# EFFECT OF OCEAN SETBACK STANDARDS ON THE LOCATION OF PERMANENT STRUCTURES IN COASTAL NORTH CAROLINA

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This work was sponsored by the Office of Sea Grant, NOAA, U.S. Department of Commerce, under Grant No. NA83AA-D-00012, and the North Carolina Department of Administration. 

UNC Sea Grant College Publication
UNC-SG-WP-83-5
August 1983
$1.25

## INTRODUCTION

The State of North Carolina as part of its Coastal Area Management Act (CAMA) has permit jurisdiction over the Ocean Hazard Area along the Atlantic Ocean Shoreline. Since 1979, the permit process has included a minimum oceanfront-setback requirement for permanent structures to reduce the likelihood and degree of storm and erosion damage. As a general rule, the safety of a structure is increased as it is located farther from the ocean. The minimum required setback has been set as thirty times either the historical long-term erosion rate or two feet per year, whichever is larger. The setback is measured landward from the seaward line of stable dune vegetation.

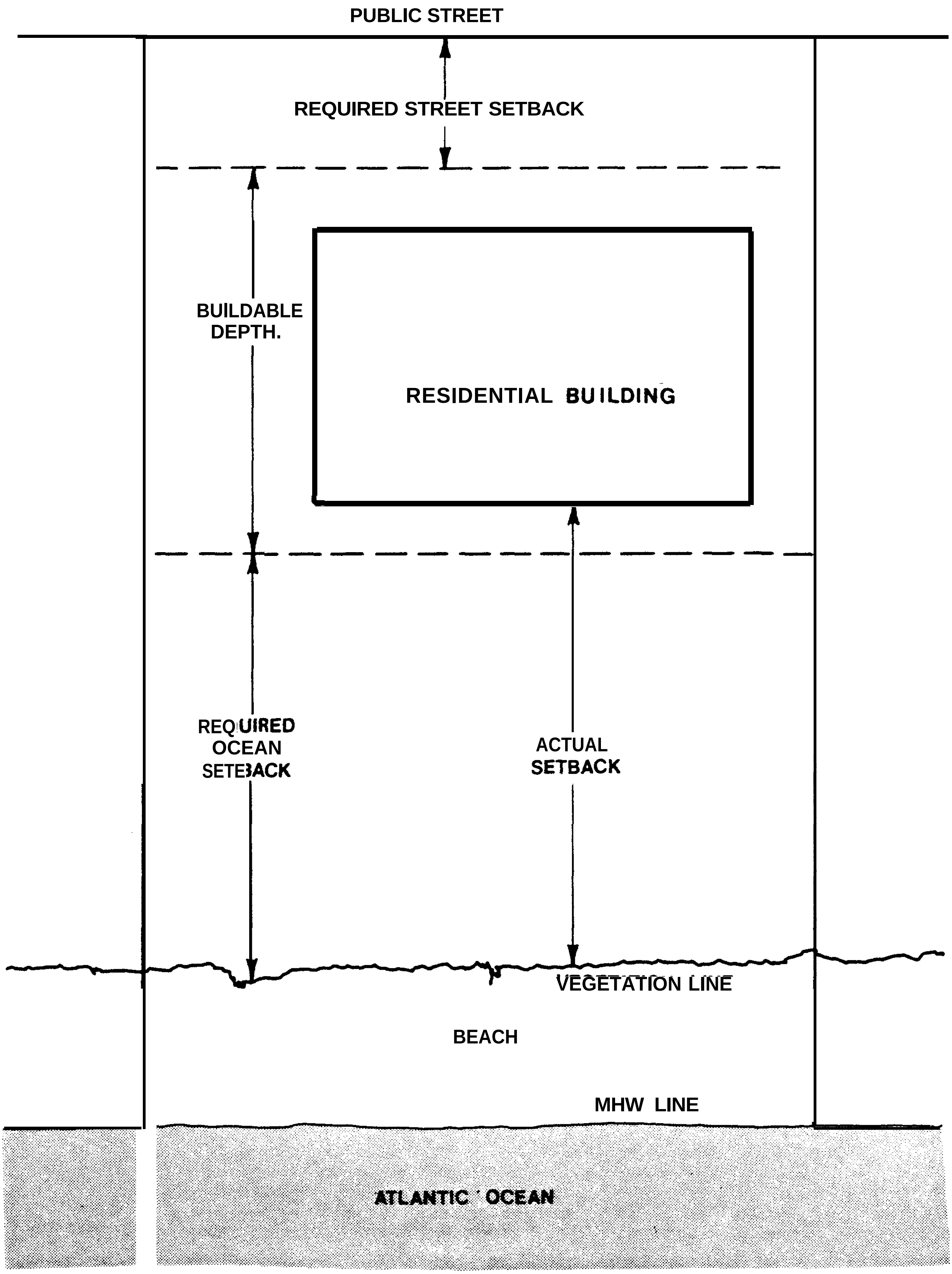
Assuming the historical erosion rate accurately predicts the future long-term rate of change, the owner's chosen setback gives a measure of degree of safety from slow erosion of the shoreline, but not necessarily the larger limits of temporary (short-term) erosion during a severe storm or shoreline deposition in the several years that follow. Then, at least theoretically, a measure of the degree of safety from long-term erosion can be estimated by comparing the actual distance an owner chooses to locate landward of the required setback with the estimate erosion rate.

