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Effective capping of a dredged material mound requires complete coverage of the dredged material mound with a set thickness of cap material. To completely cap the deposit, the areal extent of the mound must be known as well as the height of the deposit. The DAMOS Capping Model may be used to predict the diameter of the dredged material mound as well its height.

The DAMOS Capping Model predicts the extent and height of a mound by taking a known composition and volume of material and distributing it within a set radius of operations based on a center weighted distribution. The number of points in the distribution is calculated based on project volume and the average barge load. Running the Capping model using variables from five known dredged material mounds in Long Island Sound produced predicted mound heights with an average error between 15 and 25% of the actual mound height. Independently altering the variables showed the model to be very sensitive to the distance used as the radius of operations. Because the model uses a center-weighted random distribution pattern, the closer the actual distribution pattern resembles this the more accurate the model will be.

In order to make the actual dredged material disposal mimic the random center-weighted distribution, there must be a taut-wire moored disposal buoy at the site, and there must be tight navigational control over the disposal operation. If this field criterion is met, and if the grain size composition and average barge volume used in the model are approximately correct (within about 500 m^3 barge volume and with a grain size that is not skewed towards the opposite end member) the DAMOS Capping Model will very accurately predict the areal extent of the dredged material. In general, the DAMOS Capping Model model predicts mound height with less accuracy than it does areal distribution. However, when the model is run 5 times to predict a mound height at the 90% confidence level, it is very accurate (–0.13 m error) for mounds that have been formed with a small radius of operations and that have had barges *release the material in a center- weighted distribution pattern.*

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The DAMOS Capping Model predicts the extent and height of a mound by taking a known composition and volume of material and distributing it within a set radius of operations based on a center weighted distribution. The number of points in the distribution is calculated based on project volume and the average barge load. Running the Capping Model using variables from five known dredged material mounds in Long Island Sound produced predicted mound heights with an average error between 15 and 25% of the actual mound height. Independently altering the variables showed the model to be very sensitive to the distance used as the radius of operations. Because the model uses a center-weighted random distribution pattern, the closer the actual distribution pattern resembles this the more accurate the model will be.

In order to make the actual dredged material disposal mimic the random center-weighted distribution, there must be a taut-wire moored disposal buoy at the site, and there must be tight navigational control over the disposal operation. If this field criterion is met, and if the grain size composition and average barge volume used in the model are approximately correct (within about 500 m^3 barge volume and with a grain size that is not skewed towards the opposite end member) the DAMOS Capping Model will very accurately predict the areal extent of the dredged material.

To effectively cap a dredged material mound requires knowing the area that the cap material has to cover. The DAMOS Capping Model will supply that answer. Being able to accurately predict the mound height is necessary to determine if the dredged material mound has exceeded the minimum water depth (and is exposed to erosion) and to determine if all the material is accounted for in the mound. In general, the DAMOS Capping Model predicts mound height with less accuracy than it does areal distribution. However, when the DAMOS Capping Model is run 5 times to predict a mound height at the 90% confidence level, it is very accurate (~0.13 m error) for mounds that have been formed with a small radius of operations and that have had barges release the material in a center- weighted distribution pattern.

1.0 INTRODUCTION

The Disposal Area Monitoring System (DAMOS) Capping Model was designed to predict the configuration of a disposal mound and help estimate the amount of clean material needed to cap the mound adequately (i.e., to effectively isolate contaminated sediments from the water column above). Previous analysis of the model determined that it provided an accurate basis for cap volume decisions and generally predicted the lateral extent of disposal mounds but did not accurately predict mound height. The DAMOS Capping Model is based on the works of Koh and Chang (1973) and Brandsma and Divoky (1976). These reports provided the default coefficients for equations in the model that were used to calculate the convective descent and bottom encounter of dredged material (Table 1-1).

The DAMOS Capping Model is used to calculate the areal distribution and height of the dredged material covering the ambient bottom as the result of multiple barge disposal events near the designated release point. The model randomly locates each barge load of dredged material within a designated radius using a center-weighted distribution (Figure 1-1). Parameters input for each model run include: project volume, barge volume, grain size distribution, disposal depth, disposal method, and radius of operations. An *in situ* bulk density of 1450 kgm^{-3} and an ambient water density of 1030 kgm^{-3} are assumed for the DAMOS sites used in this report. The relatively weak bottom currents at DAMOS disposal sites, and the short travel time for the sediment from the sea surface to the seafloor, inhibit any significant displacement of dredged material by currents. The bottom current speed in the DAMOS Capping Model is therefore entered as 0 cms^{-1}.

The ability of the DAMOS Capping Model to predict lateral extent and height of dredged material was tested using data from five disposal mounds in Long Island Sound as variables: CLIS-89 and CS-90-1 at the Central Long Island Sound Disposal Site (CLIS), the WLIS "D" mound at the Western Long Island Sound Disposal Site (WLIS), and mounds NL-88 and NL-TR at the New London Disposal Site. The accuracy of the average barge volume, radius of operations, and grain size distribution depended on information available from the DAMOS database and New England Division (NED). Subsequent systematic changes in the parameters, or data sets, from each mound were used to determine which parameter, if any, could be refined to improve the model's accuracy in predicting mound height.

The effect of changes in the parameters on predicted mound height could not be isolated from the effect of the random distribution pattern of disposal events built into the model. Therefore, the model was modified to accept field data that placed known volumes of dredged material in specified locations, eliminating the random spatial variability. This determined the model's ability to predict mound height with the only variable being dredged material composition. The model was then altered to run an identical random distribution pattern each time.

During these runs, the grain size, barge volume, and radius of operations were varied separately to determine their effect on predicted mound height. Finally, the variability of unique center-weighted random distributions was reintroduced, and the DAMOS Capping Model was run numerous times with an identical data set to determine the number of times the model needed to be run to obtain an average mound height to specified confidence limits.

2.0 METHODS

The procedures to test the ability of the DAMOS Capping Model to accurately predict mound height evolved as the effect of the input parameters was better understood. The final test procedures included:

- comparison of model runs using best available data to actual mound heights,
- entering actual barge volumes and disposal points into the model to eliminate random distribution and comparing the results to the measured height and areal distribution of the dredged material,
- forcing the model to use the same random distribution of disposal locations and testing the effects of changing input parameters, and
- running the original model many times with an identical data set to determine variability.

Data from bathymetric surveys at five dredged material mounds in Long Island Sound (NL-88, NL-TR, CLIS-89, CS-90-1, and WLIS "D") were used to compare the DAMOS Capping Model's prediction of mound height with actual mound height. The following information was input to the model: project volume, average barge volume (calculated from the number of barge loads), sediment composition, radius of operations (determined from plots of barge release points), disposal method, and water depth. The capping model used a material density of 1450 kgm^{-3}, water density of 1030 kgm^{-3}, and a bottom current speed of 0 cms^{-1} when modeling these mounds. The dredging method in all cases was a clamshell dredge. The capping model was run five times for each mound to determine the effect of random dredged material distribution on predicted mound height.

The actual distribution of barge release points at each of the five mounds did not follow the center-weighted random distribution pattern predicted by the DAMOS Capping Model (Figures 2-1, 2-2, and 2-3). Our use of the average barge volume and radius of operations as inputs to the model was an attempt to have the model come as close to the actual distribution pattern as possible while still using the model's center-weighted distribution pattern. These parameters were changed for each mound— increasing and decreasing the barge volume and the radius of operations— to determine if the changes would improve the accuracy of the predicted mound height as compared to the actual mound height.

The composition of dredged material used in the model for each mound was a best-guess estimate based on information obtained from NED. In general, the NED information reported higher percentages of sand than generally is observed in sediment samples taken from the Long Island Sound Disposal Sites. Depending on the variability of the original NED data set, the model dredged material composition was altered one or more times and run through the DAMOS Capping Model to determine what effect this parameter had on the height of that dredged material mound.

After attempting to determine how all the parameters in the DAMOS Capping Model affected the predicted mound height, it was decided to test the model and see if it would accurately predict dredged material height and distribution by entering the actual barge volumes and barge release points for the NL-TR and WLIS "D" mounds directly into the model. The only parameter in these runs which was not based on actual field data was the dredged material composition. The predicted dredged material distributions from these model runs were contoured at the same scale as a chart of the actual dredged material mounds. Agreement between the predicted and actual dredged material location and thickness would indicate that the model accurately calculated the behavior of dredged material as it was deposited.

When the accuracy of the model was determined with actual barge volumes and release points, variability was reintroduced systematically by running the model with varying sets of parameters using an identical random distribution pattern each time. The initial hypothetical data set consisted of a 100,000 m^3 project volume, a 2,000 m^3 average barge volume, a 200 m radius of operations, and a grain size distribution of 25% gravel, 25% sand, 25% silt, and 25% clay. With the distribution pattern and project volume held constant, the model was run while changing one of the remaining variables (barge volume, radius of operations, or grain size). Barge volume was increased 25%, 50%, and 75% and decreased 25% and 50% of the initial volume. The initial radius of operations was increased and decreased 25% and 50%. The grain size distribution was varied 16 ways ranging from 70% gravel to 70% clay. The model-predicted change in mound height was then plotted against the change in the parameter.

Finally, the actual model, using different random distribution patterns for barge locations with each run, was tested many times with the same input parameters. To determine the number of DAMOS Capping Model replicate runs needed to obtain certain confidence levels, the parameters for mound NL-TR were run through the capping model 40 times. The average mean and standard deviation were used to determine the number of runs needed to obtain 80, 85, 90, and 95% confidence levels.

3.0 RESULTS

The DAMOS Capping Model showed varying degrees of success in predicting dredged material mound heights for NL-88, NL-TR, CLIS-89, CS-90-1, and WLIS "D" when the project volume, average barge volume, radius of operations, sediment composition, and water depth were entered into the model for each mound (Figure 3-1 and Table 3-1). The model predicted heights that differed by -0.06 m to +2.36 m from the actual mound height. Running the model five times for each mound predicted five different mound heights. The predicted mound height was within 0.20 m (a conservative estimate of bathymetric resolution) of the actual mound height only for NL-TR and NL-88.

Since the actual distribution pattern of barge release points for the five mounds did not correspond to the center-weighted distribution pattern used by the DAMOS Capping Model, the average barge volume and the radius of operations were changed as an initial attempt to alter the predicted pattern of dredged material distribution using the existing software. The average barge volume was increased and decreased to change the number of release points used to distribute the dredged material. When the barge volume was increased (decreasing the number of release points), the average mound height predicted by the model was within 0.20 m of the actual height for two of the five mounds tested (NL-88 and CS-90-1, Table 3-2). Decreasing the barge volume (increasing the number of release points) caused the average predicted mound height to remain within 0.20 m of the actual height for CS-90-1. For mound CS-90-1, both increasing and decreasing the barge volume seemed to increase the accuracy of the model (Figure 3-2). At WLIS "D", one run with a smaller barge volume predicted a mound height within 0.20 m of the actual height.

Changing the radius of operations increases or decreases the area over which the model randomly distributes dredged material. Altering that area did not improve consistently the ability of the model to predict mound height (Table 3-3, Figure 3-2). Predicted mound heights were within 0.20 m of the actual height for NL-88 when the radius was increased, but the correct mound height was predicted with the original radius of operations as well (Table 3-1). For mound CS-90-1, the model improved when the radius was increased.

