

THE COST OF ENVIRONMENTAL PROTECTION IN MAINTENANCE DREDGING

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ABSTRACT

The cost of safeguarding the environment during maintenance dredging may have risen with the passage over time of more and more legislation to protect the environment. One way to examine the impact is to study components of and trends in the cost of environmental protection. To keep this examination manageable the study is limited to maintenance dredging contracts in the continental United States planned, designed and contracted by Jacksonville District, U.S. Army Corps of Engineers. The Jacksonville District oversees maintenance dredging of fourteen deep-draft and seventeen shallow-draft Federal harbor projects.

A companion paper (publication in progress) addresses the cost of environmental protection in construction dredging contracts. Maintenance contracts warrant scrutiny since they may involve dredging equipment such as hopper dredges not commonly used in construction. Hopper dredges have features such as turtle deflectors on their dragheads that intend to protect the environment and for which there is a cost, both to equip the dredge with the draghead and also in lower production rates. Hopper dredging contracts contain additional bid line items such as sea turtle trawling.

The major objective of this paper is to present, analyze and interpret data on costs of protecting the environment during maintenance dredging events.

Line item pricing data collected from solicitation bid summaries was analyzed. Trends over time were noted and examined. Emphasis is placed on costs to protect the environment that are incurred during the dredging process.

The major result of this study is the observation that although intuitively one senses from qualitative examination of the planning, design and construction process that more and more funds are spent on environmental protection as time goes by, quantitatively this idea cannot be substantiated from an analysis of bid pricing information. This may be because many measures are put in place to protect the environment that are not tangible.

Keywords: navigation channels, cost estimating, harbor projects, contracting, construction.

INTRODUCTION

Civil works missions of the U.S. Army Corps of Engineers include flood control, streambank erosion control, hydroelectric power, recreation, shore protection, ecosystem restoration and navigation (USACE, 1999). The Commerce Clause of the Constitution establishes Federal interest in navigation. Transportation of goods in commerce and national defense are two drivers behind Federal involvement, historically, in navigation projects. Federal navigation projects must demonstrate economic development, viewed on a national scale. Prior to 1986 and the advent of 'cost sharing', or monetary contribution to Federal navigation projects by other interested parties (usually port authorities), Federal deep-draft navigation projects were funded in total by the Federal government, for example, construction, operation and maintenance. At present, projects for deep-draft channel construction are cost shared, while projects for maintenance are generally funded wholly by the Federal government.

As early as the mid-1800s the Corps of Engineers was engaged in dredging to improve the conditions for waterborne commerce in Florida (Baker, undated). Three waterbodies receiving early Corps involvement are St. Johns River (Jacksonville Harbor Project), Tampa Bay (Tampa Harbor Project) and Biscayne Bay (Miami Harbor Project). One of the first dredging events at the mouth of the St. Johns River was accomplished by a sidewheeler converted to a hopper dredge. A pump and suction pipes were added to the vessel, which was built as a passenger ship. When the

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Over time more and more legislation is passed that protects the environment and impacts dredging projects. Specific Federal legislation that affects dredging projects includes the Endangered Species Act, Marine Protection Research and Sanctuaries Act, Clean Water Act, and Fish and Wildlife Coordination Act. In addition to meeting Federal requirements, Federal dredging projects in Florida seek Water Quality Certification from the State of Florida. Requirements to protect the environment are often agreed to between the Corps of Engineers and the State of Florida (Florida Department of Environmental Protection) that add to project complexity. These are documented in the Water Quality Certification (permit), reflected in the plans and specifications, and accounted for monetarily in the contract bid items.

Figure 1. Example of uncompleted Optional Form 1419.

It might seem that as more and more requirements were placed on dredging contractors to protect the environment during dredging projects, more and more of the total contract price would be devoted to environmental line items. The hypothesis to be tested during this study is the following: If the amount of money spent protecting the environment on maintenance dredging contracts has increased over time then the percentage of the total price of the contract line items specific to environmental protection of the total contract price has increased over time.

