Attachment B

FACE Report

Financial Assurance Responsibility
Closure and Long-term Care Cost Estimates
Tomoka Farms Road Landfill North Cell
(Excluding Phase II Area 4)
Volusia County, Florida
April 2015

Closure and long-term care cost estimates for the Tomoka Farms Road Landfill North Cell are re-calculated according to 62-701.630(3)(a), FAC to include costs for Phase II Area 3, permitted expansion area. Note that the Phase II Area 4 is still excluded from the Financial Assurance. The basis for cost estimates is the closure design and regulations contained in Chapter 62-701 of the Florida Administrative Code (FAC). The updated FDEP Form 62-701.900(28) is provided in this report as Attachment 1.

Note that the current Financial Assurance Cost Estimate (FACE) methodology inflates unit costs used in the North Cell closure and Long Term Care (LTC) recalculations included in *2013 Financial Assurance Responsibility Report* (dated August 2013). FDEP inflation factor was used to adjust the unit cost to 2014 dollars. Detailed breakup of FDEP Form 62-701.900(28) line items and associated unit costs is provided as Attachment 2.

CLOSURE COSTS

Monitoring Wells (Item 1)

Monitoring wells were installed during the construction of Phase I of the North Cell and therefore and not included as part of the closure construction estimate.

Slope and Fill (Item 2)

As a part of on-going landfill operations a 12-inch bedding layer will be installed over compacted waste once the intermediate cover grades are achieved. The associated cost of placing this layer is not included in this cost estimate.

Cover Material (Item 3)

The proposed final cover consists of a 40-mil textured LLDPE, double sided geocomposite, and 18” layer of cover soil. The geosynthetic quantities have been adjusted by 4% to account for seams, destructive testing, wastage, anchoring, toe of slope run-out, and booting. The cover soil has been increased by 5% to account for soil bulking and other losses. A slope factor of 1.054 has been accounted in the side slope area for 3:1 side-slope.

Waste Footprint = 77.85 AC
(*Refer to Attachment 3, Figures 1 and 2 for geometry and final grading plan of waste footprint*)

Total Surface Area = Side Slope Area + Top Flat Area
Side Slope Area = 3,168,835 ft^2 (obtained from AutoCAD and adjusted with 1.054 factor)
Top Flat Area = 384,661 ft^2 (obtained from AutoCAD)
Total Surface Area = 3,553,496 ft^2 = 81.58 AC

(a) Cover Soil:
Volume of Cover Soil in 18” layer= (3,553,496 ft^2 × 1.5 ft × 1.05/ 27) = 207,287 CY

(b) Synthetics:
Area of Geosynthetics = (3,553,496 ft^2 × 1.04 / 9) = 410,626 yd^2

Top Soil Cover (Item 4)

The top soil cover consists of 6” layer over the entire closure area. Top soil has been increased by 5% to account for soil bulking and other losses.

Volume of Cover Soil in 6” layer= (3,553,496 ft^2 × 0.5 ft × 1.05/ 27) = 69,096 CY

Vegetation (Item 5)

Sod will be installed on a side slopes for the entire closure area. The top surface closure area will be vegetated by Hydroseeding.

Quantity of sod required = 3,168,835 ft^2 = 352,093SY

Area of Hydroseeding required = 384,661 ft^2 = 8.83 AC

Stormwater Control System (Item 6)

No separate earthwork, grading and ditches are considered as part of North Cell closure as it will be covered in items 2 through 4. Also, the installation of the perimeter ditch and berm installation are part of the landfill’s on-going operations and therefore, not included in this updated cost estimate. Quantities are based on conceptual closure plans provided in the *Intermediate Permit Modification to Closure Permit Application,* dated August 2010. Quantities associated with Phase II, Area 3 expansion are added to the stormwater quantities provided in previous FACE Reports for the North Cell, Phase I landfill.

- Piping:
  Total length of downdrain pipe = 8,124 LF

- Control Structures:
  Number of control structures, i.e., Baffled Endwall FDOT No. 261= 15

- Inlets:
  Number of inlets = 51

- Erosion and Sediment (E&S) Control:
  Assume $2,000 per AC for E&S Control.

  Note that the total cost of inlets ($282,824.07) and E&S Control ($158,035.50) is added as a lump sum cost in “*Other Costs*” on the FDEP Form 62-701.900(28).

Passive Gas Control (Item 7)

No passive gas control system is proposed as a part of the North Cell closure.

Active Gas Extraction Control (Item 8)

Active gas extraction control will be part of the North Cell closure. The quantities associated with the active gas extraction system required for the North Cell closure were identified in the FDEP approved cost estimates included as part of the *2013 Financial Assurance Responsibility Report* (dated August 2013). The current estimate accounts for previous gas control quantities and additional gas control quantities associated with Phase II, Area 3. A detailed breakdown of gas extraction and control system quantities is provided in Attachment 2. Note that total cost of gas extraction and control system identified in Attachment 2, line items 8(a) to 8(q), is added as a lump sum cost in "*Other Costs*" on the FDEP Form 62-701.900(28).

Security System (Item 9)

Perimeter fencing, gates and signs already exists at the facility. A $2,000 lump sum is allocated for additional signs as part of the closure costs.

Closure Permit, Contracts, CQA and Certification (Items 10 & 11)

Professional engineering services will be needed during three phases of the closure process: permitting, construction and certification. The fee for certification of closure includes a professional engineer's time spent at the landfill reviewing test data and submitting the certification report to the FDEP.

Contingency (Item 12)

A 10% of total closure cost will be allocated as a contingency.

Site Specific Costs (Item 13)

The mobilization fee has been estimated to be 5% of Items 1 through 11.

LONG-TERM CARE COSTS

Total long-term care area = 77.85 AC

Ground Water Monitoring (Item 1)

Per previous correspondence with FDEP, the long-term care costs for groundwater monitoring at the facility are included wholly in the long-term care financial assurance for the South Cell.

Surface Water Monitoring (Item 2)

There are seven surface water monitoring locations associated with the North Cell, and all the locations are monitored on a semi-annual basis. Unit cost identified in North Cell closure and Long Term Care (LTC) recalculations included in 2013 Financial Assurance Responsibility Report (dated August 2013) was inflated to 2014 dollars using FDEP approved inflation factor.

Gas Monitoring (Item 3)

There are 8 gas monitoring probes as well as surface monitoring for the North Cell long-term care and all the locations are monitored on a quarterly basis. Unit cost identified in North Cell closure and Long Term Care (LTC) recalculations included in 2013 Financial Assurance Responsibility Report (dated August 2013) was inflated to 2014 dollars using FDEP approved inflation factor.

Leachate Monitoring (Item 4)

Per Chapter 62-701 of the Florida Administrative Code (FAC), annual leachate monitoring is no longer required and therefore, no included as part of this long-term care cost estimates.

Leachate Collection & Treatment System (Item 5)

<u>Maintenance:</u>

As indicated in Attachment 2 annual maintenance costs have been increased to accommodate additional jet cleaning associated with Phase II, Area 3. Note that previously allocated pipe repairs allocation is sufficient for North Cell. Unit costs were inflated to 2014 dollars using FDEP approved inflation factor.

<u>Impoundments and Aeration Systems</u>: It is assumed that 30 SY of liner repairs will be required every year @ $9.14 per SY.

<u>Offsite Disposal</u>: The cost is based on average annual generation of 1,186,000 gallons of leachate and $30.45 per 1,000 gallons of total disposal cost for leachate. Leachate generation is adjusted based on footprint increase and unit cost is inflated to 2014 dollars using FDEP approved inflation factor.

Groundwater Monitoring Well Maintenance (Item 6)

Assume a lump sum amount of $500 per year for well maintenance and replacement.

