January 13, 2013

To the attention of Michael Abell
Environmental Analyst
Wetlands and Waterways Program
Northeast Regional Office
205B Lowell Street, Wilmington MA 01887
978 694 3200

RE: WETLANDS/Gloucester
DEP FILE #028-2211
41-46 Commercial Street
Dr Godfrey’s Report

Dear Dr. Abell,
Attached, please find my initial findings regarding the property in question. The attached is a result of many days of on-site measurements and observations. I have come to realize this area as being of vital importance both ecologically and for the protection of the City of Gloucester. Attached, please find a partial list of publications which I have provided for your records. Additional references through 2010 are available upon request.

Cordially,

Dr. Paul J. Godfrey, Professor Emeritus, Biology Department, University of Massachusetts, Amherst (54 Montague Road, Wendell, MA 01379)

cc Mortillaro, c/o Michael Faherty, Esq, law offices of Michael Faherty, 111 Main St.
Gloucester, MA 01930
Gloucester Conservation Commission, 3 Pond Road; Gloucester, MA 01930
Attn: Todd Morey; Beals Associates, Inc.; 2 Thirteenth Street; Charlestown, MA 02129
Port Community Alliance c/o Janny Madeya, Esq. Buchanan & Associates, 33 Mount Vernon Street, Boston, MA 02108
A Survey of Ecological Conditions at Pavilion Beach,
Gloucester, MA

Dr. Paul J. Godfrey
Biology Department
University of Massachusetts
Amherst, MA 01003
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Summary
During two visits to Pavilion Beach, Gloucester, MA, on January 2-5 and January 11-13, I ran elevational transects between the upper edges of the beach and the edge of the sea. In both cases, drift lines (deposits of seaweed left by the tides) were recorded up the beach and extending as far as 44ft into the parking lot. Additionally, the landward limits of each transect were joined by a series of test holes in order to learn composition and water level. All measurements were initiated during low tide to provide maximum information.

Data obtained showed that the narrowest section of the beach is in front of the Birdseye building. Furthermore, the lowest part of the upper limit of the beach is also in front of the Birdseye building. These facts, in themselves, indicate that wave action bounces off the building and erodes beach sand. It is important to note that while maps and areal photographs demonstrate that the beach outline would appear to remain the same, the transects are conclusive proof of the erosion caused by the Birdseye Building. Further comparison with historic photographs and measurements made during the many hours of survey work provided irrefutable proof of the loss of beach. More significantly than a brief study, these observations are in harmony with my work in New Jersey, Cape Cod and North Carolina’s Outer Banks as well as theory and observations based on classic beach dynamics. These, well documented, effects and the environmental risks of seawalls, and longshore transport are discussed below.

Finally, survey work in front of the Birdseye building, done during a low tide January 13, 2013, revealed an extensive bed of eelgrass which, in contrast to the description in the resource area delineation, showed the eelgrass to be actually out of the water at or near low tide. The significance of this is discussed.

In conclusion, the data obtained indicate that Pavilion Beach from Fort Square to The Cut on Western Avenue, because the existing Birdseye Building is functioning as a seawall, is undergoing accelerated erosion. This in turn is causing, not only the loss of beach, but is, in part, responsible for the undercutting of the seawall along Stacey Blvd. and Western Avenue. If the City of Gloucester is to benefit from the protective potential that the coastal barrier/tombolo that made up of Pavilion Beach, Commercial St and the Fort is capable of, it is imperative that not only should no new structures be placed on the beach side of Commercial St but that the existing Birdseye Building be removed as well, before any more damage is done to the surrounding areas.

As for the proposed development, the proposed seawall is significantly longer than the existing building, and would be placed at the point of greatest impact, erosion and undercutting (see Photo 1 and figure 3). This not only would multiply the existing problems and cause the rapid total loss of the beach and irreparable damage to the critical eelgrass beds but would place all of the businesses on the harbor side of Commercial St, from Ocean Crest to Intershell, all of Stacy Blvd. and in particular the homes located at 67 Commercial St, 2 Fort Square and 10 Fort Square at risk of destruction with even a modest tidal surge of 5ft above high tide (the surges experienced by NJ during Hurricane Sandy were over 14ft). During a storm, the proposed seawall and hotel would essentially transform a tidal surge into a series of tidal bores. This effect would be particularly grave for the residents located on Fort Square because the proposed development would essentially leave their homes in what would essentially become a canal for overwash and surges. The seawall, as proposed, would, for sometime protect only the proposed
development while placing, at even greater risk, the surrounding businesses, residents, and ecosystems.

Since this conclusion is based on many comparable studies and observations, we here express our concern for the probable effects of erosion in the zone of the Birdseye building. Unless a well-developed dune system is allowed to form, particularly on the parking lot between the Fort Square and the Chamber of Commerce, that region of the city, all the businesses on Commercial Street, and all the fishing boats, are all in grave danger of catastrophic storm damage.

Photo 1. Indicating zone at greatest risk of impact and erosion
Introduction
I was recently asked by the Port Community Alliance (the Alliance), through Mr. Nathaniel Mulcahy, a resident of Gloucester and an active member of the Alliance, to conduct a scientific survey of ecological conditions of Pavilion Beach, since members of the Alliance were concerned about the way the beach environment was being handled under current development plans by the City of Gloucester. I agreed to participate because of my long experience in research and teaching coastal ecology, in particular, barrier beach and dune ecology, at the University of Massachusetts over the past 44 years. (Godfrey, P.J., 1975, 1976, 1977). My work included research projects in Cape Lookout, NC and Cape Cod National Seashores for the National Park Service and Cranes Beach (MA) for the Trustees of Reservations. A list of my recent publications is attached, indicating my qualifications for this project.

A Survey of Ecological Conditions at Pavilion Beach, Gloucester, MA.