Dredged material grain size composition originally was estimated based on NED information. Due to the uncertainty of these data, the model dredged material composition was changed to reflect either a greater percent of fine-grained sediment or a more homogeneous composition (Table 3-4). These changes in grain size generally decreased the accuracy of the predicted mound heights (Figure 3-2). The few close approximations to actual mound height that were predicted when the grain size composition was changed had been obtained previously by changing other parameters (Figure 3-2).

After none of the attempted variations to the input parameters consistently improved the predicted mound height, the capping model was altered temporarily to use the actual barge volumes and release locations for NL-TR and WLIS "D" to determine if the model would place dredged material accurately and predict its lateral extent after deposition. The resulting plots of the predicted location and thickness of dredged material were contoured at the same interval as a topographic chart of the actual mounds. The predicted mound from WLIS "D" parameters produced a generally round shape with a radius of 250 m (Figure 3-3). This corresponds to the contour plot of WLIS "D" mound and the location of barge release points (Figures 3-4 and 3-5). However, the peak height was predicted to be 6.55 m whereas the actual mound height is 5.43 m. The model prediction based on the NL-TR data generated a multipeaked mound slightly triangular in shape (Figure 3-6). This corresponds to the locations of the actual barge release points (Figure 3-7). The actual NL-TR mound is similar in shape to the model prediction with an additional small peak in the northeast corner of the mound (Figure 3-8). The highest peak predicted for NL-TR was 2.74 whereas the actual mound peaked at 1.79 m.

The individual influences of barge volume, radius of operations, and dredged material composition on predicted mound height in the DAMOS Capping Model were measured using a standard hypothetical data set and altering each variable one at a time. The DAMOS Capping Model was adapted to run the standard data set through the same random distribution pattern each time. The data set consisted of:

- 100,000 m^3 project volume
- 2,000 m^3 barge volume
- 200 m radius of operations
- 18 m water depth
- 25% gravel, 25% sand, 25% silt, and 25% clay

Using this set of data, the model predicted a mound 3.20 m high. Increasing and decreasing the barge volume up to 50% caused changes in the peak height up to 15% (Figure 3-9). Increasing and decreasing the radius of operations by 50% produced up to 100% changes in peak height (Figure 3-10). Changes in grain size composition produced varying increases in height when coarse sediment was increased and decreases in height when the percent of fines was increased (Figure 3-11).

The original DAMOS Capping Model, with the random center-weighted distribution, was run 40 times using the same set of data to determine the number of repetitions needed to obtain a specified level of accuracy. The number of runs needed to obtain 80%, 85%, 90%, and 95% confidence levels were calculated by the following formula:

$$n = s^2/(D^2x^2)$$

where

n = number of runs
s^2 = variance
D = index of precision (0.2 for 80%, 0.15 for 85%, 0.10 for 90%, and 0.05 for 95%)
x = mean (Elliott, 1977)

Five to six repetitions were needed to obtain results at the 90% confidence level. Increasing the confidence level to 95% required 22 model runs (Figure 3-12).

4.0 DISCUSSION

The ability of the DAMOS Capping Model to predict the lateral extent and height of dredged material mounds was tested by incorporating parameters from the DAMOS database and New England Division (NED) information into the model to recreate actual disposal mounds NL-TR, NL-88, CLIS-89, CS-90-1, and WLIS "D". The heights predicted by the model varied widely from the actual height of the dredged material mounds. When the model was run five times for each mound to approach a value at the 90% confidence level, the model predicted a mound height within 20 cm of the actual height for only one mound, NL-88 (Table 4-1).

Errors in predicting mound height may have been due to the accuracy of the data input to the model or to behavior of dredged material that is not accounted for in the model. Of three parameters input to the model—barge volume, radius of operations, and grain size distribution—changing the radius of operations had the greatest effect on the predicted mound height (Figures 3-9, 3-10, 3-11). The radius of operations value used in the model is based on the anticipated dredged material release locations. When it is anticipated that the barges will release material in close proximity to the buoy (100 m radius of operations for NL-88; Figure 2-1), the DAMOS Capping Model predicts mound height very accurately.

When the barge locations were accurate, the model correctly predicted the shape of the mound (Figures 3-3 and 3-6). If that shape was based on a center-weighted distribution of dredged material, there would be a single peak as predicted by the model rather than the multipeak mounds produced by the actual distribution of dredged material at NL-TR and WLIS "D".

Inaccuracies in grain size distribution or average barge volume caused smaller errors in mound height. However, when combined, inaccuracies in the grain size and barge volume could cause significant errors in predicted mound heights. Predicting an accurate average barge volume for the model would be possible only if the size of the barges for a project were known when doing the modeling. Errors in grain size composition become more important in predicting the mound height when the major grain size is skewed erroneously to the coarse or fine-grained material (Figure 3-11).

Factors that may affect mound height and which were not accounted for in the DAMOS Capping Model were different dredged material densities and the compaction of sediments after deposition. The model's *in situ* bulk density value is set at 1400 kgm^{-3} but can be changed if more accurate information becomes available. The model does not allow for more than one value for bulk density. Compaction of the dredged material after disposal can be a significant factor in the final mound height (Poindexter-Rollins, 1990). Compaction of dredged material may be controlled by many factors, including the type of sediment (base, cap, or foundation material), the total amount of sediment, and the time the material has had to settle. Bathymetric surveys used to obtain mound heights for this report were conducted a few months (CLIS-89) to more than a year (NL-88) after most disposal ceased at the respective locations. The DAMOS Capping Model predictions were made for mounds that varied in height from 0.82 m to 5.43 m. The effect of the silt cap at CS-90-1 and the behavior of Long Island Sound ambient sediment when compressed also were not factored into the prediction of mound height. A study at the Central Long Island Disposal Site showed compaction after one year on the order of 15% to 37% of the original mound height. Compaction rate increased if the mound was capped, and increased further if the cap was a free draining sand cap rather than silt (Poindexter-Rollins, 1990).

5.0 CONCLUSIONS AND RECOMMENDATIONS

The DAMOS Capping Model calculates the height and shape of a dredged material mound by distributing material of a known composition (grain size) within a defined area (radius of operations) using a set number of disposal points (project volume divided by average barge volume). The model randomly distributes the material using a center-weighted distribution pattern. Since the project volume is known prior to the modeling, the remaining variables are the grain size composition, barge volume, and radius of operations.

SAIC ran the model using estimated data (grain size, barge volume, and radius of operations) from five dredged material mounds in Long Island Sound. Because the model uses center-weighted random distribution rather than the distribution pattern found in most barge release points (Figures 2-1, 2-2, and 2-3), the model successfully predicted mound height in only 2 out of the 5 mounds. Rerunning the model with different variables showed mound height to be most sensitive to changes in the radius of operations and least sensitive to changes in the grain size composition. When the model was altered to distribute material at known release points, it successfully predicted the shape of the distribution but predicted a mound height that was too large. The DAMOS Capping Model does not take material consolidation into consideration, which may contribute to the excess mound height in the model. Introducing a constant center-weighted distribution pattern to the model, and altering only the radius of operations, barge volume, or grain size, again showed the model to be most sensitive to changes in radius of operations. The final test of the model, multiple runs with the same data set and a center-weighted random distribution pattern, calculated that 5 model runs were needed to reach 90% confidence level.

Given the sensitivity of the DAMOS Capping Model to the radius of operations, it is important that the actual disposal and ultimately, distribution of the dredged material in the field mimic the center-weighted distribution used in the model. This is accomplished by modeling the mound using a small radius of operations and then conducting field operations using a taut-wired disposal buoy and accurate navigation. This will allow the model to more accurately predict not only the height of the dredged material mound but also the shape. The center-weighted distribution in the model results in a single peak mound. Releasing material accurately at the disposal point should also imitate the model by forming a single peak rather than the multipeaked mounds formed when the release points are scattered over a larger area. Finally, the variability inherent in the random distribution pattern requires that the model be run with the same data 5 times to obtain the 90% confidence level.

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Table 1-1.

List Of Default Coefficients

Capping model parameters which are not normally changed by the user:

ALPHA	ALPHAC	CM	CD	CF	FRCTN	FL	H
0.25	0.001	1.25	0.50	0.01	0.01	1.10	1.0
Gravel	Sand	Silt	Clay	(Fall velocities in ms^{-1}).			
0.255	0.105	0.0262	0.0039				
In situ densities (kgm^{-3}) after disposal for the above classifications.							
1400.0	1400.0	1400.0	1400.0				
H-FCT	C-FCT	(Entrainment factors (% of Vs) which is ambient water).					
0.10	0.05						

Notes:

ALPHA	Entrainment coefficient in volume
ALPHAC	Not used by program
CM	Apparent mass coefficient
CD	Drag coefficient
CF	Skin friction coefficient of slice element
FRCTN	Not used by model
Fl	Not used by model
H	Model time step (seconds).
H-FCT	Percent of barge volume (Vs) added as ambient water to barge during dredging by hopper dredge
C-FCT	Same factor for clamshell dredge

Table 3-1.

Actual Dredged Material Mound Height Compared To Mound Height Predicted By DAMOS Capping Model.

	Mound & Parameters	Actual Mound Height	Mound Height Predicted By Model	Error Between Actual & Predicted Mound Height	Error As A % Of Actual Mound Height	Average % Error
New London Disposal Site	NL-TR 18 m Water Depth 100,273 m³ p.v. 800 m b.v. 300 m r.o. 2% 65% 23% 10% composition*	1.79 m	1.47 m 2.57 m 1.73 m 1.85 m 2.72 m	-0.32 m +0.78 m -0.06 m +0.06 m +0.93 m	-18% +44% -3% +3% +52%	+16%
	NL-88 18 m Water Depth 21,200 m³ p.v. 800 m³ b.v. 100 m r.o. 2% 60% 19% 19% composition*	1.27 m	1.35 m 1.48 m 1.45 m 1.52 m 1.18 m	+0.08 m +0.21 m +0.18 m +0.25 m -0.09 m	+6% +17% +14% +20% -7%	+10%
Central Long Island Sound Disposal Site	CLIS-89 18 m Water Depth 149,205 m³ p.v. 685 m³ b.v. 200 m r.o. 1% 46% 27% 26% compositoin*	3.0 m	4.40 m 4.82 m 5.17 m 4.91 m 5.36 m	+1.40 m +1.82 m +2.17 m +1.91 m +2.36 m	+47% +61% +72% +64% +70%	+65%
	CS-90-1 18 m Water Depth 26,462 m³ p.v. 39,112 m³ p.v. 735 m³ b.v. Base: 814 m³ b.v. Cap 200 m r.o. 0% 7% 47% 46% composition*	0.82 m	1.21 m 1.13 m 1.17 m 1.03 m 1.23 m	+0.39 m +0.31 m +0.35 m +0.21 m +0.41 m	+48% +38% +43% +26% +50%	+41%
Western Long Island Sound Disposal Site	WLIS "D" 30 m Water Depth 154,150 m³ p.v. 907 m³ b.v. 150 m r.o. 0% 19% 44% 37% composition*	5.43 m	4.40 m 4.80 m 4.82 m 4.62 m 4.53 m	-1.03 m -0.63 m -0.61 m -0.81 m -0.90 m	-19% -12% -11% -15% -17%	-15%

Key: p.v. = project volume; b.v. = barge volume
r.o. = radius of operations; * = %gravel %sand %silt %clay

Table 3-2.

