COASTAL PROCESSES OF THE LOWER HUDSON RIVER

CONFERENCE PROCEEDINGS
MARCH 1984

Contents

Summary Proceedings

Coastal Processes of the Lower Hudson River Conference

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at the

Neighborhood Center, Peekskill, New York

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Communications concerning this publication should be referred to: NYS Sea Grant Extension Program, Lower Hudson River Office, 62 Old Middletown Road, New City, NY 10956, Attention: Stephen H. Lopez, Phone (914) 638-5500.

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Welcome Address
Honorable George Pataki
Mayor, City of Peekskill

We are very proud to have this meeting in Peekskill. Peekskill is what was always referred to as one of those old Hudson River towns. A hundred years ago that was a great thing. More recently, maybe just 10 years ago, that became a negative connotation. I believe that reflected the public's interest and perception of the Hudson River. I now think that Peekskill is going to be a new river town. We're going to be proud to be on the Hudson, we're going to be proud to be a river town, because the Hudson is going to be seen as a tremendous asset to all the communities that lie along its borders.

We have a unique opportunity right now because of the railroads' willingness to give up land, because of the unfortunate decline of industries, because of the willingness of large institutions along the Hudson to give up some of their properties, to develop the Hudson River in a way to benefit everyone.

Three things must be done to achieve this. First, and most important, is to provide public access to and use of the river. If you have a chance to look at the Riverfront Green in Peekskill you will see what public access means to a community. Second, we must make sure that development of industrial areas is compatible with recreational access to the river. Third, residential redevelopment will help give people more direct contact with the river, restore the tax base and population centers.

We must have tremendous cooperation between the private sector and the public sector to bring about better use and enjoyment of the river. We have a tremendous opportunity to turn the river front into an economic boom for the area for recreation and tourism. For too long the Hudson River has been the back door of the river towns. It has been where you take out your waste, the part you don't bring people to, the part you ignore. What we can do in the '80s, working together with the private and public sectors, is to make it once again the front door, for recreational purposes, for industrial purposes, for tourism and for improving the image and quality of life in the Hudson River Valley.

Welcome to the City of Peekskill. I hope you come back in the next couple of years and see the progress that occurs.

PROGRAM OVERVIEW

Designing with Nature in the Hudson River Valley

Stephen H. Lopez
Regional Extension Specialist,
Lower Hudson River Sea Grant Extension Program

On Sea Grant

The New York State Sea Grant Institute is a joint venture of Cornell University and the State University of New York. The New York State Sea Grant Extension Program is a component of Cornell University Cooperative Extension, and is a partnership with county Extension Associations in the Lower Hudson Valley. The Sea Grant Program has a research and education mandate. It is a national program funded in part by the U.S. Department of Ccmmerce.

History of the Hudson River

Henry Hudson discovered the Hudson River. It was first exploited for timber, animal pelts and other raw materials. Water borne commerce opened up the valley to settlements but a decline in river communities came with a shift of commerce from the Erie Canal system to rail and truck transport. Recent resurgence of interest in the Hudson River is largely due to natural aesthetic assets and efforts of regional environmentalists.

Looking to the Future: Needs

Waterfront revitalization relies on new businesses, new uses. These need to be identified as appropriate for specific areas. There is a need for comprehension of opportunities and constraints in harnessing natural resources to exploit without ruining e.g. how can developers enhance natural resources and accomplish profit objectives simultaneously.

Informational Resources of the Hudson River

At the local level EMCs, Planning Boards, Citizen Organizations, such as the Westchester County Federation of Conservationists, and others have much useful information. At the State level agencies such as the NYS Department of Environmental Conservation, and at the regional level groups such as Scenic Hudson, Hudson River Sloop Clearwater, Mid Hudson Pattern (Rockefeller Foundation Reports) Hudson River Environmental Society (proceedings) Hudson River Estuarine Sanctuary Program and the Heritage Task Force, are all good resources. At the Federal level agencies, such as the Army Corps of Engineers (dredge permit program), National Marine Fisheries Services, EPA, US Fish and Wildlife, and Soil Conservation Service are good sources. Academic sources include universities, and Cooperative Extension/Sea Grant. Private sources are usually consultants.

A diverse informational resource base implies three major issues:
1) Where to start looking
2) How to distill important issues
3) How to synthesize appropriate plans based on available information.

A regional computer based information system would likely be extremely helpful in developing and reviewing coastal improvement and conservation plans.

Program Overview

Topical areas to be presented at this conference in general reflect concerns of contacts made by Sea Grant in the Hudson Valley. The sediment load and transport session will explain the origins and nature of river sediment and will aid understanding its management. The marine construction session will address practical concerns of shoreline construction on the river, dredging and dredge spoil disposal in view of contaminant problems, and ice engineering considerations of importance in the Hudson River where ice floes and ice jacking can be a major problem. The natural systems session will cover the broad spectrum of environmental conservation issues, then the specific problems of aquatic weed control, and, finally, enhancement of the fisheries habitat. An evaluation will give an opportunity to evaluate the program and suggest future programs of interest.

A special note of thanks to the Mayor of Peekskill for making the conference facility available, to the individuals who volunteered their time and services to speak or help in other ways, and to the County Extension Associations of Dutchess, Orange, Putnam, Rockland, Ulster and Westchester counties for their support.