The purpose of this analysis is to describe where permanent structures were located in relation to the setback requirements during 1979-1981. The analysis will include the ocean hazard areas in Long Beach, Caswell Beach, West Onslow Beach, Emerald Isle and Nags Head. In these areas the Coastal Area Management Act (CAMA) permits are issued by the towns except for West Onslow Beach which is handled by Onslow County and Caswell Beach which was handled by Long Beach at that time.

## METHODS

The CAMA permits issued by the jurisdiction were reviewed and a list developed of those permits that involved the construction of a residential structure that was permitted after the CAMA setback requirements took effect. In compiling the list the investigators recorded the proposed location of the structure with respect to the CAMA setback, the depth of the lot on which the structure was to be developed and the buildable depth available for the proposed dwelling. The buildable depth was determined by subtracting both the CAMA setback and the locally required street setback from the total depth of the lot. A typical site plan is shown in Figure 1. Following a compilation of this data, a sample of properties on the list from each area was visited to ascertain the accuracy of recorded data (e.g., whether a permanent structure had been constructed, the actual location of the dwelling on the property, etc.). If the permit data could not be verified, those properties in question were excluded from further analysis.

FIGURE 1. TYPICAL SURVEY OF LOT



## ANALYSIS

The decision by an owner to locate a residence on a lot is based on a wide variety of often conflicting factors. Required setbacks and other land-use regulations restrict the lot initially. Within the remaining buildable area, some of the factors which may be considered are: the threat of shoreline erosion; the view of the ocean; the building size and shape, the number of floors; the lot topography; the location of neighboring houses and the existing landscape. While this study cannot determine the reasoning of the owner, it is possible to evaluate the relative importance of the threat of long-term erosion in comparison to other reasons by comparing the erosion rate, the actual setback chosen and the available buildable depth.

The relative long-term erosion safety is estimated by dividing the actual distance the residence is located landward of the stable vegetation line by the local erosion rate. For example, a typical residence constructed seventy feet from the vegetation line with two feet per-year of erosion, has a safety level of 35 years. After that period of time the average house will be located seaward of the vegetation on the beach and regularly affected by even non-storm waves. Erosion rates are sufficiently variable over time and space that no one site is likely to be exactly predicted. However, since the rates are likely to both under-estimate and over-estimate, the resulting level of safety should be representative of the average of a large number of home sites. The individual results are listed by locality in the appendix.