On January 2 - 5, I visited the Pavilion Beach area in the company of Mr. Nathaniel Mulcahy who is very familiar with the beach area and issues involved. I collected data at several sites of the beach using standard ecological methods, which included elevation profiles, water samples from holes we dug in the beach, evaluation of plant species present, and overall conditions. In addition, I studied the driftlines created by various tide levels on the beach. Herein is a brief description of our methods and findings.

Methods
On January 2, 2013, I made a general reconnaissance of the area and selected a site to make an elevation profile of the winter beach foreshore. We laid out a survey line from the highest point on berm (or Foreshore) crest, at a right angle to the water line, which was at low tide. From there, moving toward the parking lot, we placed markers every 5 ft up the beach to the location where we had placed a standard optical transit at the top of berm crest. The line was oriented S22°W and is shown in Figure 1.
Figure 1. Pavilion beach, showing transects and location of Eelgrass beds.
The profile (Figure 2) shows winter beach conditions when heavy wave action moves sand and cobbles to an offshore bar. In contrast, a summer beach would be much wider because low energy waves move sand from the bar up onto the beach. The beach ridge extends up to the parking lot, and that is where we set up the transit, over an old iron pipe as a “bench mark”. I then took elevation readings with the transit, located places where drift lines (containing organic matter) had been placed by the tides, and measured the elevations at those sites.

The next step was to extend the beach line as far North as possible to a water hydrant located on Commercial Street, which represented the lowest point of the backshore, and determined its relative elevation. We also measured the elevation of a wall attached to the Birdseye building to the east, and the level of sand below the wall.

In order to determine the depth to ground water and to measure its salinity, we then dug holes, where possible, at various places along the upper edge of the beach, moving toward Fort Square. We were able to reach the water table only in front of the Birdseye building. The fact that this location was both the lowest and the narrowest part of Pavilion Beach is indicative of extensive wave induced beach erosion in front of the Birdseye building.
Results
The first (western) beach profile showed that recent tide levels had reached the crest at 13.45 ft, above low tide at 9:20 AM on Jan. 3, 2013, a location very near the south end of the parking lot, and could easily be overtopped by even a moderate storm tide. A number of plant species were found among the rocks at the site including seaside golden rod (*Solidago sempervirens*). When seawater overtops the berm crest, it flows N down the lot to Commercial Street. The fire hydrant is 244 ft. from the berm crest and the ground elevation along is about 10 ft. above low water.

Analysis of drift lines on the beach showed a mixed array of knotted wrack (*Ascophyllum nodosum*), and a great deal of cord grass fragments (*Spartina alterniflora*, and *S. patens*), which must have come out of the nearby canal (The Cut). There were also many rhizomes (underground stems) of eelgrass (*Zostera marina*), some of which were already sprouting, that were carried in from beds offshore. These eelgrass habitats are essential for maintaining a scallop population, and many juvenile fish species habitats. In addition, we found seeds of several dune species, such as beach pea (*Lathyrus japonicus*), and an unidentified species of upland grass. Many species of insects were found, miscellaneous organic matter from the sea, and numerous small animals. Migrating shore birds frequently scour these drift lines for food.

On this first profile there were several driftlines along the middle of the beach, and anothers at the top. The upper tide line frequently contains propagules from which dune species can grow, such as American beach grass, but we found none of these. Buried organic matter, mainly algae, provide fertilizer for dune plants when covered by sand. (Bacteria which can digest the agar in algae are found only in beach environments.)

Towards the eastern side of the beach, the holes dug reached ground water only opposite the Birdseye building, the lowest point on the beach and was at least 7.5 feet from the surf zone, and approximately 13 feet from the Birdseye building wall. While digging these holes we found several layers of rotting driftlines beneath the sand, and there were even some sprouting beach peas. The water level in the one successful hole was at a level of 4.6 ft below the beach surface at low tide, where we found a layer of fine gray sand, indicating anaerobic conditions. When the tide rose 5.0 feet, the water level in the hole rose only 1.0 foot (to 3.6 feet), demonstrating that the beach was moderating the ocean’s tide range, indicating the protective function of the beach.

Salinities in the hole was at first 29-30 ppt (that of seawater) but after an hour or so, had dropped to 25-26 ppt, or brackish, indicating there must be a flow of freshwater from somewhere north of the sample hole, perhaps the uplands nearby or even from under the Birdseye building.

Discussion
There is no doubt that Pavilion Beach is part of a coastal barrier system. Maps of the beach area in 1835, ((currently on display in the Town Hall) clearly show that, at that time, a sandy beach/dune system connected the Gloucester mainland and what was Fort Island) (Note: this is described as a “tombolo” where two or more upland environments are connected by a sandy beach/dune system, (Komar, 1976.)) In those days there was no development on the ocean side of this connecting coastal barrier. The map also shows that the whole beach system was designated as a public beach. The coastal barrier and
Pavilion Beach sloped down to what became an outstanding deep water port since many piers had been built out into the bay. The areas without piers mostly contained low marsh cordgrass (*Spartina alterniflora*) which is a most important and critical habitat for hundreds of marine species and birds. That entire habitat is gone, except for a few localized populations low marsh cordgrass. The land between the beach and the boat docks was used for drying fish, and therefore mostly open. Overwashes, then, as now, carrying sand and gravel from the beach during storms must have occurred during those days, thus raising the elevation of barrier as sea level rose, and is still rising.

**Conclusions**

Recent studies indicate that the coast of eastern North America, from North Carolina to north of Boston will be a “Hotspot” for sea level rise (Sallenger, et al. 2012). In addition to gradual sea level rise, the town should consider the effects of a 14 foot storm surge, such as was seen during Storm Sandy. The beach would absorb some of the wave energy, but a surge would send sea water all the way across the developed area to the bay where the Schooner *Thomas E. Lannon* and fishing boats are berthed and could thereby cause considerable damage.