SEDIMENT LOAD TRANSPORT AND INFORMATION SYSTEMS

Summary by: Jeffrey Overton

Sediment transport in the Hudson River directly affects man by restricting navigation and transporting pollutants. The following overview of basic sediment tranport processes in the Hudson provides coastal decision makers an understanding of the natural processes which affect local and regional river uses.

General Setting of the Hudson River and Physical Characteristics

Henry Bokuniewicz,
Professor, Marine Sciences Research Center, SUNY/Stony Brook

The Hudson/Mohawk River watershed has a drainage basin of over 13,000 square miles, and spans over 300 miles from its source in the Adirondacks to the Battery in Manhattan on New York Harbor. The lower 105 miles of the river is considered to be tidally dominated, where the tides can be strong enough to reverse the flow of the river. Mean water height difference between Troy and the Battery is only three feet. It is the tidally-dominated section that is of interest in the following discussion.

The Hudson River crosses perpendicular to an area of low relief called the Appalachian Valley. The river changes from a shallow nearly braided stream as it crosses the valley to cutting a deep, narrow course through the Hudson/New Jersey Highlands. Below the Highlands the river widens and shallows becoming the Haverstraw Bay complex. Further south, the river curves and winds along the Palisades of New Jersey, eventually emptying into New York Harbor and the Atlantic Ocean.

Over 200 million years ago there was no Hudson River. Rivers in this region at that time probably drained parallel to the present coast. By the time of the Pleistocene Age, 5 million years ago, however, the north-south drainage of the Hudson River was well established. At that time, the Hudson River probably drained through the New Jersey Meadowlands. This drainage pattern has persisted over the last 5 million years, interrupted periodically by glaciations. Glaciation caused changes in valleys, filling some with stone and creating new valleys.

The most recent glaciation, the Wisconsin, ended approximately 20 thousand years ago. The ice at that time covered the highest mountains in Northeast North America, and was probably one-half of a mile thick over Long Island and New York City. So much water had been taken out of the ocean that sea level was depressed to the edge of the contential shelf, about 100 miles off the present-day shore line.

It was about eight thousand years ago that the Hudson River began to take its present form. At that time salt water penetrated the river beyond Manhattan. Ocean water reached a maximum northward edge around the Peekskill to Poughkeepsie areas nearly six thousand years ago.

Since that time it appears that salt water has been pushed gradually out to sea. This may be due to climate changes causing sea level to slowly rise, or accumulation of sediments that change the flow patterns.

The estuary appears to be dynamic rather than static. The action of sediment deposition and resulting flow pattern changes has implications for dredging and pollution problems. The Hudson estuary is a trap for a great amount of silt and clay from the ocean. Sediment characteristics in the river have been shown to correlate with the intrusion of ocean waters. In north sections upriver of Peekskill, sediments consist of mostly coarse grain material such as sand. further south in the more saline waters of Haverstraw Bay and the Palisades, sediments are mostly mud. This indicates that fine grain material is being deposited through an esturaine deposition process. In the New York Harbor section muddy sediments are less prevalent due to tides and wave action.

Estuarine deposition of fine grain materials occurs as a result of both the river flow and tidal flow. Annual river discharge averages at 550 m3/sec but is usually less than 250 m3/sec. In springtime discharges in excess of 2,000 m3/sec are possible. Tidal discharge can be up to twenty times the freshwater discharge. This creates a special circulation which is superimposed on the tides. This estuarine circulation is density driven, with less dense freshwater passing seaward above the more dense saline waters travelling upriver along the bottom. This recirculation plays an important role in creating a sediment trap of the estuary.

Sources of Fine Grain Sediment to the Lower Hudson River

John Ellsworth,
Research Assistant, MSRC

Fine grain sediments only are considered in this section since they are 1) sites for accumulation of pollutants, 2) more active than sand and gravel in filling navigation channels, and 3) detrimental to organisms due to high suspended sediment loads. Several easily recognized potential sources of fine grain sediment include the Appalachian Valley drainage basin, glacial lake deposits in the drainage basin, and river shoreline materials.

Over 20% of, fine grain sediments introduced to the Connecticut River and Chesapeake Bay are from unconsolidated stream bank deposits. Along the lower Hudson River, however, much of the shoreline is stabilized with man-made erosion control, structures (i.e. dikes, bulkheads) railroad track beds, or natural rock shoreline. Over 50% of the eastern shore is stabilized, 213 represented by railroad rip-rap stone. This restricts shore sediment input to the system.

Other sediment inputs have been investigated. Data is lacking for some of these determinations, and in certain cases studies from other Hudson River projects, or research on similar water bodies (i.e. Connecticut River, Chesapeake Bay, Long Island Sound) has been applied.

From calculations in Ellsworth (1982), annual input of fine grain sediments include shoreline erosion (6000 metric tons per year), stream runoff (870,000 MTY) atmospheric particles (4000 MTY), municipal wastes, (52,000 MTY), biological production (135,000 MTY), and ocean sediment inputs (unknown). Of these inputs, biological production and stream runoff were the major known sources. To determine the sediment input from the sea, an indirect mass balance calculation was performed. A mass balance of inorganic material input was calculated by subtracting the sediment removal factors (wetlands, dredging and deposition) from the sediment inputs, including the unknown sea input. The resulting total should equal zero. Sea input calculated through mass balance was 139,000 to 734,000 MTY, which represents a tremendous input of sediment.

