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US NAVY NORTHERN DIVISION
REMEDIAL ACTION CONTRACT (RAC)
CONTRACT NO. N62472-94-D-0398
DELIVERY ORDER NO. 0011
FOSTER WHEELER ENVIRONMENTAL CORPORATION

STORM WATER POLLUTION PREVENTION PLAN AND SOIL EROSION AND SEDIMENT CONTROL PLAN

FOR

LANDFILL EXCAVATION
AT THE
MELVILLE NORTH LANDFILL

PORTSMOUTH, RHODE ISLAND

Prepared for

U.S. Navy Northern Division

FEBRUARY 1999

Revision	Date	Prepared By	Approved By	Pages Affected
0	2/5/99	Michael W. Junghans, P.E.	Carl Tippmann, P E.	all

Prepare in quintuplicate (original and 4 copies)

CONTRACTOR DRAWINGS & INFORMATION SUBMITTAL
NORTHNAVFACENGCOM 4335/3 (Rev 6/80)

CONTROL NO 10

CONTRACT NO. DELIVERY ORDER #	ACTIVITY LOCATION
N62472-94-D-0398	Naval Education and Training Center - Newport, RI

PROJECT TITLE:
Melville North Landfill at Naval Education and Training Center (NETC), Newport, RI

FROM:	DATE
Foster Wheeler Environmental Corp. - Program QCM: Mark Miller	February 11, 1999
TO: DESIGN NTR	DATE
T. Gibision (5 Copies + 1 original)	February 11, 1999

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ITEM NO.	SUBMITTAL DESCRIPTION	PREPARED/ SUBMITTED BY	APPROVED	DISAPPROVED	REMARKS
10	SD-18. Records: Storm Water Pollution Prevention Plan & Soil Erosion and Sediment Control Plan R0	M Miller			Original to be forwarded to Jim Shafer for owners signature
					Once signed return to FWENC for Submittal to RIDEM

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1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) respectfully submits this Storm Water Pollution Prevention Plan (SWPPP) and Soil Erosion and Sediment Control Plan (SESCP) to the Department of the Navy in response to the Delivery Order entitled "Melville North Landfill Waste Removal and Disposal" located at the Melville NETC Newport, Portsmouth, Rhode Island. The purpose of the report is to describe the methodology to minimize sediment runoff in storm water discharge from the subject site during construction activities. All sediment and erosion control measures are described herein. The activities described in this plan will be conducted as part of the tasks required by the Department of the Navy under Contract No. N62472-94-D-0398.

2.0 PROJECT DESCRIPTION

2.1 SITE HISTORY

The site is approximately 10 acres in size and was used as a landfill from World War II until 1955. The site was excessed to the State of Rhode Island in September 1983, and was sold to Melville Marine Industries six months later. Since ownership of the site was transferred to the State of Rhode Island prior to NETC being placed on the National Priorities List (NPL) in November 1989, remediation activities at the landfill will be performed in accordance with the Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Remediation Regulations).

2.2 EXISTING CONDITIONS

NETC is located in the City of Newport, and Towns of Middletown and Portsmouth, Rhode Island on the western shore of Aquidneck Island facing the east passage of Narragansett Bay (see Figure 1, Appendix A). The Melville North Landfill site is located in the northwest portion of NETC on the shoreline of Narragansett Bay in the Town of Portsmouth Access to the Melville North Landfill site is from Defense Highway. The site is bound to the west by Narragansett Bay, to the east by the Penn Central railroad tracks and Defense Highway, to the north by vegetated wetlands, and to the south by a wooded upland area

As presented on attached drawing SE-1, the site topography is relatively flat with elevation drops between 5 and 10 feet along the shoreline and an increase in elevation between 5 and 10 feet along Defense Highway Presently upland area of the site is completely vegetated with grass, low-lying shrubbery and occasional small caliper trees. The water front area consists of a natural sand and gravel beach typical with the local shoreline. Areas of wetlands are present at the north end of the site as presented on the drawing SE-1. The proposed soil excavation will result in the disturbance of wetlands. Required wetland

disturbance permits will be obtained from RIDEM and The U. S. Army Corps prior to the start of construction. Details for disturbance and restoration of wetlands will not be addressed in this report, although will be addressed in the above mentioned submissions.

2.3 SOIL INFORMATION

The site soil generally consists three distinct unconsolidated geological units overlying bedrock. The units, in ascending order include: 1). deposited fill consisting of debris and soil cover; 2) stratified drift ; and 3). glacial till. Bedrock is a fine grained metamorphic rock described as foliated graphitic rock including slate, phyllite and schist.

The average thickness of deposited fill material is approximately 4 feet with a maximum thickness of 8 feet The stratified drift material consists mainly of stratified sand with varying amounts of silt and gravel. Peat is also intermittently through the site at the north and central portions of the landfill.

2.4 EXISTING SITE DRAINAGE

Drawing SE-1 presents the existing site topography and flow patterns at the Site The site consists of five drainage areas encompassing from the centerline of the rail line on the east, west to the waterfront. Runoff collected at the east side of the railroad tracks from up-gradient drainage areas are presently conveyed to the east and west beyond the site to culverts under rail and then ultimately to the waterfront.

3.0 CONSTRUCTION ACTIVITIES

The proposed remedy at the Melville North Landfill includes excavating approximately 40,000 cubic yards (cy) of contaminated soil, stockpiling the soil for characterization, and treating/disposing the soil at an approved off-site facility. The excavation will be performed in three phases, Area 1, Area 2 and Area 3 as presented in attached Drawing SE-2. Areas 1 and 2 are upland areas beyond the high water line Excavation of these areas will be performed to remove all contaminated soil exceeding established clean-up criteria. The extent of the excavation has been estimated based on soil sampling data collected during previous site investigations. Post excavation sampling will be performed to verify the complete removal of contaminated material It is anticipated that only a small portion of excavation will extend below the groundwater table and that dewatering will not be required.

Excavated soils will be transported to a temporary staging/stockpiling area that the south end of the site as shown on Drawing SE-2. The staging area will be constructed of a using a continuous perimeter earth berm being a minimum of one foot height. The area will be covered with 40 mil seamed HDPE lined keyed into the outer edge of the earth berm. Typical sections and details of the proposed earth berms are

presented on attached Drawing SE-3. Rain water will be collected with in the staging area will be removed via vacuum tanker truck at transported to appropriate disposal location.

Segregated piles from each excavation will then be characterized by laboratory sampling to determine disposal requirements Stock piles will also be covered using tarps to prevent mixing with rainwater.

The contaminated soil staging area will be graded to prevent run-on and runoff of storm water A temporary diversion ditch will be installed along the eastern berm to intercept runoff from up-gradient and convey it to the waterfront.

At the completion of construction, the site will be restored to the pre-construction grades and revegetated with grass The proposed condition shall have the storm water runoff characteristics as the original site and therefore no storm water management features are proposed

4.0 TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

Soil erosion and sediment control on this project will be conducted in accordance with the Rhode Island Sediment and Erosion Control Handbook (RISESCH), latest edition. The guidelines will be followed through the use of silt fence, hay bales, seeding and mulching, and other means. Temporary soil erosion and sedimentation controls to be utilized as presented on Drawing SE-2.

4.1 DIVERSION DITCHES

During construction activities, temporary diversion ditches will be constructed up-gradient of the excavation to intercept storm water runoff and convey it to the waterfront. Two diversion ditches, Ditch 1 and 2, presented on Drawing SE-2, will intercept runoff from the east. Calculations for these diversion ditches are included in Attachment C.

Diversion ditches required for management of storm water runoff within the area of disturbance will be determined by Foster Wheeler's Resident Engineer during construction. The progression of construction will be dependent on the nature of encountered material and results of chemical characterization. Excavation will be performed starting in Area 1 and 3 and then move to Area 3. Excavation in Areas 1 and 2 will be performed from east to west. Clean fill will be backfilled behind the excavation to minimize the extent of the open excavation where ever practical. Temporary diversion ditches and silt fence will be installed along the area of excavation at the direction of the Resident Engineer in accordance with the RISESCH to satisfy the following criteria:

- minimize runoff to the excavation;
- segregate runoff from excavation area and backfilled areas;
- prevent the migration of sediment from excavation and backfill areas.

Excavation of Area 3, which located on the beach below the high water level, will only be performed during low tide. Excavation in this area is estimated to be approximately 500 cubic yards.