The Effect Of Changing Average Barge Volume On Mound Height Predictions.

Mound	Actual Mound Height	Original Barge Volume	New Barge Volume	Predicted Mound Height	Average Predicted Mound Height	Average Error In Predicted Mound Height	Average Error As % Of Mound Height
NL-TR	1.79 m	800 m^3	500 m^3	1.79 m 2.58 m 3.11 m	2.49 m	+.70 m	+39%
			1000 m^3	2.15 m 1.84 m 2.12 m	2.04 m	+.25 m	+14%
NL-88	1.27 m	800 m^3	500 m^3	2.00 m 1.74 m 1.59 m	1.78 m	+.51 m	+40%
			1000 m^3	1.11 m 1.37 m 0.95 m	1.14 m	-.13 m	-10%
CLIS-89	3.0 m	685 m^3	500 m^3	5.25 m 6.53 m 5.27 m	5.68 m	+2.68 m	+89%
			900 m^3	4.26 m 4.40 m 5.61 m	4.76 m	+1.76 m	+58%
CS-90-1	0.82 m	735 m^3 - base 814 m^3 - cap	500 m^3 base 550 m^3 cap	0.99 m 0.97 m 1.10 m	1.02 m	+.20 m	+24%
			1000 m^3 base 1200 m^3 cap	0.77 m 0.96 m 0.85 m	0.86 m	-.04 m	-5%
WLIS "D"	5.43 m	907 m^3	500 m^3	4.85 m 4.92 m 5.30 m	5.02 m	-.41 m	-8%
			1500 m^3	3.92 m 4.41 m 4.11 m	4.15 m	-1.28 m	-24%

Table 3-3.

The Effect Of Changing Radius Of Operations On Mound Height Predictions.

Mound	Actual Mound Height	Original Radius Of Operations	New Radius Of Operations	Predicted Mound Height	Average Predicted Mound Height	Average Error In Predicted Mound Height	Average Error As % Of Mound Height
NL-TR	1.79 m	300 m	100 m	7.08 m 6.88 m 6.67 m	6.88 m	+5.09 m	+284%
			200 m	3.27 m 3.20 m 2.85 m	3.11 m	+1.32 m	+74%
			400 m	2.63 m 2.16 m 1.24 m	2.01 m	+0.22 m	+12%
NL-88	1.27 m	100 m	50 m	2.47 m 2.37 m 2.97 m	2.60 m	+1.33 m	+105%
			150 m	1.05 m 1.36 m 0.96 m	1.12 m	-0.15 m	-12%
			200 m	0.55 m 0.75 m 1.31 m	0.87 m	-0.40 m	-31%
CLIS-89	3.0 m	200 m	150 m	6.64 m 6.24 m 7.98 m	6.95 m	+3.95 m	+132%
			250 m	4.33 m 4.08 m 4.27 m	4.23 m	+1.23 m	+41%
CS-90-1	0.82 m	200 m	150 m	1.69 m 1.64 m 0.86 m	1.40 m	+0.58 m	+71%
			250 m	0.70 m 0.72 m 0.59 m	0.67 m	-0.15 m	-18%
WLIS "D"	5.43 m	150 m	100 m	6.82 m 7.10 m 6.38 m	6.77 m	+1.34 m	+25%
			200 m	3.21 m 3.87 m 3.51 m	3.53 m	-1.9 m	-35%

Table 3-4.

The Effect Of Changing Dredged Material Composition On Mound Height Predictions.

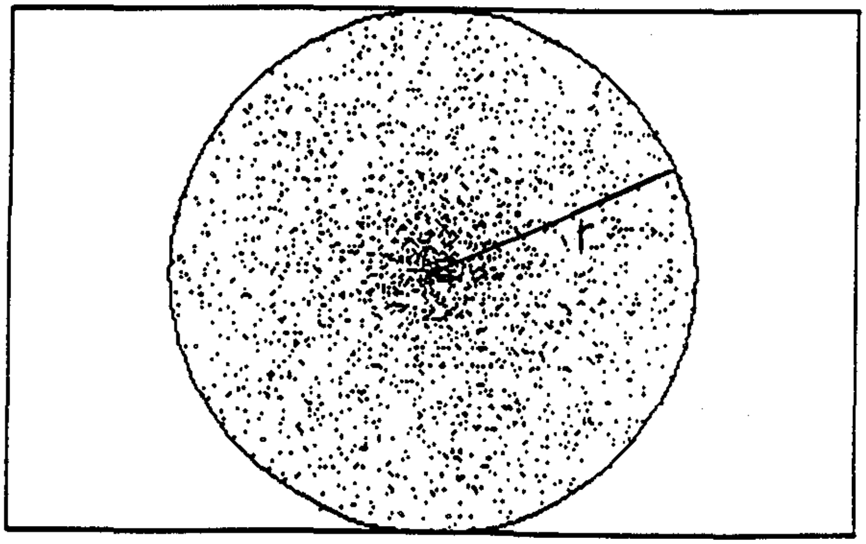
Mound	Actual Mound Height	Original Composition*	New Composition*	Predicted Mound Height	Average Predicted Mound Height	Average Error In Predicted Mound Height	Average Error As % Of Mound Height
NL-TR	1.79 m	2% 65% 23% 10%	2% 10% 23% 65%	1.74 m	1.74 m	-0.05 m	-3%
			2% 23% 65% 10%	2.15 m 2.37 m	2.26 m	+.47 m	+26%
			65% 10% 23% 2%	2.17 m	2.17 m	+0.38 m	+21%
NL-88	1.27 m	2% 60% 19% 19%	0% 40% 30% 30%	0.86 m	0.86 m	-0.41 m	-32%
			0% 20% 50% 30%	1.15 m	1.15 m	-0.12 m	-9%
			0% 20% 30% 50%	0.95 m	0.95 m	-0.32 m	-25%
CLIS-89	3.0 m	1% 46% 27% 26%	3% 55% 23% 19%	6.62 m	6.62 m	+3.62 m	+120%
			1% 27% 46% 26%	5.33 m 4.28 m	4.80 m	+1.80 m	+60%
			1% 26% 27% 46%	4.56 m	4.56 m	+1.56 m	+52%
CS-90-1	0.82 m	0% 7% 47% 46%	2% 38% 30% 30%	0.98 m 0.86 m	0.92 m	+.10 m	+12%
WLIS "D"	5.43 m	0% 19% 44% 37%	3% 50% 16% 31%	4.15 m 5.31 m	4.73 m	-.70 m	-13%
			5% 20% 25% 50%	4.87 m 4.43 m	4.65 m	-.78 m	-14%
			1% 33% 33% 33%	4.81 m 4.76 m	4.79 m	-.64 m	-12%
			27% 60% 30% 8%	4.03 m 5.83 m	4.93 m	-.50 m	-9%

* % Gravel % Sand % Silt % Clay

Table 4-1.

Model Predicted Mound Heights at 90% Confidence Level.

Mound	Actual Mound Height	Predicted Mound Heights	Predicted Mound Height At 90% Confidence Level	Error Between Predicted Height At 90% Confidence Level & Actual Mound Height
NL-TR	1.79 m	1.47 m 2.57 m 1.73 m 1.85 m 2.72 m	2.07 m	+0.28 m
NL-88	1.27 m	1.35 m 1.48 m 1.45 m 1.52 m 1.18 m	1.40 m	-0.13 m
CLIS 89	3.0 m	4.40 m 4.82 m 5.17 m 4.91 m 5.36 m	4.93 m	+1.93 m
CS-90-1	0.82 m	1.21 m 1.13 m 1.17 m 1.03 m 1.23 m	1.15 m	+0.33 m
WLIS"D"	5.43 m	4.40 m 4.80 m 4.82 m 4.62 m 4.53 m	4.63 m	-0.80 m



r = *radius of operations*

Figure 1-1. Center-weighted random distribution pattern of barge release locations within radius of operations.

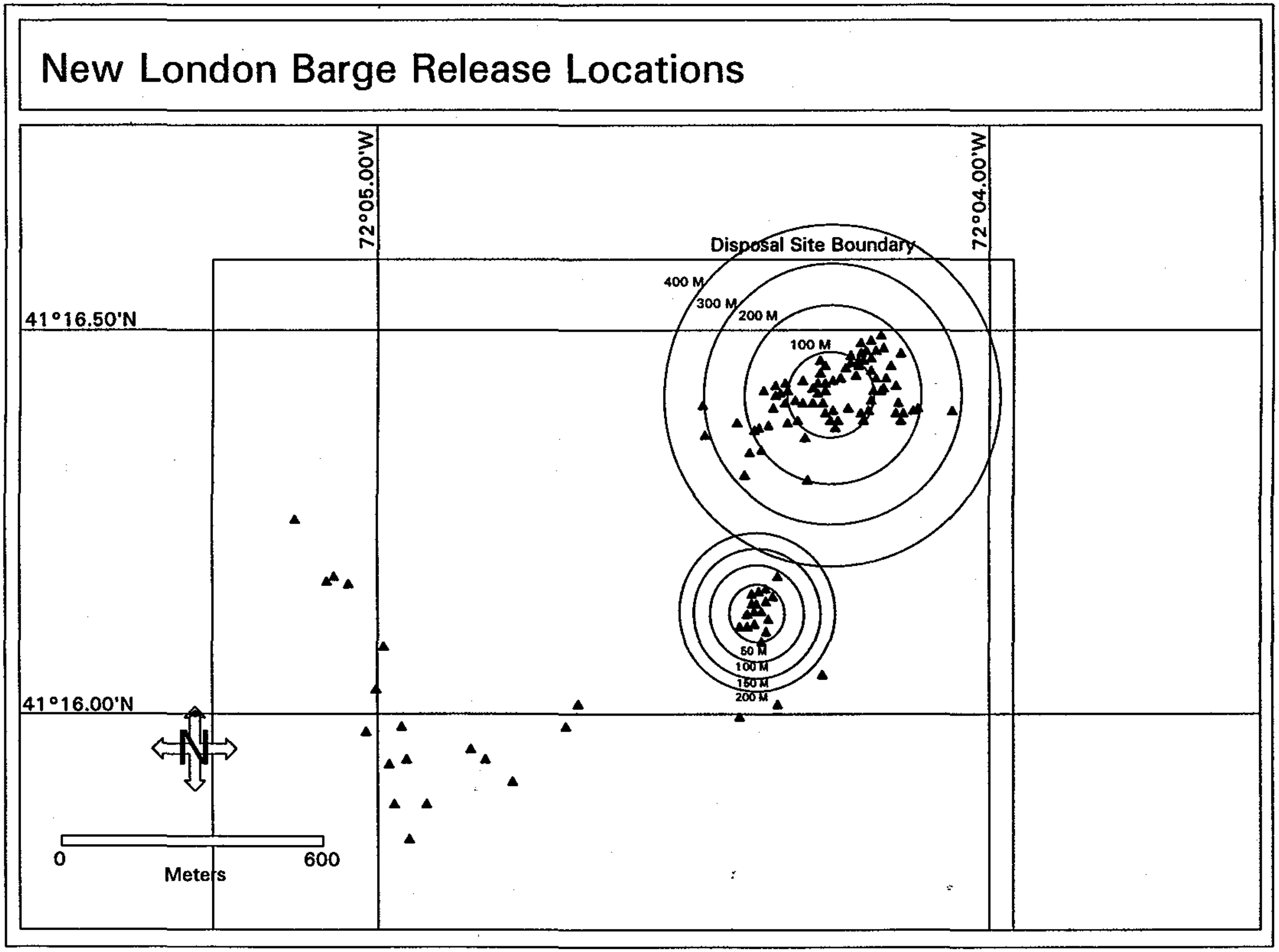


Figure 2-1. The location of barge release points at New London Disposal Site from October 1988 to July 1990.