In conclusion, important sources of fine grain sediments include riverine or fluvial sediments, and oceanic suspended sediments carried up river. The amount of sediments produced by biological processes is still uncertain, but appears to be important. The atmosphere and shoreline are insignificant sources of fine grain sediments, as are industrial and municipal sources. These are two sources which are controllable by man, but were shown to have little impact. Dredging of materials from the river on an annual basis - 676,000 MTY - is more than is coming into the river from the sea.

Basic Processes Affecting Suspended Sediment Load in the River

Chester Lee Arnold,
Research Assistant, MSRC

Transport of materials downstream is a complex, discontinous process. For practical reasons suspended sediment transport is important since pollutants such as PCB's, radionuclides, and heavy metals rapidly adhere to fine particles. A large percentage of sediments: around the New York Harbor area are marine muds. There are three major controlling factors influencing sediment transport in the Hudson: 1) seasonal runoff of freshwater, which is highest in the spring: 2) tidal flows, which respond to a lunar cycle and: 3) biological effects, which are also seasonal. Each are considered briefly below.

Fresh mineral grains enter the estuary during the high flow periods of spring. Due to the density-drive circulation peculiar to estuaries, a natural sediment trap is formed at the freshwater/saltwater interface. Particles falling out of the freshwater layer are carried back upstream and kept in suspension by the saltwater layer. A "turbidity maximum" occurs at the upstream salt limit where high zones of suspended sediment are developed. Along the salt edge is where the zone of sediment deposition occurs. In times of high river flow, this zone is near the Yonkers section of the river. In dry periods, low river flow allows the deposition zone to occur further upriver near Poughkeepsie. Storm effects are point events with unpredictable effects on the river flow, yet seasonal events are somewhat predictable.

Tidal flows are not seasonal, but respond to lunar cycles. The main effect of tidal flows is the resuspension of sediments deposited on the river bottom, rather than an introduction of new sediments. The reversing flows of the tidally-dominated section of the river resuspend sediment into the water column. Tidal influence is strong in the Hudson River. At Albany, river flow is almost equal to tidal flow, yet at the Battery, tidal flow is nearly 20 times the river flow. Due to the tidal domination downriver, seasonal changes in suspended sediment levels due to river flow cycles are much more pronounced upriver than in lower reaches, such as at the Tappan Zee Bridge.

Biological effects on suspended sediments are seasonal due to production and biological cycling of sediment. Fecal pellets and agglomerated particles are produced by planktonic filter feeders. Particle size greatly affects the settling rate of particles, and therefore the residence time in the water column. Particles are transported to eventually settle away from their point of production. Water cycling by filter feeding planktonic organisms can be significant. For example, just one species, the copepod Acartia tonsa, can reach peak densities of 100,000 per litre in the summer near the Tappan Zee Bridge. Multiplying this density by the filtering rate of these animals shows that they are capable of recycling the entire water column in just 10 days. There are many other planktonic filter feeders recycling the water column of the Hudson River.

The settling rate of particles is proportional to, the density of the particle times the particle diameter squared (Stokes Law). Fecal pellets are large particles, and can settle in less than 12 hours. Fine grain minerals introduced from river runoff can remain in suspension for over 100 days, if not processed biologically on their passage down river. Since the residence time of water in the Hudson is from five to ten days (seven days average), these particles can be carried out to sea. The natural particle assemblages found in the water are agglomerates of organic and inorganic particles. Agglomerates have a high surface area and low density, but will settle in approximately three days. These particles can therefore be deposited almost anywhere in the river, necessitating dredging and other problems associated with sedimentation.

Personal Computer Information System

Tom Gulbranson,
Research Assistant, MSRC

Management of the coastal zone requires use of information specific to the land/water interface and nearshore areas. At Marine Sciences Research Center, Dr. Peter Weyl and his associates have developed a system for managers which simplifies tasks of storage, access, and interaction with coastal zone information. With assistance of a personal computer and standard database software, the coastal decisionmakers can utilize this system.

Information relative to specific points along a coast are filed by Linear coordinates. Lists of information are filed for each coordinate on the coast. Data are manipulated through a pre-programmed series of information extraction routines to provide a desired characteristic or measurement such as land use close to shore.

A range of points can be considered in this system, such as land use close to shore overs land use close to shore.

A range of points can be considered in this system, such as land use close to shore over a 1/2 mile length of shoreline. A practical application of land use information would be in facilitating the permitting of an Army Corps of Engineers project for shoreline construction. The scale of application of the system is virtually unlimited, ranging from small island perimeters to multi-national coastlines in recent system applications.

More sophisticated interactions can be achieved with this system, but the value to the system user is simplified access to coastal information. The use of the system in recent Federally-funded research projects and the growing interest in it shown by several coastal state resource management programs indicates an exciting future for this tool.

MARINE CONSTRUCTION

Summary by: Jay Tanski

Selecting the Optimum Marine Structure

Peter Sanko,
Principal, Peter Sanko Associates

The optimum coastal structure is one which will perform the intended function or functions at the least cost with the minimum adverse environmental impact. When selecting a coastal structure, these three factors - function, cost, and environmental impact should be carefully considered in the planning stages of the project.

Function

Although it may seem obvious, one of the first considerations should be, does the intended structure really have a function? Most structures do have a well defined function. However, there are cases where structures have been built even though there is no good reason to have them in a certain area. This most frequently occurs in the area of shore protection or erosion control where those responsible are not familiar with the nature of the physical processes acting in the area. This is common, for instance in areas with a well defined Summer-winter beach cycle.