Gas System Maintenance (Item 7)

To estimate the cost of maintaining the active gas collection system, maintenance of the well field and flare station were taken into consideration. Routine maintenance includes replacing the thermocouples in the flare stack every few months, inspecting and cleaning of the flare arrestor and replacing the bearings on the blower. Installation of replacement collection wells, especially in the years immediately after closure, was budgeted in addition to replacement of the blower every fifteen years. It was assumed a field technician would be needed for two days per month (20 hours @ $65 per hour, $500 misc expenses, and 15% profit and contingency fee) to monitor the collection wells, perform well field adjustments and document readings.

Landscaping (Item 8)

It is anticipated the landfill cap will need landscaping/mowing four times a year.

Erosion Control and Cover Maintenance (Item 9)

To account for erosion control and cover maintenance in the post closure care period, reconstruction of the final cover (including sod, liner and soil fill material) and re-grading were considered. An annual average soil loss of 944 CY was calculated using the Universal Soil Loss Equation (USLE). This is a conservative assumption since it is assumed that 60% of the ground is covered by vegetation. Please refer to Attachment 4 for further explanation of the USLE equation.

For financial assurance estimation, it is assumed that soil will erode in channels that will cut an average of six inches deep into the final cover.

- Sodding: 944 CY * 27 CF/CY * 150% machinery disturbance / (0.5 FT average depth) = 76,464 SF = 8,495 SY
- Liner Repair: 944 CY * 27 CF/CY * 25% / 0.5 FT = 12,744 SF = 1,416 SY
- Soil: 944 CY

It was assumed that 25% of the disturbed area will require liner repairs. Replacement soil will include cover soil and top soil. As the unit price of installed top soil is higher, the unit cost of replacement soil was assumed similar to that of top soil.

Stormwater Maintenance (Item 10)

A lump sum amount of $5,000 has been allocated for annual storm water management system maintenance.

Security System Maintenance (Item 11)

A lump sum amount of $500 is assumed as cost associated with fence repairs and other security management.

Utilities (Item 12)

Estimated power requirement for site equipment = $150/month = $1,800/year

Leachate Collection/Treatment Systems Operation (Item 13)

It is assumed that a technician will be needed for an average of eight hours every four weeks to monitor, inspect, and maintain the system.

Administrative Costs (Item 14)

Professional engineering services expected during the long-term care period include semiannual water quality monitoring, water quality technical reports, ten-year long-term care permit renewal applications, stabilization reports and other miscellaneous reporting requirements. Time was added for inspections of the stormwater and landfill cap systems.

Attachment 1
FDEP Form 62-701.900(28)

Print Form Reset Form

Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

DEP Form # 62-701.900(28), F.A.C.

Form Title: Closure Cost Estimating Form For Solid Waste Facilities

Effective Date: January 6, 2010

Incorporated in Rule 62-701.630(3), F.A.C.

CLOSURE COST ESTIMATING FORM FOR SOLID WASTE FACILITIES

Date of DEP Approval: ______________

I. GENERAL INFORMATION:

Facility Name: Tomoka Farms Road Landfill-North Cell, Class I WACS ID: 27540

Permit Application or Consent Order No.: SF64-0078767-028 Expiration Date: 03/19/2017

Facility Address: 1990 Tomoka Farms Road, Daytona Beach, Florida

Permittee or Owner/Operator: Volusia County Solid Waste Division

Mailing Address: 3151 East New York Avenue, DeLand, Florida 32724

Latitude: 29 ° 07 ' 50 " Longitude: 81 ° 06 ' 02 "

Coordinate Method: AutoCAD/GPS Datum: NAD 1983/90 (east)

Collected by: J.E. Zapert Company/Affiliation Sliger & Associates, Inc.

Solid Waste Disposal Units Included in Estimate:

Phase / Cell	Acres	Date Unit Began Accepting Waste	Active Life of Unit From Date of Initial Receipt of Waste	If active: Remaining life of unit	If closed: Date last waste received	If closed: Official date of closing
North Cell - Excluding Area 4	77.85	June 1999	16 years	9 years	NA	NA

Total disposal unit acreage included in this estimate: Closure: 77.85 Long-Term Care: 77.85

Facility type: (Check all that apply)
☒ Class I ☐ Class III ☐ C&D Debris Disposal
☐ Other: ______________

II. TYPE OF FINANCIAL ASSURANCE DOCUMENT (Check type)

☐ Letter of Credit* ☐ Insurance Certificate ☒ Escrow Account
☐ Performance Bond* ☐ Financial Test ☐ Form 29 (FA Deferral)
☐ Guarantee Bond* ☐ Trust Fund Agreement

* - Indicates mechanisms that require the use of a Standby Trust Fund Agreement

III. ESTIMATE ADJUSTMENT

40 CFR Part 264 Subpart H as adopted by reference in Rule 62-701.630, Florida Administrative Code, (F.A.C.) sets forth the method of annual cost estimate adjustment. Cost estimates may be adjusted by using an inflation factor or by recalculating the maximum costs of closure in current dollars. Select one of the methods of cost estimate ajustment below.

☐ **(a) Inflation Factor Adjustment** ☒ **(b) Recalculated or New Cost Estimates**

Inflation adjustment using an inflation factor may only be made when a Department approved closure cost estimate exists and no changes have occurred in the facility operation which would necessitate modification to the closure plan. The inflation factor is derived from the most recent Implicit Price Deflator for Gross National Product published by the U.S. Department of Commerce in its survey of Current Business. The inflation factor is the result of dividing the latest published annual Deflatory by the Deflator for the previous year. The inflation factor may also be obtained from the Solid Waste website www.dep.state.fl.us/waste/categories/swfr or call the Financial Coordinator at (850) 245-8706.

This adjustment is based on the Department approved closing cost estimate dated: ____________

Latest Department Approved **Closing Cost** Estimate:		Current Year Inflation Factor, ***e.g. 1.02***		Inflation Adjusted Closing Cost Estimate:
____________	×	______	=	____________

This adjustment is based on the Department approved long-term care cost estimate dated: ____________

Latest Department Approved Annual **Long-Term Care** Cost Estimate:		Current Year Inflation Factor, ***e.g. 1.02***		Inflation Adjusted Annual Long-Term Care Cost Estimate:
____________	×	______	=	____________

Number of Years of Long Term Care Remaining: × ____________

Inflation Adjusted Long-Term Care Cost Estimate: = ____________

Signature by: ☐ **Owner/Operator** ☒ **Engineer** (check what applies)

Signature	Address
Name & Title	City, State, Zip Code
Date	E-Mail Address
Telephone Number	

IV. ESTIMATED CLOSING COST (check what applies)

☒ **Recalculated Cost Estimate** ☐ **New Facility Cost Estimate**

Notes: 1. Cost estimates for the time period when the extent and manner of landfill operation makes closing most ex

2. Cost estimate must be certified by a professional engineer.

3. Cost estimates based on third party suppliers of material, equipment and labor at fair market value.

4. In some cases, a price quote in support of individual item estimates may be required.

Description	Unit	Number of Units	Cost / Unit	Total Cost
1. Proposed Monitoring Wells	**(Do not include wells already in existence.)**			
	EA			
		Subtotal Proposed Monitoring Wells:		
2. Slope and Fill (bedding layer between waste and barrier layer):				
Excavation	CY			
Placement and Spreading	CY			
Compaction	CY			
Off-Site Material	CY			
Delivery	CY			
			Subtotal Slope and Fill:	
3. Cover Material (Barrier Layer):				
Off-Site ~~Clay~~ Cover Soil	CY	207,287	$11.42	$2,367,217.54
Synthetics - 40 mil	SY	410,626	$4.36	$1,790,329.36
Synthetics - GCL	SY			
Synthetics - Geonet	SY			
Synthetics - Other (explain)	SY	410,626	$5.31	$2,180,424.06
Double Sided Geocomposite			Subtotal Cover Material:	$6,337,970.96
4. Top Soil Cover:				
Off-Site Material	CY	69,096	$12.69	$876,828.24
Delivery	CY			
Spread	CY			
			Subtotal Top Soil Cover:	$876,828.24
5. Vegetative Layer				
Sodding	SY	352,093	$2.28	$802,772.04
Hydroseeding	AC	8.83	$2,537.50	$22,406.13
Fertilizer	AC			
Mulch	AC			
Other (explain)				
			Subtotal Vegetative Layer:	$825,178.17
6. Stormwater Control System:				
Earthwork	CY			
Grading	SY			
Piping	LF	8,124	$21.41	$173,934.84
Ditches	LF			
Berms	LF			
Control Structures	EA	15	$1,948.02	$29,220.30
Other (explain)	LS	1	$440,859.57	$440,859.57
See Attachment 2, Items 6(c) & 6(d)			Subtotal Stormwater Control System:	$644,014.71