The relative level of erosion safety determined by each owner can be placed in perspective by comparison with the average useful life of the building. The nationwide average lifetime for wood-frame residences had been estimated to be 70 years before the building is purposely demolished, destroyed by fire, or other causes. Other time periods are often more significant to owners or others involved with the residence. For instance, a banker may be more interested in the 30-year-mortgage life, a landlord the 10- to 20-year-depreciation life of rental property or an architect or engineer in a 50-year-design life. However, for coastal management purposes the 70-year-average, useful life is a most important yardstick. Buildings are usually bought and sold numerous times and have had many different mortgages before the end of its useful life. Any coastal management agency is required to make a permit decision that will impact the coast for the full, useful life of the structure regardless of who owns it, or when a commercial owner has received an adequate return on his investment. While buildings will often last longer and shorter periods, on average the building's impact on the coast will extend for 70 years. Therefore, in the earlier example, a new residence with a level of erosion safety of 35 years will spend the first half of its useful life landward of the vegetation line. However, during the last 35 years, the building will be seaward of the vegetation line, in a location highly susceptible to wave and erosion damage.

It has been previously noted for many types of regulations at various levels of government that when minimum standards are established they often become THE standard. The minimum level is perceived as adequate or "safe" regardless of adequacy of limitations because the level has been set by the governmental authority. Prior to this study it was speculated that the CAMA ocean setback regulations were causing a similar reaction by encouraging some owners to build closer to the ocean. Upon completion of the study it is still unclear whether property owners locating at the minimum CAMA setback would have selected alternate locations if the CAMA line was not evident. However, the data from this study displayed in Figure 2 indicates that most of the new houses are located on or near the minimum required setback. About 29 percent build as close to the ocean as possible, a 30-year level of safety from long-term erosion. Almost half, chose locations with 35 or fewer years of erosion safety. Only three percent built with more than 70 years of erosion safety. Prior to the end of the average 70-year useful life of the residence, approximately 97 percent of the buildings sampled can be expected to be located on the traditionally used public beach, require construction of an erosion control structure, or to be moved further inland.

The buildable depth available on any particular lot varies greatly along the coast. A scatter diagram of the level of erosion safety versus the available buildable depth on each lot is presented in Figure 3. Line 1 represents the maximum practical setback feasible on a lot with any given buildable depth, assuming at least a modest sized house (1000 + square feet, single story, 2000 + square feet, two story typical of single family residential construction along the coast) using the full buildable width of the lot and locating as far landward as the street setback will allow. In addition, it is assumed that as the buildable depth of the lot increases, the owners' desired house size will also increase (1600-square feet, single story, 3200 square feet, two story, for a buildable depth of 100 feet). Line 1 describes for any given buildable depth the highest practical level of safety that an owner could choose on the lot without substantially reducing the size of the typical house. This maximum practical setback seems to agree with the actual data.

The decision to build at or near the minimum setback may be by choice, but is often by necessity on lots with little depth. The figure reveals that about one third of the lots sampled have such limited buildable depth (less than 50 feet) that erosion safety levels greater than 40 years are difficult to achieve without reducing the house size. While most of these chose to build at the minimum setback, several owners took advantage of their limited depth to build at higher levels of erosion safety.

Most (70 percent) of the sampled lots are sufficiently shallow that a modest-sized residence could not be constructed on the lot with an erosion safety level as high as 70 years, the expected average useful lifetime. Therefore if any house is constructed on these sampled lots, the structure is likely *to* be located seaward of the vegetation line before the end of