4.2 SILT FENCE

Silt fence will be utilized as a temporary sedimentation control device during construction. Silt fence will be installed using a hay bale filter to intercept sheet flow from the site and will be located as shown on Drawing SE-2, Appendix D. Material and construction shall be in accordance with the RISESCH.

4.3 HAY BALE CHECK DAMS

Hay Bale check dams will be utilized within the temporary diversion ditches during the course of construction. Hay bale check dams will be constructed in accordance with the RISESCH. Hay bale check dams will be placed at 100-foot intervals within the swale, but in no case shall they be spaced so that the toe of the upstream dam is higher than the top of the downstream dam. Hay bale check dams will be temporary and will be inspected and maintained during routine erosion and sediment control inspections. Hay bales will be toed to a depth of 3 to 4 inches and all weeds/weed seeds will be removed from the hay bales so that the native grasses and wetland vegetation will establish itself, or other measures will be taken. If erosion of the 3H:1V or steeper side slopes becomes a problem during construction, earth dikes may be constructed at the top of the slope to control run-off

4.4 TEMPORARY SEEDING AND MULCHING

Temporary seeding and mulching will be used to stabilize disturbed areas where construction activity has been temporarily or permanently ceased for a period greater than 14 days, unless the construction activity in the area will resume within 21 days. All temporary seeding and mulching shall be performed in accordance with "Temporary Vegetative Cover", Chapter 4, Section A and "Temporary Mulching" Chapter 5, Section A of the Rhode Island Soil Erosion and Sediment Control Handbook, latest edition.

4.5 CONSTRUCTION ENTRANCE STABILIZATION

The existing gravel access road shall be improved to provide a 6-inch thick (minimum), crushed stone platform extending 100 feet at the site exit(s) to remove soil from the tires of construction traffic before exiting onto Defense Highway. The crushed stone platform will be underlain by a non-woven geotextile for stabilization, if required as determined by the Resident Engineer Materials and construction shall be in accordance with the RISESCH. Defense Highway will be swept or scraped, as necessary, to remove any excess dirt, mud, or rock tracked from the construction site.

4.6 TURBIDITY BARRIER

During excavation of the beach area (Area 3), a heavy duty floating turbidity barrier will be placed adjacent to the waterfront encompassing the area below the high water tide limit. The barrier will limit siltation of the waterfront during construction activities The turbidity barrier shall be high visibility yellow and will extend the full depth of water at high tide See Detail 2 on Drawing SE-3, Appendix D

4.7 DUST CONTROL

Dust control will be maintained on site throughout the duration of the construction activities Many of the temporary erosion control measures will aid in dust suppression, such as temporary grassing, mulching, and the construction entrance stabilization. Water spraying will be used to reduce the generation of dust during construction, and is expected to generate little, if any, run-off from the site. The frequency of water spraying will be dependent upon the weather conditions at the site

5.0 PERMANENT EROSION AND SEDIMENT CONTROL

Permanent mulching and seeding of grass will be used over the final graded surface to reduce sediment runoff and increase infiltration. Seeding will commence within 14 days following cessation of construction. All permanent planting and seeding shall be performed in accordance with "Permanent Vegetative Cover Requirements", Chapter 4, Section B and "Permanent Mulching", Chapter Five, Section B of the Rhode Island Soil Erosion and Sediment Control Handbook, latest edition Mulch will be applied around plantings and on all seeded areas. Mulch will be applied to the seeded swales and other areas, as necessary.

6.0 INSPECTION AND MAINTENANCE

Maintenance of the temporary erosion and sediment controls during the course of the construction work will be performed by Foster Wheeler Environmental A copy of the SWPP/SESCP will be kept on site at all times for the duration of construction activities. Routine inspections will be performed to assure that erosion and sediment control measures are effective (see attached form, Appendix B). Section 212 of the Rhode Island Department of Transportation Specifications will be used as a guideline during the routine inspections. All controls will be inspected on a weekly basis and within 24 hours after any storm event that generates at least 0.25 inches of rainfall in a 24-hour period The inspections will include checking the silt fence for structural integrity, siltation, and undermining; checking rock check dams for silt accumulation and for proper spacing between check dams; and inspecting the diversion ditches for structural integrity and soil erosion. Significant releases of sediment to off site receiving waters will be reported to RIDEM. The reporting requirements for and the definition of a significant release of sediment

will be worked out, and agreed to, by RIDEM. All measures taken to clean up the discharge and steps taken to prevent future releases will also be reported to RIDEM.

Sediment will be removed from erosion and sediment control structures when it has accumulated to a point where the control structures would be ineffective during the next storm event. Sediment removed from the temporary controls will be collected and stockpiled for placement in the landfill subgrade. Sediment temporarily stockpiled on site will be placed in such areas and in such a manner as to minimize wash-off of sediments back into the site drainage system Silt fence, and hay bales may be used in minimizing wash-off. Before covering the last of the subgrade, sediment deposits will be removed from erosion control features and placed in the landfill subgrade.

Areas of the site that have been permanently seeded will be inspected regularly after seed germination to ensure complete coverage of exposed areas. Temporary erosion and sediment controls will be removed once the disturbed areas have been stabilized.

7.0 PLAN MODIFICATION AND RECORD KEEPING

Should routine inspection indicate that this plan requires modification to prevent discharge of pollutants from the site, the plan modification and implementation of modified controls will be done within 7 days of the inspection that identified the deficiency

Records relating to the implementation of the Soil Erosion and Sediment Control Plan will be maintained for 2 years following final stabilization of the site.

8.0 SPILL CONTROL AND RESPONSE

Possible spills include diesel fuel and hydraulic fluid from trucks and heavy equipment operating on site. These and other small hazardous spills/environmental releases will be contained as close to the source as possible An exclusion zone around the spill area will be established The material safety data sheets will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents will be placed directly on the substance to contain the spill and aid recovery. Any acid spills will be neutralized prior to attempting recovery. Berms of earthen or sorbent materials will be used to contain the leading edge of the spills. Drainage ways will be blocked to prevent spilled material from leaving the site and entering the waterfront. Spill containment materials and recovered spilled material will be properly disposed. The following will be the responsibility of the Emergency Coordinator:

- Determine the nature of major spill components.

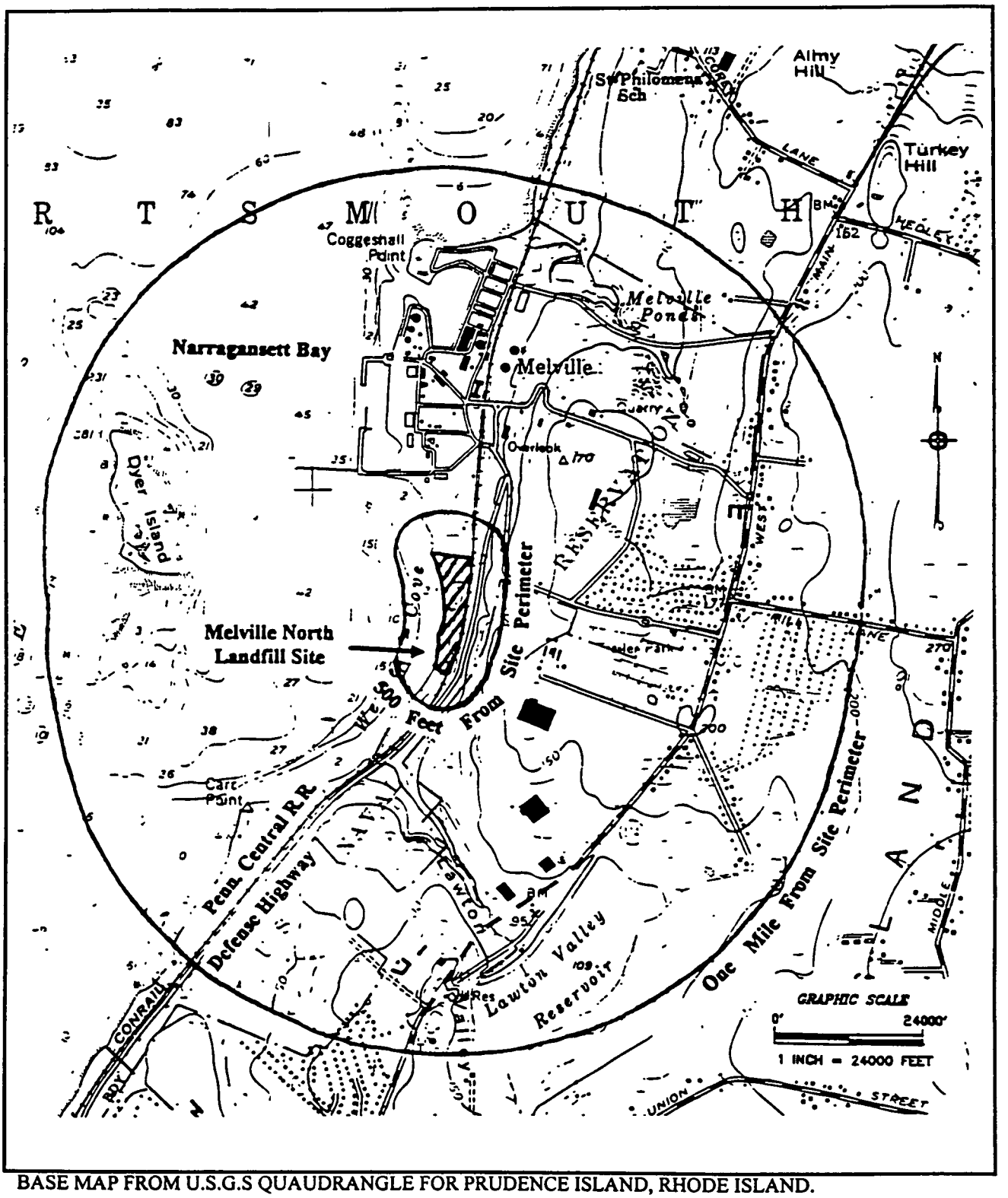
- Make sure all unnecessary persons are removed from the spill area.
- Notify appropriate response teams and authorities.
- Prescribe PPE in accordance with the Site-Specific Health and Safety Plan.
- If a flammable liquid, gas, or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, pumps, etc.)
- Try to stop the leak with appropriate material.
- Remove all surrounding materials that can react or compound with the spill.