METHODS

Optional Form 1419, “Abstract of Offers-Construction”, becomes public record after a bid opening. Bid openings are held by the U.S. Army Corps of Engineers in conjunction with solicitations for construction contracts of the Information For Bid, ‘IFB’, type, known casually as ‘low bid.’ The completed Form 1419 contains valuable information such as date of bid opening, line items, estimated government line item cost, and offeror line item pricing. Figure 1. shows the blank form. A hardcopy of the “Abstract of Offers” form, also known as the ‘bid abstract’, is filed in the Jacksonville District after each bid opening.

For this study a photocopy was made of each “Abstract of Offers” form for maintenance dredging contracts bid at the Jacksonville District since 1974. This year was chosen since line items specific to environmental protection could not be found for maintenance dredging contracts prior to that year. Approximately 120 “Abstract of Offers” forms were photocopied. In order to qualify for inclusion into the study the contract had to meet several requirements. First, the contract had to be primarily for maintenance dredging of a Federal navigation project. Beach renourishment projects also employ dredging as a construction method and this type of project was excluded from the scope of this study. New work dredging contracts were not included. Second, the contract had to be for a Federal civil works navigation project, deep draft or shallow draft, within the jurisdiction of the U.S. Army Corps of Engineers, Jacksonville District, in Florida. Shallow draft projects have a project depth equal to or less than 14 feet. Deep draft projects have a project depth greater than 14 feet. Jacksonville District also oversees maintenance dredging of Federal navigation projects in the U.S. Virgin Islands and Puerto Rico. No contracts were included that involved dredging of a military installation.

Due to the large number of forms found it was necessary to choose only some for analysis. The forms were ordered by date of bid opening. Every tenth form was selected for inclusion in the analysis. Thus, thirteen forms were chosen for study.

A spreadsheet was created containing data from each tenth form. The data taken from the “Abstract of Offers” included project name (abbreviated), date of bid opening, environmental protection line item designation, environmental protection line item price, total bid price, mobilization price, and dredging price per cubic yard. The data put into the spreadsheet is for the low bidder.

Table 1. Spreadsheet of data from Forms 1419.

Project	Gulf Intracoastal Waterway	Atlantic Intracoastal Waterway	Tampa Harbor/Alafia River	Charlotte Harbor	Palm Beach Harbor	Canaveral Harbor	Charlotte Harbor	Palm Beach Harbor	Charlotte Harbor	Tampa Harbor/Alafia River	Atlantic Intracoastal Waterway	Port Everglades Harbor	Palm Beach Harbor	
Line Item	Year	1974	1980	1983	1985	1988	1991	1992	1994	1996	1999	2001	2005	2006
Date of bid opening		4/18/1974	8/26/1980	2/9/1983	6/20/1985	11/9/1988	6/17/1991	11/19/1992	11/22/1994	12/30/1996	6/15/1999	12/18/2001	5/17/2005	7/26/2006
Disposal Area Monitoring		\$20,000												
Turbidity Monitoring			\$5,000			\$10,000	\$4,000	\$1,000		\$7,500	\$10,000	\$49,000	\$3,258	\$9,350
Environmental Monitoring				\$20,000										
Turtle Monitoring							\$1,000							
Beach Tilling								\$500		\$4,200				
Endangered Species Observer									\$9,650					\$7,650
Endangered Species Monitoring											\$0		\$3,600	
Mob/demob. Turtle Trawler													\$0	
Relocation Trawler													\$0	\$56,000
Total Bid		\$1,048,800	\$343,800	\$988,000	\$1,885,100	\$1,061,000	\$1,283,800	\$1,584,100	\$941,650	\$2,445,000	\$2,136,000	\$7,112,069	\$938,900	\$1,935,270
Subtotal/Env Prot Line Items		\$20,000	\$5,000	\$20,000	\$0	\$10,000	\$5,000	\$1,500	\$9,650	\$11,700	\$10,000	\$49,000	\$6,858	\$73,000
Percent of Total Bid		1.91%	1.45%	2.02%	0.00%	0.94%	0.39%	0.09%	1.02%	0.48%	0.47%	0.69%	0.73%	3.77%
Mobilization		\$250,000	\$130,000	\$308,000	\$200,000	\$250,000	\$200,000	\$748,600	\$495,000	\$750,000	\$965,000	\$2,113,069	\$242,000	\$800,000
Percent of Total Bid		24%	38%	31%	11%	24%	16%	47%	53%	31%	45%	30%	26%	41%
Dredging Cost Per Cubic Yard		\$1.65	\$3.48	\$1.25	\$2.74	\$5.50	\$2.32	\$3.00	\$8.74	\$5.88	\$2.25	\$5.50	\$5.03	Not available
Dredging Cost Per Meter		\$2.16	\$4.55	\$1.63	\$3.58	\$7.19	\$3.03	\$3.92	\$11.43	\$7.69	\$2.94	\$7.19	\$6.58	Not available
Number of Line Items		1	1	1	0	1	2	2	1	2	2	1	4	3