FIGURE 2. NUMBER OF NEW HOUSES vs. RELATIVE SAFETY FROM LONG TERM EROSION

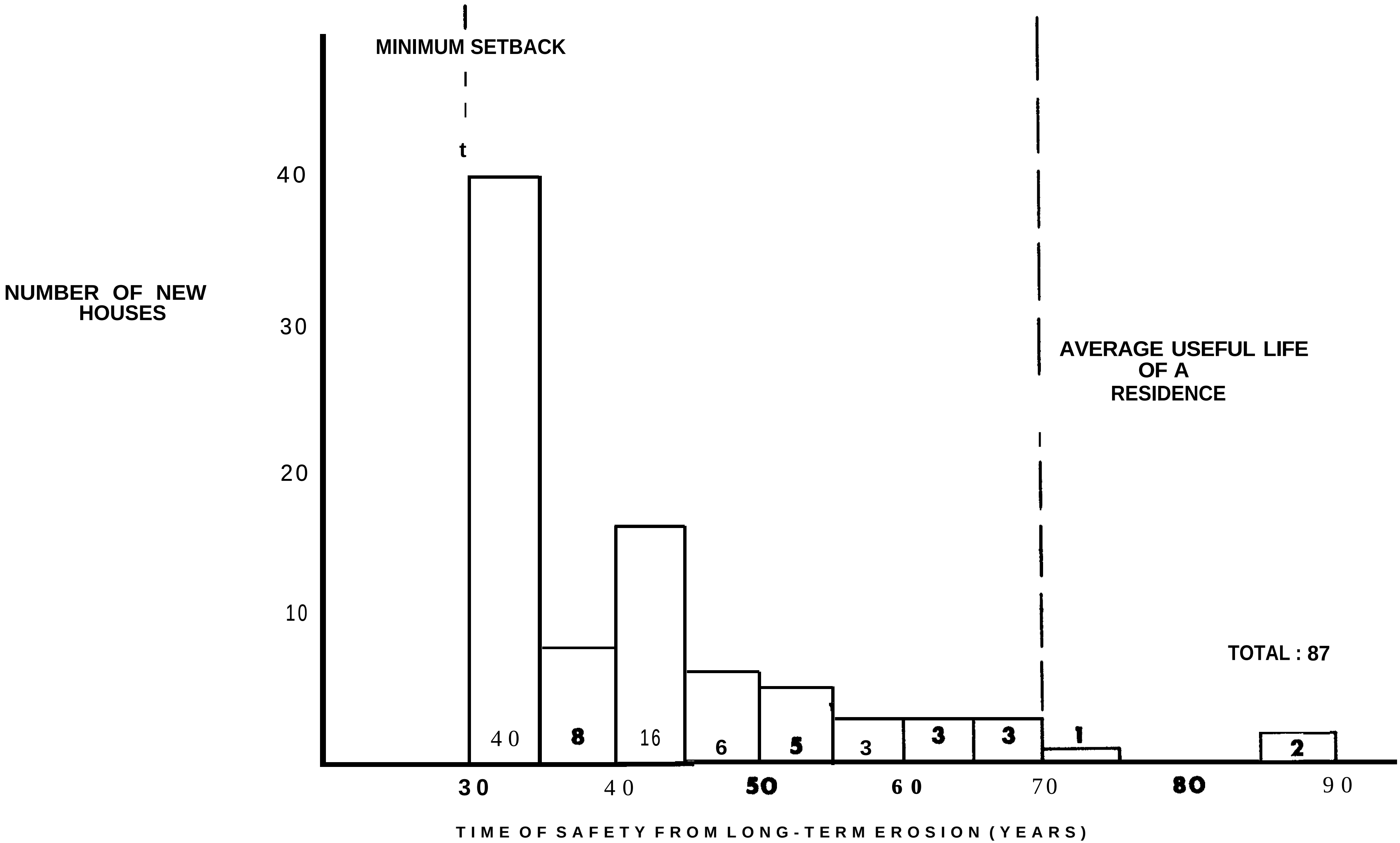
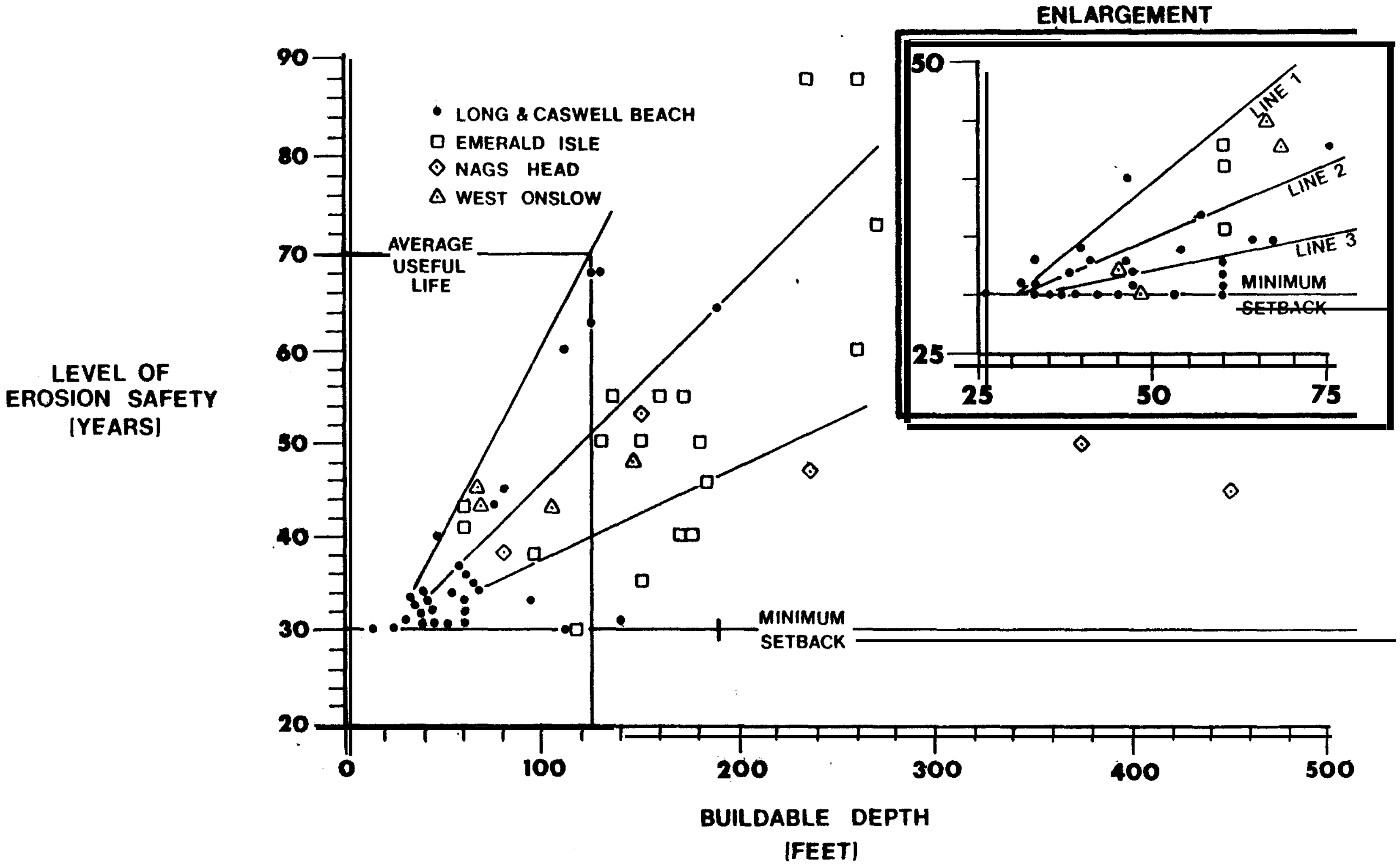