9.0 WASTE DISPOSAL

Waste material of all types will be disposed of in a manner consistent with federal, state, and local laws and/or regulations.

APPENDIX A

FIGURES



BASE MAP FROM U.S.G.S QUAUDRANGLE FOR PRUDENCE ISLAND, RHODE ISLAND.

SITE LOCATION MAP

MELVILLE NORTH LANDFILL, PORTSMOUTH, RHODE ISLAND

FIGURE 1

APPENDIX B

INSPECTION FORM FOR EROSION CONTROL STRUCTURES

INSPECTION FORM FOR EROSION CONTROL STRUCTURES

MELVILLE NORTH LANDFILL REMEDIATION

NETC, NEWPORT, RHODE ISLAND

INSPECTOR _____ DATE: _____

Location of Control	In Place?	Condition	Sediment-Depth	Washed Out or Overtopped?

MAINTENANCE REQUIRED:

_____

_____

_____

_____

_____

_____

TO BE PERFORMED BY:

_____

ON OR BEFORE:

_____

SIGNATURE:

_____

APPENDIX C

CALCULATIONS

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CALCULATION COVER SHEET

Sheet 1 of 10

PROJECT Melville North SUBJECT Diversion Ditch Sizing

CLIENT Department of The Navy

CALCULATION NO. _____ PROJECT NO. 1284.D011.0103

NO OF SHEETS 10 DESIGN LEVEL _____

CALCULATION BY OTHERS ____ YES X NO PREPARER MWJ

REVIEWED BY _____ DATE _____

ASSUMPTIONS THAT REQUIRE CONFIRMATION ___ YES X NO

ASSUMPTIONS CONFIRMED BY _____ DATE _____

PRINT NAME, DATE AND INITIAL

Rev No	Affected Sheets	Prepared by Date	Checked by Date	Verified by Date

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MWJ DATE 1/13/99 SHEET 2 OF ____

CHKD. BY ____ DATE ____ OFS NO ____ DEPT NO ____

CLIENT Department of the Navy

PROJECT Melville North Landfill

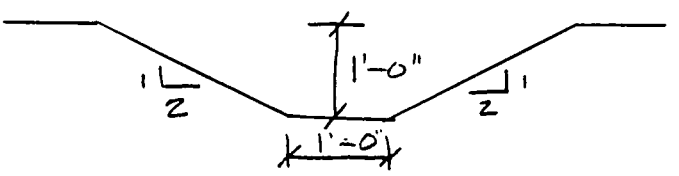
SUBJECT Diversion Ditch Sizing

1 - Check diversion ditch size based on worse case:
two diversion ditches are proposed with the following contributing drainage areas

Diversion Ditch #1 1.4 Ac contrib.
Diversion Ditch #2 0.7 Ac contrib

∴ Ditch #1 worst case

A - Determine Capacity of Estimated Ditch size:



Ditch Considerations:
- Ditch Slope 1%
- Bare earth ditch

- Cross Section Area = A_c = (1 x 1) + (1 x 2) = 3 ft²
- Flow using Manning Formula: (Sheet 5 of 10)

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A_c$$

R = Hydralic radius = $\frac{A}{WP}$
A = Area (ft²)
WP = Wetted perimeter (ft)
S = Slope (ft/ft)
n = roughness coef.

n = 0.06 (required for determining capacity - Sheet 6 of 10)

$$Q = \frac{1.49}{0.06}\left(\frac{3}{1+2\sqrt{5}}\right)^{2/3}(0.01)^{1/2}(3)$$

= 4.99 cfs capacity

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MWJ DATE 1/13/99 SHEET 3 OF

CHKD. BY DATE OFS NO DEPT. NO

CLIENT Department of The Navy

PROJECT Melville North Landfill

SUBJECT Diversion Ditch Sizing

B- Determine actual flow from drainage area:

- Drainage Area #1 = A_D = 1.4 Ac (worse case)
- Use Rational Method (sheet 7 of)

$Q = CIA_D$ (sheet of)

A_D = Area of Drainage Area (Ac)
I = Rainfall intensity (in/hr)
C = runoff coefficient

C = 0.15 (sheet 7 of 10)

- Determine time of concentration (t_c)

$$t_c = \frac{\text{Distance}}{\text{Velocity}}$$

- Distance = 1400 ft of channel
- Velocity = 1.0 ft/s (sheet 8 of 10)

$$t_c = \frac{1400 \text{ ft}}{1.0 \text{ ft/s}} = 1400 \text{ sec}$$
$$= 23.3 \text{ min}$$

- Determine rainfall intensity (I)

(2 year storm, sheet 9 of 10)

$$I = \frac{k}{t_c + b}$$

k = 106
b = 17
(sheet 10 of 10)
t_c = min

$$I = \frac{106}{23.3 + 17} = 2.63 \text{ in/hr}$$

$$Q = CIA = (0.15)(2.63 \text{ in/hr})(1.4 \text{ Ac})$$
$$= 0.55 \text{ cfs}$$

∴ actual flow is less than design flow, ditch is sufficiently sized.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MWJ DATE 1/13/99 SHEET 4 OF ____

CHKD. BY ____ DATE ____ OFS NO ____ DEPT. NO. ____

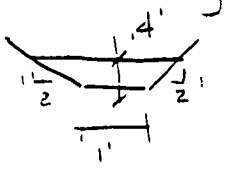
CLIENT Department of The Navy

PROJECT Melville North Landfill

SUBJECT Diversion Ditch Sizing

2 – Check velocity at actual flow

- Determine depth of flow by trial & error
  - Try h = 0.4 ft



$A_\Delta = (1 \times .4) + (.4 \times .8)$
$= 0.72$ SF

$$Q = \frac{1.49}{0.06}\left(\frac{0.72}{1+2\sqrt{.4^2+.8^2}}\right)^{2/3}(0.01)^{1/2}(0.72) = 0.73 \text{ cfs}$$

∴ to high

- Try h = 0.35 ft → Q = 0.55 cfs ∴ to low
- estimate between

$$\frac{.73-.55}{.4-.35} = \frac{.73-.68}{.4-d} \qquad d = 0.386 \text{ ft} \qquad A_d = 0.639 \text{ sf}$$

- Mannings Velocity Equation (Sheet 5 of 10)

$$V = \frac{Q}{A} = \frac{1.49}{n}(R)^{2/3}S^{1/2} \qquad n = 0.03 \text{ (for determining velocity, Sheet 6 of 10)}$$

$$= \frac{1.49}{0.03}\left(\frac{0.639}{1+2\sqrt{.386^2+2(.368)^2}}\right)(0.01)^{1/2}$$

$= 1.20$ fps ∴ less than 2 fps, OK

large, then the friction loss will not depend so much on the Reynolds number as on the channel roughness. The *Manning formula* is frequently used to evaluate the constant C. Notice that the value of C depends only on the channel roughness and geometry.[3]

$$C = \frac{1.49}{n}(r_H)^{1/6} \qquad 5.7$$

n is the Manning roughness constant. Combining equations 5.6 and 5.7 produces the *Chezy-Manning equation.*

$$v = \frac{1.49}{n}(r_H)^{2/3}\sqrt{S} \qquad 5.8$$

All of the coefficients and constants in the Chezy-Manning equation may be combined into the *conveyance*, K.

$$\begin{aligned} Q = vA &= \frac{1.49}{n}(A)(r_H)^{2/3}\sqrt{S} \\ &= K\sqrt{S} \end{aligned} \qquad 5.9$$

Example 5.1

A rectangular channel on a 0.002 slope is constructed of finished concrete and is 8 feet wide. What is the uniform flow if water is at a depth of 5 feet?

