewater treatment plants can remove many pollutants from runoff that enters the sewers, stormwater often overwhelms the system, allowing raw sewage

and untreated runoff to divert straight to the Bay.

Pollution endures; that is the final lesson. That fact that activities from a century and a half ago are still polluting our environment should sound a clear warning. The activities of today will have an equally lasting effect. Cleaner watersheds today will make a cleaner Bay tomorrow.



WANT TO KNOW MORE?

This publication by the Casco Bay Estuary Partnership is just a summary of the wealth of information contained in the full report, "Historic Sources of Pollution in Portland Harbor" by Edward L. Hawes, 1993. Copies of the report are filed with libraries at the University of Southern Maine, Bowdoin College, and University of New England, Westbrook Campus, and the Portland, South Portland, Westbrook Public Libraries.

The mission of the Casco Bay Estuary Partnership is to preserve the ecological integrity of Casco Bay and ensure the compatible human uses of the Bay's resources through public stewardship and effective management.

For more information about the Casco Bay Estuary Partnership, please visit us at: www.cascobayestuary.org or contact us at: (207) 780-4306.

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