From the data extracted a subtotal was calculated of all the line items specific to environmental protection for each contract. A percentage was then calculated of the subtotal divided by the total contract price. A percentage was also calculated of the mobilization price divided by the total contract price. The subtotal as well as the percentages are shown in Table 1. The number of line items was counted for each contract.

Graphs were created of the line item subtotal/total contract price versus time, mobilization/total contract price versus time, dredging cost per cubic yard versus time and number of line items per contract versus time.

RESULTS

The graph of the environmental protection line item subtotal/total contract price versus time is shown as Figure 2. Data points are plotted in a scatter diagram. A linear trendline plotted using the points has a slope that is nearly flat. This means that the trend in the percentage expressed by the subtotal of the line item prices for environmental protection line items divided by the total contract price is barely increasing over time.

The graph of the mobilization line item price/total contract price versus time is shown as Figure 3. Again, data points are graphed in a scatter diagram. A linear trendline plotted of the points has a slope that is positive. This means that the trend in the percentage expressed by the mobilization price divided by the total contract price is increasing with time.

The graph of the dredging unit price versus time is shown as Figure 4. The unit prices are plotted in a scatter diagram. A linear trendline plotted using the unit prices has a positive slope. This means that the trend in the unit prices is increasing over time.

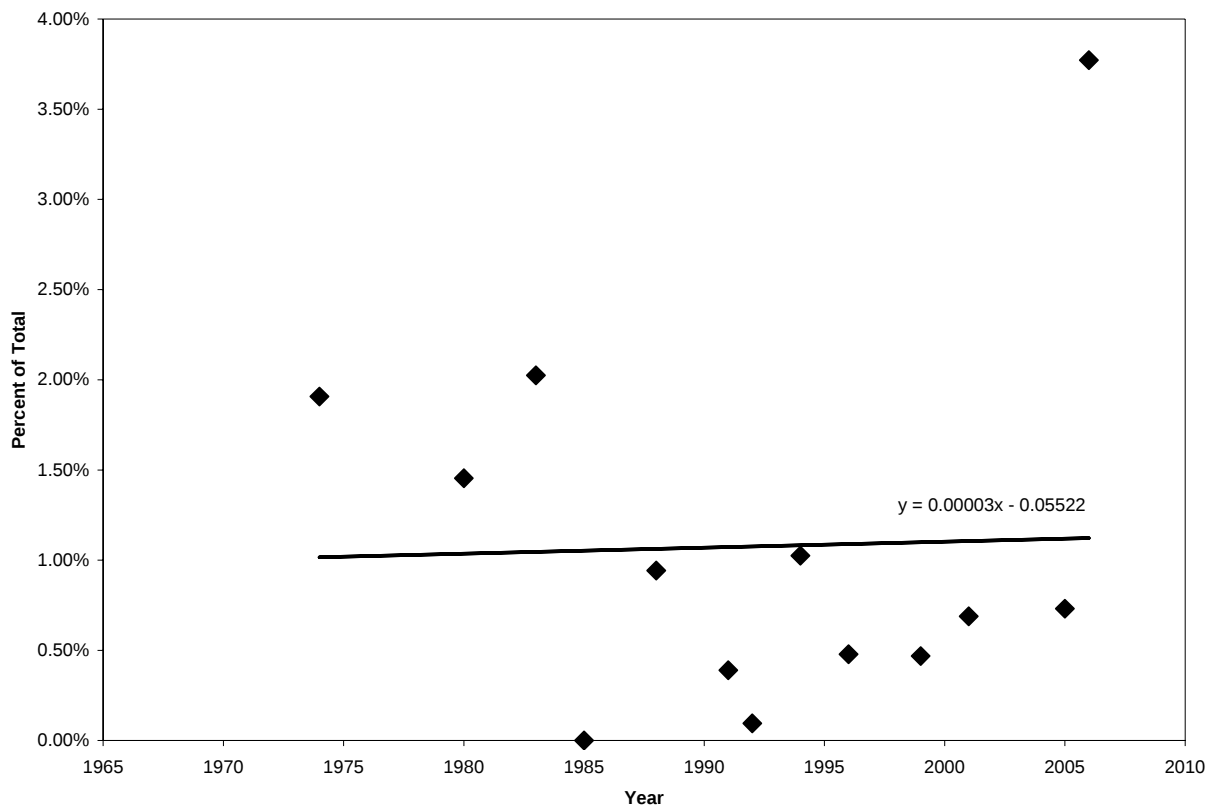


Figure 2. Environmental protection line item/total contract price versus time.