The hydraulic radius is: $r_H = \frac{(8)(5)}{5+8+5} = 2.22$ ft

From Appendix A, the roughness coefficient for finished concrete is 0.012. The Manning coefficient is

$$C = \frac{1.49}{0.012}(2.22)^{1/6} = 141.8$$

The discharge from equation 5.9 is

$$Q = (141.8)(8)(5)\sqrt{(2.22)(0.002)} = 377.9 \text{ cfs}$$

5 VARIATIONS IN THE MANNING ROUGHNESS CONSTANT, n

For most calculations, n is assumed to be constant. The accuracy of other parameters used in open flow calculations often does not warrant considering the variation of n with depth, and the choice to use varying n values is left to the individual designer.

If it is desired to acknowledge variations in n with respect to depth, it is expedient to make use of tables or graphs of hydraulic elements. Table 5.1 lists such hydraulic elements under the assumption that n varies. (Appendix C can be used for both varying and non-varying n.)

[3] Originally proposed in 1868 by an investigator with the name of Gaukler. In Europe, the Manning equation may be known as *Strickler's equation.*

Table 5.1
Circular Channel Ratios
(n varying with depth)

d/D	Q/Q_{full}	v/v_{full}
0.1	0.02	0.31
0.2	0.07	0.48
0.3	0.14	0.61
0.4	0.26	0.71
0.5	0.41	0.80
0.6	0.56	0.88
0.7	0.72	0.95
0.8	0.87	1.01
0.9	0.99	1.04
0.95	1.02	1.03
1.00	1.00	1.00

Example 5.2

2.5 cfs of water are in uniform flow in a 20″ sewer line ($n = 0.015$, $S = 0.001$). What are the depth and velocity? (Assume n varies with depth.)

If the pipe were to flow full, it would carry Q_{full}.

$$\begin{aligned} D &= 20/12 = 1.667 \text{ ft} \\ r_H &= \frac{1}{4}D = \frac{1}{4}(1.667) = 0.417 \text{ ft} \\ Q_{\text{full}} &= \frac{1}{4}\pi(1.667)^2\left(\frac{1.49}{0.015}\right)(0.417)^{2/3}\sqrt{0.001} \\ &= 3.83 \text{ cfs} \\ v_{\text{full}} &= \frac{3.83}{\frac{1}{4}\pi(1.667)^2} = 1.75 \text{ ft/sec} \end{aligned}$$

$Q/Q_{\text{full}} = 2.5/3.83 = 0.65$. From Appendix C, $(d/D) = 0.66$ and $(v/v_{\text{full}}) = 0.92$. So,

$$\begin{aligned} v &= (0.92)(1.75) = 1.61 \text{ ft/sec} \\ d &= (0.66)(20) = 13.2 \text{ inches} \end{aligned}$$

6 NORMAL DEPTH

When the depth of flow is constant along the length of the channel (i.e., depth is neither increasing nor decreasing), the flow is said to be *uniform.* The depth of flow in that case is known as the *normal depth*, d_o. If the normal depth is known or can be calculated, it can be compared with the actual depth of flow to determine if the flow is uniform.[4]

[4] In reality, there are two normal depths for any given discharge. This is apparent from the specific energy curves presented elsewhere in this chapter.

Source: Rhode Island Soil Erosion and Sedimentation Control Handbook.

appropriate vegetative retardance factors listed in Table 6B-5.

Bare Channels The minimum capacity and maximum velocity shall be determined by using Manning's equation with an "n" value of 0.06 for capacity and 0.03 for velocity. Bare channels are recommended only for temporary installations and agriculturals uses.

D. Cross Section The shape of the channel cross section shall be such that the diversion can be properly maintained with modern equipment. The channel may be parabolic, vee-shaped or trapezoidal (Figure 6B-1). The side slopes for permanent diversions shall not be steeper than 2:1 and preferably 4.1 for maintenance purposes. Where frequent crossings are expected, side slopes should be flatter. The back slope of the ridge is not to be steeper than 2:1 and preferably 4:1. The ridge shall include a settlement factor equal to 5 percent of the height. The minimum top width of the diversion ridge after settlement is to be 4.0 feet at the design water elevation.

In determining the cross section for temporary diversions, give consideration to soil type, frequency of operation and type of equipment that is anticipated to be crossing the diversion. In no case shall slopes be steeper than 1-1/2:1.

The top of the constructed ridge shall not be lower at any point than the design elevation plus the specified overfill for settlement.

TABLE 6 B-4

Maximum Permissible Velocity (ft./sec.)

SOIL TEXTURE	BARE CHANNEL	CHANNEL VEGETATION CONDITION		
		Poor	*Fair*	*Good*
Sand, silt, loam, sandy loam, loamy sand, loam and muck	2.0	2.0	2.5	3.5
Silty clay loam, sandy clay loam, clay, clay loam, sandy clay, silty clay	2.5	3.0	4.0	5 0

Source Engineering Field Manual for Conservation Practices, USDA Soil Conservation Service, 1979

TABLE 6 B-5

Vegetative Retardance Factors

RANGE OF VEGETATION HEIGHT DURING DIFFERENT PERIODS OF THE YEAR	VEGETATIVE RETARDANCE FACTORS	
	For Determining Minimum Capacity	*For Determining Maximum Allowable Velocity*
Good Stand		
between 6" and less than 2"	D	E
between 10" and 2"	C	D
between 24" and 2"	B	D
Fair or Poor Stand		
between 10" and less than 2"	D	E
between 24" and 2"	C	D
between 30" and 2"	B	D

Source: Engineering Field Manual for Conservation Practices, USDA Soil Conservation Service, 1979

Sheet 6 of 10

Source: Civil Engineering Reference Manual

many unit hydrographs, each lagging the other by time t, the duration of the storm which produced the unit hydrograph. After a sufficient number of lagging unit hydrographs have been added together, the accumulation will level off and remain constant. At that point, the lagging can be stopped. The resulting accumulation is known as an *S-curve*.

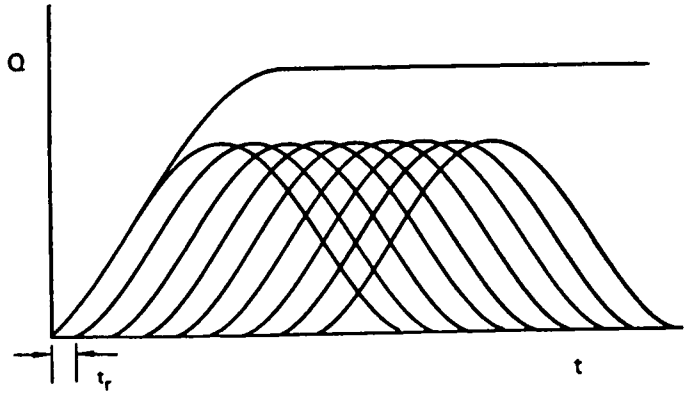


Figure 6.14 Constructing the S-Curve

If two S-curves are drawn, one lagging the other by time t', the area between the two curves represents a hydrograph area for a storm of duration t'_r. The differences between the two curves can be plotted and scaled to a unit hydrograph by multiplying by the ratio of (t_r/t'_r).