Description	Unit	Number of Units	Cost / Unit	Total Cost
7. Passive Gas Control:				
Wells	EA			
Pipe and Fittings	LF			
Monitoring Probes	EA			
NSPS/Title V requirements	LS	1		
			Subtotal Passive Gas Control:	
8. Active Gas Extraction Control:				
Traps	EA			
Sumps	EA			
Flare Assembly	EA			
Flame Arrestor	EA			
Mist Eliminator	EA			
Flow Meter	EA			
Blowers	EA			
Collection System	LF			
Other (explain)	LS	1	$454,825.02	$454,825.02
See Attachment 2, Items 8(a) to 8(g)			Subtotal Active Gas Extraction Control:	$454,825.02
9. Security System:				
Fencing	LF	1	$2,000.00	$2,000.00
Gate(s)	EA			
Sign(s)	EA			
			Subtotal Security System:	$2,000.00
10. Engineering:				
Closure Plan Report	LS	1	$50,000.00	$50,000.00
Certified Engineering Drawings	LS	1	$25,000.00	$25,000.00
NSPS/Title V Air Permit	LS	1	$20,000.00	$20,000.00
Final Survey	LS	1	$25,000.00	$25,000.00
Certification of Closure	LS	1	$50,000.00	$50,000.00
Other (explain)				
			Subtotal Engineering:	$170,000.00

Description	Hours	Cost / Hour	Hours	Cost / Hour	Total Cost
11. Professional Services					
	Contract Management		Quality Assurance		
P.E. Supervisor	160	$130.0(	80	$130.0(	$31,200.00
On-Site Engineer	300	$100.0(	180	$100.0(	$48,000.00
Office Engineer	200	$100.0(	144	$100.0(	$34,400.00
On-Site Technician			2,992	$65.00	$194,480.00
Other (explain)			1	$50,00(	$50,000.00
Lump Sump Amount					

Description	Unit	Number of Units	Cost / Unit	Total Cost
Quality Assurance Testing	LS	1	$75,000.00	$75,000.00
			Subtotal Professional Services:	$433,080.00

Subtotal of 1-11 Above:	$9,743,897.10
12. Contingency 10 % of Subtotal of 1-11 Above	$974,389.71
Subtotal Contingency:	$974,389.71
Estimated Closing Cost Subtotal:	$10,718,286.80

Description	Total Cost
13. Site Specific Costs	
Mobilization	$487,194.85
Waste Tire Facility	
Materials Recovery Facility	
Special Wastes	
Leachate Management System Modification	
Other (explain)	
Subtotal Site Specific Costs:	$487,194.85

TOTAL ESTIMATED CLOSING COSTS ($):	$11,205,481.65

V. ANNUAL COST FOR LONG-TERM CARE

See 62-701.600(1)a.1., 62-701.620(1), 62-701.630(3)a. and 62-701.730(11)b. F.A.C. for required term length. For landfills certified closed and Department accepted, enter the remaining long-term care length as "Other" and provide years remaining.

(Check Term Length) ☐ 5 Years ☐ 20 Years ☒ 30 Years ☐ Other, ___ Years

Notes: 1. Cost estimates must be certified by a professional engineer.

2. Cost estimates based on third party suppliers of material, equipment and labor at fair market value.

3. In some cases, a price quote in support of individual item estimates may be required.

All items must be addressed. Attach a detailed explanation for all entries left blank.

Description	Sampling Frequency (Events / Year)	Number of Wells	(Cost / Well) / Event	Annual Cost
1. Groundwater Monitoring [62-701.510(6), and (8)(a)]				
Monthly	12			
Quarterly	4			
Semi-Annually	2			
Annually	1			
			Subtotal Groundwater Monitoring:	
2. Surface Water Monitoring [62-701.510(4), and (8)(b)]				
Monthly	12			
Quarterly	4			
Semi-Annually	2	7	$432.76	$6,058.64
Annually	1			
			Subtotal Surface Water Monitoring:	$6,058.64
3. Gas Monitoring [62-701.400(10)]				
Monthly	12			
Quarterly	4	1	$2,066.03	$8,264.12
Semi-Annually	2			
Annually	1			
			Subtotal Gas Monitoring:	$8,264.12
4. Leachate Monitoring [62-701.510(5), (6)(b) and 62-701.510(8)c]				
Monthly	12			
Quarterly	4			
Semi-Annually	2			
Annually	1			
Other (explain) ____				
			Subtotal Leachate Monitoring:	

Description	Unit	Number of Units / Year	Cost / Unit	Annual Cost
5. Leachate Collection/Treatment Systems Maintenance				
Maintenance				
Collection Pipes	LF			
Sumps, Traps	EA			
Lift Stations	EA			
Cleaning	LS	1	$2,319.28	$2,319.28
Tanks	EA			

Description	Unit	Number of Units / Year	Cost / Unit	Annual Cost
5. (continued)				
Impoundments				
Liner Repair	SY	30	$9.14	$274.20
Sludge Removal	CY			
Aeration Systems				
Floating Aerators	EA			
Spray Aerators	EA			
Disposal				
Off-site (Includes transportation and disposal)	1000 gallon	1,186	$30.45	$36,113.70
			Subtotal Leachate Collection / Treatment Systems Maintenance:	$38,707.18
6. Groundwater Monitoring Well Maintenance				
Monitoring Wells	LF	1	$500.00	$500.00
Replacement	EA			
Abandonment	EA			
			Subtotal Groundwater Monitoring Well Maintenance:	$500.00
7. Gas System Maintenance				
Piping, Vents	LF	1	$5,000.00	$5,000.00
Blowers	EA	1	$1,200.00	$1,200.00
Flaring Units	EA	1	$400.00	$400.00
Meters, Valves	EA	1	$500.00	$500.00
Compressors	EA			
Flame Arrestors	EA	1	$1,200.00	$1,200.00
Operation	LS	1	$24,840.00	$24,840.00
			Subtotal Gas System Maintenance:	$33,140.00
8. Landscape Maintenance				
Mowing	AC	81.58	$299.34	$24,420.16
Fertilizer	AC			
			Subtotal Landscape Maintenance:	$24,420.16
9. Erosion Control and Cover Maintenance				
Sodding	SY	8,495	$2.28	$19,368.60
Regrading	AC			
Liner Repair	SY	1,416	$8.70	$12,319.20
Clay	CY	944	$12.69	$11,979.36
			Subtotal Erosion Control and Cover Maintenance:	$43,667.16
10. Storm Water Management System Maintenance				
Conveyance Maintenance	LS	1	$5,000.00	$5,000.00
			Subtotal Storm Water Management System Maintenance:	$5,000.00
11. Security System Maintenance				
Fences	LS	1	$500.00	$500.00
Gate(s)	EA			
Sign(s)	EA			
			Subtotal Security System Maintenance:	$500.00

Description	Unit	Number of Units / Year	Cost / Unit	Annual Cost
12. Utilities	LS	1	$1,800.00	$1,800.00
			Subtotal Utilities:	$1,800.00
13. Leachate Collection/Treatment Systems Operation				
Operation				
P.E. Supervisor	HR			
On-Site Engineer	HR			
Office Engineer	HR			
OnSite Technician	HR	104	$65.00	$6,760.00
Materials	LS	1		
	Subtotal Leachate Collection/Treatment Systems Operation:			$6,760.00
14. Administrative				
P.E. Supervisor	HR	30	$135.00	$4,050.00
On-Site Engineer	HR	48	$75.00	$3,600.00
Office Engineer	HR	60	$75.00	$4,500.00
OnSite Technician	HR			
Other Administrative Assistant	HR	30	$35.00	$1,050.00
			Subtotal Administrative:	$13,200.00
			Subtotal of 1-14 Above:	$182,017.26
15. Contingency	10	% of Subtotal of 1-14 Above		$18,201.73
			Subtotal Contingency:	$18,201.73