The structures now on the beach side of barrier prevent some of the overwash. There is no protecting dune line between the crest of Pavilion Beach and the lowlands (now the streets and buildings) behind. Unless a well-developed dune system is allowed to form, particularly on the parking lot between the Birdseye building and the Chamber of Commerce, that region of the city, all the businesses on Commercial Street, and all the fishing boats, are all in grave danger of catastrophic storm damage. The economic and social consequences for Gloucester would certainly be profound. In my opinion, the conditions I observed on Pavilion Beach and its surroundings indicate that their vulnerability to storm damage is very great. Soon the ocean will have its way. Those working and living in that area of the Gloucester are in danger. It all could happen the next time a Sandy Super Storm rolls up the coast.

To reiterate, our current data indicate that, whether or not the Birdseye building was built in the intertidal zone in 1926, it is there now. Therefore, from an ecological point of view, this indicates that, if a dune is not allowed to develop on the lots between Fort Square and 33 Commercial Street, with rising sea level a certainty, particularly on the Eastern North American Coast north of Boston (Sallenger et al. 2012), ever larger percentages of the Birdseye lot and Commercial Street will find themselves becoming part of the intertidal zone and subjected to erosion and severe flooding. Any structures on the beach side lots immediately adjacent to Fort Square, would put at risk many of the businesses on Commercial Street from Oceancrest Seafood to Intershell would be exposed to tidal surges. If tidal surges are comparable to those experienced in NJ from Hurricane Sandy, the same consequences would be expected for the properties and the fishing fleet in the DPA. Furthermore, because of the long shore transport that our survey has revealed, the existence of a sea wall of any sort along 46 and 48 Commercial Street, would result in an ever greater weakening and undercutting of the existence sea wall along Western Avenue.

These conclusions on the effects of a sea wall are supported by the experience of the US Army Corps of Engineers on Coast Guard Beach, Cape Cod, Massachusetts. When beach erosion endangered the bathhouse used by tourists, the Corps of Engineers,
installed a rip-rap sea wall. Here is their informative description: “In the structural experiment, a total of 10,000 cubic yards of rubble was placed in front of the parking lot on Coast Guard Beach from 1966 to 1972 in an attempt to slow erosion. It became apparent that the rubble was actually accelerating erosion in adjacent areas and the jagged edges of the rubble had become a hazard to swimmers (Figure 1 – E12) By the fall of 1976 the rubble was removed.” (See Cape Cod Easterly Shore Beach Erosion Study Vol II April 1979 US Army Corps of Engineers New England Division.). Appendix 1 E-14-16. “Instilation [sic] of Rubble Mound at Coast Guard Beach.

What would be the effects of vertical seawalls? Pilkey and Wright (1988) state,

“It is argued in this paper that there are a number of mechanisms by which seawalls can accelerate erosion of the beach in front of them and that, until research proves otherwise, active beach degradation remains a real possibility. In this investigation, we have also compared the dry beach width on selected stabilized and unstabilized East Coast shorelines and note that dry beach width is consistently and significantly narrower in front of walls.”

Not only does Leatherman’s 1979 illustration from the U.S. Department of the Interior not only shows the inevitable fate of beaches that are located in front of seawalls (see Photo 2 on page 10) but the current transects and a comparison of existing conditions with historic photographs indicate a dramatic loss of beach caused by both the Birdseye building acting as a seawall and the longshore transport which is a result of the shape of Gloucester Harbor. (see photos 3 and 4)
Our findings from this, Part 1, indicate the construction of any sort of seawall in front of the proposed hotel location, while it may, temporarily, protect the hotel from rising tides and storms would place the beach, the marine industries on Commercial St., the properties along the DPA, and the structural stability of Western Avenue and Stacey Boulevard at greater risk.
On January 11, 2013, I returned to continue my earlier investigations and was rewarded by a number of surprises that can play an even more important roles in the ecology of the Pavilion Beach system, and its value as a prime natural resource for Gloucester.

On Friday, Jan 11, I saw evidence of changes which had occurred since January 3. A rather massive line of cobbles had been rolled up by winter waves, reaching about half-way up on the beach profile we made last week. These lines of cobbles (smooth, round rocks) can play a very significant role in stabilizing the beach foreshore during winter storms and their presence is an additional clear indication of erosion. They provide a free service of slowing down wave run-up on the beach, and can prevent, or slow down, the usual winter erosion cycles. They will also provide a base for the fine beach sand that will arrive in a few months.

At a time close to low tide, a second elevation transect was run, this time from the south wall of the Birdseye building to the water, digging holes in the process (See Transect #2 in Figure 1 and the data in Figure 3 below).

![Birdseye Transect Jan 12, 2012](image)

**Figure 3. Second profile**

From 80 ft above this low tide mark, the beach consisted of fine sand, dead eelgrass, cobbles and rocks. At 42 ft we found living sea lettuce (*Ulva* sp.) and rockweed (*Fucus* sp.) in the drift line. Going higher up the beach, there was fine sand 14 in. over a layer of cobbles at 120 ft. There fine sand covered cobbles and broken shells to a depth of 8 to 9 inches. The sand layers continued up to 135 ft, and a layer light drift was on the surface. Conditions changed dramatically where light sand was thicker, namely, 18
inches deep at 140 ft. At 150 ft, there was light drift cover, but fine sand was very deep and no cobbles were found in holes. Heavy drift material was at 157 ft, but 160 ft showed a substantial driftline containing pieces of crab shells, eel grass rhizomes, with one alive and about 1 ft long. There were a lot of cordgrass pieces of both species (S. alterniflora and S. patens) in the same driftline. The slope here was 11\(^\circ\), which is rather steep for a normal beach. This 160 foot drift line marked a tide level among the highest reached on that day. At 167 ft, fine sand was deep and had covered earlier driftlines which showed waves had been washing up toward the Birdseye building wall. The first layer of rotting drift material was 9 inches below the surface, and the second at 15 inches. We could not dig deeper, but there were undoubtedly more layers further down. Therefore, layer upon layer of sand from the beach got as far as the south wall of the Birdseye building during high tide. At 170 ft. driftline material was against the wall. Figure 3 shows the elevation dropped at the wall indicating that waves hit it, bounced off, and gouged out sand driven up there by high tides. All of this evidence clearly shows that the south end of the Birdseye Building is within the intertidal zone.