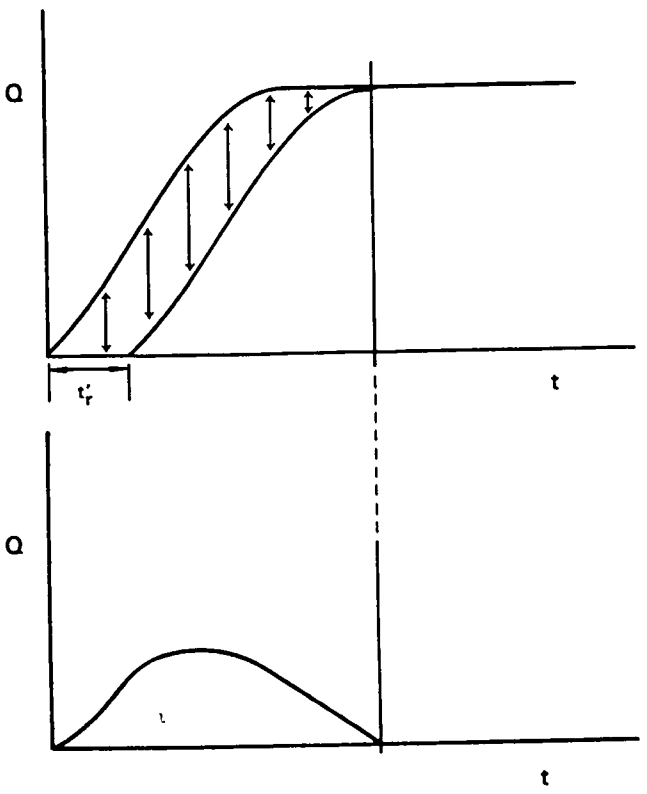


Figure 6.15 Using S-Curves to Construct a t' hydrograph

12 PEAK RUNOFF FROM THE RATIONAL METHOD

Although total runoff data is required for reservoir and dam design, the instantaneous peak runoff is needed to size culverts and storm drains.

In the closed-form equations used to find peak runoff, it is usually assumed that the rainfall is applied to a surface at a constant rate. If this assumption is true and the surface is largely impervious, the runoff will eventually equal the rate of rainfall. The time between the start of rainfall and the time of peak flow is known as the *time of concentration*, t_c. Typical values of t_c for areas less than 50 acres range from 5 to 30 minutes.

The *rational formula* is based on the assumptions given and has been in widespread use for small areas (i.e., less than several hundred acres or so) but is seldom used for areas greater than five square miles. Values of C are found in appendix A.

$$Q_p = CIA_d \qquad 6.29$$

Strictly speaking, Q_p is in acre-inches/hour, but it is typically taken as cubic feet per second since the conversion between these two units is 1.008. For a small drainage area, t_c is taken as the largest combination of overland flow time and channel time. *Channel time* is found by dividing the channel length by the (usually assumed) channel velocity.[6] Assuming laminar flow, the overland flow time for small areas without defined channels can be found from the *Izzard formula*. Equation 6.30 should be used only if the product (IL_o) is less than 500.

$$t = \frac{(41)(b)(L_o)^{1/3}}{(CI)^{2/3}} \qquad 6.30$$

$$b = \frac{0.0007(I) + C_r}{S^{1/3}} \qquad 6.31$$

The retardance coefficient, C_r, is given in table 6.4.

Table 6.4
Retardance Coefficient

Type of Surface	C_r
smooth asphalt	0.007
concrete pavement	0.012
tar & gravel pavement	0.017
closely clipped lawn	0.046
dense bluegrass turf	0.060

[6] If the pipe or channel size is known, the velocity can be found from $Q = Av$. If the pipe size is not known, then A will have to be estimated. In that case, one might as well estimate v instead. 5 fps is a reasonable velocity. The minimum velocity for a self-cleansing pipe is 2 fps.

HYDROLOGY

Sheet 7 of 10

:r precipitation or stream
u[illegible] in the determination
[illegible]omplete hydrograph.
[illegible]a method.
runoff problems encoun-
st[illegible]ctures, the second to
[illegible]atively minor impor-
[illegible]s are small highway
structures are character-
[illegible]e potential. Typical
[illegible]nder vital highways

[illegible] The most common
[illegible] formula

(21-127)

[illegible]unoff

s [illegible] the duration of rain-
of [illegible]ncentration is com-
[illegible] point of a drainage

duration is equal to or
[illegible]fall intensity.
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a[illegible] of application have
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[illegible]infall rather than
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ary data would not be

[illegible] an example, the
function of the soil and
er similar refinements
[illegible]ficient C will give
[illegible] Table 21-16 for
Hydrologic Determina-

TABLE 21-16 Common Runoff Coefficients

Type of Drainage Area	Runoff Coefficient C
Business	
Downtown areas	0.70–0.95
Neighborhood areas	0.50–0.70
Residential	
Single-family areas	0.30–0.50
Multi-units, detached	0.40–0.60
Multi-units, attached	0.60–0.75
Suburban	0.25–0.40
Apartment dwelling areas	0.50–0.70
Industrial	
Light areas	0.50–0.80
Heavy areas	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad-yard areas	0.20–0.40
Unimproved areas	0.10–0.30
Streets	
Asphaltic	0.70–0.95
Concrete	0.80–0.95
Brick	0.70–0.85
Drives and walks	0.75–0.85
Roofs	0.75–0.95
Lawns	
Sandy soil, flat, 2%	0.05–0.10
Sandy soil, avg, 2–7%	0.10–0.15
Sandy soil, steep, 7%	0.15–0.20
Heavy soil, flat, 2%	0.13–0.17
Heavy soil, avg, 2–7%	0.18–0.22
Heavy soil, steep, 7%	0.25–0.35

tion of Waterway Areas for the Design of Drainage Structures in Small Drainage Basins," *University of Illinois Engineering Experimental Station Bulletin* 426, 1962).

After selection of the design-storm frequency of occurrence, for example, a 50- or 100-year-frequency storm, the rainfall intensity I may be determined from any of a number of formulas or from a statistical analysis of rainfall data if enough are available. Chow lists 24 rainfall-intensity formulas of the form

$$I = \frac{KF^{n_1}}{(t + b)^n} \tag{21-128}$$

where I = rainfall intensity, in/h
K, b, n, and n_1 = respectively, coefficient, factor, and exponents depending on conditions that affect rainfall intensity
F = frequency of occurrence of rainfall, years
t = duration of storm, min
= time of concentration

Perhaps the most useful of these formulas is the Steel formula:

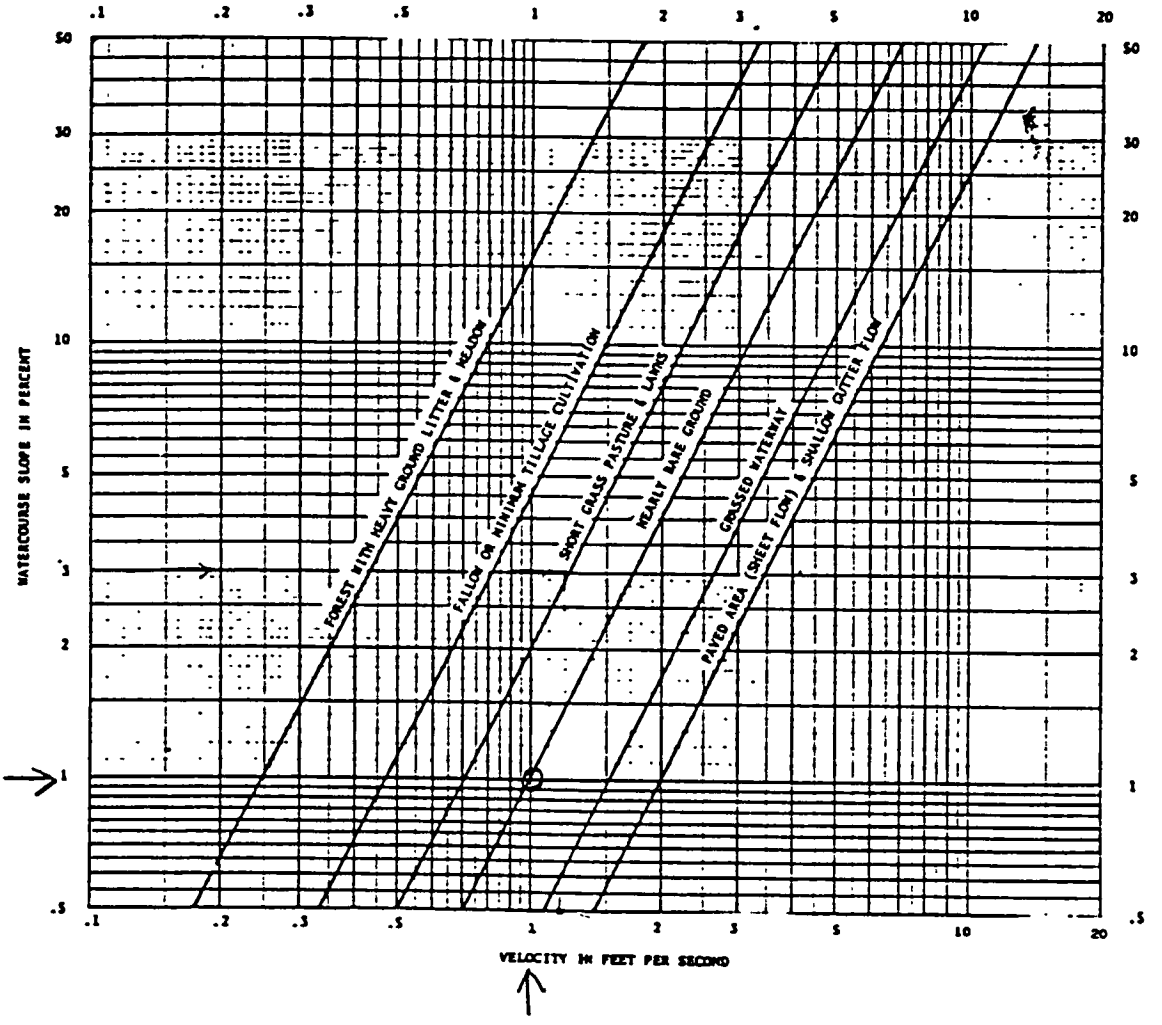
$$I = \frac{K}{t + b} \tag{21-129}$$

where K and b are dependent on the storm frequency and region of the United States (Fig. 21-73 and Table 21-17).

Equation (21-129) gives the average maximum precipitation rates for durations up to 2 h.

Source; Standard Handbook for Civil Engineers, 3rd Edition

Sheet 7 of 10



VELOCITIES FOR ESTIMATING OVERLAND FLOW TIME

FIGURE 2-2

Source: USDA Soil Conservation Service

The time of concentration T_c at any point in a drainage system is the sum of the overland flow time; the flow time in streets, gutters, or ditches; and the flow time in conduits. Overland flow time may be determined from any number of nomographs developed for the purpose. (See V. T. Chow, "Handbook of Applied Hydrology," McGraw-Hill Book Company, New York.) The flow time in gutters, streets, ditches, and conduits can be determined from a calculation of the average velocity using the Manning equation [Eq. (21-89)]. The time of concentration is usually expressed in minutes.

After determining the time of concentration, calculate the corresponding rainfall intensity from either Eq. (21-128) or Eq. (21-129), or any equivalent method. Then select the runoff coefficient from Table 21-16 and determine the peak discharge from Eq. (21-127).

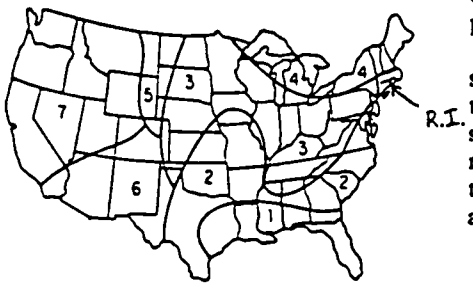


Fig. 21-73. Regions of the United States for use with the Steel formula.

Since the rational formula assumes a constant uniform rainfall for the time of concentration over the entire area, the area A must be selected so that this assumption applies with reasonable accuracy. Adhering to this assumption may necessitate subdividing the drainage area.

Method for Determining Runoff for Major Hydraulic Structures • The unit-hydrograph method, pioneered in 1932 by LeRoy K. Sherman, is a convenient, widely accepted procedure for determining runoff for major hydraulic structures. (Leroy K. Sherman, "Streamflow from Rainfall by Unit-Graph Method," *Engineering News-Record*, vol. 108, pp. 501–505, January–June 1932.) It permits calculation of the complete runoff hydrograph from any rainfall after the unit hydrograph has been established for the particular area of concern.

The **unit hydrograph** is defined as a runoff hydrograph resulting from a **unit storm.** A unit storm has practically constant rainfall intensity for its duration, termed a *unit period*, and a runoff volume of 1 in (water with a depth of 1 in over a unit area, usually 1 acre). Thus, a unit storm may have a 2 in/h effective intensity lasting ½ h or a 0.2-in/h effective intensity lasting 5 h. The significant part of the definition is not the volume but the constancy of intensity. Adjustments can be made within unit-hydrograph theory for situations where the runoff volume is different from 1 in, but corrections for highly variable rainfall rates cannot be made.

The unit hydrograph is similar in concept to determining a set of factors for a specific drain-

TABLE 21-17 Coefficients for Steel Formula

Frequency, years	Coefficients	Region						
		1	2	3	4	5	6	7
2	K	206	140	106	70	70	68	32
	b	30	21	17	13	16	14	11
4	K	247	190	131	97	81	75	48
	b	29	25	19	16	13	12	12
10	K	300	230	170	111	111	122	60
	b	36	29	23	16	17	23	13
25	K	327	260	230	170	130	155	67
	b	33	32	30	27	17	26	10
50	K	315	350	250	187	187	160	65
	b	28	38	27	24	25	21	8
100	K	367	375	290	220	240	210	77
	b	33	36	31	28	29	26	10

Source: "Std. Handbook for Civil Engineers", 3rd Edition

Sheet 9 of 10

Source: Rhode Island Soil Erosion and Sedimentation Control Handbook

TABLE 6 B-1

Design Storm and Freeboard Determinations

DIVERSION TYPE	TYPICAL AREA OF PROTECTION	DESIGN STORM FREQUENCY	FREEBOARD REQUIRED
Temporary	Construction areas (structures, roads, piplelines, etc)	2 years	0.0
	Building sites	5 years	0.0
Permanent	Infiltration	10 years	0.3 ft.
	Agricultural Land	10 years	0.3 ft.
	Urban Land Areas, Play Fields, Recreation Areas, Agricultural Buildings, etc.)	25 years	0.3 ft.
	Homes, schools, industrial buildings,etc.	25 years	0.5 ft.

Source: National Handbook of Conservation Practices, USDA Soil Conservation Service, 1987

TABLE 6 B-2

Channel Dimensions for Small Diversions

Q (cfs)	CHANNEL DIMENSIONS TOP WIDTH (ft.)	DEPTH (ft.)*
5	12	1.9
10	22	1.9

* The depth given above includes 0.3 ft. freeboard and 0.1 ft. settlement. Side slopes shall be 3 : 1 or flatter, and the ridge top width shall be 4 ft. or wider.

Source: Standards for Soil Erosion and Sediment Control in New Jersey, New Jersey State Soil Conservation Committee, 1980

TABLE 6 B-3

Spacing for Small Diversions Used with Road Right of Ways

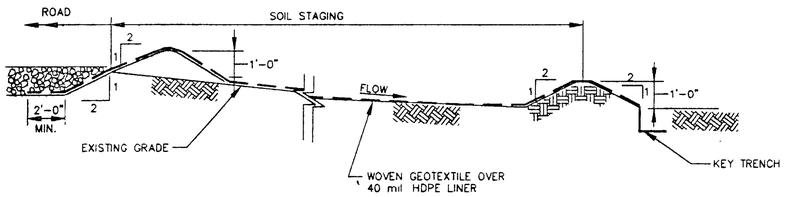
ROAD GRADE (percent)	APPROXIMATE DISTANCE BETWEEN DIVERSIONS (ft.)
1	400
2	245
5	125
10	78
15	58
20	47
25	40
30	35

Source: Standards for Soil Erosion and Sediment Control in New Jersey, New Jersey State Soil Conservation Committee, 1980

Sheet 10 of 10

APPENDIX D

REFERENCE DRAWINGS



SECTION A
SOIL STAGING AREA (2|3)
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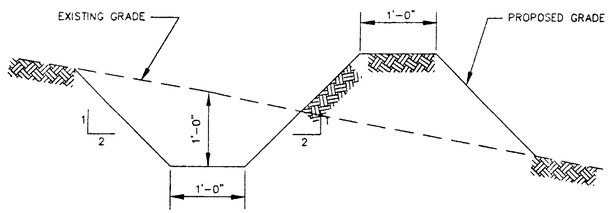
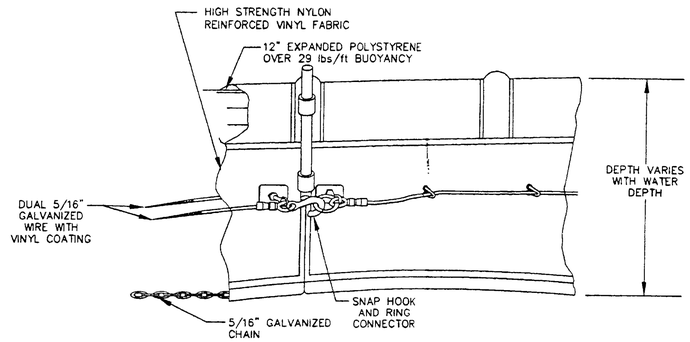