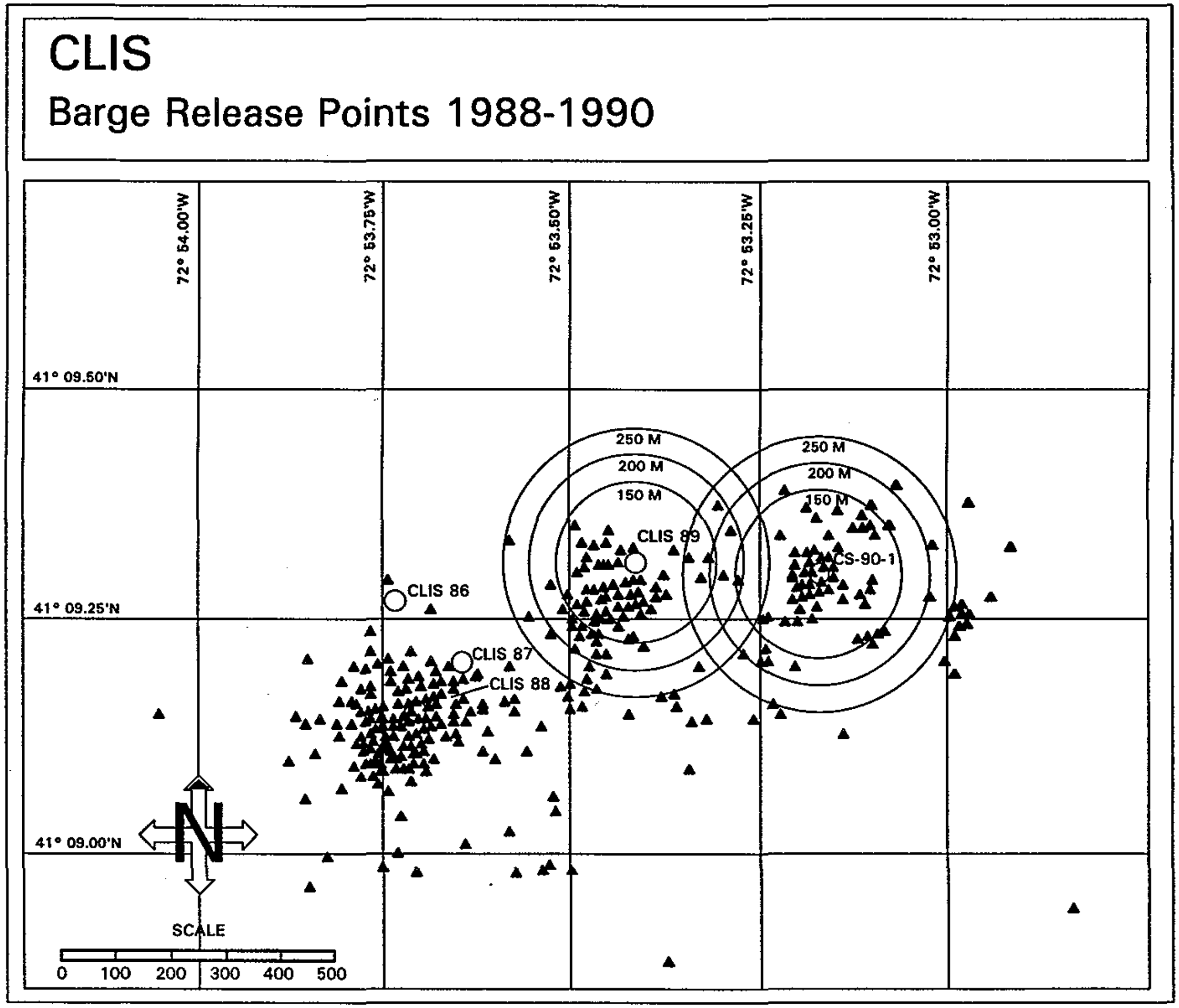


Figure 2-2. The location of barge release points at CLIS from July 1988 to July 1990.

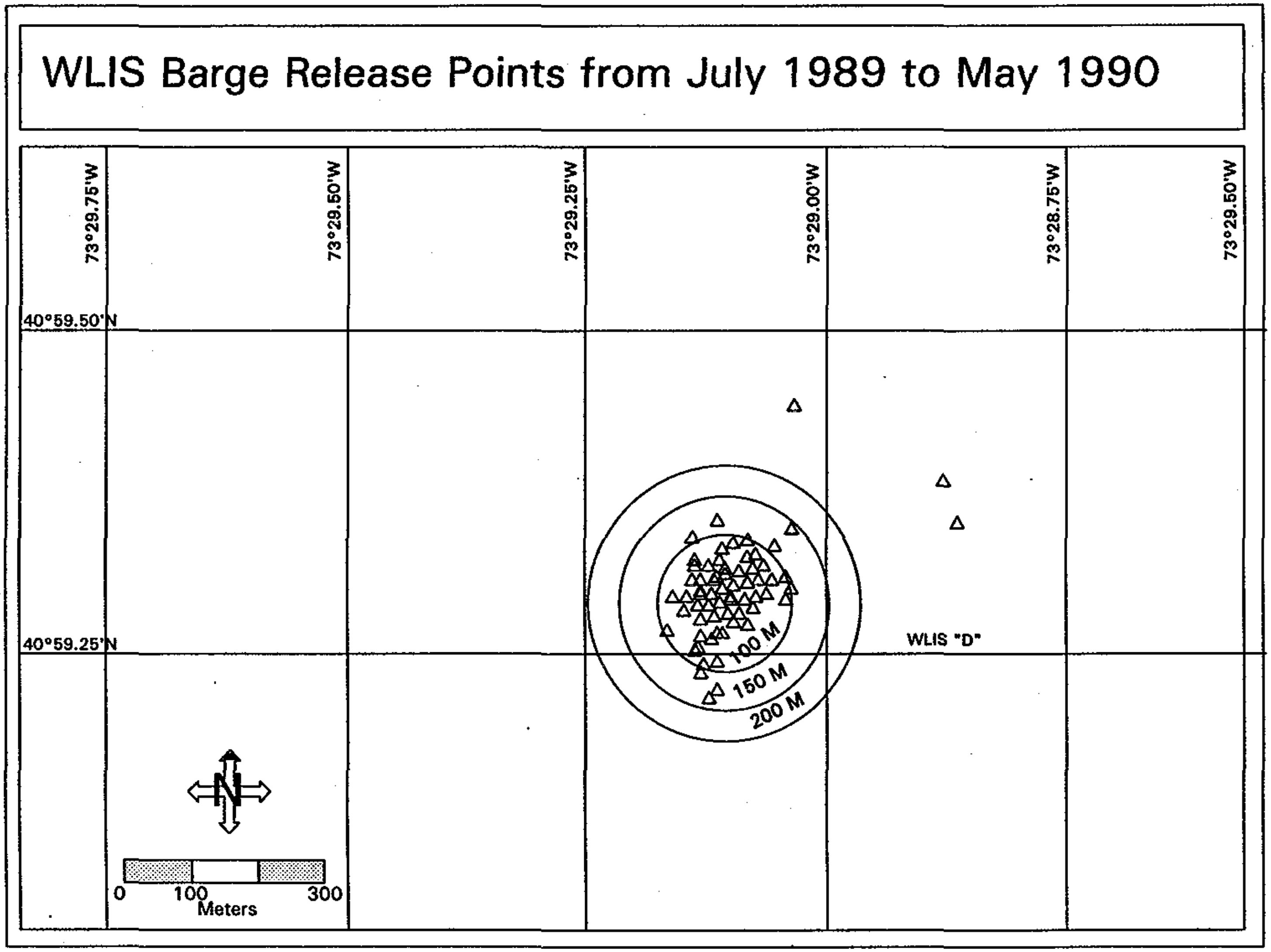


Figure 2-3. The location of barge release points at WLIS from July 1989 to May 1990.

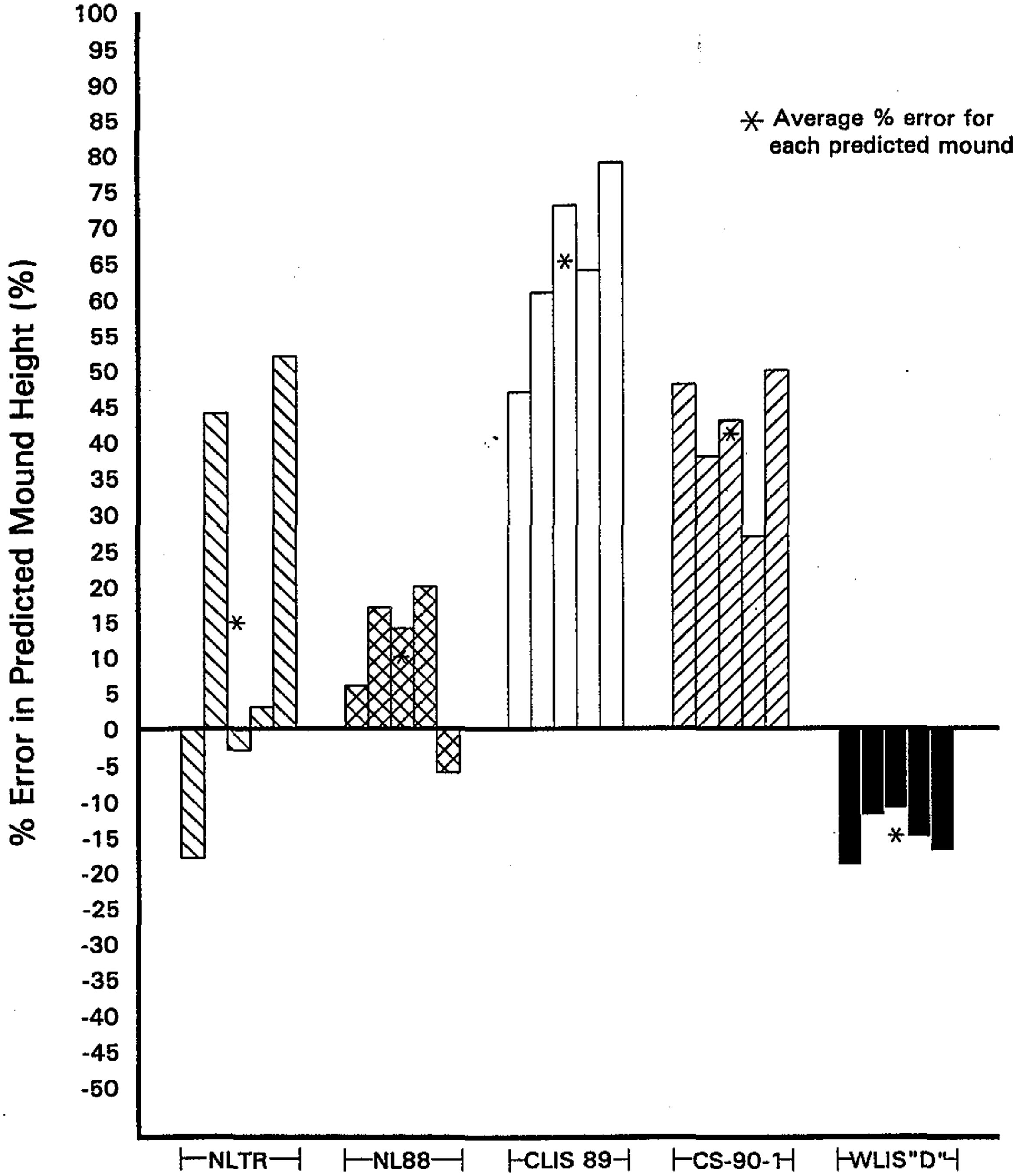


Figure 3-1. Error in predicted mound height as a percentage of actual mound height for five replicate runs at each mound.