FIGURE 3. LEVEL OF EROSION SAFETY vs BUILDABLE DEPTH



its useful life regardless of how far landward the owner chooses to build. On the other 30 percent of the lots the owner has sufficient depth to build with more than 70 years of erosion safety, but generally chose not to do so for the various reasons listed earlier. Only three percent of those sampled are estimated to be safe from long term erosion for more than the 70-year-average, useful life of the residence.

Line 2 in Figure 3 approximates the same optimal house layout used for the maximum practical setback, but allocating the available open space an equal distance from the ocean and street setbacks. For example, a lot with 100 feet of buildable depth and a 40-feet-by-40-feet-house design leaves 60 feet of open depth in which to locate the house. The middle diagonal line represents a house located 30 feet landward of the minimum ocean setback and 30 feet farther away from the minimum street setback. Line 3 utilizes open space at one foot of extra ocean setback for every three feet of extra street setback. In the above example, the same house would be located 15 feet from the minimum ocean setback and 45 feet away from the minimum street setback.

In practice, property owners seldom choose to optimize the location and layout of a residence for erosion safety. Besides increasing the street setback, it is a common practice to use less than the available unrestricted width of the lot and to build larger area, single-story houses rather than dividing the floor space into two stories. Lines 2 and 3 are therefore not exact reflections of how open space was divided between ocean and street setbacks. However, the lines should be small overestimations of the actual division of space. Keeping that bias in mind, three quarters of the buildings sampled are plotted with more space used for increased street setback than for increased ocean setback, below line 2. One third are plotted below line 3 with three feet of increased street setback for each foot of increased ocean setback.

## CONCLUSIONS

Within the communities studied, new construction subject to the CAMA ocean setback was exactly on (29 percent) or very near (49 percent with 35 or fewer years of safety) the minimum allowable distance from the ocean. While some owners had little choice on where to build due to little buildable depth, most chose to locate near the minimum even though safer locations farther away from the ocean were on the lot. The majority of the buildings sampled appear to use more of any available open space to build farther away from the street setback than away from the ocean setback, reflecting a lack of understanding or concern for erosion safety, and/or a stronger desire for a closer view of the ocean.

Assuming the long-term erosion rates are reasonably accurate for a large sample of lots, and that the useful life of a residential building on the beach is similar to the national average, almost all (97 percent) of the new structures studied are likely to be threatened by long-term erosion in less than the average lifetime of the buildings. Roughly half the houses sampled are predicted to be seaward of the vegetation line in 35 years or less. Even without the effects of a major storm or hurricane, the structures can be expected to be located on the recreational, dry beach due to long-term erosion. Most of the recently permitted structures surveyed are likely to require further attention under the Coastal Area Management Act for relocation, for permits of erosion control methods, beach bulldozing and/or structural damage.

# APPENDIX

The Location of New Residential Structures in the Ocean Hazard Area 1979-1981 by Community.

Table 1. The Location of New Permanent Residential Structures in the Ocean Hazard Area of Long Beach and Caswell Beach with a Minimum CAMA Setback of 60 feet (erosion rate = 2 feet per year) for 1979-1981.

| Actual Setback Selected by Owner (feet) | | Buildable Depth (feet) | Expected Level of Safety from Long Term Erosion (years) |
|---|---|---|---|
| 60 | | 45 | 30 |
| 60 | | 35 | 30 |
| 60 | | 40 | 30 |
| 60 | | 113 | 30 |
| 60 | | 14 | 30 |
| 60 | | 35 | 30 |
| 60 | | 53 | 30 |
| 60 | | 26 | 30 |
| 60 | | 39 | 30 |
| 60 | | 42 | 30 |
| 60 | | 37 | 30 |
| 60 | | 39 | 30 |
| 60 | | 42 | 30 |
| 60 | | 33 | 30 |
| 60 | minimum | 24 | 30 |
| 61 | setback | 33 | 31 |
| 61 | | 47 | 31 |
| 62 | | 31 | 31 |
| 62 | | 140 | 31 |
| 64 | | 38 | 32 |
| 64 | | 47 | 32 |
| 65 | | 94 | 33 |
| 65 | | 41 | 33 |
| 65 | | 33 | 33 |
| 66 | | 46 | 33 |
| 66 | | 60 | 33 |
| 67 | | 40 | 34 |
| 68 | | 54 | 34 |
| 69 | | 67 | 35 |
| 70 | | 64 | 35 |
| 73 | | 57 | 37 |
| 80 | | 46 | 40 |
| 85 | | 75 | 43 |
| 90 | | 80 | 45 |
| 120 | | 111 | 60 |
| 125 | | 125 | 63 |
| 130 | | 188 | 65 |
| 135 | | 128 | 68 |
| 135 | | 125 | 68 |