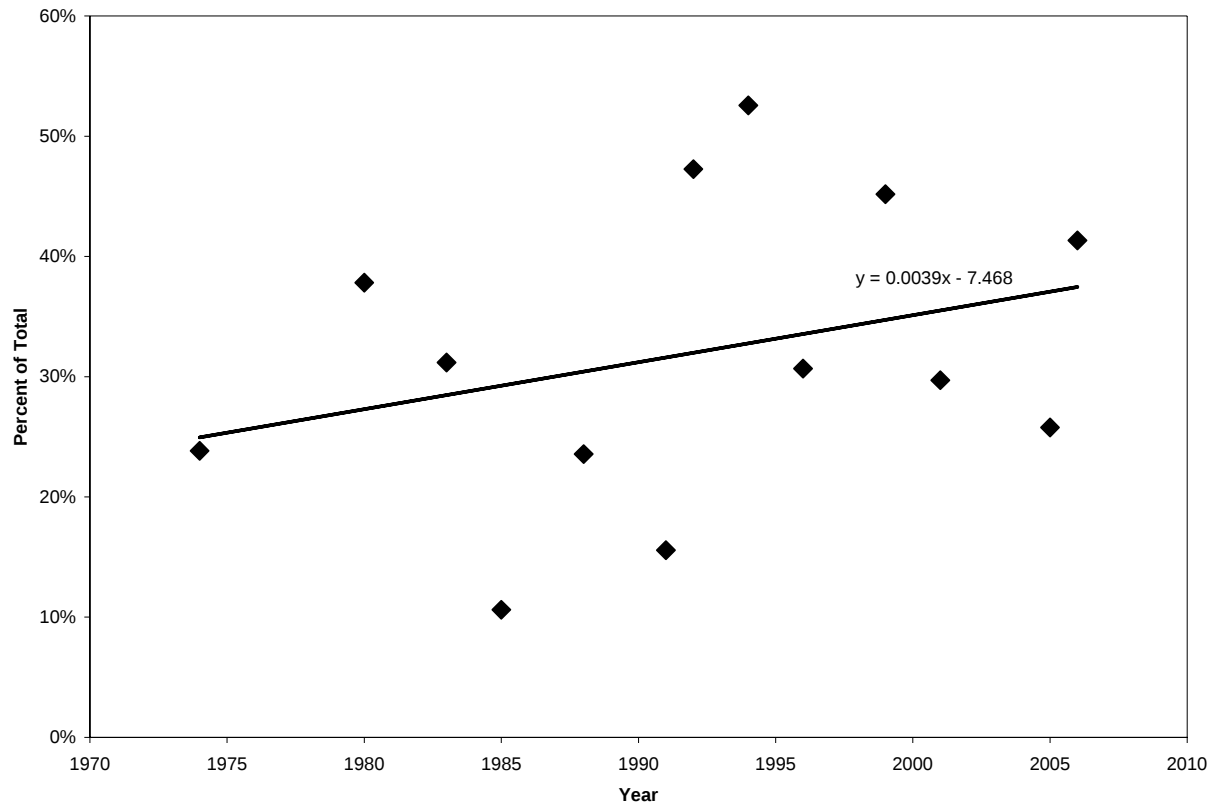


Figure 3. Mobilization price/total contract price versus time.

The graph of the number of environmental line items per contract versus time is shown as Figure 5. The numbers of line items are plotted in a scatter diagram. The linear trendline plotted using the numbers has a positive slope. This means that the trend in the number of line items per contract is increasing over time.

DISCUSSION

The intention of this study was to investigate the cost of environmental protection in maintenance dredging contracts. The suspicion was that as time has gone by and increasingly stringent legislation has been passed and put into practice, the cost would have risen. The hypothesis tested during this study is the following: If the amount of money spent protecting the environment on maintenance dredging contracts has increased over time then the percentage of the total price of the contract line items specific to environmental protection of the total contract price has increased over time. Readily accessible, reproducible, non-confidential data existed for a numerical analysis of costs in the published "Abstract of Offers-Construction" forms (Optional Form 1419). To give the data some type of comparability, restrictions were placed on which construction projects would be studied. Previously new work dredging contracts were examined (Leeser, 2007). At that time it was suggested that maintenance dredging contracts might be revealing since maintenance dredging equipment includes the hopper dredge, not often employed in new work dredging projects, and hopper dredges have special equipment for the protection of sea turtles. Jacksonville District of the U.S. Army Corps of Engineers contracts for maintenance dredging projects in Florida, the U.S. Virgin Islands and Puerto Rico. Only projects in Florida were included in the study. Jacksonville District also contracts maintenance dredging projects for the military and for civil works. Only civil works projects were included. One hundred twenty "Abstract of Offers" forms were found on file in Jacksonville District for civil works maintenance dredging projects in Florida that had at least one bid item for environmental protection. The first form found is dated 1974. A sampling of the 120 forms was used for the numerical analysis. Thirteen "Abstract of Offers" were included. Only the low bidder's prices were examined. A spreadsheet was made of data extracted from the forms. The data included is the name of the project (for recordkeeping only), the date of the bid opening (to allow of analysis over time), the names of the bid items for environmental protection, the price bid for each of