Once the need and primary functions of a structure are established, the planner should consider how the use of the structure can be maximized. Many structures can be designed to perform more than one function. A dock can provide berthing space for boats as well as provide ice and wave protection if properly planned. Certain shoreline stabilization structures can be used to protect the shore from wave action, retain fill for extending or raising land to a desired elevation, and dock vessels. When looking at a structure, the planner should be thinking about other ways the structure can be used to save money.

Cost

Cost is usually the bottom line in coastal construction. Marine structures are very expensive given their relatively short life span of 30-50 years. In terms of erosion control, it is important to determine whether the land to be protected is worth the cost of the structure. Quite often sacrifices in terms of functions,convenience, environmental impact, or life span will have to be made for economic reasons. Planners should always think about the two different kinds of costs involved in coastal structures - the initial cost and the cost over the projected lifetime of the structure.

Most homeowners and individuals are concerned primarily about the initial investment or how much it will cost to install the structure. While individuals may be justified in considering only initial costs in many cases, low initial cost may not be the most important factor especially in the larger, more expensive projects usually undertaken by businesses and governments who are looking towards the future.

Structures with very low initial coats can lead to major problems. For instance barges, which can be obtained very cheaply, are often lined up, filled with soil and then sunk to act as breakwaters. They work fine until they deteriorate and have to be replaced. The amount of money needed just to remove the old barges in order to put in a new structure could make the entire project econanically unfeasible.

Maintenance is also a big factor in determining the projected cost of a structure. As a general rule, the lower the initial cost of a structure the higher the required maintenance. In many cases, a structure that is more expensive to install might be cheaper in the long run due to decreased maintenance requirements. Planners should consider the cost of the structure over the projected life span in terms of cost per unit area per year. The cost per unit area per year also becomes a factor when considering the life span of a structure. A structure designed to last fifty years may cost three times as much as the same structure built to last only ten years. However, the cost per year for the fifty-year structure would be considerably cheaper than for the ten-year structure.

Fnvironmentsl Impacts

Finally, the effect a structure may have on the environment must also be considered. While you may be able to design an optimum structure in terms of function and cost, its use may be precluded due to possible adverse environmental impacts. For instance, a solid-fill dock with steel sheeting may be the most durable structure for an area affected by ice. However, the dock's effect on currents, sediment transport, or biological activity may make it environmentally unacceptable. In such a case an open-work dock may have to be used, even though maintenance costs would be higher due to ice damage, to minimize the physical and biological impacts. These environmental considerations are usually addressed by the local, state, and federal environmental agencies responsible for issuing the permits for coastal construction.

Dredging and Dredge Material Disposal

John Tavolaro,
Geologist, U.S. Army Corps of Engineers, New York District

Dredqing and Disposal Methods

Basically, there are two ways of dredging - mechanical dredqinq and hydraulic dredging. In the Hudson estuary region, mechanical dredging is probably the most common method. Generally a clamshell dredqe is used. A clamshell is essentially a derrick mounted on a barge which has control over a large bucket. The bucket picks up material from the bottom and deposits it on the barge. Since quite a bit of water is taken up in the bucket, the dredge operator allows water to overflow until he feels the barge is predominantly filled with the dredged material. At this point the barge is removed, another is brouqht alongside and the process continues. While there are other means of mechanical dredging such as backhoe or bucket-ladder, the clamshell is the most common form in the harbor.

In hydraulic dredging, a rotary drilling head digs into the bottom. Hydraulic pumps bring up the water sediment and discharge it out the back of the dredge to a pipeline or barge. Hopper dredges are also used for hydraulic dredging. However, due to their large size and cost (tens of thousands of dollars a day), they are not often used in the upper regions of the Hudson.

There are essentially two ways you can dispose of dredged material at this time. The material can either be placed on dry land (upland disposal) or in the waterways. Costs for the different disposal methods are hiqhly variable depending on the specific project but some generalizations can be made. The use of hopper dredges for ocean disposal can usually be ruled out in the Hudson Valley because of the expense. Hydraulic dredqinq, including preparation of an upland disposal site, is comparable to clamshell dredging in terms of price. However, since there are no authorized river disposal areas in the Hudson River at this time, material mechanically dredged would have to be pumped to an upland site rather than bottom dumped from the barge. This pumping could double the cost for clamshell dredging. For this reason, hydraulic dredging with nearby upland disposal is probably the cheapest method available for the Hudson Valley reqion.

Regulations

Local, state and federal permits are needed for any kind of dredging and/or disposal operations. On the state level, the Department of Environmental Conservation and the Coastal Management Program under the Coastal Management Consistency Review are responsible for authorizations while on the federal level the Corps of Engineers (COE) handles dredging and disposal permits.

For the dredqing itself, the COE requires a Section 10 permit and a Section 404 authorization if there is any overflow into the water. If there is no overflow, the Section 404 permit is not required. The state requires Article 15 permit for any kind of work done in the waterways and a 401 water quality certification if overflow occurs.

The major thrust of government regulation is aimed at the disposal methods rather than the dredging itself. For waterway disposal, the Corps requires a Section 404 permit from the COE. On the state level, a 401 water quality certification is needed. If the state determines the disposal is going to affect wetlands, an Article 24 permit for freshwater wetlands or an Article 25 permit for tidal wetlands may also be needed.