An important resource discovery was made during the extreme low spring tide (January 11). While preparing to run the second profile, we found an extensive, very healthy zone of eelgrass (Zostera marina). It is one of the most important marine habitats in the North. Zostera forms extensive beds of marine vegetation just below the spring tide line at Pavilion Beach. We saw very healthy, green leaves even in January. The plant spreads via rhizomes and makes a dense colony which trap sediments, thus helping to stabilize the shore line by reducing wave energy. The plants we saw were at least a foot tall, and spread all along the shoreline opposite the old Birdseye plant.

Since we were hoping to catch the lowest tide line, it was nearly dark by the time we found the eelgrass zone. However, we did see the shells of numerous marine animals that live in the low tide flats including the large, surf clam (Spisula spp.), razor clams, mussels, pieces of crabs Limpets (Crepidula) were found on the shells of clams. (Many species of snails live in these beds and lay eggs of the leaves of Zostera.)

There were several fresh species of algae in the new driftlines, such as sea lettuce (Ulva sp.), rockweed (Fucus), Irish “moss” (Chondrus crispus), pieces of kelp (Laminaria sp.), knotted rockweed (Ascophyllum nodosum), and many smaller species not identified at the moment.

From what we could see, these beds of eelgrass extend along the whole shoreline west of Pavilion Beach. Any kind of structure build in the inter-tidal zone would have severe effects on this very valuable resource and should be illegal, if it is not already so. Many species are dependant for survival in eelgrass. Small, young fish can hide from larger predators amongst the leaves. We saw many small fish in the shallow waters of low tide, including a juvenile founder which had already developed its usual morphology.

Many references attest to the enormous value of Zostera beds, but here are two more, one by Fox (1983) and one from our current observations. At the time of the wasting disease that wiped out many eelgrass beds in the early 20th Century, nearly all species of geese, called Brants, disappeared because they were entirely dependant this plant for their food (Fox, 1983). Furthermore, nearshore eelgrass beds are the nurseries for ocean scallops, now an important part of the catch by Gloucester fishermen. Investigating these eelgrass beds, we were able observe vast numbers of scallop in the pedi-veliger stage on the eelgrass and seaweed. These represent one of the primary food
sources in this vitally important ecosystem. For more information on the significance of eelgrass zones, see the Addendum re Eelgrass in this report.
References Cited in this Report

Cape Cod Easterly Shore Beach Erosion Study Vol II April 1979 US Army Corps of Engineers New England Division.

Coastal Barrier Task Force, Department of the Interior (1983). Final Environmental Statement. - Undeveloped Coastal Barriers. See Figure 19, by Leatherman, p. A-40)


Addenda

A. Eelgrass, \textit{(Zostera marina)}

B. Eelgrass Habitat Restoration in the Annisquam River

C. Further comments regarding the development proposal for Pavilion Beach, Gloucester, MA and Related definitions of terms used in this field report.

D. Port Community Alliance submission to Conservation Commission 31 August 2012

E. \textit{Curriculum vitae} of Paul J. Godfrey including recent publications
ADDENDUM A

Eelgrass, *Zostera marina*
Dr. Paul Godfrey, author

Just offshore of Pavilion Beach is one of the most important shallow water marine communities we have in New England, the eelgrass (*Zostera marina*) ecosystems. It is extremely diverse in animal species and nurseries for many species, some economically significant, as mentioned previously. The beds also contain numerous species of small algae. *Zostera* is the only flowering marine plant in the system and serves as food, shelter, and substrate for marine animals; it produces dense colonies of green blades growing up from underground rhizomes. It can also help to stabilize sediments on the sea floor by trapping sand and making low mounds as water flows through the leaves. However, it cannot build these mounds above the low tide level and must remain submerged. On our transect, the beds were slightly exposed at the extreme low tide line, 170 ft. from the Birdseye building’s south wall.

Plans proposed for the development, such as a 17 ft tall armored seawall in the intertidal zone, and plans to add loads of white sand on the beach which will most probably wash down onto the eelgrass beds by back and forth tide flows and smother the beds. Since eelgrass can only withstand small mounts of sediment, this project can seriously affect, or even destroy the habitats. Plans show that eelgrass beds fall within the proposed development zone seaward of the Birdseye building, and so they will be certainly affected by this development; and this would go directly against Gloucester’s Eelgrass Restoration Program under the auspices of the Massachusetts Office of Coastal Zone Management in partnership with the U.S. Environmental Protection Agency, and the Massachusetts Division of Marine Fisheries.

As an example of how biodiversity rich eelgrass beds are, I have listed a few of the hundreds of species found in a northern region such as Gloucester:

- **Fish:** winter flounders, mackerel, lump fish, eels (*Anguila americana*), Northern pipefish (*Syngnathus fuscus*), etc.

- **Crustaceans:** lobsters, skeleton shrimp, common prawns (*Palaemonetes vulgaris*), mud crabs (*Neopanope texana*), etc

- **Polychaetes** (many-legged worms): *Platynereis dumerilii*, *Nereis pelagica*, *Melinna cristata*, etc.

- **Mollusks:** horn shell (*Bittieu alternatum*), dove shell (*Mitrella lunata*), slipper shell (*Crepidula fornicata*), chink snail, and many other snails, Atlantic sea scallops (*Placopecten magellanicus*), pyramid shell (*Odostomea seminuda*)-a parasite on scallops, jingle shell (*Anomia simplex*), gem clam (*Gemma gemma*), Martin’s egg cockle (*Laevicardium*), little surf clam (*Mulinia lateralis*), etc.
• **Hydroids** (many armed coelenterates): little tiara (*Pennaria tiarella*), and many more.

• **Sea Squirts:** Folded sea squirt (*Styelia plicata*), plus many more.