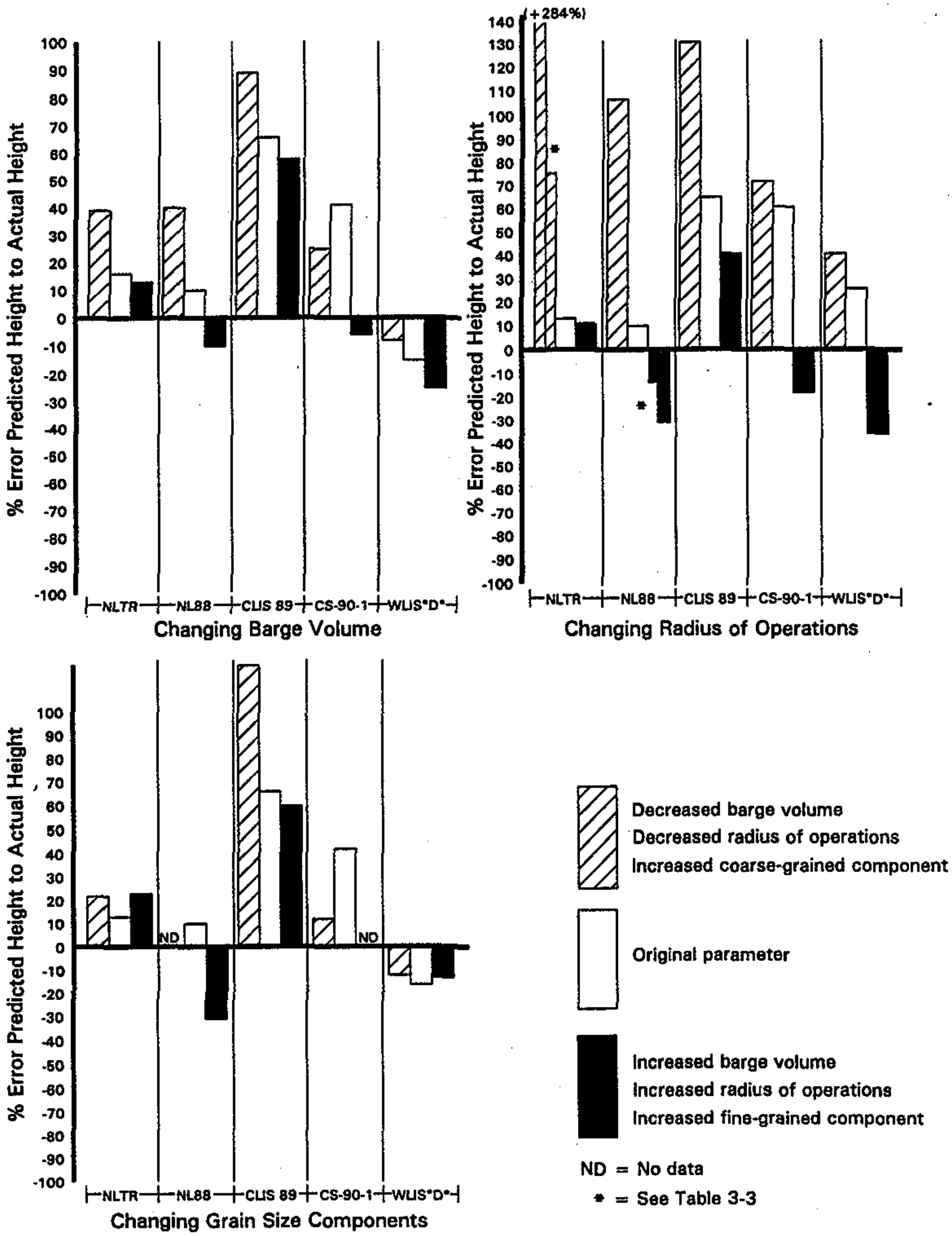


Figure 3-2. Effect of changing barge volume, radius of operations, and grain size on percent error in predicted mound height.

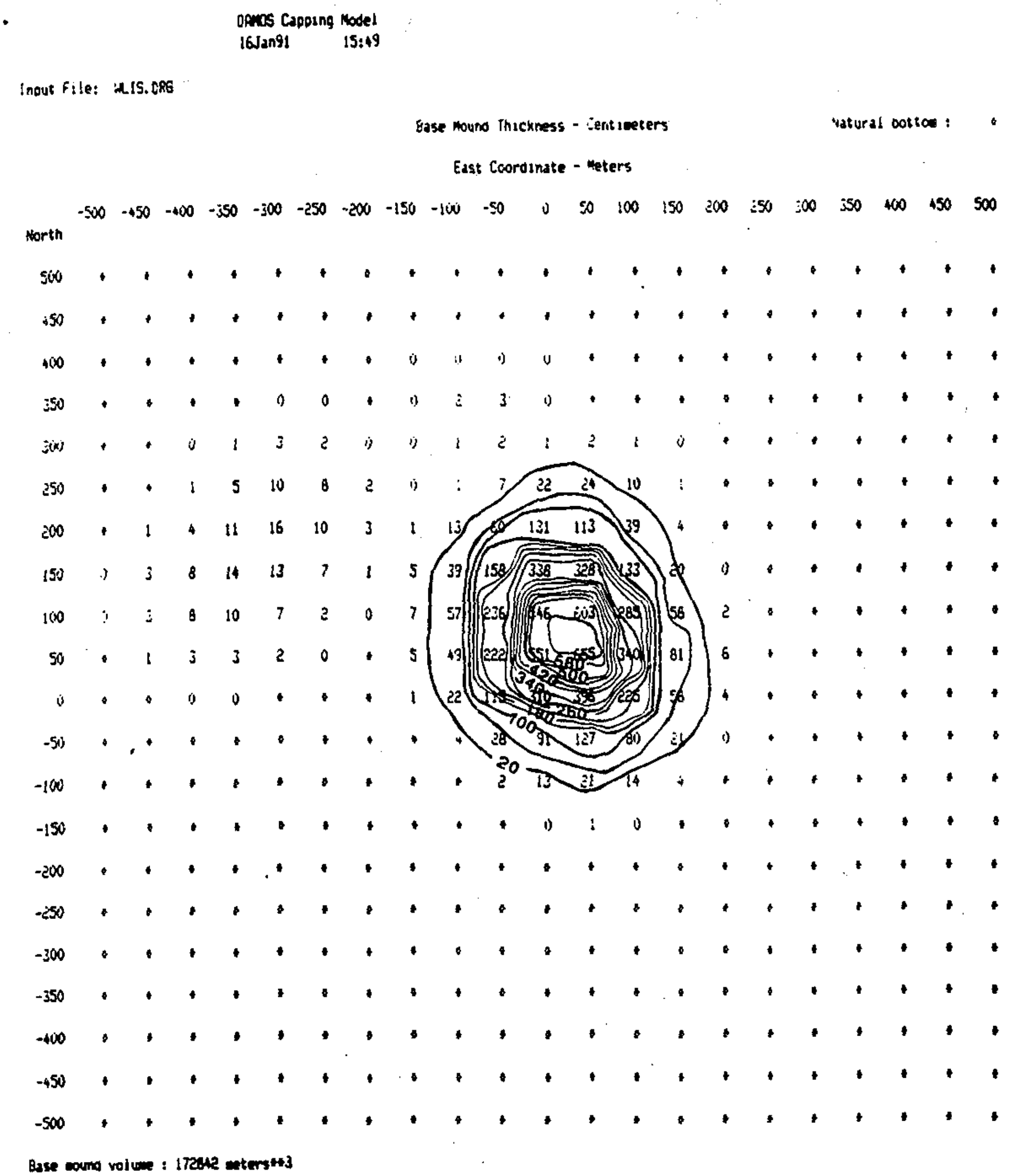


Figure 3-3. Mound height and lateral extent of dredged material predicted by DAMOS Capping Model using parameters from WLIS "D" mound.