For upland disposal, the COE only has jurisdiction on overflow coming from the disposal area and entering into U.S. waters. Once again, a Section 404 permit must be issued for this type of overflow. New York State requires an Article 27 permit for upland disposal sites and 401 water quality certification for overflow.

In addition to the permits, the local, state or federal government may require an environmental impact statement (EIS) for any project. The COE will review any permit action under the NEPA (National Environmental Policy Act) to determine if an EIS is necessary. The state equivalent is known as SEQRA (State Environmental Quality Review Act). Because the Hudson River is considered a coastal zone, dredging and disposal projects are also subject to Coastal Management Consistency Review which can be required by the state and by local governments if the local government has an authorized coastal management policy.

For any project, there is a wide range of testing that may have to be done to receive a permit. Usually testing is required for the disposal of material rather than the dredging. The type of testing that is required depends on many factors. It is important to contact the COE or the state to determine what tests are needed. In qeneral, the three types of testinq that could be required are physical, chemical, and biological. Costs can range from $30-$50 for physical testing (grain size) to approximately $10,000 for biological testing (bioassay and bioaccumulation) for one sample. Because of the potentially high cost, the state and the COE should be contacted to determine testing requirements during the application procedure.

Dredge Material Disposal Management Plan

Presently the COE in conjunction with a number of state and federal agencies and a public involvement group is active in investiqating a variety of new disposal options for the New York Harbor. The public involvement group is composed of people from all walks of life, including local government, business, academia and environmental groups, and has direct input into the technical studies undertaken by the Corps. Anyone wishing to join the group should contact the Corps of Enqineers, New York District.

Under the Dredqed Material Disposal Manaqement plan, the COE is studying a number of different disposal options. These options include ocean disposal, subaqueous borrow pits, containment islands, upland sites, wetlands enhancement, and beach nourishment. To keep people informed of the status of the studies on these alternatives and of the management plan in general, there is an informational newsletter which can be obtained from the COE.

Ice Engineering

Guenther Frankenstein,
Chief of Ice Engineering,
U.S. Cold Regions Research, Engineering Laboratory

The ice engineering laboratory of the U.S. Cold Regions Research Engineering Laboratory (CRREL) was dedicated in 1979 to help people in the northern states solve problems associated with ice. The facility is equipped to do research on river modeling, sediment transport under an ice cover, ice dynamics and ice control mechanisms for navigation structures. Most of this work is done under contract.

Ice Formation

Most of the ice causing problems on the Hudson River is frazil ice. Frazil ice is composed of fine crystals that are formed when super-cooled surface water is mixed by turbulence. Water is forced down where it is nucleated and crystals form. These crystals grow and return to the surface areas of low water velocity producing an ice cover that can be tens of feet thick under the right conditions. This cover not only causes naviqation problems, but can also cause damage to structures due to the vertical and horizontal forces associated with the movement of the ice.

Uplifting Forces

Because frazil ice will adhere strongly to submerged portions of a coastal structure, water level changes during periods of ice cover can cause severe problems. This is especially true of pilings. Ice formed at a low water level will exert an upward pressure on a pile as water level increases due to a rising tide. If the pile is driven deep enough, the forces holding the pile in the ground will be stronger than the uplifting forces exerted by the ice adhering to the pile. In this case, the ice will break and the pile will remain in place. However, in instances where the pile is not down far enough, the ice can actually lift the pile as the water rises. Material slumps into the void beneath the pile preventing it from returning to its original position as water level falls. Over several tidal cycles, the pile can be completely lifted out of the bottom. This phenomena is known as ice jacking and can occur on steel, wood, or concrete piles.

There are several methods available to help alleviate ice jacking in marine structures. Tests have shown that if the fluctuation in water level is known, a polyethylene sleeve or boot wrapped around the pile will allow the ice to slide up and down without disturbing the pile. Coatings, if applied correctly to new structures, can also work well. However, their effectiveness can be diminished with time. Since warmer water is usually found near the bottom, bubbler systems can be used to bring this water up to the surface and prevent ice forming around piles. To be cost effective, it is important to design the bubbler system to provide just enough discharge to protect the structure rather than melting the ice in the entire area.

Horizontal Forces

Moving ice can impart tremendous horizontal forces to marine structures. When designing a structure, the engineer should consider not only the magnitude of these forces but also where the ice is likely to hit the structure. For this reason, it is important to check historical records to determine where the maximum flood water level has been. Experiments have shown rubber tire breakwaters can be very helpful in protecting some individual dock structures. The breakwater can be placed around the structure to reduce ice thickness. The thinner ice in the vicinity of the breakwater breaks first reducing the total amount of horizontal pressure applied to the structure. Another inexpensive means of protecting a dock from horizontal movement is to install an isolated pile or piles upstream of the structure. These piles act as a trap allowing ice to move around offshore of the structure while the ice adjacent to the structure is anchored to the pilings and the shoreline.

NATURAL SYSTEMS
Summary by: Robert Geneslaw

Environmental Conservation Perspectives
Ralph Manna,
Regional Supervisor for Regulatory Affairs, Region 3, NYSDEC

DEC really doesn't have comprehensive planning. DEC does, however, have an overlapping network of regulatory programs that I believe begins to put together a piecemeal approach to a Hudson River policy or a Hudson River management plan. Many things are regulated activities under the environmental conservation law.