Description	Unit	Number of Units / Year	Cost / Unit	Annual Cost
16. Site Specific Costs				
			Subtotal Site Specific Costs:	

ANNUAL LONG-TERM CARE COST ($ / YEAR): $200,218.98

Number of Years of Long-Term Care: 30

TOTAL LONG-TERM CARE COST ($): $6,006,569.49

VI. CERTIFICATION BY ENGINEER

This is to certify that the Cost Estimates pertaining to the engineering features of this solid waste management facility have been examined by me and found to conform to engineering principles applicable to such facilities. In my professional judgment, the Cost Estimates are a true, correct and complete representation of the financial liabilities for closing and/or long-term care of the facility and comply with the requirements of Rule 62-701.630 F.A.C. and all other Department of Environmental Protection rules, and statutes of the State of Florida. It is understood that the Cost Estimates shall be submitted to the Department annually, revised or adjusted as required by Rule 62-701.630(4), F.A.C.

Signature	200 W. Forsyth St., Ste. 800 Mailing Address
Mark G. Roberts, Project Manager Name and Title (please type)	Jacksonville, FL 32202-4321 City, State, Zip Code
3/27/15 Date	Mark.Roberts@hdrinc.com E-Mail address (if available)
54187 Florida Registration Number (please affix seal)	(904)-598-8900 Telephone Number

VII. SIGNATURE BY OWNER/OPERATOR

Signature of Applicant	3151 East New York Avenue Mailing Address
Leonard Marion, Director Name and Title (please type)	DeLand, FL 32724 City, State, Zip Code
lmarion@co.volusia.fl.us E-Mail address (if available)	(386)-943-7889 Telephone Number

Attachment 2
Detailed Breakup of Line Items

Tomoka Farms Road Landfill - North Cell Class I Financial Assurance Closure Cost Estimates (Excluding Phase II Area 4)

Line Item No.	Description	Original Quantity[1]	Revised Quantity[1]	Unit	2013 Unit Cost	2014 Inflated Unit Cost	Total Cost in 2014 Dollars	Line Item Subtotal
1	Proposed Monitoring Wells	0	0	EA	$ -	$ -	$ -	$ -
2	Slope and Fill	0	0	CY	$ -	$ -	$ -	$ -
3(a)	Cover Material - Off-site Cover Soil	175,086	207,287	CY	$ 11.25	$ 11.42	$ 2,367,217.54	$ 6,337,970.96
3(b)	Cover Material - Synthetics 40 mil	346,837	410,626	SY	$ 4.30	$ 4.36	$ 1,790,329.36	
3(c)	Cover Material - Double Sided Geocomposite	346,837	410,626	SY	$ 5.23	$ 5.31	$ 2,180,424.06	
4	Top Soil Cover - Off-site Soil	58,362	69,096	CY	$ 12.50	$ 12.69	$ 876,828.24	$ 876,828.24
5(a)	Vegetative Layer - SOD	307,333	352,093	SY	$ 2.25	$ 2.28	$ 802,772.04	$ 825,178.17
5(b)	Vegetative Layer - HYDROSEED	5.41	8.83	AC	$ 2,500.00	$ 2,537.50	$ 22,406.13	
6(a)	Stormwater - PIPING	6,778	8,124	LF	$ 21.09	$ 21.41	$ 173,934.84	$ 644,014.71
6(b)	Stormwater - CONTROL STRUCTURES	12	15	EA	$ 1,919.23	$ 1,948.02	$ 29,220.30	
6(c)	Stormwater - INLETS	42	51	EA	$ 5,463.62	$ 5,545.57	$ 282,824.07	
6(d)	Stormwater - E&S CONTROL	65.65	77.85	AC	$ 2,000.00	$ 2,030.00	$ 158,035.50	
7	Passive Gas Control	0	0	LS	$ -	$ -	$ -	$ -
8(a)	Active GCCS - Mobilization/Demobilization	1	1	LS	$ 12,863.02	$ 13,055.96	$ 13,055.96	$ 454,825.02
8(b)	Active GCCS - Wellhead Assembly	17	23	EA	$ 518.67	$ 526.45	$ 12,108.35	
8(c)	Active GCCS - Drilling of 36" borehole and completion of Vertical Well (0'-274')	274	274	LF	$ 135.89	$ 137.93	$ 37,792.82	
8(d)	Active GCCS - Drilling of 36" borehole and completion of Vertical Well (275'-549')	275	275	LF	$ 96.47	$ 97.92	$ 26,928.00	
8(e)	Active GCCS - Drilling of 36" Borehole and Completion of Vertical Well (550' - 999')	450	450	LF	$ 81.43	$ 82.65	$ 37,192.50	
8(f)	Active GCCS - Drilling of 36" Borehole and Completion of Vertical Well (1,000'+)	878	1,574	LF	$ 78.84	$ 80.02	$ 125,951.48	
8(g)	Active GCCS - Benching	14	20	EA	$ 414.94	$ 421.16	$ 8,423.20	
8(h)	Active GCCS - 18" HDPE SDR 17 Header Pipe (0'-499)	318	318	LF	$ 53.94	$ 54.75	$ 17,410.50	
8(i)	Active GCCS - 16" HDPE SDR 17 Header Pipe (0'-499')	349	349	LF	$ 51.87	$ 52.65	$ 18,374.85	
8(j)	Active GCCS - 6" HDPE SDR 11 Lateral Pipe (0'-499')	499	499	LF	$ 20.75	$ 21.06	$ 10,508.94	
8(k)	Active GCCS - 6" HDPE SDR 11 Lateral Pipe (500'-1,499')	1,000	1,000	LF	$ 18.67	$ 18.95	$ 18,950.00	
8(l)	Active GCCS - 6" HDPE SDR 11 Lateral Pipe (1,500'+)	1,177	2,889	LF	$ 17.63	$ 17.90	$ 51,713.10	
8(m)	Active GCCS - 4" HDPE SDR 11 Lateral Pipe (0'-499')	499	499	LF	$ 15.56	$ 15.79	$ 7,879.21	
8(n)	Active GCCS - 4" HDPE SDR 11 Lateral Pipe (500'-1,499')	1,000	1,000	LF	$ 14.52	$ 14.74	$ 14,740.00	
8(o)	Active GCCS - 4" HDPE SDR 11 Lateral Pipe (1,500'+)	584	584	LF	$ 13.49	$ 13.69	$ 7,994.96	
8(p)	Active GCCS - Header/Condensate Access Point	3	5	EA	$ 2,385.88	$ 2,421.67	$ 12,108.35	
8(q)	Active GCCS - Condensate Sump	2	2	EA	$ 16,597.44	$ 16,846.40	$ 33,692.80	
9	Security System - See Note 2	1	1	LS	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00
10	Engineering - See Note 2	1	1	LS	$ 170,000.00	$ 170,000.00	$ 170,000.00	$ 170,000.00
11	Professional Services - See Note 3	1	1	LS	$ 408,080.00	$ 433,080.00	$ 433,080.00	$ 433,080.00
12	Contingency (conservatively assumed 10% of Subtotal of items 1 to 11)	-		-	-	-	$ 974,389.71	$ 974,389.71
13	Site Specific Costs - Mobilization (assumed 5% of Subtotal of items 1 to 11)	-		-	-	-	$ 487,194.85	$ 487,194.85

Notes:

1. Original Quantities include North Cell excluding Phase II Areas 3 and 4. Revised quantities incorporates Phase II Area 3; therefore Revised Quantities include North Cell excluding Phase II Area 4.