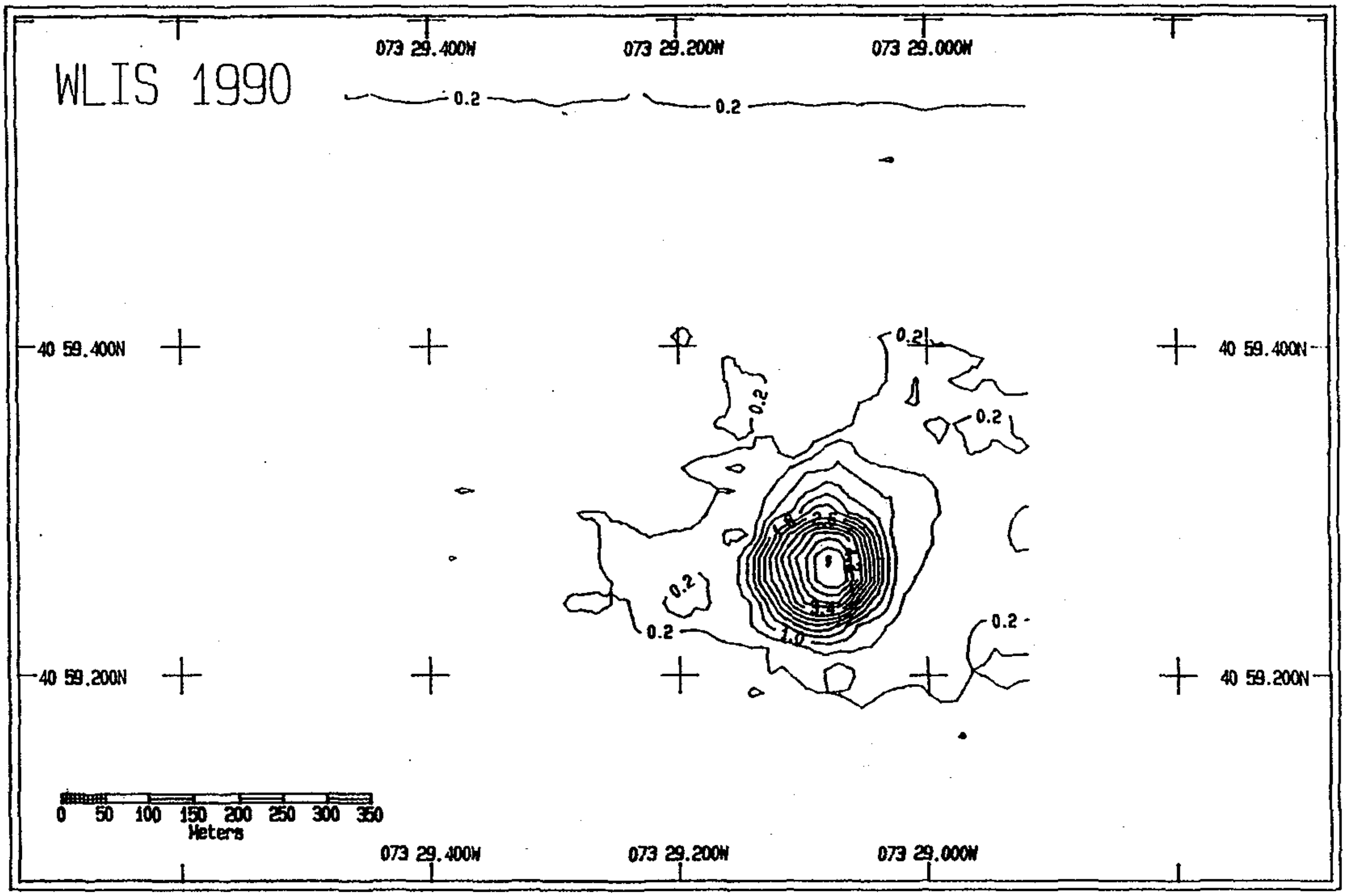


Figure 3-4. Depth difference (in meters) contour map based on comparison of July 1990 and July 1988 precision bathymetric survey at the WLIS "D" mound.

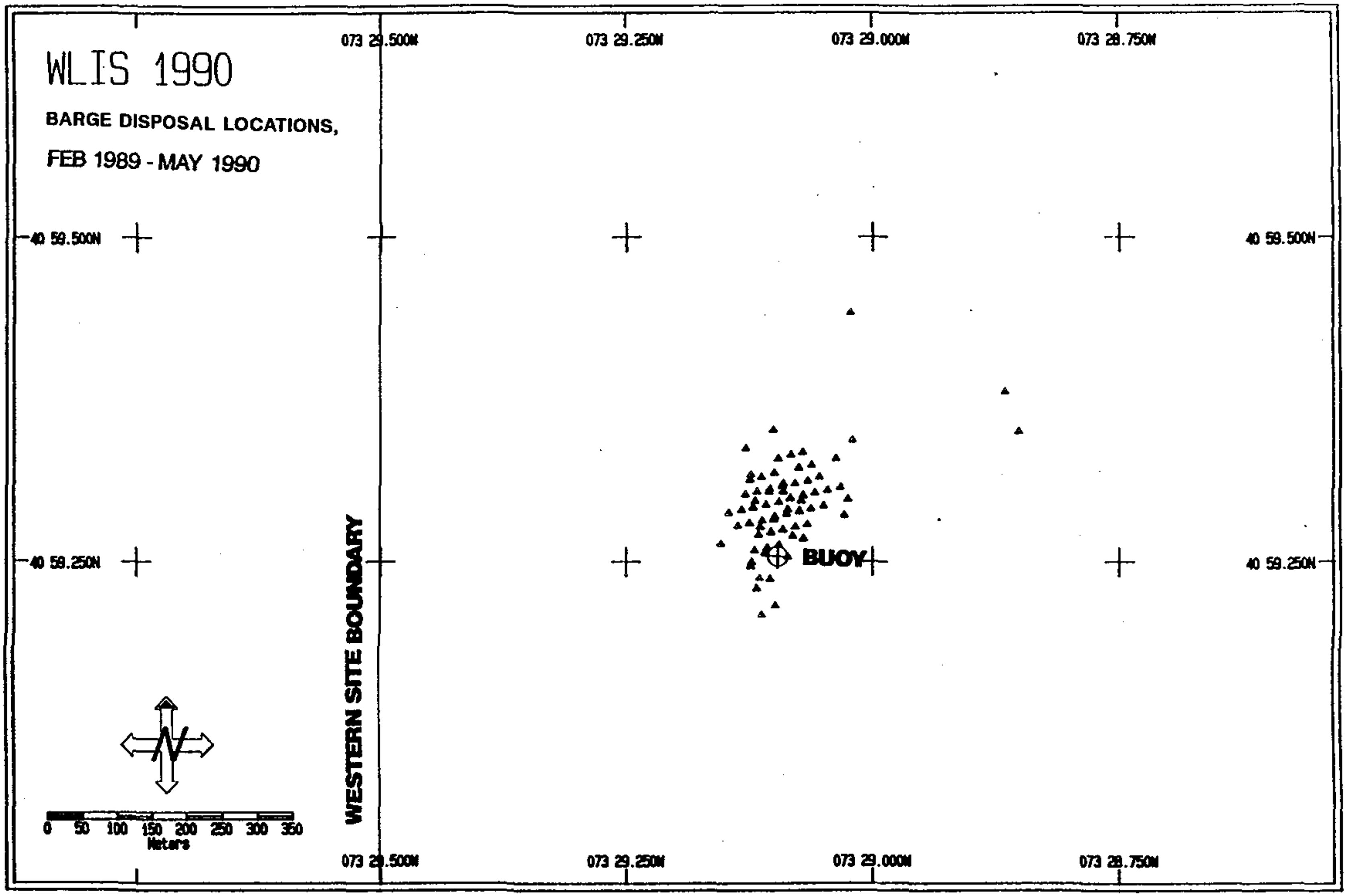


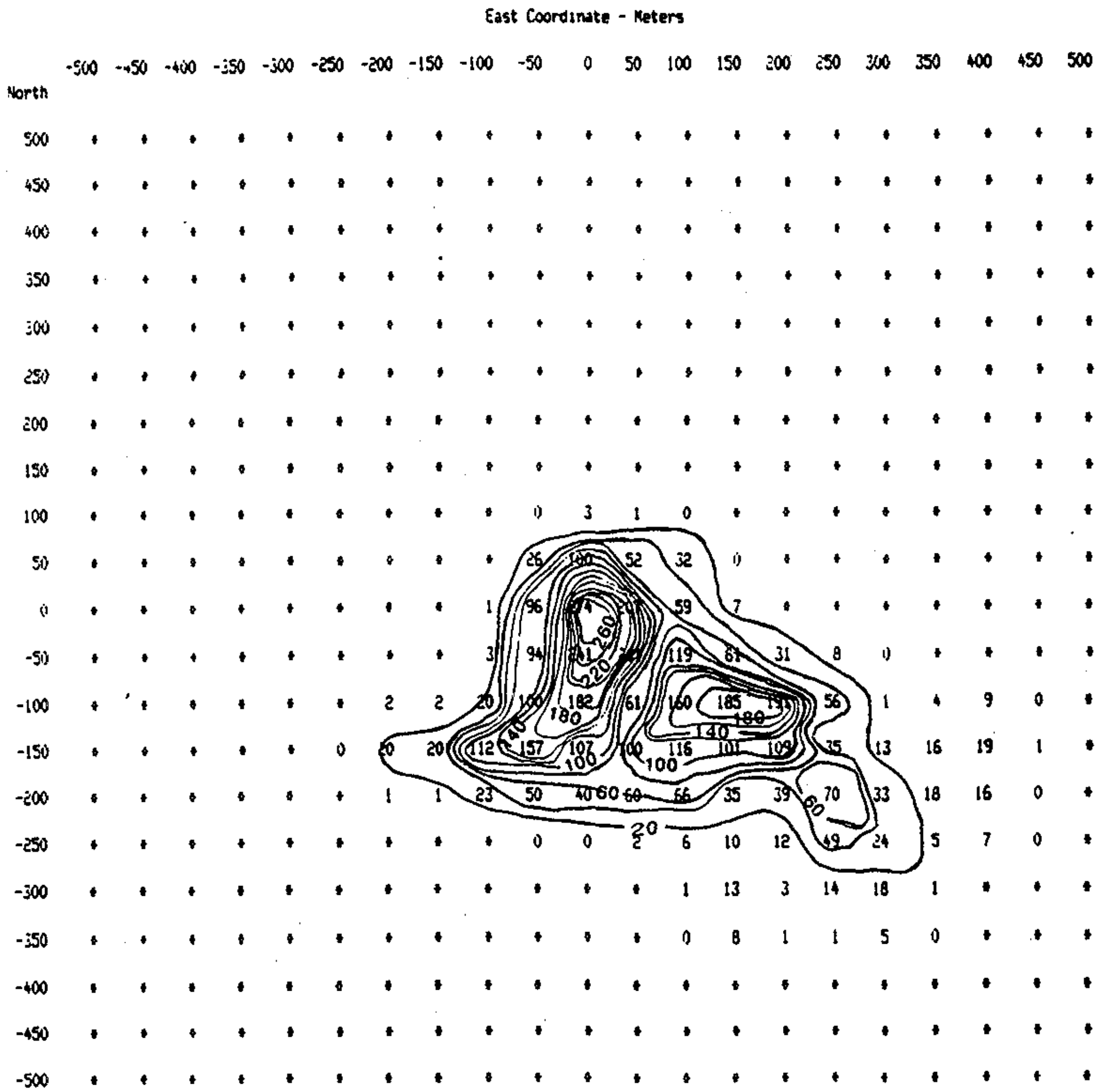
Figure 3-5. Barge release locations at WLIS "D" mound, February 1989-May 1990.

DAMOS Capping Model
17Jan91 12:06

Input File: NLTR.ORG

Base Mound Thickness - Centimeters

Natural bottom : *



Base mound volume : 104777 meters**3

Figure 3-6. Mound height and lateral extent of dredged material predicted by DAMOS Capping Model using parameters from NL-TR mound.