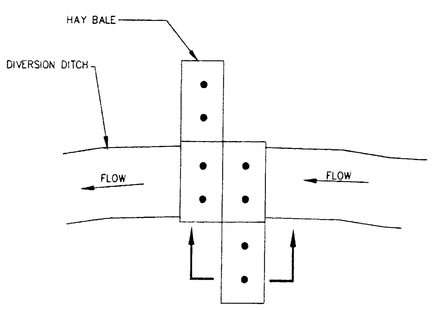
TEMPORARY DIVERSION DITCH (1|2|3)
NOT TO SCALE

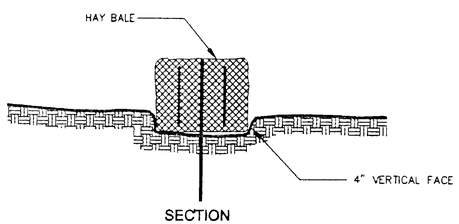


DETAIL 2
TURBIDITY BARRIER (2|3)
NOT TO SCALE

NOTES

1. SHALL BE INSTALLED IN 100' LENGTHS
2. SHALL BE CONSTRUCTED OF HIGH VISIBILITY YELLOW MATERIAL
3. BARRIER SHALL BE SIZED TO EXTEND TO THE HARBOR FLOOR AT HIGH TIDE.





SECTION

HAY BALE FILTER (3|2|3)
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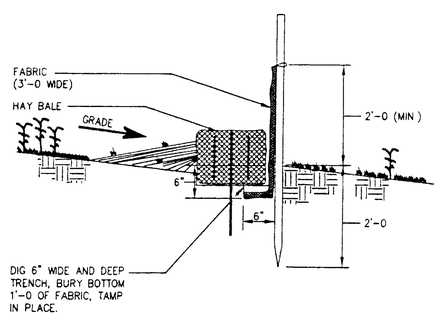

DETAIL 4
SILT FENCE WITH HAY BALE (2|3)
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MELVILLE NORTH LANDFILL

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DETAILS AND SECTIONS

FOSTER WHEELER ENVIRONMENTAL CORPORATION
LIVINGSTON, NEW JERSEY

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SH. 3 OF 3 REV 0

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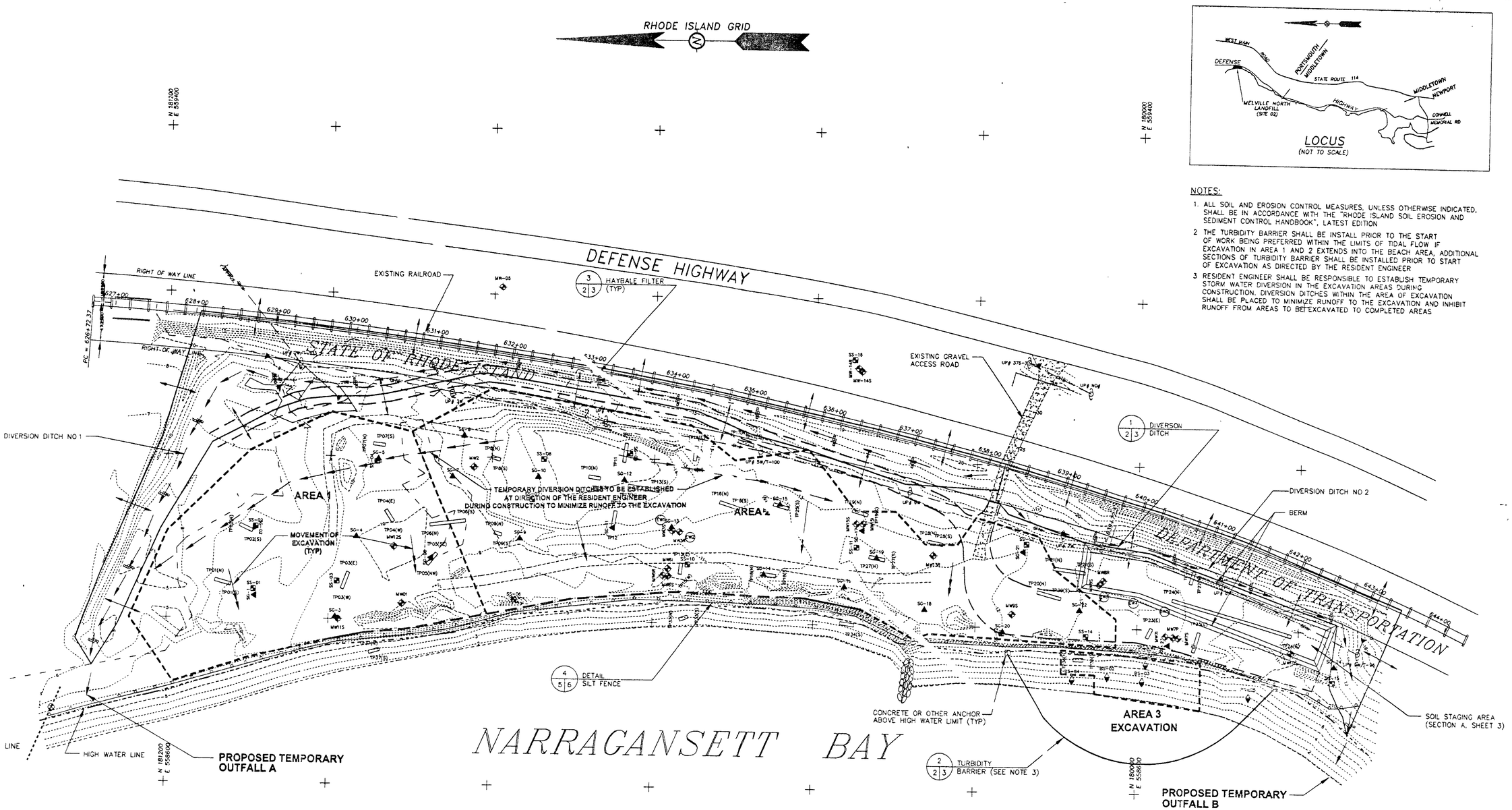

NOTES:

1. ALL SOIL AND EROSION CONTROL MEASURES, UNLESS OTHERWISE INDICATED, SHALL BE IN ACCORDANCE WITH THE "RHODE ISLAND SOIL EROSION AND SEDIMENT CONTROL HANDBOOK", LATEST EDITION
2. THE TURBIDITY BARRIER SHALL BE INSTALL PRIOR TO THE START OF WORK BEING PREFERRED WITHIN THE LIMITS OF TIDAL FLOW IF EXCAVATION IN AREA 1 AND 2 EXTENDS INTO THE BEACH AREA, ADDITIONAL SECTIONS OF TURBIDITY BARRIER SHALL BE INSTALLED PRIOR TO START OF EXCAVATION AS DIRECTED BY THE RESIDENT ENGINEER
3. RESIDENT ENGINEER SHALL BE RESPONSIBLE TO ESTABLISH TEMPORARY STORM WATER DIVERSION IN THE EXCAVATION AREAS DURING CONSTRUCTION. DIVERSION DITCHES WITHIN THE AREA OF EXCAVATION SHALL BE PLACED TO MINIMIZE RUNOFF TO THE EXCAVATION AND INHIBIT RUNOFF FROM AREAS TO BE EXCAVATED TO COMPLETED AREAS

LEGEND:

- TEST PIT LOCATION
- SURFACE SAMPLE LOCATION
- MONITORING WELL LOCATION
- BEACH SAMPLE LOCATION
- TEMPORARY DRAINAGE DIVIDE DURING CONSTRUCTION
- DIVERSION DITCH
- WETLANDS LIMITS
- CONST. ROAD
- EXISTING GRADE
- HIGH WATER LINE
- SILT FENCE
- HAY BALE FILTER