2. Addition of Phase II, Area 3 will not impact Security System and Engineering Costs. The dollar amounts calculated/assumed in 2013 still are conservative cost estimates per HDR experience. Therefore, these numbers are retained as it is in 2014 dollars.

3. Addition of Phase II, Area 3 will not impact Professional Services Cost. The dollar amounts calculated/assumed in 2013 still are conservative cost estimates per HDR experience. Therefore, these numbers are retained as it is in 2014 dollars. However, $25,000 are added to the CQA Services to accommodate additional testing required during Phase II, Area 3 Closure.

4. Inflation Factors obtained from the FDEP website: http://www.dep.state.fl.us/waste/categories/swfr/pages/CostEstimates.htm.

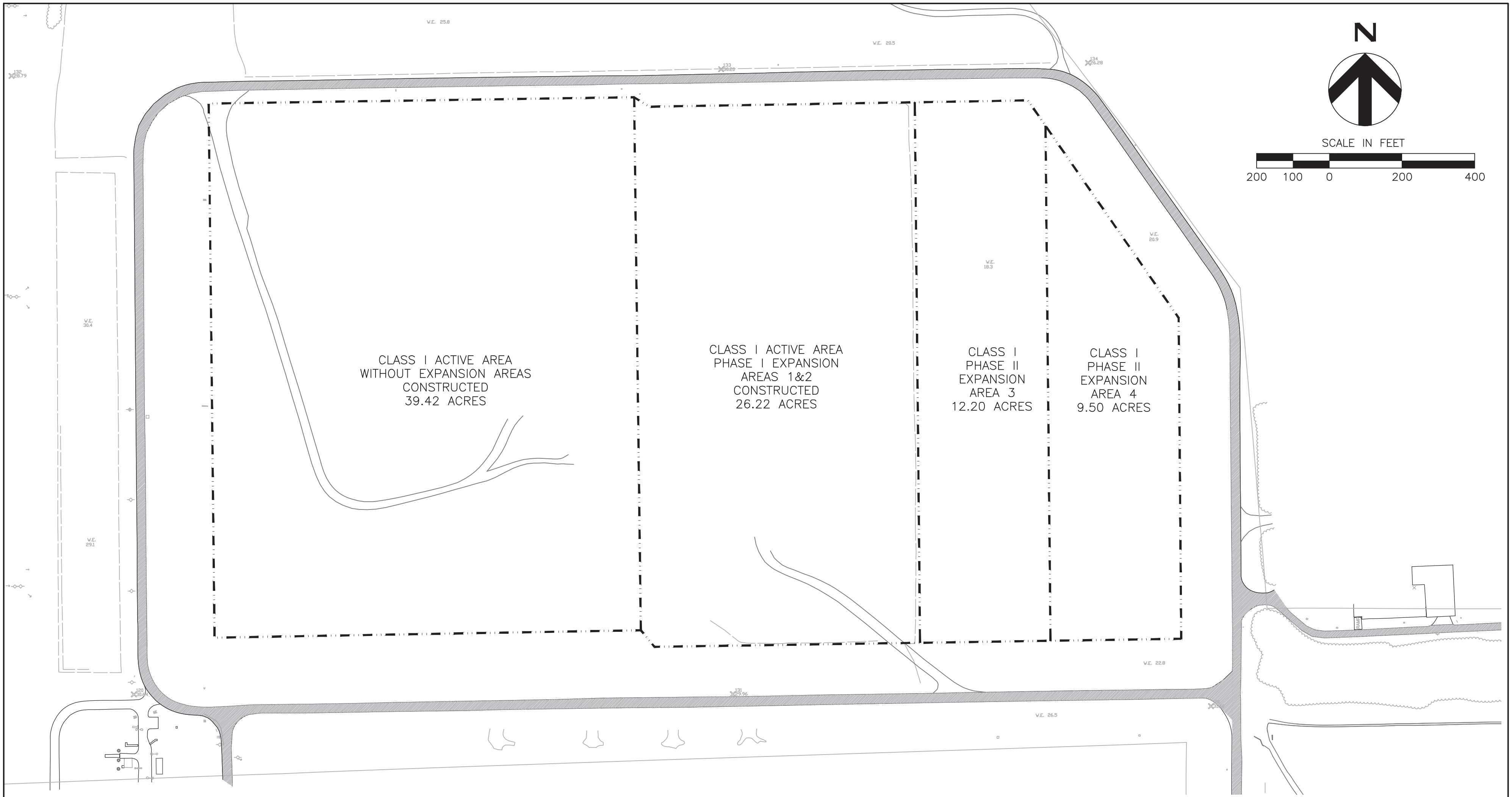
Tomoka Farms Road Landfill - North Cell Class I Financial Assurance LTC Cost Estimates (Excluding Phase II Area 4)

Line Item No.	Description	Original Quantity[1]	Revised Quantity[1]	Unit	2013 Unit Cost	2014 Inflated Unit Cost	Total Cost in 2014 Dollars	Line Item Subtotal
1	Groundwater Monitoring	0	0	LS	$ -	$ -	$ -	$ -
2	Surface Water Monitoring	1	1	LS	$ 5,969.04	$ 6,058.58	$ 6,058.58	$ 6,058.58
3	Gas Monitoring	1	1	LS	$ 8,142.00	$ 8,264.13	$ 8,264.13	$ 8,264.13
4	Leachate Monitoring	0	0	LS	$ -	$ -	$ -	$ -
5(a)	Leachate Collection System - Maintenance (Pipe Repairs)	1	1	LS	$ 500.00	$ 507.50	$ 507.50	$ 38,707.18
5(b)	Leachate Collection System - Maintenance (Jet Cleaning)	1	1.19	LS	$ 1,500.00	$ 1,522.50	$ 1,811.78	
5(c)	Leachate Collection System - Impoundments (Liner Repair)	20	30	SY	$ 9.00	$ 9.14	$ 274.20	
5(d)	Leachate Collection System - Leachate Disposal	1,000	1186	MMGal	$ 30.00	$ 30.45	$ 36,113.70	
6	Groundwater Monitoring Well Maintenance (See Note 2)	1	1	LS	$ 500.00	$ 500.00	$ 500.00	$ 500.00
7	Gas System Maintenance (See Note 2)	1	1	LS	$ 33,140.00	$ 33,140.00	$ 33,140.00	$ 33,140.00
8	Landscape Maintenance - Mowing	65.65	81.58	AC	$ 294.92	$ 299.34	$ 24,420.16	$ 24,420.16
9(a)	Erosion Control and Cover Maintenance - Sodding	7,164	8,495	SY	$ 2.25	$ 2.28	$ 19,368.60	$ 43,667.16
9(b)	Erosion Control and Cover Maintenance - Liner Repair	1,194	1,416	SY	$ 8.57	$ 8.70	$ 12,319.20	
9(c)	Erosion Control and Cover Maintenance - Clay	796	944	CY	$ 12.50	$ 12.69	$ 11,979.36	
10	Storm Water Management System Maintenance (See Note 2)	1	1	LS	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00
11	Security System Maintenance (See Note 2)	1	1	LS	$ 500.00	$ 500.00	$ 500.00	$ 500.00
12	Utilities (See Note 2)	1	1	LS	$ 1,800.00	$ 1,800.00	$ 1,800.00	$ 1,800.00
13	Leachate System Operations (See Note 2)	1	1	LS	$ 6,760.00	$ 6,760.00	$ 6,760.00	$ 6,760.00
14	Administrative (See Note 2)	1	1	LS	$ 13,200.00	$ 13,200.00	$ 13,200.00	$ 13,200.00
15	Contingency (conservatively assumed 10% of Subtotal of items 1 to 14)	-	-	-	-	-	$ 18,201.73	$ 18,201.73
16	Site Specific Costs	1	1	LS	$ -	$ -	$ -	$ -

Notes:

1. Original Quantities include North Cell excluding Phase II Areas 3 and 4. Revised quantities incorporates Phase II Area 3; therefore Revised Quantities include North Cell excluding Phase II Area 4.
2. Addition of Phase II, Area 3 will not impact the cost associated with these items. The dollar amounts calculated/assumed in 2013 still are conservative cost estimates per HDR experience. Therefore, these numbers are retained as it is in 2014 dollars.