N = 39

Table 2. The Location of New Residential Structures in the Ocean Hazard Area of Long Beach with a Minimum CAMA Setback of 141 feet (erosion rate = 4.7 feet per year) for 1979-1981.

| Actual Setback by Owner (feet) | Selected | Buildable Depth (feet) | Expected Level of Safety From Long Term Erosion (years) |
|---|---|---|---|
| 142 | minimum | 60 | 30 |
| 144 | setback | 60 | 31 |
| 151 | | 60 | 32 |
| N = 3 | | | |

Table 3. The Location of New Residential Structures in the Ocean hazard Area of West Onslow Beach with a Minimum CAMA Setback of 60 feet (erosion rate = 2 feet per year) for 1979-1981.

| Actual Setback Selected by Owner (feet) | Buildable Depth (feet) | Expected Level of Safety from Long Term Erosion (years) |
|---|---|---|
| 60 | 40 | 30 |
| 60 | 48 | 30 |
| 60 | 190 | 30 |
| 60 | 42 | 30 |
| 64 | 45 | 32 |
| 85 | 105 | 43 |
| 85 | 68 | 43 |
| 90 | 66 | 45 |
| 95 | 146 | 48 |

N=9

Table 4. The Location of New Residential Structures in the Ocean Hazard Area of Emerald Isle With a Minimum CAMA Setback of 60 feet (erosion rate = 2 feet per year) for 1979-1981.

| Actual Setback Selected by Owner (feet) | Buildable Depth (feet) | Expected Level of Safety From Long Term Erosion (years) |
|---|---|---|
| 60 | 60 | 30 |
| 60 | 115 | 30 |
| 70 | 150 | 35 |
| 71 | **60** | 36 |
| 75 | 96 | 38 |
| 80 | 175 | 40 |
| 80 | 172 | 40 |
| 82 | 60 | 41 |
| 85 | 60 | 43 |
| 92 | 183 | 46 |
| 100 | 130 | 50 |
| 100 | 150 | 50 |
| 100 | 180 | 50 |
| 110 | 172 | 55 |
| 110 | 136 | 55 |
| 110 | 160 | 55 |
| 120 | 260 | 60 |
| 145 | 270 | 73 |
| 175 | 260 | 88 |
| 175 | 234 | 88 |

N = 20

Table 5. The Location of New Residential Structures in the Ocean Hazard Area of Nags Head vith a Minimum CAMA Setback of 120 feet (erosion rate = 4 feet per year) for 1979-1981.

| Actual Setback Selected by Owner (feet) | Buildable Depth (feet) | Expected Level of Safety from Long Term Erosion (years) |
|---|---|---|
| 150 | 80 | 38 |
| 180 | 450 | 45 |
| 187 | 236 | 47 |
| 200 | 374 | 50 |
| 210 | 150 | 53 |
| N = 5 | | |

Table 6. The Location of New Residential Structures in the Ocean Hazard Area of Nags Head with a Minimum CAMA Setback of 180 feet (erosion rate = 6 feet per year) for 1979-i981.

| Actual Setback Selected by Owner (feet) | Buildable Depth (feet) | Expected Level of Safety From Long Term Erosion (years) |
|---|---|---|
| 180 | 180 | 30 |
| 188 | 308 | 31 |
| 236 | 102 | 39 |
| 241 | 103 | 40 |
| 243 | 116 | 41 |
| 244 | 157 | 41 |
| 246 | 103 | 41 |
| 249 | 115 | 42 |
| 249 | 95 | 42 |
| 252 | 106 | 42 |
| 257 | 107 | 43 |

N = 11