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SEDIMENTATION AND SOIL EROSION CONTROL PLAN

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LIVINGSTON, NEW JERSEY

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APPENDIX E

CONSTRUCTION SCHEDULE

CONSTRUCTION SCHEDULE

Mobilize	April 5, 1999
Begin Waste Removal	April 26, 1999
Complete Waste removal	July 23, 1999
Complete Site Restoration	August 10, 1999
Demobilize	August 20, 1999

APPENDIX F

PERMIT APPLICATIONS

RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES)
NOTICE OF INTENT (NOI)
STORM WATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY
(Revised 1/98)

DEM USE ONLY
Date NOI Received _____
Date Fee Received _____
RIPDES# RIR _____

MARK ONLY ONE ITEM: ☐ Existing Construction RIPDES Authorization No. RIR_____ ☒ New Construction ☐ Change of Information

I. OWNER

Name: Melville Marine Industries			
Mailing Address: One Little Harbor Landing			
City: Portsmouth	State: RI	Zip: 02871	Phone: (401) 683-7015
Contact Person: Mr. Fredrick E. Hood	Title:		

Ownership (please circle one):
PRI - Private PUB - Public BPP - Public/Private STA - State FED - Federal
Other (pl ase specify):

II. OPERATOR (if different from Owner)

Name: Foster Wheeler Environmental Corporation			
Local Mailing Address: 2300 Lincoln Highway E., One Oxford Valley, Suite 200			
City: Langhorne	State: PA	Zip: 19047	Phone: (215) 702-4000
Contact Person: Carl Tippman	Title:		

III. CONSTRUCTION SITE INFORMATION

Street Address: Defense Highway			
City: Portsmouth	State: RI	Zip:	Phone: NA
Nearest Utility Pole Number:	Assessors Plat:		Lot:

Is the construction site part of a larger common plan of development or sale ? ☐ YES ☒ NO

If yes, name of development:

Projected or Actual Construction Commencement 4/5/99 MO/DY/YR
Projected Construction Completion 8/20/99 MO/DY/YR

Area of Site:	Total area of Impervious Surface:	Runoff Coefficient:
Total 10 Acres	Pre-Construction 0 Acres	Pre-Construction .15
Disturbed 5.5 Acres	Post-Construction 0 Acres	Post-Construction .15

IV. RECEIVING WATER INFORMATION

☒ Surface Water Body	Name: Narragansett Bay
☐ Separate Storm Sewer System	Name:
Ultimate Receiving Water	Name:
Watershed Code:	Name of Watershed:

R.I. DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Resources

APPLICATION(S) FEES FORM

Please complete the information below and **submit this completed form and your check (payable to "R.I. General Treasurer") for the appropriate fee directly to**:

R.I. Department of Environmental Management
Office of Management Services
235 Promenade Street
Providence, RI 02908

***** FEES ARE NOT REFUNDABLE *****

APPLICANT'S NAME: Department of the Navy/Foster Wheeler Environmental Corp.

OWNER'S NAME: Melville Marine Industries

SITE LOCATION: Portsmouth, RI

APPLICATION TYPE (Permit, Order of Approval): **RIPDES General Permit**

NOTE: The application and all accompanying documents should be submitted to the appropriate section of the Office of Water Resources, 235 Promenade Street, Providence, RI 02908-5767. Application review will be initiated only upon receipt of the complete application fee.

FOR OFFICE USE ONLY

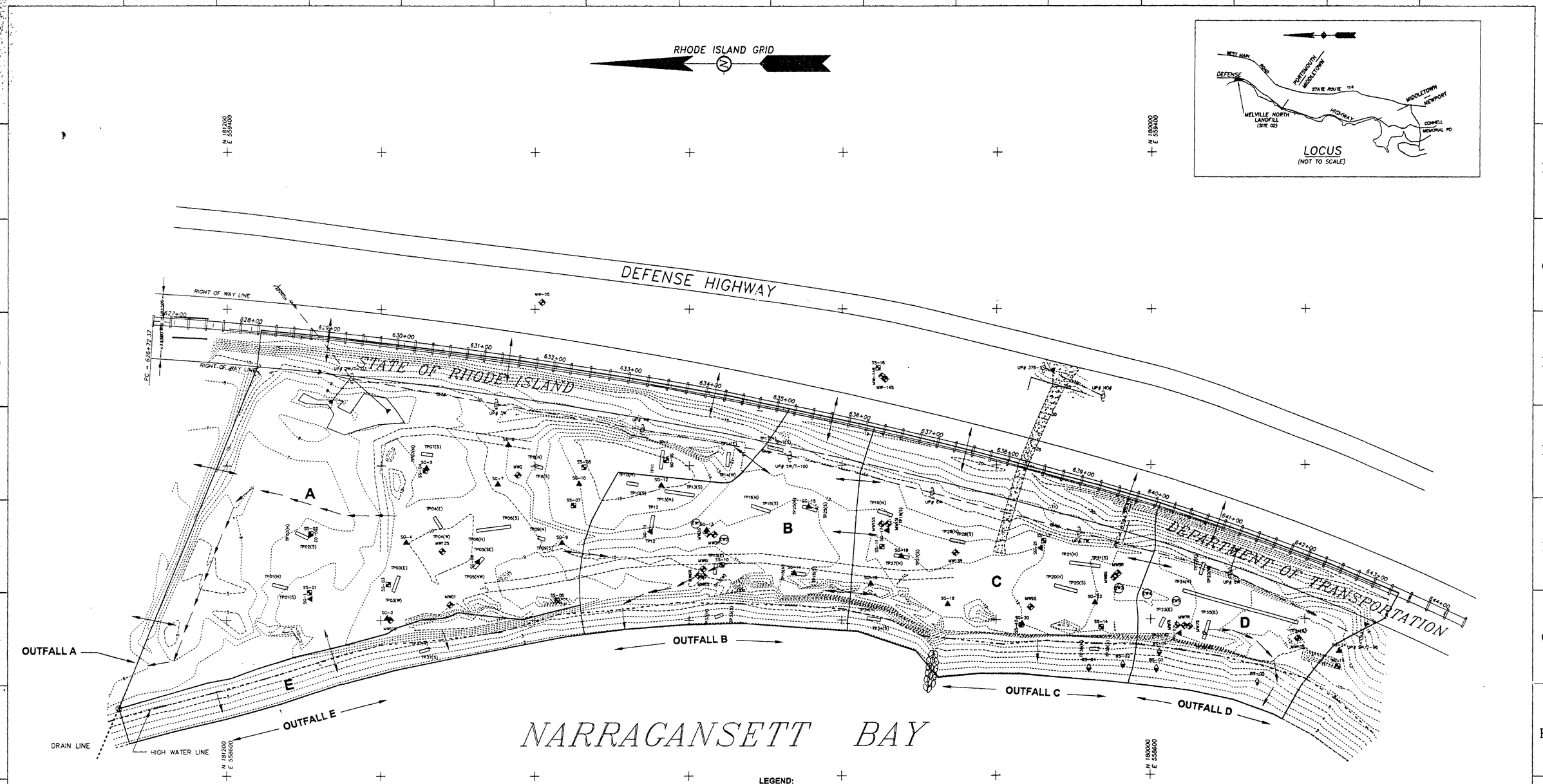
OMS Receipt Date:_____

Fee Amount Received:_____

Processor Initials:_____

OWR Telephone Number (401) 222-4700
OWR Telefax Number (401) 222-6177
DEM Telecommunications for the Deaf (401) 831-5508

STCGENRL.MST



LEGEND:

- EXISTING CONTOUR
- HIGHWATER LINE
- TEST PIT LOCATION
- SURFACE SAMPLE LOCATION
- MONITORING WELL LOCATION
- BEACH SAMPLE LOCATION
- EXISTING DRAINAGE DIVIDE

TOPOGRAPHICAL SURVEY PREPARED BY SAI SURVEYING CO., TAKEN FROM DRAWING ENTITLED "SITE 02, MELVILLE NORTH LANDFILL SITE MAP," DATED 5/29/91

CAD FILE NAME: ME11299.DWG DATE: 01/13/99
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EXISTING CONDITIONS AND SAMPLING LOCATION

FOSTER WHEELER ENVIRONMENTAL CORPORATION
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CE	MWJ	J.R.	C.T.		

SCALE:	DRAWING NUMBER:	SH.	OF	REV
1"=60'-0"	SE-1	1	3	0

FWD1R12.DWG

001-72602X