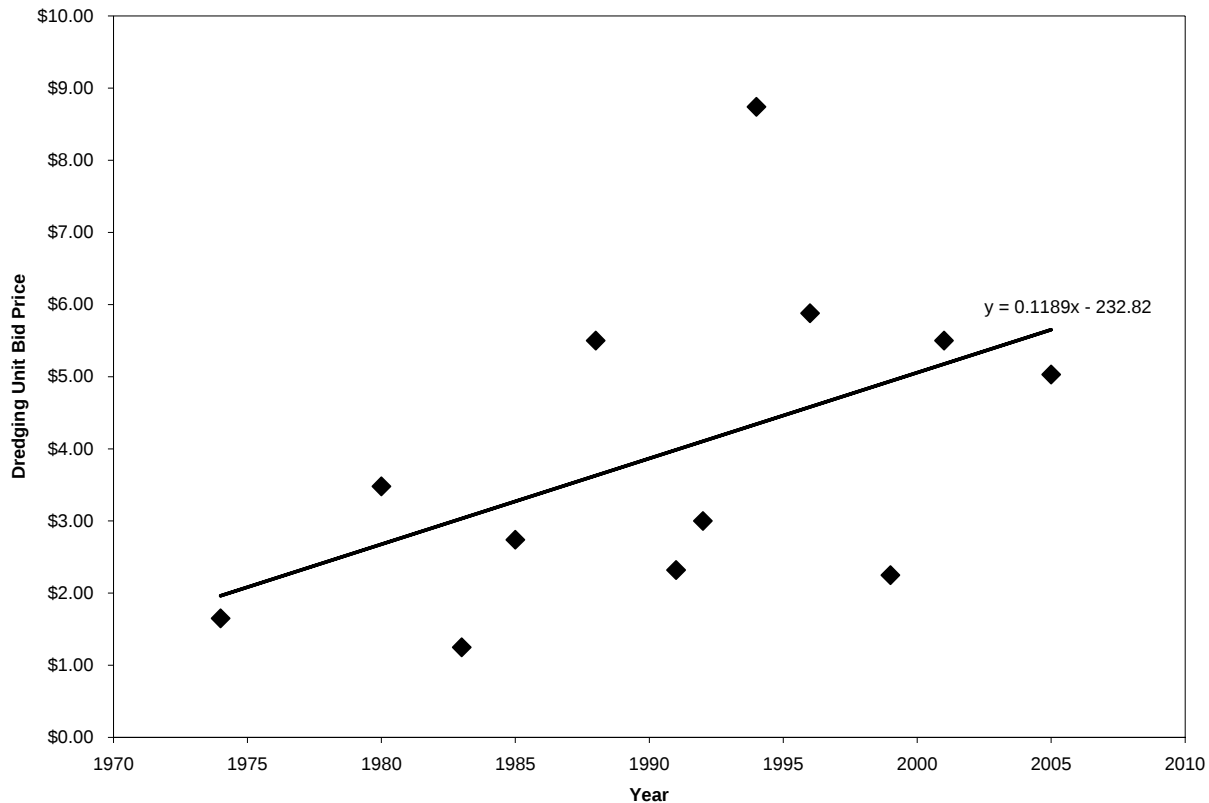


Figure 4. Dredging unit bid price versus time.

these items, the total price bid for the base bid (in case there were contract options, which may or may not be awarded eventually), the price for the mobilization bid item, and the price bid for the dredging itself, sometimes referred to as excavation. For each contract low bidder studied, and using this data, a subtotal was calculated of all the line items for environmental protection. A percentage was then calculated of the subtotal divided by the total contract bid price. This percentage was graphed over time. A trendline was added to the graph. The trendline is approximately horizontal and demonstrates no obvious increase over time. The flat trendline implicates the portion of the hypothesis that says, “then the percentage of the total price of the contract line items specific to environmental protection of the total contract price has increased over time”. The flat trendline is an indication that the percentage may not have increased over time. This leads one to question whether indeed more and more has been spent over time protecting the environment in maintenance dredging contracts. Perhaps there are other line items in a contract that bear the cost of environmental protection, even if not explicitly. Two line items common to all dredging contracts are mobilization/demobilization and excavation.

A percentage was calculated of the mobilization/demobilization price divided by the total contract price. This percentage was graphed over time. A trendline was added to the graph. In this case the trendline is obviously increasing, leading one to note that as time goes by the mobilization/demobilization price is a higher percentage of the total contract price. Contractors are only asked to divulge their exact mobilization/demobilization costs under very certain circumstances, and not very often, so one might never know exactly what makes up these costs. It might be that some of the costs to protect the environment are placed in this line item. A dredging contractor receives 60 percent of his mobilization/demobilization price once mobilization is complete (about 60 days after contract award), so this is funding up front if it is needed to pay subcontractors or if the contract is risky.