Very briefly, stream protection allows DEC to regulate excavation and fill in the navigable waters. DEC has stream disturbance permits on many of the tributary streams of the Hudson River to avoid the problem of sediment loads going into the river. DEC regulates dams and docks in certain situations where they are associated with fills, or floodplain disturbances.

Tidal wet lands are something that affects this region below the Tappan Zee Bridge. In the case of tidal wetlands there are a number of factors to be considered, there are benefits of the law that have to be identified, and used in making decisions on permits. There are setbacks and standards that have to be applied for the purpose of protecting the benefits of the river and its system.

Fresh water wetlands are very important. In addition to sediment removal, they serve as biological purifiers, as a nursery, sometimes as spawning areas. They are very critical habitats and DEC tries to protect them accordingly.

The state pollution discharge elimination system is a federally delegated program, for waste water discharges. People that discharge to any of the surface waters of the state need discharge permits. NYS has gone beyond the minimum mandate and has added certain discharges to ground waters as well because water quality is so fundamental to human health.

Coastal erosion and floodplain regulations tend to be more construction oriented. We say people shouldn't build in certain areas because we recognize certain areas are subject to damage by natural processes. The coastal erosion and floodplain programs are intended to prevent building in the areas where the elements are too severe.

In addition, the department regulates all sorts of additional fish and Wildlife type controls, and has regulatory programs and licensing designed to keep the Hudson River healthy. We try to make sure that we don't wipe out species and try to bring back those that have not been doing well. A good example of that is the striped bass fishery. It seems to be doing pretty well in NY and through public input and our own professional efforts we may even allow commercial fishing again.

As a regulatory agency DEC and many local agencies, must deal with the State Environmental Quality Review Act. If the other programs don't get at some of the more difficult problems and don't get at some of the things that fall between the cracks, SEQR is the environmental impact statement process **that allows DEC to look more carefully at an issue. In some cases SEQR can be used to identify and regulate, or protect, or take into account the importance of an action and a resource in a way that the individual agency just wouldn't.**

Similarly with our historic Hudson Valley, the State Historic Preservation Act required state agency compliance. DEC takes direction from the Office of Parks, Recreation and Historical Preservation and increasing interest is being shown in that area.

Not last or least, is the new Local Waterfront Revitalization Proqram, that affects local planning, administered by the Department of State.

These programs are designed to protect those benefits that we identified in the river. These programs recognize and consider and take advantage wherever possible of the natural processes of the Hudson River and I think in the long run that to Design with Nature is the most consistent and effective and beneficial design.

To wrap up, we must protect and enhance the water quality, and the aquatic habitat, and the other elements. Regulatory programs adequately managed will be positive and my biggest concern here today is to ask you to be sure that you are aware of where and what you have going for you as river resources. Make sure that you are committed to follow through, and participate in the department's process, participate in the town process, the county processes. I think if we understand the regulatory structure, understand the issues and do our homework on them, we will make better decisions.

Aquatic Weeds and their Control

Mike Duttweiler,
Program Coordinator, NYS Sea Grant Extension Program

Topics covered will include: the roles of aquatic plants, things that cause plants to bs there in the first place, and management practices. The optimum plant management strategy would be that which is most effective, least expensive, and least environmentally damaging. Plants don't equal. weeds, with the possible exception of introduced exotics, which would include the water chestnut in the Hudson River. Plants are parts of the natural system and they make several important contributions. For example, in the area of biological impacts they provide feed for water fowl, and breeding areas for fish.Aquatic plants also generate important physical and chemical effects as well. They increase deposition, which can be positive or negative, depending on where the plants are. They shade the water **providing temperature differences which can be very important during the summer months for younger fish or other organisms.**

What's a problem situation? Plants are a problem (become weeds) when they interfere with some intended use of a body of water. It's important first to step back to a model that you have at home, either your garden, your house plants, or your lawn, and to ask what makes plants qrow in the first place. Aquatic plants like any other kind of plants, need certain things in order to appear in a body of water. They need an appropriate amount of light otherwise they can't photosynthesize, which is the way they get energy from the natural environment. They can't grow without liqht and that's basically why plants grow in shallow water. Light can't penetrate deep water sufficiently to allow the plants to grow. They also need nutrients. If there is a way of influencing the nutrients you will influence the plant qrowth. They need appropriate bottom materials. There has to be something for rooted plants to attach to or they are not going to be there, together with factors such as current, waves, turbulence, etc. These considerations explain why plants appear in some places.

Short term management approaches sort out into three sub-categories, physical approaches, biological approaches and chemical aporoaches. The physical approaches include such things as cutting and harvesting, shading and dredging. Cutting and harvesting are mentioned together because if all you are doing with problem plants is cutting them you likely are seeding the plant bed. Many problem plants regenerate vegetatively so if you cut one plant in five pieces, you don't have one dead plant cut in five pieces, you have five new plants that can go somewhere else and qrow. Harvesting requires that plants be removed after cutting.

The simplest version of shading is constructing a raft and coverinq it up with some opaque material, typically black polyethylene. In small scale situations--say you have one dock you are trying to keep access to--all it amounts to is anchoring this raft over the area you would like to use, hopefully for a couple of weeks at a time. What you are doinq is cuttinq off the light from the plants which will knock down the growth significantly.