There is great diversity in these eelgrass beds here because Gloucester is in the transition zone between cold waters of north, and warm waters from the south shore of Cape Cod to Cape Lookout National Seashore in North Carolina. This distinction of being a very high diversity, but very small, “hot spot” in Massachusetts makes the Pavilion Beach eelgrass ecosystem extremely important to protect at all costs.

Unless the City of Gloucester has no interest in protecting the fishing stocks or by extension the fishing community, then, by all means, build the seawall.
EELGRASS HABITAT RESTORATION IN THE ANNISQUAM RIVER

Can eelgrass habitat be successfully restored in the Annisquam River? That is the question being answered through a study by the Massachusetts Office of Coastal Zone Management (CZM), in partnership with the City of Gloucester, U.S. Environmental Protection Agency, and the Massachusetts Division of Marine Fisheries.

EELGRASS - AN IMPORTANT COASTAL HABITAT
Eelgrass, Zostera marina, is a flowering marine plant that forms one of the most— if not the most—valuable shallow-water coastal habitats in Massachusetts. Eelgrass, either as isolated clumps or continuous beds, forms a complex underwater landscape that stabilizes the seafloor and adjacent shorelines, filters the water of sediments and nutrients, and provides valuable habitat to a diversity of life. Eelgrass is home to both economically important species, such as American lobster and winter flounder, and relatively unknown creatures—chinook snails, skeleton shrimp, and lumpfish, to name a few.

WHY EELGRASS RESTORATION?
Eelgrass habitat is at risk, with significant losses in eelgrass abundance throughout Massachusetts. While conservation and protection of existing eelgrass beds are the best strategies for addressing this problem, restoring areas that supported eelgrass habitat in the past is a valuable management measure.

Eelgrass was historically found throughout the Annisquam River—but now this valuable habitat is largely absent. This study will improve our understanding of probable causes of eelgrass disappearance and identify ways to stimulate eelgrass recovery in the river.

THE STUDY APPROACH
Appropriate site selection is critical for eelgrass restoration. This study uses a systematic approach to identify potential restoration areas in the Annisquam River. This approach includes modeling environmental requirements of eelgrass, studying water quality, and planting test plots of eelgrass. These test plots are observed through time to determine which sites are appropriate for large-scale transplanting and/or seeding.

LOCATIONS IN THE ANNISQUAM RIVER
Through three years of research and consultation with the City of Gloucester, CZM identified five areas for test plots: Lobster Cove, Goose Cove, outside of Goose Cove, Mill River, and the mouth of the Little River. These areas are marked by orange floats and floerglass rods with flags.
EELGRASS HABITAT RESTORATION

Map: Eelgrass was historically found throughout the Annisquam River. Test transplants will determine the feasibility of restoring eelgrass.

Raise awareness and help conserve and restore eelgrass habitat.

HOW TO HELP
Eelgrass habitat restoration is a long-term effort. To help us ensure the success of the Annisquam River study, please:

- Do not disturb test plots and restoration areas.
- Contact CZM with any observations and/or concerns.
- Help spread the word about the study and the importance of eelgrass habitat.

FOR MORE INFORMATION, CONTACT:
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A publication of the Massachusetts Office of Coastal Zone Management (CZM) pursuant to National Oceanic and Atmospheric Administration Award No. NOS-AG04-100137.

This publication is funded in part by a grant cooperative agreement from the National Oceanic and Atmospheric Administration (NOAA). The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its subagencies.

Publication Date: October, 2007
This information is available in alternate formats upon request.
ADDENDUM C

Further comments regarding the development proposal for Pavilion Beach, Gloucester, MA and Related definition of terms used in this field report.

(Dr. Paul Godfrey, Author)

1/14/13

1. **General agreement with Dr. Rosen’s report.** I have read Dr. Rosen’s report to the Port Community Alliance, and agree with his general conclusions regarding the “dune issue” at Pavilion Beach. However, there are a number of issues on which we have some, perhaps minor, disagreements relating more to definitions rather than observations. (I know Dr. Rosen and have a very high regard for his research and while we may use different terminology, we agree on concepts.

2. **There is enough sand blowing from the beach to supply a substantial dune.** Dr. Rosen, and others have referred to the “rise of sand” along the windward side of the beach as a “dune”. In ecological terms I would call that phenomenon a “proto-dune”, or “dune supply source”. Dunes in our part of the world are created as sand is blown landward from the beach onto a zone called the “backshore”. There is very little of what would be called a natural backshore because it has been covered with macadam, although it still falls into that category regardless. What is being called a “dune” is the accumulation (“rise of sand”) produced when wind moves fine sand up against low walls, or the side of the Birdseye building.

   A more acceptable definition to me would relate to the upper region of the shore, where sand fences, and vegetation, especially American beachgrass (*Ammophila breviligulata*) should be present. Since I observed the shoreline in winter, the beach was at its shortest width. In the summer, it would be much wider. Both Dr. Rosen and I have noted that fine dune sand has been, and is, being blown across the beach, piled along the present walls, and even blown over 200 ft N down the parking lot to Commercial St. A better definition of a dune ridge should refer to sand accumulation higher up on the leeward parking lot where it would be allowed to continue growing in elevation and breadth. Such a dune is not there now because of winter conditions, or, as I have been told, regularly removed by the City, thus making the backshore much more vulnerable to flooding and damage. I would prefer that the “rise of sand” or “dune” which Dr. Rosen referred to, be considered as a “proto-dune” from which sand could be blown up into a vegetated zone, in keeping with normal patterns of dune ridge formation.

   There is definitely enough sand blowing from the beach, and well across the parking lot, to supply a substantial dune on the highest elevations (i.e. 13 ft above the low water we measured) and if it were allowed to grow much higher plantings of beach grass it would provide much more protection from storm flooding (especially since there is

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1 I know that for a fact. When my transit was located 4 ft above the ground, it was very clear which way the wind was blowing because it took a long time to clean very fine dune sand out of that delicate instrument.
nothing now). Such a dune should be back on the parking lot, where apparently it once was.