Attachment 3
Report Figures
(*Waste Footprint Geometry and Final Grading*)



NOTES:

1. BOUNDARIES ARE APPROXIMATE.

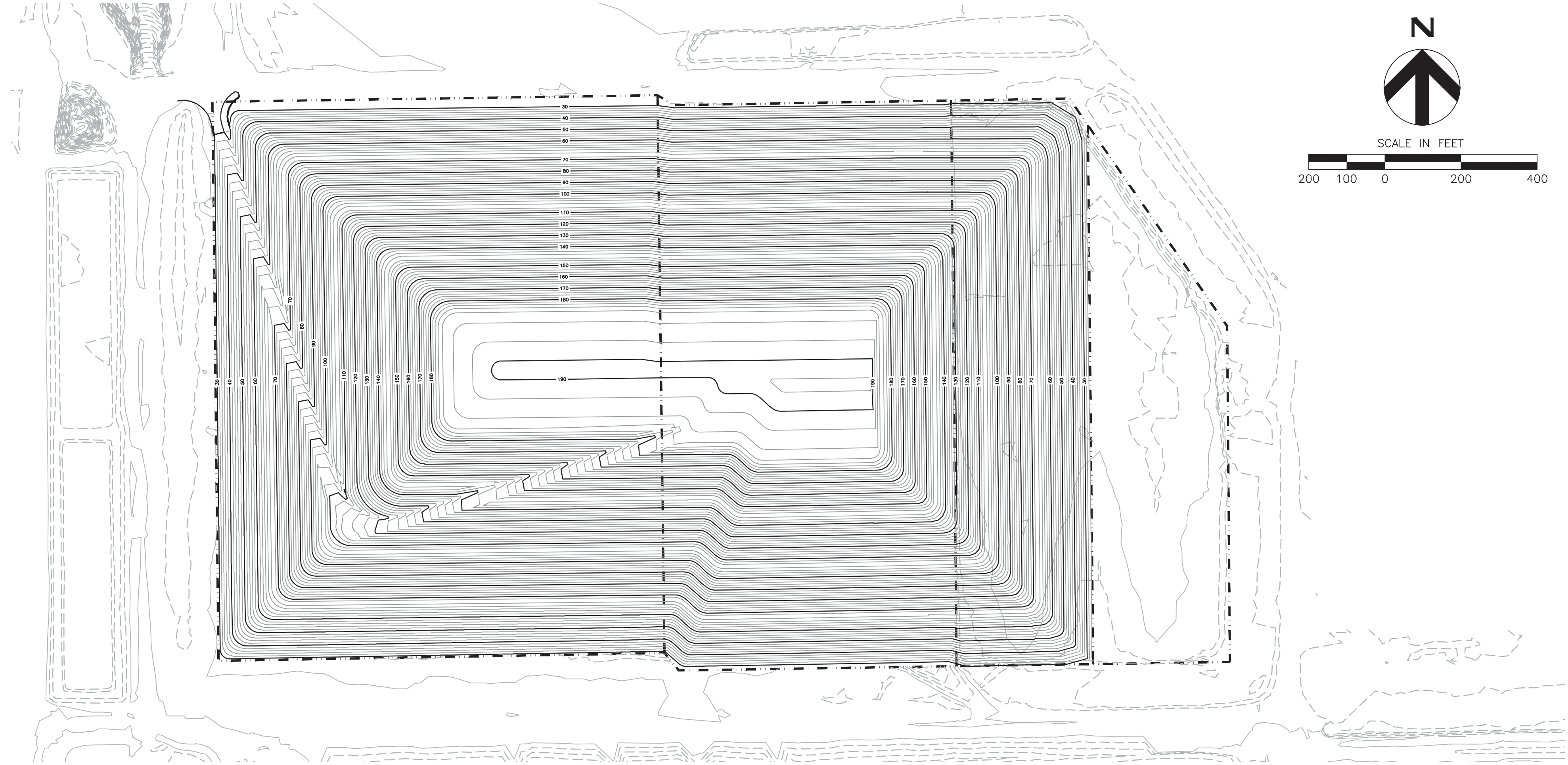
CLASS I NORTH CELL
ACTIVE AND EXPANSION AREAS

VOLUSIA COUNTY, FL

DATE 04/15

FIGURE

FIGURE 1



NOTES:

1. FINAL GRADES SHOWN REPRESENT MAXIMUM ALLOWABLE ELEVATIONS.
2. BOUNDARIES ARE APPROXIMATE.

LEGEND

— · · — · · — AREA BOUNDARY

HDR

FINAL GRADING PLAN WITHOUT PHASE II AREA 4 EXPANSION CLASS I NORTH CELL

VOLUSIA COUNTY, FL

DATE

04/15

FIGURE

FIGURE 2

Attachment 4
USLE Calculation

Volusia County- Tomoka Farms Road Landfill
April 2015

Soil Erosion using the Universal Soil Loss Equation (USLE)

The Universal Soil Loss Equation A (tons/AC/year) = R * K * LS * C * P

Name	Value	Reference*
Rainfall Factor		
R =	400	Figure 1 of USDA "Predicting Rainfall Loss Handbook"
Soil Erodibility Factor		
K =	0.08	Figure 3 of USDA "Predicting Rainfall Loss Handbook"; assuming 10% silt and very fine sand (.15 to .075 mm), 90% sand (0.1 to 2 mm), 2% organic matter, fine granular structure, and moderate permeability
Topographic Factor (North Cell)		
LS =	11.57	Table 3 USDA "Predicting Rainfall Loss Handbook"; 150 ft slope, 33% slope
Topographic Factor (South Cell)		
LS =	5.77	Table 3 USDA "Predicting Rainfall Loss Handbook"; 200 ft slope, 20% slope
Cover and Management Factor		
C =	0.042	Assuming 60% of the ground is covered by vegetation.
Support Practice Factor		
P =	1	support practice factor (ranges 0 to 1), assumed for slope with no farming

Assumptions:

density	95	lb/ft^3	dry density for silty sand
acreage	77.85	acres	North Cell Landfill area
acreage	114	acres	South Cell Landfill area

e of Soil Loss

	C	A (tons/AC/year)	tons/ year	CF/ year	CY/ year
North Cell	0.042	15.55	1,211	25,486	944
South Cell	0.042	7.75	884	18,612	689

reference United States Department of Agriculture. "Predicting Rainfall Erosion Losses." Agriculture Handbook No. 537, December 1978.

AH537/12/78

PREDICTING RAINFALL EROSION LOSSES

A GUIDE TO CONSERVATION PLANNING

UNITED STATES
DEPARTMENT OF
AGRICULTURE

AGRICULTURE
HANDBOOK
NUMBER 537

PREPARED BY
SCIENCE AND
EDUCATION
ADMINISTRATION

site as the product of six major factors whose most likely values at a particular location can be expressed numerically. Erosion variables reflected by these factors vary considerably about their means from storm to storm, but effects of the random fluctuations tend to average out over extended periods. Because of the unpredictable short-time fluctuations in the levels of influential variables, however, present soil loss equations are substantially less accurate for prediction of specific events than for prediction of longtime averages.

The soil loss equation is

$$A = RKLSCP \quad (1)$$

where

A is the computed soil loss per unit area, expressed in the units selected for **K** and for the period selected for **R.** In practice, these are usually so selected that they compute **A** in tons per acre per year, but other units can be selected.

R, the rainfall and runoff factor, is the number of rainfall erosion index units, plus a factor for runoff from snowmelt or applied water where such runoff is significant.

K, the soil erodibility factor, is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot, which is defined as a 72.6-ft length of uniform 9-percent slope continuously in clean-tilled fallow.