Another physical approach--matting--gets at both the availability of light as well as the fact that plants need something appropriate to anchor to. It amounts to putting down a new bottom underneath the plants. Slack polyethylene, anchored on the bottom with sand or gravel works. Puncture some holes in the polyethylene, otherwise you are going to have methane and other gasses building up and the next thing you know you will have the Loch Ness monster going down the Hudson River. A woven material that allows gasses to get through but is small enough that plants have trouble rootinq in it can be used. Poly-vinyl is better than polyethylene matting--polyethylene floats, poly-vinyl sinks.

The last major category is chemical control, primarily herbicides. They can be very effective. They can have the advantage of not being labor intensive. They have some distinct disadvantages though--here your Hudson River current comes into play. They require permits for application in a public water supply with a requirement that you be able to control the effluent of the treated area. You would have to be able to control where that chemical goes once you apply it so that is doesn't influence downstream interests. That effectively rules out legal private applications in the Hudson River.

In establishing a plant management program, one of the first steps is knowing the intended use of the body of water. If you are trying to encourage fishing you are looking for a different mix of plants than if you are to use the area for swimming. The next thing you want to know is which of the many different aquatic plants you are dealing with. A brief literature review revealed more than 40 common aquatic plants in the Hudson River.

There are several different forms of plants. Those that live totally under the water are generally called sub-mergents. They may flower above the water. There are also plants that are rooted underwater with a siqnificant portion of their vegetation above water. There are floating plants, like duckweed which are not rooted, or plants that are rooted and have a significant portion of their vegetation at the surface. There also are emergents, plants that are in shallow areas growing predominantly above water, the cattails, the rushes, etc. Each of these different forms of plants need very different management approaches, different physical approaches, different chemical approaches.

When you think about plant management you have to go back to the basics--the depth of the water, the light penetration, the bottom material, what do they say about selecting an appropriate management technique. Something else that you have to factor into a management strategy is seasonality.

You have to think of plants as a part of a natural process, think about what contributions they make, think about intended uses for the body of water and why they are there in the first place. Then you are in a position to start considering an appropriate management strategy.

Fisheries Impacts

Wayne Elliot
Regional Fisheries Manager, Region 3, NYSDEC

In putting together my part of the program, I decided to be very focussed as to fisheries impacts, as they are related to Section 150505, which is part of the stream protection law. Specifically, 150505 talks about excavation or fill in navigable water such as the Hudson River.The Law is rather specific: you must have a permit for dredge or fill operations in navigable water and the essence of the concept is that before granting a permit the NYSDEC must ascertain,"the probable effect on the use of such waters for navigation, health, safety and welfare of the people of the state and the effect on the natural resources of the state, including soils, forests, water, and fish resources."

We are dealing with two fairly simple-minded concepts: filling and dredging. To the aquatic biologist filling is more significant. If you have been involved with SEQR or NEPA you know that you have to look at lonq term irretrievable impacts. Filling in water and making it land is a long term irretrievable impact--the water is permanently removed from the habitat. We view filling quite skeptically, first on the philosophical basis that we are losing water, and also from a historical perspective. In the Hudson River, as most of you know, there has been an enormous amount of filling and bulkheading, primarily back in the pre-permit era and particularly further up the river. The end result is that there are hundreds, of acres of formerly productive shallows that are now permanently filled and bulkheaded, What is left is, therefore, of greater consequence. From a biological perspective most of the fill takes place in perhaps the most important area of the river, the so-called littoral zone--the shallow area within the depth of light penetration. This littoral zone is exceptionally important in regard to food production and many species of fish require this type of area for spawning and nursery areas. The fillinq proposals that we most typically review are therefore proposals to fill in the most important part of the river.

The Article 15 Law requires that DEC assess whether proposed proiects are "reasonable and necessary," and in the public interest. Therefore, the objectives of a proposal have some bearinq on the review process. For example, we are less critical of projects that are designed for in-place bank stabilization. If you own some property along the river and the river is takinq it away, then it's probably not appropriate for our review process to prohibit you from stabilizinq that bank even though that process may involve some fill within our precious littoral zone. We also have a slightly more benevolent outlook on fills that may be associated with public access to the river--that's relatively easy logic too. Our particular business is involved with fishing in the river; it's somethinq we are concerned with and try to foster. You can't fish it unless you can get on it. If somebody proposes a fill that is essentially a boat launch ramp, although it is fill from the habitat destruction viewpoint we can have a more liberal perspective if that boat ramp is in the public interest.

On the other end of the spectrum are projects that may not be reasonable, necessary, or in the public interest that we are a lot less favorably inclined toward. For example, proposals that are merely qoinq to result in additional property for the landowner do not appear to meet the intent of the law.

There are alternatives to fill, but not many: floating docks, or driven piers are options to putting in a permanent solid substance into the water. At least then you have something where there is water underneath the surface. If we do object to a proposal, we try to identify alternatives so the applicant can qet what they want with less environmental cost. Violations of Article 15 are strictly enforced. There have been several cases in which an un-permitted fill has been removed. There is a fair amount of public participation and involvement with dredqe and fill proposals in the river. When we as an agency accept a fill application and issue a permit, there are a lot of people very interested in our rationale for approvinq that request. I think that's how the process is designed to work, they are sort of overseeing the way we implement this particular leqislation, so there are pressures from both sides.