3. Pavilion Beach is a coastal barrier. Substantial discussion, and disagreement, has been directed to what type of geological structure Pavilion Beach is. The term generally used now is “Coastal Barrier”, as defined in the Federal document which followed President Carter’s initiative, and is cited in this document. Under the term “Coastal Barrier” would fall several kinds of coastal structures made of sedimentary materials (i.e. sand, gravel, small rocks, etc.) that have been moved by wind and water, and protects a marsh, lagoon, bay or any other aquatic/semi-aquatic habitat from the direct effects of oceanic forces, therefore acting as a barrier by definition.

There are various kinds of coastal barriers such as: barrier islands, barrier spits, bay barriers, tombolos (2 or more uplands connected by a sedimentary structure) and others. We have many illustrated examples of these classifications. Neither size (width/length) nor present conditions negates the reality that this whole structure is protecting a vital aquatic habitat from the sea. In that sense all parts of the structure, not just the beach, is relevant. Of the many coastal barrier types, Pavilion Beach and its backshore region which extends to the bay, even if there are buildings, roads, docks, etc. on the structure, is still, in this case, a “tombolo” type of barrier, because it meets all the basic definitions.

The problem that exists, however, as seen with Hurricane Sandy on the NJ barriers and similar situations, it is not able to grow higher, or retreat, in response to sea level rise, as compared to undeveloped barriers (in other words, the developed barrier gets lower and lower, relative to sea level) unless something is done to compensate for that effect, while the more natural barriers rise in elevation and move as the sea shifts sand up and over or around.

4. Seawalls, riprap, groins, jetties and other structures designed to prevent or stop erosion simply do not work, as shown in countless textbooks and reports (of which I have many) over the long run, as well as being expensive. Only the property directly behind might be protected for a while. With seawalls especially, waves that break against the wall with their full force, rather than dissipating it on a sloping beach/dune system, rebound with nearly the same force and eventually undercut the structure and it fails. This process is already occurring along the seawall on the western side of the harbor. We also saw the start of a wave rebound effect at the North end of our Birdseye Transect where we reach the wall. The elevation of sand at the wall dropped from only a few feet away. In addition, these structures frequently create havoc with those beach environments “downdrift”. This scenario will surely exist if the proposed seawall is constructed in the intertidal zone. All beaches west of the Pavilion project would be severely affected. Little thought seems to have been given to an extremely severe situation that would develop for the entire sand transport system.

5. Longshore Transport (or Littoral Drift) which applies to the situation in #4. Sand moves along the water/sand interface by the physical action and direction from which waves approach. I have many textbook examples, as well as personal observations, that describe this process. As waves approach a beach, they are generally curved, or come in
at an angle to the beach. A curving wave will have its landward end basically slow down as it moves into shallow water, while the rest of the wave continues into the beach directly. Wave energy thus moves along the beach, and as waves slide up and then down the beach face, sand moves along in the swash zone, with a resultant direction. If waves approach from the southeast or south, the most predominate direction here, they produce a resultant force moving sand westward, as we see at Pavilion Beach. Actual wave fronts can be seen moving towards the beach at an angle or curving inward on aerial photographs we have, and the one shown in Figure 1 (see page 5).

A type of wave pattern that occurs directly in front of the Birdseye building, where the greatest erosion is occurring, results from wave “refraction”. Ocean waves moving from the SE bend around Fort Point and in towards the beach, first running along the seawall where they the hit shallow water, then onto Pavilion Beach. Much of the wave energy from refraction, as they (waves) bend around, ends up on the beach in front of the Birdseye building, creating the obvious indentation or erosion node. Since sand cannot be moved from the seawall that runs N-S, waves pick sand from the beach running E-W, starting at the Birdseye building. Any structure no matter how strong, will constantly be in the same, if not worse, situation, especially as sea level rises and storm energies, plus their predicted frequencies, are expected to increase. All intertidal and beach habitats will be severely affected westward along this Gloucester shoreline all the way to the western seawall.

It appears to me that all these major coastal processes, let alone the ecological ones, and the concomitant downdrift problems they will create, have been totally ignored by designers of the proposed project, and have not considered the major detrimental effects it will have for the whole city to the west along Pavilion Beach, nor to the north and the harbor with its famous and historic fishing fleet, considered the best in New England, and its seafood industries. Such actions fly in the face of all that is commonly known about coastal processes that can be found in any relevant text book, plus hundreds of scientific papers, and the consequences of ignoring them.
ADDENDUM D
Port Community Alliance submission to Conservation Commission 31 August 2012

Port Community Alliance Submission to the Conservation Commission
Gloucester, MA

Originally submitted 31 August 2012 to: To: Lisa Press LPress@gloucester-ma.gov Cc: Marie Demick <MDemick@gloucester-ma.gov> tmarden@woodsholegroup.com

Dear Conservation Commission Members and Conservation Agent Lisa Press,

At the previous Conservation Commission meeting on August 8, 2012, several experts presented on a variety of findings in relation to mapping resource areas for the Commercial St. property.

While we are not coastal geologists, our organization is focused on the preservation and best use of The Fort and port areas in Gloucester. Our membership has a vested interest in fully participating in the ongoing discussion related to the Delineation of Resources and to contribute to that discussion with photographic evidence and testimony so that the Conservation Commission has the benefit of hearing from those who live in the area and use the area for business and recreation.

The following photographs focus on four key areas:
- Evidence of a dune and landward migration of sand
- Evidence of dune vegetation
- Wildlife on the property and surrounds over a twelve year period
- Historical photographs showing historical dune formation and vegetation

These four areas are based on the categories highlighted by Tara Marden (Coastal Geologist for Woods Hole Group, Inc., the third party scientist hired by the Commission as being important to the appropriate delineation of resources. During her presentation she stated that her mandate was to address three key questions:

1. Is there a coastal ridge?
2. Is the area a barrier beach?
3. Are there dunes on the property?

To answer those, she indicated that she relied on a single site visit (July 23, 2012) and a series of satellite images from Google Earth.