L, the slope-length factor, is the ratio of soil loss from the field slope length to that from a 72.6-ft length under identical conditions.

S, the slope-steepness factor, is the ratio of soil loss from the field slope gradient to that from a 9-percent slope under otherwise identical conditions.

C, the cover and management factor, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P, the support practice factor, is the ratio of soil loss with a support practice like contouring, stripcropping, or terracing to that with straight-row farming up and down the slope.

The soil loss equation and factor evaluation charts were initially developed in terms of the English units commonly used in the United States. The factor definitions are interdependent, and direct conversion of acres, tons, inches, and feet to metric units would not produce the kind of integers that would be desirable for an expression of the equation in that system. Therefore, only the English units are used in the initial presentation of the equation and factor evaluation materials, and their counterparts in metric units are given in the Appendix under **Conversion to Metric System.**

Numerical values for each of the six factors were derived from analyses of the assembled research data and from National Weather Service precipitation records. For most conditions in the United States, the approximate values of the factors for any particular site may be obtained from charts and tables in this handbook. Localities or countries where the rainfall characteristics, soil types, topographic features, or farm practices are substantially beyond the range of present U.S. data will find these charts and tables incomplete and perhaps inaccurate for their conditions. However, they will provide guidelines that can reduce the amount of local research needed to develop comparable charts and tables for their conditions.

The subsection on **Predicting Cropland Soil Losses,** page 40 illustrates how to select factor values from the tables and charts. Readers who have had no experience with the soil loss equation may wish to read that section first. After they have referred to the tables and figures and located the values used in the sample, they may move readily to the intervening detailed discussions of the equation's factors.

The soil loss prediction procedure is more valuable as a guide for selection of practices if the user has a general knowledge of the principles and factor interrelations on which the equation is based. Therefore, the significance of each factor is discussed before presenting the reference table or chart from which local values may be obtained. Limitations of the data available for evaluation of some of the factors are also pointed out.

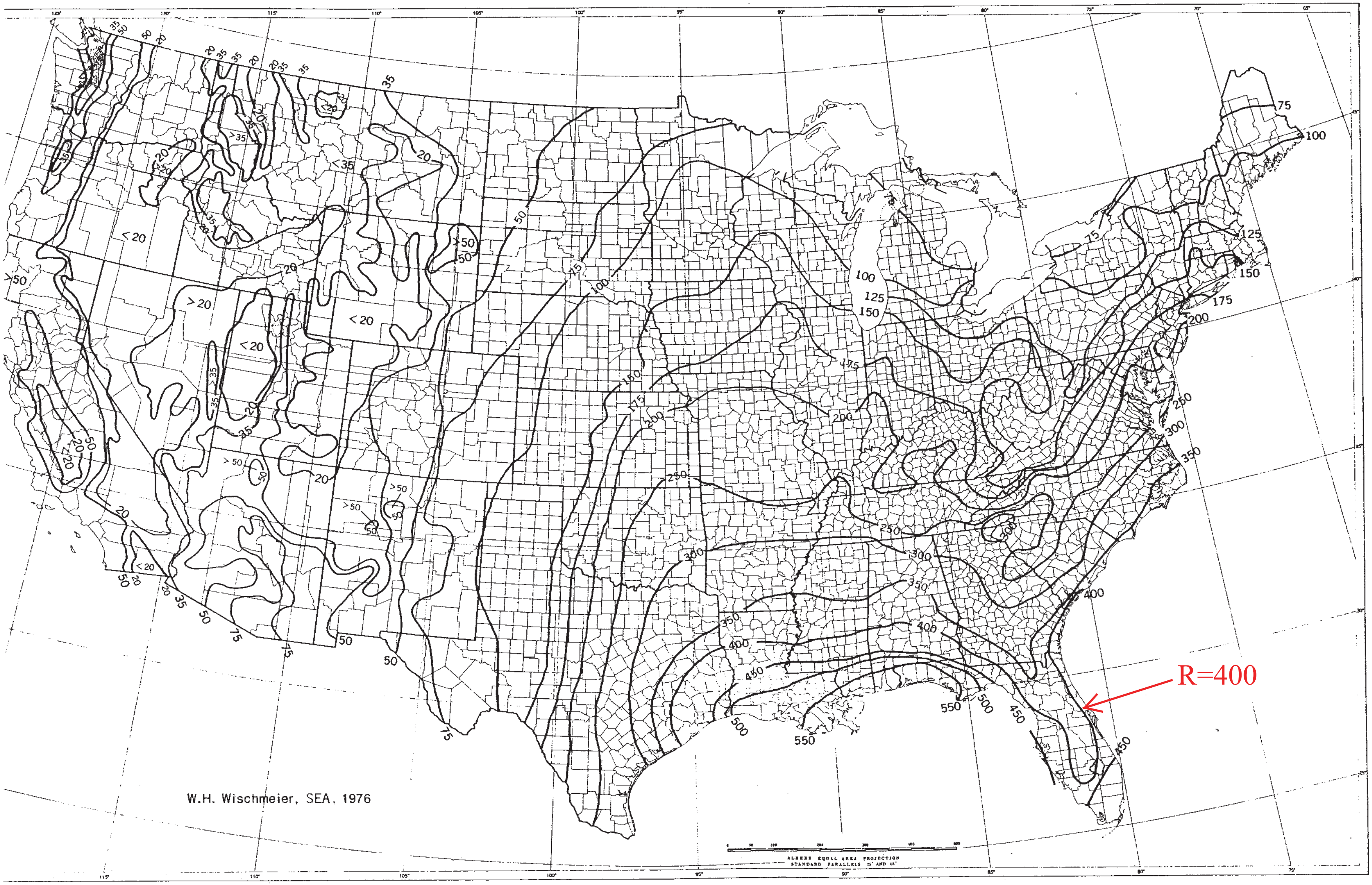


FIGURE 1.—Average annual values of the rainfall erosion index.