The other cart of this 150505 is dredging: that's generally less of a problem for us biologists. It's more of a short term reversible thinq, and our attitude is less toward total prohibition and more toward qettinq the intended results accomplished under the best possible circumstances. There are some evident biological impacts of dredging. The most serious is turbidity --stirring up a lot of mud from the project. This may cause direct mortality to orqanisms. It has been proven in the laboratory and the field that if you have muddy enough water things are going to die and particularly things that live on the bottom. In a dredging project there is direct removal of organisms from the water that are thrown on the land, and that is one of the bioloqical impacts. One that may not be so evident is that if you dredge what was shallow and make it deep, you may remove it from the littoral zone: you then have an area that may not be as productive as before.

Another possible biological problem is with reference to disturbance and re-suspension of toxic substances. We evaluate these biological concerns in the article 15 process. If you have a dredging operation, then the spoil or disposal material has to find a home. We look critically at how and where this is done. Also, where are the turbidity patterns if you dredge? How frequently will you have to dredge to maintain your desired elevation? Is it going to be an annual event?

After reviewinq the request our mitiqation proposals logically come from our concerns. The primary thing that we utilize is timing. If you accept that high turbidity levels are lethal or detrimental to orqanisms; if you accept that the organisms' life stage might be impacted--the egg and larval staqes, and that small relatively non-mobile creatures are goinq to be in the work zone, you try and set the timing so that the egg and larval stages aren't around in that part of the river when the dredging takes place. That's a perhaps easy generality that gets complicated when you realize there are some hundred thirty species of fish, just talking about fish alone, in the river. It is difficult to decide which to select as our major organism when we try to establish these windows when dredging can take place. Species that have been used are short nose sturgeon, because of its rare and endangered status, striped bass, shad and herring because of their important sport and commercial aspects, and the tomcod simply because it is biologically susceptible to winter dredqinq. They are the weird type fish that come up to spawn in the winter. In that very cold water, the eggs are laid on the bottom and take weeks to develop. If you have a dredging project in January or February in an area where tomcod are spawninq they are just laying there begqing to be sucked up. In certain instances we have a closed window for dredging during that January, February period to try to protect these fish. So timing is the biqqest form of mitigation and it is site specific and we spend a lot of time to figure what it is. Usually dredging projects are relatively short. If they get out and get on with it there is only going to be a finite number of weeks that project is ongoing and what we try is to have it start and end to accommodate our biological windows. If the time of the dredqinq project goes longer, then we have to negotiate. But often if someone is just lookinq for four weeks to go out and do a dredging project we can tailor the four weeks so it's less of an environmental disturbance.

We also review the methods. There are clam shells versus suction dredging and they each have advantaqes in particular situations. In a dredge situation, a suction dredge, we review the size and configuration of the settling basin. We sometimes utilize turbidity curtains. That is a floating structure, a canvas or other curtain that hangs down the side to contain the work area. That contains the highest water turbidity within a finite area.

In a condensed presentation this is how we as biologists and the agency, I believe, reviews dredging and filling, tailored specifically to the Hudson River.

ATTENDEES

William J. D. Boyd, Planning Board Chairman, Town of Highlands
Benjamin B. Brooks, Commodore, Highlands Yacht Club
Leonard Cacciatore, Engineer, Yonkers Yacht Club
John L. Clark, Senior Park Engineer, Palisades Interstate Park Commission
Sheldon Cole, Town Engineer, Town of Cortlandt
Wayne Corts, Owner, Willow Cove Marina; Stony Point
Edward Gaudy, Gaudy-Hadley Associates, South Nyack
Robert Geneslaw, Vice-President, Raymond, Parish, Pine & Weiner, Inc., Tarrytown
John W. Goff, Club Representative, Cornwall Yacht Club
Jim Hahn, Village Engineer, Village of Buchanan
Cheryl Harding, Mayor, Village of Buchanan
Kevin B. Keenan, Environmental Planner, Putnam County Planning Department
Jack Krasko, Dredge Chairman, Yonkers Yacht Club, Yonkers
Georqe Kohler, President, Parrott Dockbuilders, Inc., Newburgh
Natalie Mackintosh, Assistant to Village Manager, Village of Ossining
Cathy McDonald, Reporter, Evening Star, Peekskill
James Morton, Coastal Resources Specialist, NYS Dept. of State, Albany
Lorraine Moscow, Mayor, Grandview-on-Hudson
John W. Muenzinger, Director, Natural Resources Planning, Westchester County
Barbara Murphy, Village Trustee, Cold Spring
Deborah Parriott, Senior Associate, Raymond, Parish, Pine & Weiner, Inc.,
Charles E. Pound, President, Aqua Dredge, Inc., Armonk
Robert J. Pound, Vice-President, Hudson Highlands Cruises
Carleton B. Quinby, Village Engineer, Village of Fishkill
Tina Rickett, Recreation Supervisor, Village of Buchanan
Anita Rodino, Administrative Asst., PROCO, Cold Spring
Kay Santiago, Advisory Board, Coastal management Program, Nyack
Robert O. Snyder, Recreation Director, Town of Ossining
Michael T. Sobczak, Ecologist/Biologist, Tippetts-Abbett-McCarthy-Stratton, NYC
Carol Sondheimer, Environmental Director, Scenic Hudson, Inc., Poughkeepsie
Aram Terchunian, Coastal Processes Specialist, NYS Dept. of State, Albany
Robert Torgersen, Landscape Architect, Nanuet
John Williams, Executive Director, Beacon Community Development Agency
Jean Wort, Vice-President, Hudson Highlands Cruises