Attorney Faherty, on behalf of his client Motillaro Lobster, hired a Coastal Geologist, Dr. Stephen Rosen, to also complete a site review. Dr. Rosen used a document he and Attorney Faherty compiled and given to the Commission ahead of time as the backbone of their presentation. Using photographs from Dr. Rosen’s site visit (May 8, 2012), they showed, from two angles, the rise in the sand. According to photographs from Ms. Marden’s visit, this rise in the sand was no longer there.

Both coastal geologists said that the change in the elevation in the sand would not be possible due to natural activity. We, like Attorney Faherty have chosen not to speculate on the drastic change in the sand between Dr. Rosen’s assessment in May 2012 and Ms.
Marden’s in July 2012. However, Attorney Faherty did present a photograph taken on May 31, 2012 showing a City owned vehicle raking the sand in the location of the dune. We would like to point out that if the City is removing an active dune from the designated resource area, no matter how small, and those actions benefit one specific developer it should be a point of concern.

While we are not qualified to determine whether or not The Fort is a barrier beach, we do attest that there is a dune and that there is landward migration of sand as evidenced by sand blown into the parking lot on a regular basis. Additionally, the beach is a community asset and a natural resource—a feeding area for seabirds and a stop for seasonal migration of seals.

We ask that the Commission carefully review our submission and consider how the construction of a hotel with 101 rooms, higher use of the limited beach area, and the construction of an 8ft ramp on the beach (proposed in the plans submitted to City Council by the applicant) will impact the landward migration of sand, the wildlife that use the beach for food and a safe place for their young, neighborhood residents and Gloucester citizens who use the beach in all seasons and the natural barriers that Mother Nature has provided for Fort residents and businesses in the form of a small dune with vegetation.

“Local governments play an important role in barrier beach management. Since municipal commissions, committees and boards review proposals for construction activities on barrier beaches, a large responsibility resides with local officials to ensure that proposed activities reflect both the natural and economic hazards and the environmental sensitivity characteristic of barrier beaches. The Massachusetts Barrier Beach Task Force strongly encourages municipalities to develop management plans for locally owned barrier beach areas to promote appropriate use.”

Thank you for reading through our comments and for carefully considering the photographs and what they portray as you delineate resources. We consider Pavilion Beach an important environmental and recreational asset to the City of Gloucester, not to mention a key asset to the Fort residential and marine industrial communities.

Sincerely,
Port Community Alliance
Evidence of a dune and landward migration of sand
The following photographs show the ongoing landward migration of sand over a period of one year. The photographs in this section were taken between May 2011 and May 2012.

“The strength of the barrier beach system lies in its natural dynamic character. This character is most clearly represented by the beach's and dune's abilities to respond (move and reshape) to storm winds and waves as a complete ecological unit. When left unaltered, barrier beaches respond to storm overwash quite well by building up again. The overwash provides the substrate for re-establishment of landward saltmarsh and/or dunes, as well as, in some cases, allowing landward migration. Aerial photographs of barrier beaches often show the re-establishment of saltmarsh or dunes on overwash fans. Beachgrass grows on overwash fans and traps windblown sand to begin the formation of new dunes.” (pg. 13)

Date photo taken: August 30, 2011
Location: Birdseye Building
Significance: This photo shows sand blown across the Birdseye parking lot and to the street. This happens naturally in this area and will pile up if it’s not cleaned off the property.

Guidelines for Barrier Beach Management in Massachusetts: A report from the Massachusetts Barrier Beach Task Force, February 1994
Date photo taken: 2009-2010
Location: Birdseye building
Significance: Sand accumulated on the site indicating seasonal landward migration of the beach. This happens naturally in this area and will pile up if it’s not cleaned off the property. This photo shows the sand forming a mound next to the Birdseye Building and sand on the sidewalk.
Date photo taken: May 5, 2012
Location: Pavilion Beach in front of the Birdseye building parking lot
Significance: This photo shows the rise of sand between the beach and the parking lot in context of a broader beach view.
Date photo taken: May 5, 2012
Location: Pavilion Beach in front of the Birdseye building parking lot
Significance: This photo shows the rise of sand between the beach and the parking lot in context of a broader beach view.
Date photo taken: May 5, 2012
Location: Pavilion Beach, directly in front of Birdseye building standing on the tidal flats.
Significance: This photo shows two concerned citizens showing the 10 feet of beach that Beauport LLC plans on developing as part of the Hotel Overlay District.
Date photo taken:
Location: The park along the point looking at the Birdseye Building during St. Peter’s Festival
Significance: This photo shows sand accumulated along the building and the rise along the edge of the Birdseye building and the parking lot.
“The process of overwash acts as an energy release mechanism preventing numerous other overwashes from forming by redirecting wave energy through itself.”

Taken from: (Guidelines for Barrier Beach Management in Massachusetts: A report from the Massachusetts Barrier Beach Task Force, February 1994, pg. 13)

Significance: Shows the basic structure of a barrier beach.

Date photo taken: 3/29/2011
Location: Commercial St. facing towards Beach Ct
Significance: This photo shows flooding that happens in this area during heavy storms. In a Barrier Beach formation, this would represent the Overwash Fan (referenced above)
Evidence of dune vegetation
The following photographs show vegetation on the dune formation and the dynamic landward movement of sand from wind over time.

**Date photo taken:** 8/17/2012  
**Location:** Pavilion Beach Dune  
**Significance:** This photo shows Sea Rocket: (Cakile Edentula) on Pavillion Beach Dune. It grows above high tide line on beaches and in dunes.

**Date photo taken:** 8/17/2012  
**Location:** Pavilion Beach Dune  
**Significance:** This photo shows Sea Rocket: (Cakile Edentula) on Pavillion Beach Dune. It grows above high tide line on beaches and in dunes.