Contract specifications sometimes include environmental protection measures that fall under work needed to perform the dredging, or excavation, line item. For example, if the disposal of the dredged material is on a beach, shorebird monitoring may be needed. Were this activity included in the Dredging Section of the specifications and not specifically accounted for in a Shorebird Monitoring line item, the cost for the activity would be included in the

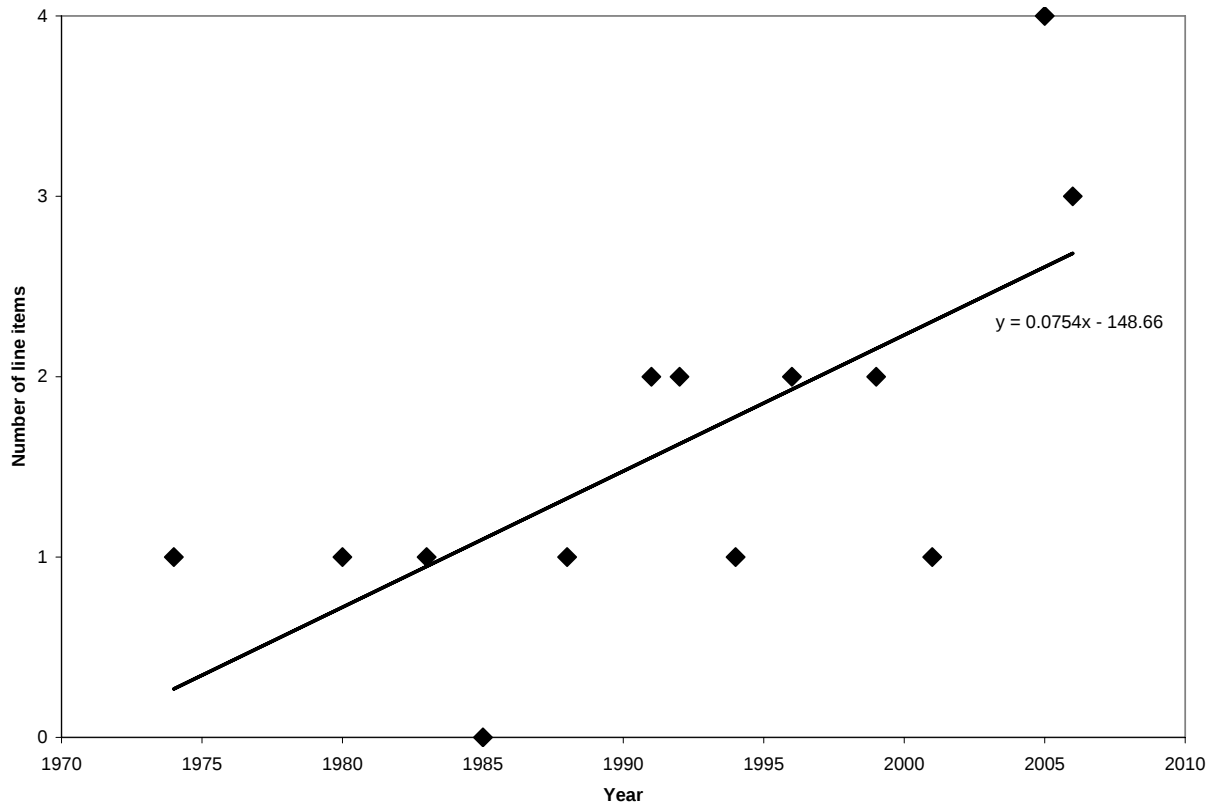


Figure 5. Number of environmental line items versus time.

dredging unit cost. An examination of the trendline plotted on the graph of the dredging unit cost versus time indicates the slope of the trendline is increasing. Many factors might account for an increase in the dredging unit cost over time, including increased labor and fuel costs. Inclusion of additional environmental protection activities might also.