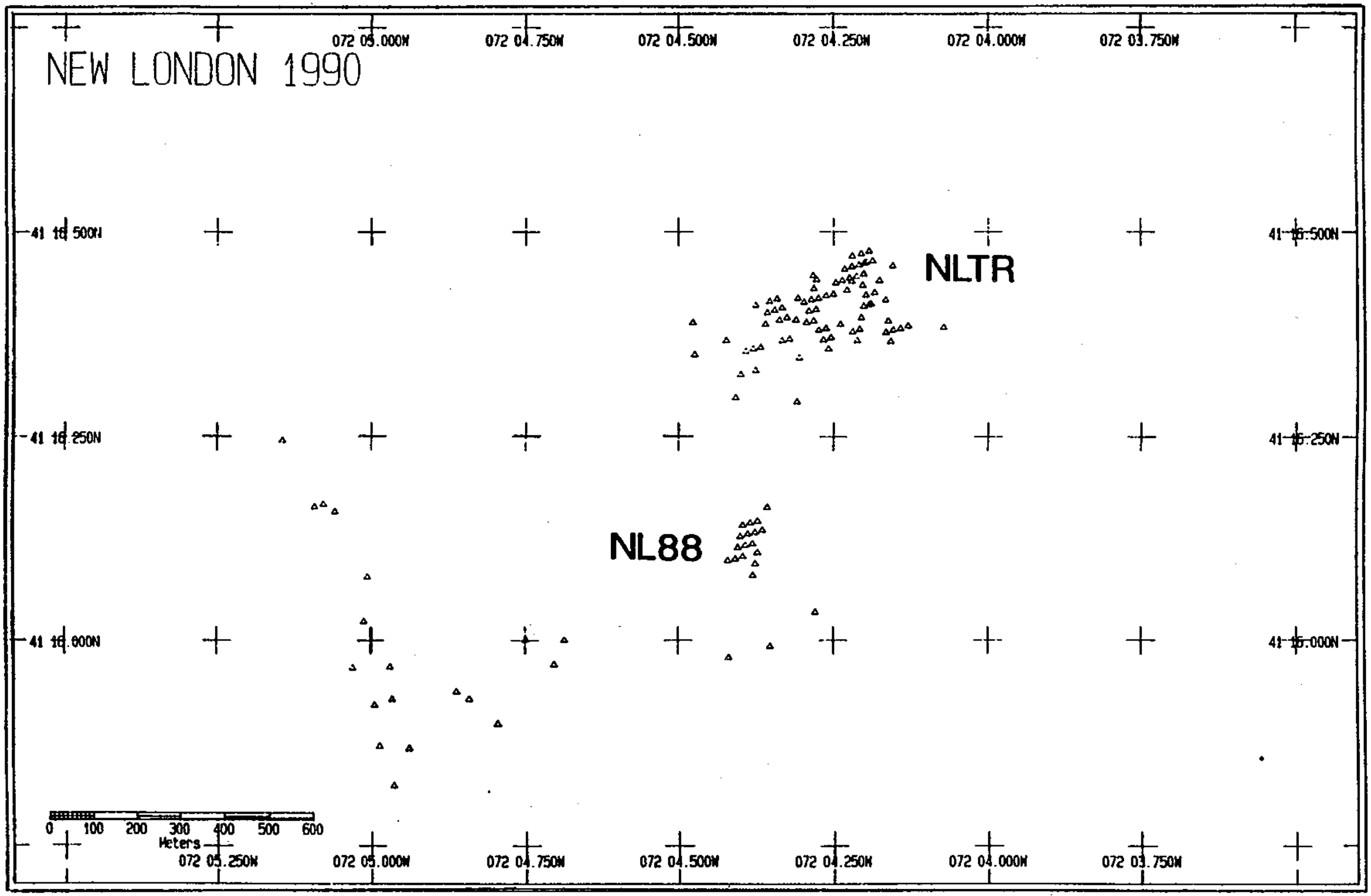


Figure 3-7. Barge release locations at New London Disposal Site, 1988-1990.

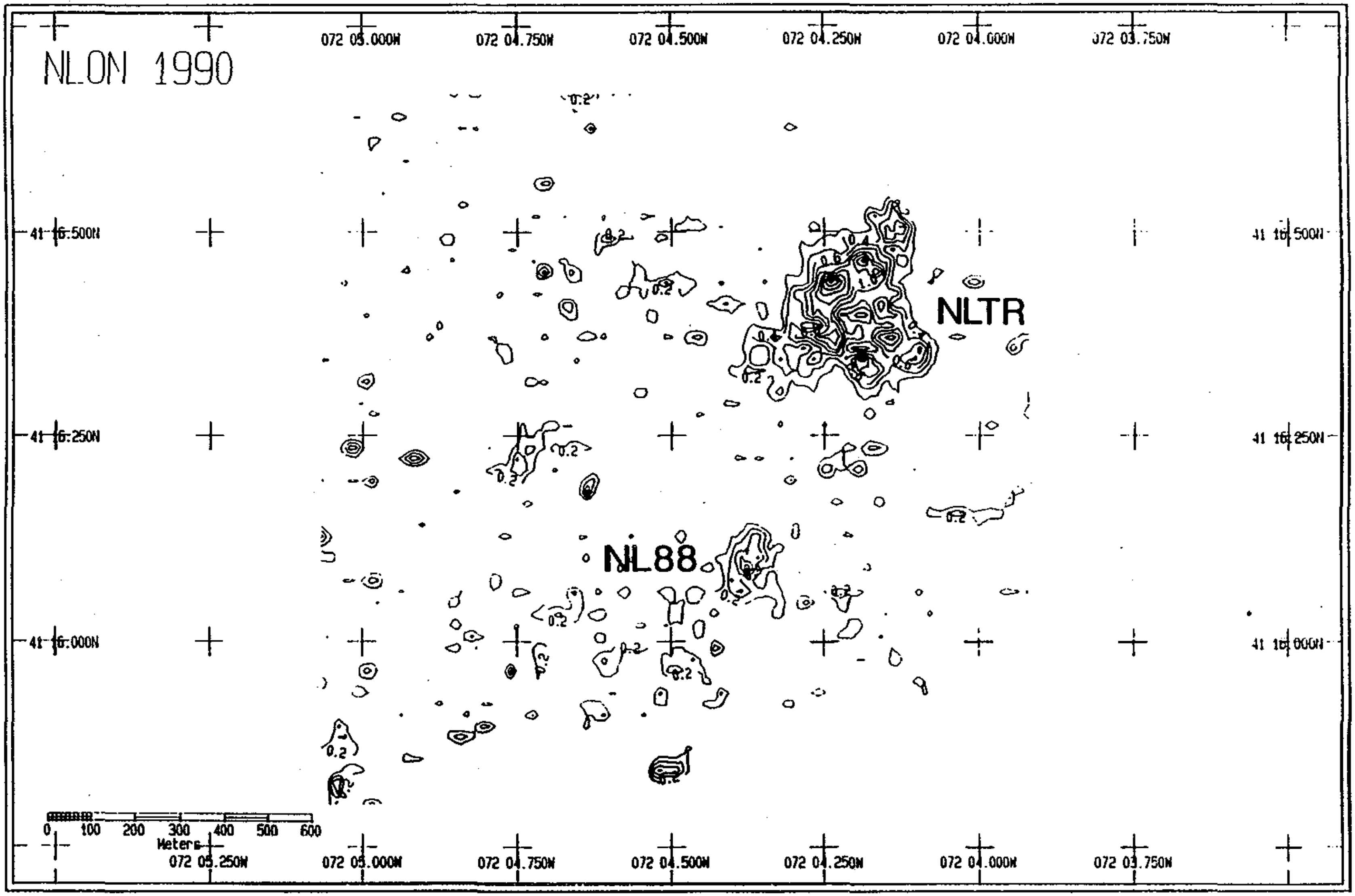


Figure 3-8. Depth difference (in meters) contour map based on comparison of August 1988 and July 1990 precision bathymetric survey at the New London Disposal Site.

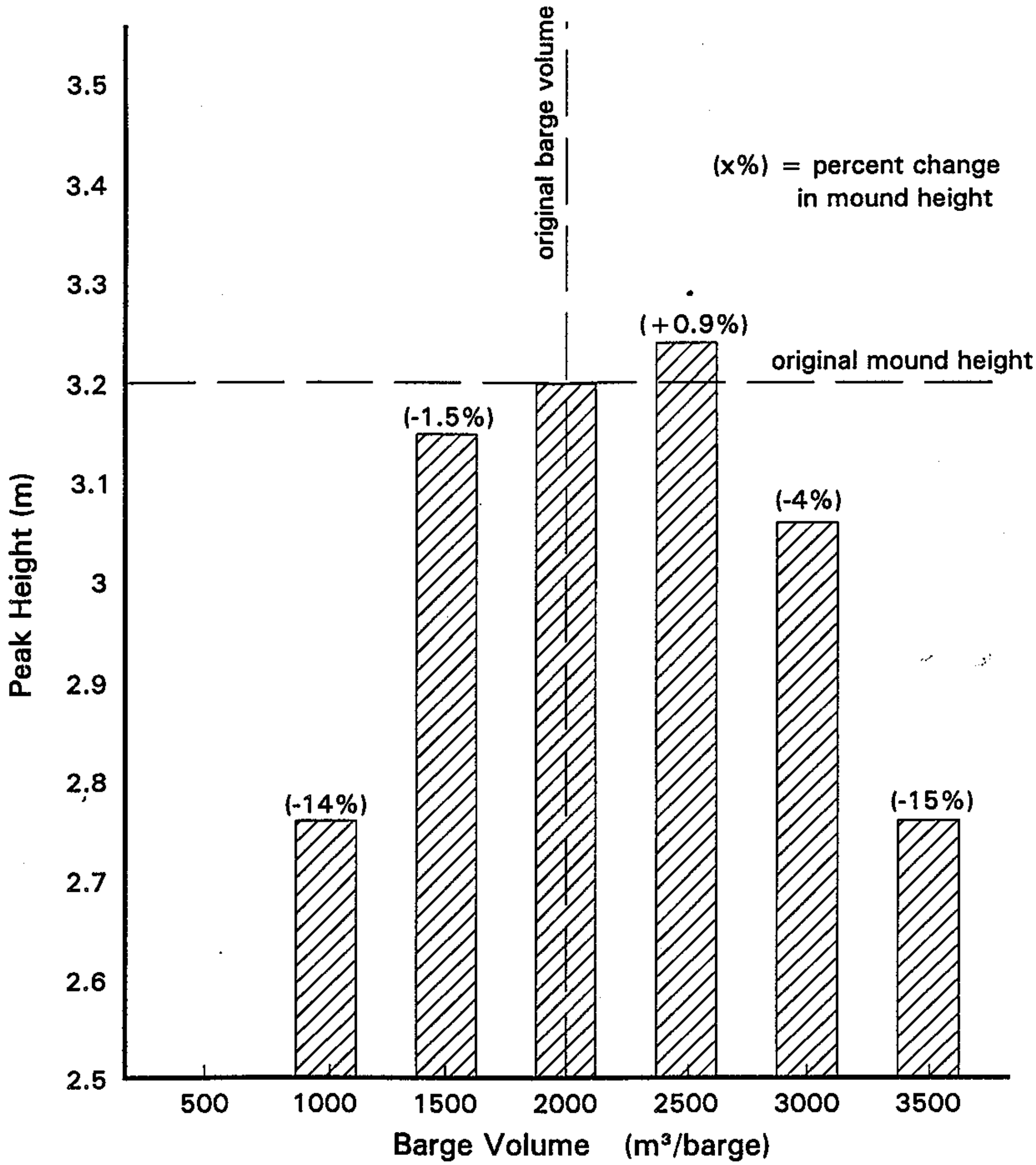


Figure 3-9. Barge volume versus peak height.