**Date photo taken:** 8/17/2012  
**Location:** Pavilion Beach Dune  
**Significance:** This photo shows Sea Rocket: (Cakile Edentula) on Pavillion Beach Dune. It grows above high tide line on beaches and in dunes.
**Date photo taken:** 8/17/2012  
**Location:** Pavilion Beach Dune  
**Significance:** This photo shows Sea Rocket: (Cakile Edentula) on Pavilion Beach Dune. It grows above high tide line on beaches and in dunes.
Date photo taken: 2000
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg. I've only seen these particular Reeds grow in marshes along our shore. They are continuously weed wacked, but some can still be seen approximately 2' tall today.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds (Fragmites) growing against the metal part of Birdseye Bldg.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds (Fragmites) growing against the metal part of Birdseye Bldg. Current photo of reeds.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg.
Date photo taken: August 29, 2012
Location: Pavilion Beach
Significance: Reeds growing against the metal part of Birdseye Bldg.
Additionally, eelgrass restoration work to restore Pavilion Beach has been undertaken by the city.
Neither Executive Order Number 181 nor the definition of a barrier beach imply that altered barrier beaches should be identified or designated with any special status. Also, a landform does not have to be above any specific size threshold to be considered a barrier beach. Whether small or large, developed or undeveloped, these coastal barriers remain subject to significant storm damage and may provide important habitat for wildlife. Therefore, if a landform meets the geomorphic requirements, it is identified as a barrier beach regardless of size and degree of alteration (such as development). This is an important point that should not to be overlooked by barrier beach managers.”

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5 Guidelines for Barrier Beach Management in Massachusetts: A report from the Massachusetts Barrier Beach Task Force, February 1994 pg. 28
Wildlife on the property and surrounds over a twelve year period

Date photo taken: 2012
Location: Pavilion Beach
Significance: This photo shows a baby seal on Pavilion Beach

Date photo taken: late winter / early spring 2000
Location: Off the rocks adjacent to Pavilion Beach
Significance: This photo shows a baby seal on Pavilion Beach
Date photo taken: 2002
Location: Pavilion Beach
Significance: This photo shows a seal on Pavilion Beach
Date photo taken: 1970s
Location: Edge of Birdseye parking lot
Significance: This photo shows plant life growing out of the dune.
Date photo taken: 1970s
Location: Pavilion Beach
Significance: This photo shows grass and sea rocket plant growing out of the dune
Date photo taken: 1960s
Location: Pavilion Beach
Significance: This photo shows a dune in the background on the right hand side.

Date photo taken: 1960s
Location: Pavilion Beach Entrance Fort Square
Significance: This photo shows the sand blown across the street and into the driveway/walkway.
ADDENDUM E

CURRICULUM VITAE

Name: Paul Jeffrey Godfrey

Birthdate: April 2, 1940

Education:
- Ph.D., Duke University, Durham, North Carolina, 1969 (Botany, Plant Ecology)

Positions:
- Teaching Assistant, Duke University, 1962, 1968
- Research Assistant, Duke University, 1963-1968
- Biologist, Cape Lookout National Seashore, Beaufort, North Carolina, 1968-1969
- Research Biologist, W.A.N., National Park Service, 1970 to present
- Assistant Professor, Department of Botany, University of Massachusetts, Amherst, Mass., 1970-1976
- Associate Professor, Department of Botany, University of Massachusetts, Amherst, Mass., 1976 to present
- Leader, National Park Service Cooperative Research Unit, University of Massachusetts, Amherst, 1973-1976
- Director, N.P.S. Cooperative Research Unit Laboratory, Truro, Mass., 1976-1976
- Visiting Assoc. Professor, Duke University Marine Laboratory, Beaufort, N.C. Summers 1978-81

National Appointments:
- MAB Directorate (UNESCO) Coastal Biosphere Reserve Selection Panel, 1984
- Steering Committee, National Park Service Atlantic Coastal Research Laboratory, 1979 to present
- U.S. Department of the Interior; Barrier Island Study Group, 1977-1978
- U.S.D.I.; Coastal Barrier Study Group, Northeast Team Leader, 1983 - to present

State Appointment
- Leverett Conservation Commission, 1983 - to present

University Affiliations:
- University of Massachusetts Coastal Research Center, 1972-1975
- Univ. of Mass. Institute for Man and Environment, 1973-1977
- Advisory Committee, Water Resources Research Center, Univer-
city of Massachusetts, Amherst, 1980 to present,
Five Colleges Coastal and Marine Sciences Steering
Committee, 1981 to present.

Professional Organizations:
American Association for the Advancement of Science
American Institute of Biological Sciences
British Ecological Society
Ecological Society of America
International Society of Biometeorology
International Cooperation Group on Sand Dune Management
Ocean Research and Education Society
Sigma Xi
Phi Kappa Phi

Advisory Boards:
Academic Advisory Committee, Ocean Research & Education Soc.
American Littoral Society
Northeast Marine Environmental Institution, Inc.

Consulting:
Agawam Conservation Commission, Agawam, Mass.
Borough of Mantoloking, New Jersey
Charles T. Main, Inc,
Connecticut River Basin Commission
Northeast Utilities
Metcalf and Eddy, Boston, Mass.
State of Maine; Department of Conservation
The Trustees of Reservations
Town of Harwich, Massachusetts

Expert Testimony
Towns of Leverett, Sunderland and Clinton vs. Mass, DEQE and
Railroad Commission (Wetlands Act), Boston and Worces-
ter, Feb. 28 - March 1, 1984 (for Leverett).
Borough of Mantoloking, N.J. vs. Watson (violation of Dune
Ordinance), August 1982 (for Borough of Mantoloking).
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Interior, pending, (for Sec. of Interior)
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August 11, 1981, Gaige Auditorium, Rhode Island College,
Providence, RI
State of Massachusetts vs. Backus (developers of Wawwinet,
Nantucket), Boston, Mass., 1976, (for State of Mass.).
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