The first environmental line item to appear on the “Abstract of Offers”-Construction form was disposal area monitoring. This was followed by turbidity monitoring, environmental monitoring, turtle monitoring, beach tilling, endangered species observer, endangered species monitoring, sea turtle trawler mobilization/demobilization and sea turtle relocation trawling. The number of line items in a maintenance dredging contract depends in part on project specifics. Turtle monitoring and beach tilling would be found as line items in a contract where the dredged material was placed on a beach. Sea turtle trawler mobilization/demobilization and sea turtle relocation trawling would be found as line items in a contract using a hopper dredge. Contractors are not told what equipment to use for the dredging so as long as hopper dredges are not excluded by environmental statute or permit requirement (water quality certification) these line items would appear in the contract. A contractor planning to use another type of equipment, not a hopper dredge, would typically enter zero as the price for the sea turtle trawler mobilization/demobilization and sea turtle relocation trawling line items.

While the contract line items specific to environmental protection are tangible and measurable, there are other items of work that contribute to a dredging project that are for environmental protection and are less tangible and less or non-measurable. Less tangible environmental protection measures include closed clamshell buckets (versus open buckets), no night-time clamshell dredging in manatee zones, no wake by tug/barge combinations or crew boats in manatee zones, propeller guards on vessels for manatee protection, and no dredge anchoring in seagrass beds. When a dredging contractor is required by law, the specifications or the permit/water quality certification, to employ such measures, capital costs can go up and productivity can be lowered. The effect of both is to increase the contractor’s price of a contract. Gains in productivity, the number of cubic yards of material dredged per unit time, due to

technological advances in dredging equipment may have gone up over time, only to be offset in the cost of dredging by reductions in productivity due to restrictions placed on dredges for protection of the environment.

In addition to contract costs there are costs to supervise and administer the contract, costs to prepare plans and specifications, and costs to plan the project. These costs are made up primarily of labor costs. A tenet of planning a navigation project is avoiding significant environmental resources. If intense discussions with environmental resource agencies are needed to ensure or promote avoidance and total labor hours devoted to the planning are more, then the cost of this project component will be higher. Negotiating permit or water quality certification conditions with the State of Florida, or compliance with Federal laws with other Federal agencies, can be extremely labor intense and increase the cost of developing the plans and specifications.

An idea for further study is to verify the results of the numerical analysis by adding data from more of the 120 forms found. Another idea is to study dredge productivity and the effect of environmental restrictions on productivity. In addition, labor costs to incorporate environmental protection into planning, design, and construction management could be quantified and studied over time.

CONCLUSIONS

Whether the percentage calculated from the total price of the maintenance dredging contract line items specific to environmental protection divided by the total contract price has increased over time is dubious. A linear trendline plotted using the points has a slope that is nearly flat. This means that the trend in the percentage expressed by the subtotal of the line item prices for environmental protection line items divided by the total contract price is barely increasing over time.

However, the trend in the percentage expressed by the mobilization price divided by the total contract price is increasing with time. A linear trendline plotted of these points has a slope that is positive. Dredging contractors may or may not be including measures to protect the environment in the mobilization/demobilization line item.

In addition, the trend in the maintenance dredging unit prices is increasing over time. A linear trendline plotted using the unit prices has a positive slope. Again, dredging contractors may or may not be including measures to protect the environment in the dredging line item.

Finally, the trend in the number of line items per contract is increasing over time. The linear trendline plotted using the number of line items has a positive slope. More and more environmental line items are included in maintenance dredging contracts as time goes by. This may be due to the passage of legislation to protect the environment and due to the stricter interpretation of existing legislation.

While intuitively one senses from qualitative examination of the planning, design and construction management process that more and more funds are spent on environmental protection as time goes by, quantitatively this idea cannot be substantiated from an analysis of bid pricing information. This may be because many measures are put in place to protect the environment that are not tangible.

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This paper represents the views of the author, and not necessarily the policies or procedures of the U.S. Army Corps of Engineers or the Jacksonville District.