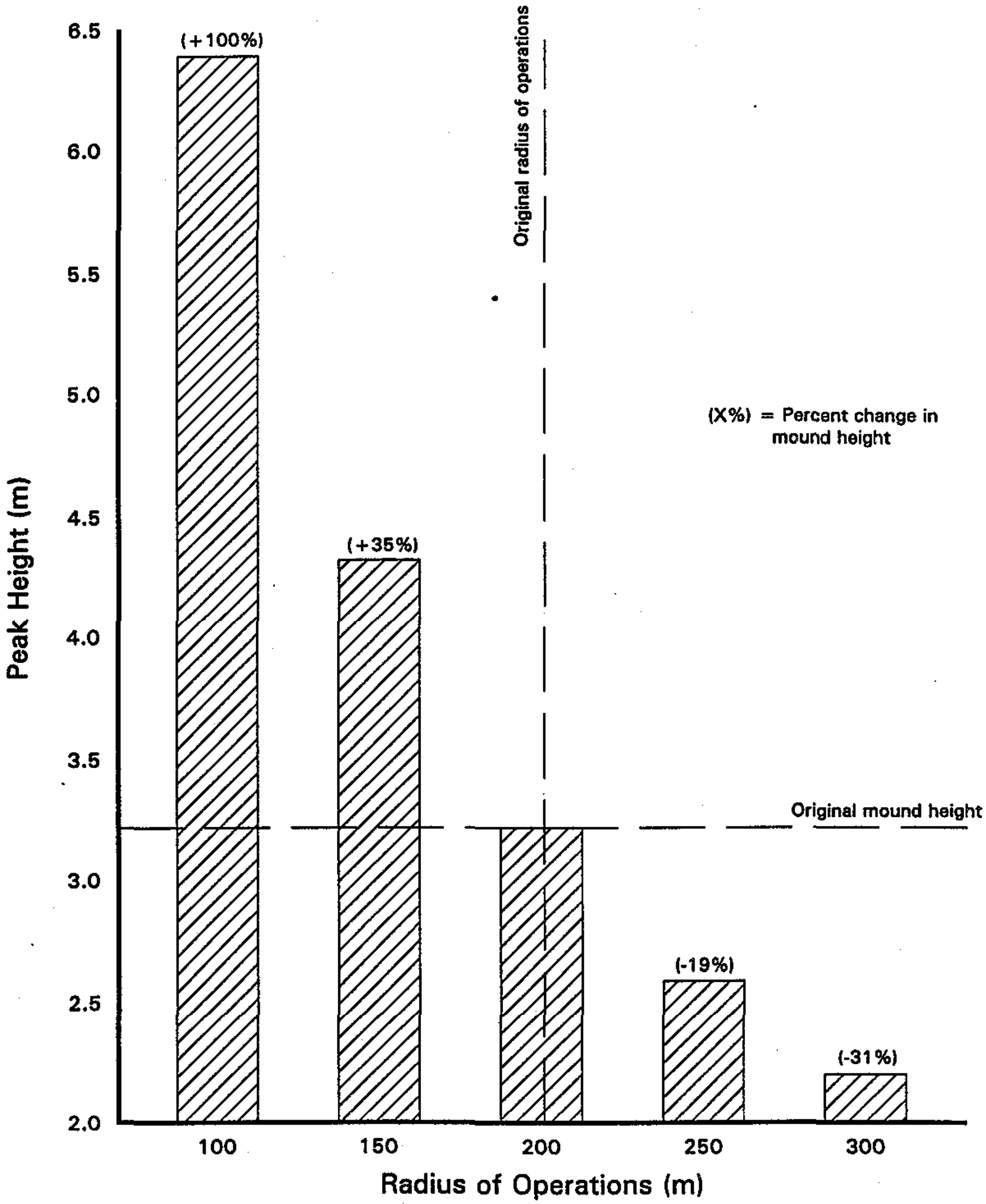


Figure 3-10. Radius of operations versus peak height.

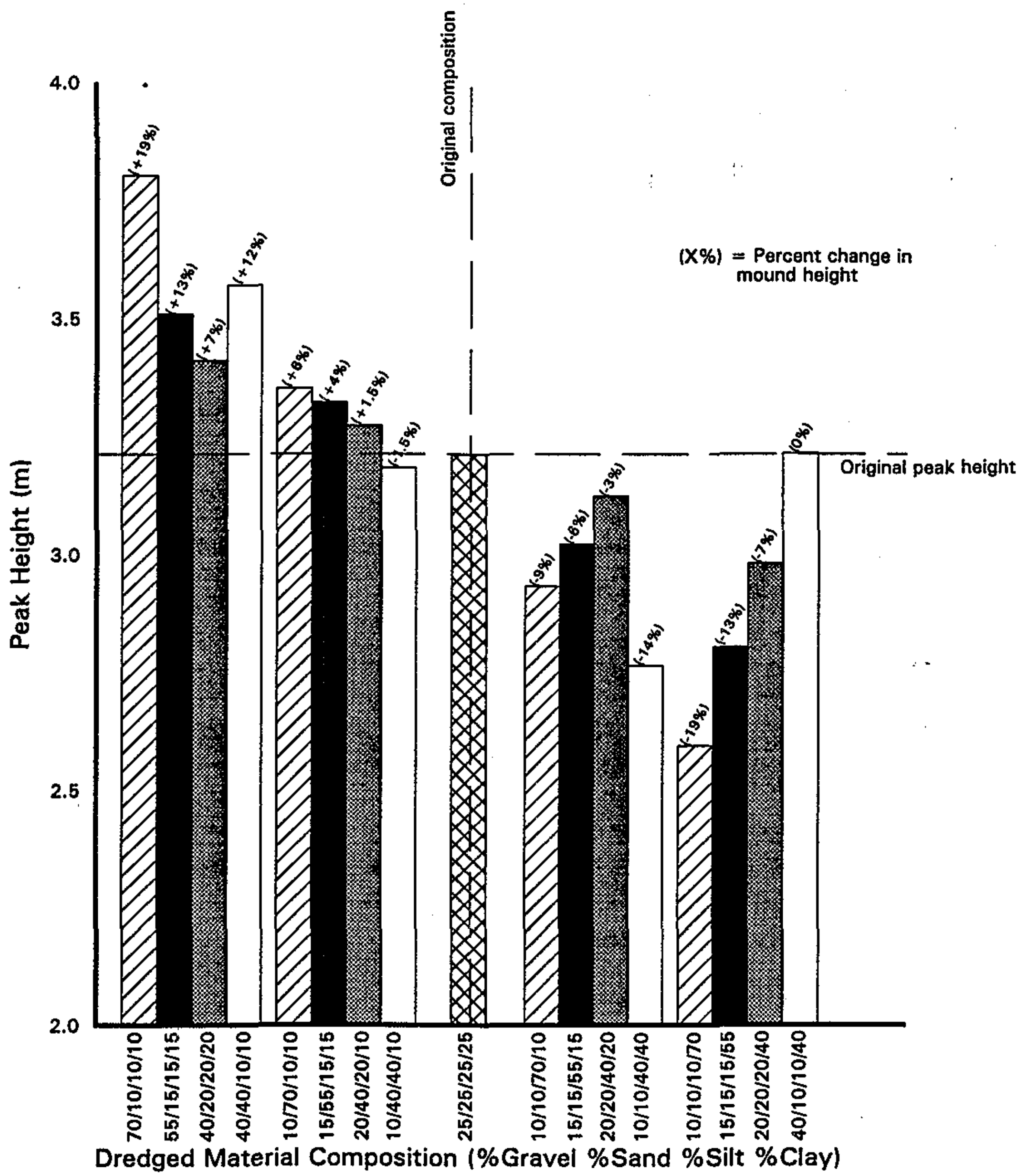


Figure 3-11. Dredged material composition versus peak height.

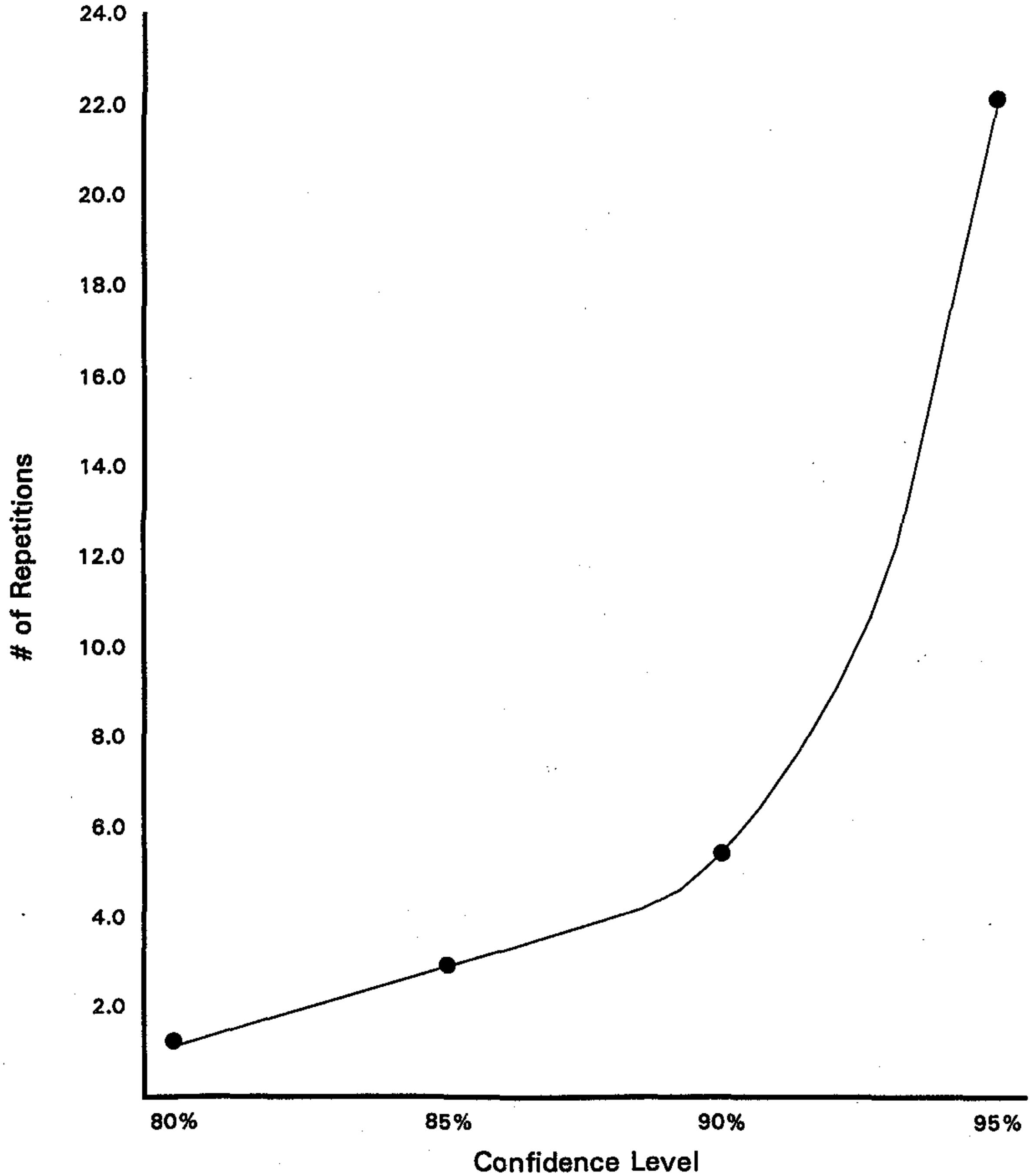


Figure 3-12. Number of repetitions required for varying confidence levels.