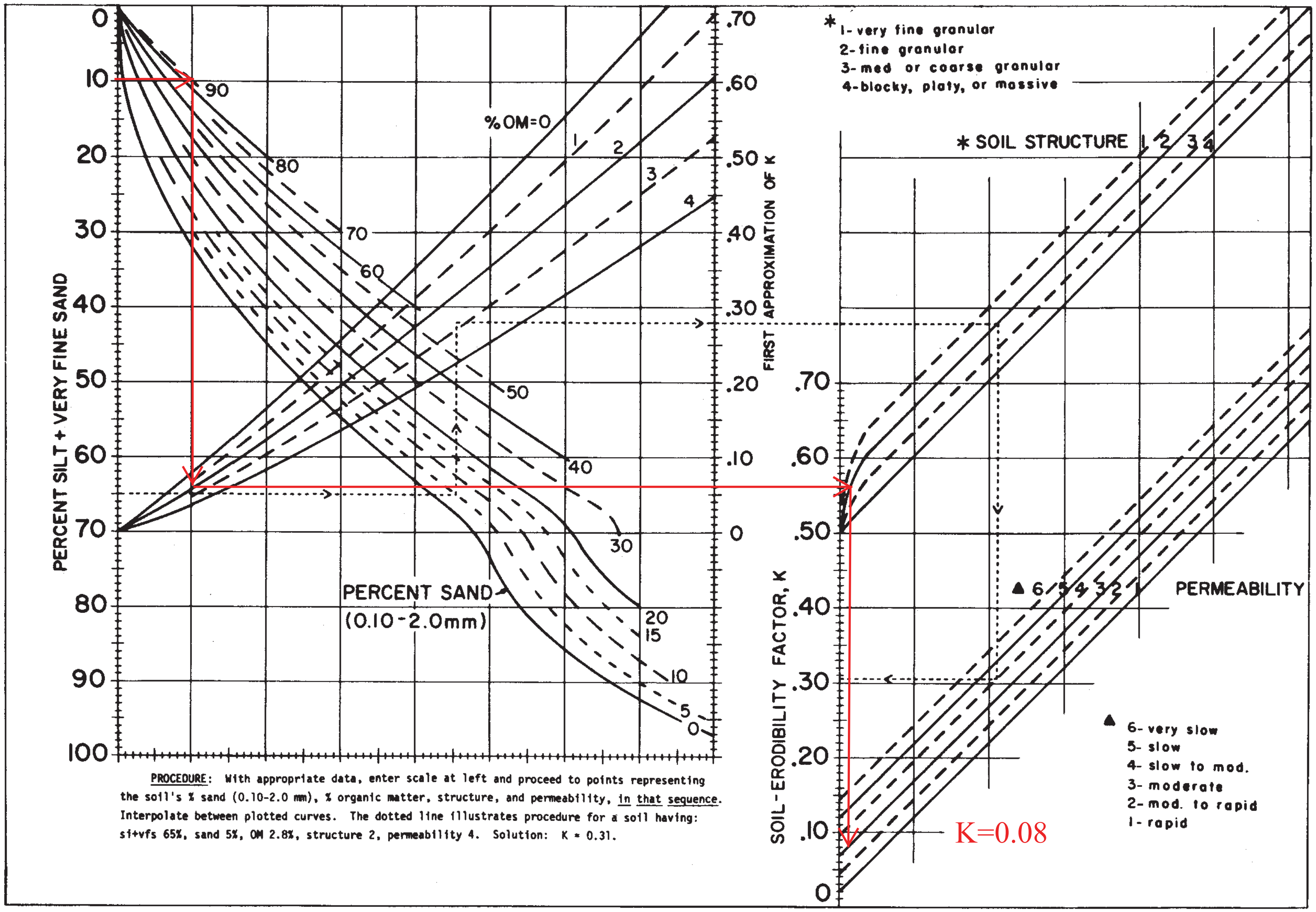


FIGURE 3.—The soil-erodibility nomograph. Where the silt fraction does not exceed 70 percent, the equation is 100 **K** = 2.1 **M**$^{1.14}$ (10^{-4}) (12 — a) + 3.25 (b — 2) + 2.5 (c — 3) where **M** = (percent si + vfs) (100 — percent **c**), **a** = percent organic matter, **b** = structure code, and **c** = profile permeability class.

TOPOGRAPHIC FACTOR (LS)

Both the length and the steepness of the land slope substantially affect the rate of soil erosion by water. The two effects have been evaluated separately in research and are represented in the soil loss equation by **L** and **S**, respectively. In field applications, however, considering the two as a single topographic factor, **LS**, is more convenient.

Slope-Effect Chart

LS is the expected ratio of soil loss per unit area from a field slope to that from a 72.6-ft length of uniform 9-percent slope under otherwise identical conditions. This ratio for specified combinations of field slope length and uniform gradient may be obtained directly from the slope-effect chart (fig. 4). Enter on the horizontal axis with the field slope length, move vertically to the appropriate percent-slope curve, and read **LS** on the scale at the left. For example, the **LS** factor for a 300-ft length of 10-percent slope is 2.4. Those who prefer a table may use table 3 and interpolate between listed values.

To compute soil loss from slopes that are appreciably convex, concave, or complex, the chart **LS** values need to be adjusted as indicated in the section **LS Values for Irregular Slopes.** Figure 4 and table 3 assume slopes that have essentially uniform gradient. The chart and table were derived by the equation

$$LS = (\lambda/72.6)^m \quad (65.41 \sin^2 \theta + 4.56 \sin \theta + 0.065) \qquad (4)$$

where λ = slope length in feet;
θ = angle of slope; and
m = 0.5 if the percent slope is 5 or more, 0.4 on slopes of 3.5 to 4.5 percent, 0.3 on slopes of 1 to 3 percent, and 0.2 on uniform gradients of less than 1 percent.

The basis for this equation is given in the subsection discussing the individual effects of slope length and steepness. However, the relationships expressed by the equation were derived from data obtained on cropland, under natural rainfall, on slopes ranging from 3 to 18 percent in steepness and about 30 to 300 ft in length. How far beyond these ranges in slope characteristics the relationships derived from the data continue to be accurate has not been determined by direct soil loss measurements.

The Palouse Region of the Northwest represents

TABLE 3.—*Values of the topographic factor,* **LS**, *for specific combinations of slope length and steepness*[1]

Percent slope	Slope length (feet)											
	25	50	75	100	150	200	300	400	500	600	800	1,000
0.2	0.060	0.069	0.075	0.080	0.086	0.092	0.099	0.105	0.110	0.114	0.121	0.126
0.5	.073	.083	.090	.096	.104	.110	.119	.126	.132	.137	.145	.152
0.8	.086	.098	.107	.113	.123	.130	.141	.149	.156	.162	.171	.179
2	.133	.163	.185	.201	.227	.248	.280	.305	.326	.344	.376	.402
3	.190	.233	.264	.287	.325	.354	.400	.437	.466	.492	.536	.573
4	.230	.303	.357	.400	.471	.528	.621	.697	.762	.820	.920	1.01
5	.268	.379	.464	.536	.656	.758	.928	1.07	1.20	1.31	1.52	1.69
6	.336	.476	.583	.673	.824	.952	1.17	1.35	1.50	1.65	1.90	2.13
8	.496	.701	.859	.992	1.21	1.41	1.72	1.98	2.22	2.43	2.81	3.14
10	.685	.968	1.19	1.37	1.68	1.94	2.37	2.74	3.06	3.36	3.87	4.33
12	.903	1.28	1.56	1.80	2.21	2.55	3.13	3.61	4.04	4.42	5.11	5.71
14	1.15	1.62	1.99	2.30	2.81	3.25	3.98	4.59	5.13	5.62	6.49	7.26
16	1.42	2.01	2.46	2.84	3.48	4.01	4.92	5.68	6.35	6.95	8.03	8.98
18	1.72	2.43	2.97	3.43	4.21	3.86	5.95	6.87	7.68	8.41	9.71	10.9
20	2.04	2.88	3.53	4.08	5.00	5.77	7.07	8.16	9.12	10.0	11.5	12.9

[1] $LS = (\lambda/72.6)^m \ (65.41 \sin^2 \theta + 4.56 \sin \theta + 0.065)$ where λ = slope length in feet; m = 0.2 for gradients $<$ 1 percent, 0.3 for 1 to 3 percent slopes, 0.4 for 3.5 to 4.5 percent slopes, 0.5 for 5 percent slopes and steeper; and θ = angle of slope. (For other combinations of length and gradient, interpolate between adjacent values or see fig. 4.)

LS

tion and developmental areas can be obtained from table 5 if good judgment is exercised in comparing the surface conditions with those of agricultural conditions specified in lines of the table. Time intervals analogous to cropstage periods will be defined to begin and end with successive construction or management activities that appreciably change the surface conditions. The procedure is then similar to that described for cropland.

Establishing vegetation on the denuded areas as quickly as possible is highly important. A good sod has a **C** value of 0.01 or less (table 5-B), but such a low **C** value can be obtained quickly only by laying sod on the area, at a substantial cost. When grass or small grain is started from seed, the probable soil loss for the period while cover is developing can be computed by the procedure outlined for estimating cropstage-period soil losses. If the seeding is on topsoil, without a mulch, the soil loss ratios given in line 141 of table 5 are appropriate for cropstage **C** values. If the seeding is on a desurfaced area, where residual effects of prior vegetation are no longer significant, the ratios for periods SB, 1 and 2 are 1.0, 0.75 and 0.50, respectively, and line 141 applies for cropstage 3. When the seedbed is protected by a mulch, the pertinent mulch factor from the upper curve of figure 6 or table 9 is applicable until good canopy cover is attained. The combined effects of vegetative mulch and low-growing canopy are given in figure 7. When grass is established in small grain, it can usually be evaluated as established meadow about 2 mo after the grain is cut.

C Values for Pasture, Range, and Idle Land

Factor **C** for a specific combination of cover conditions on these types of land may be obtained from table 10 (57). The cover characteristics that must be appraised before consulting this table are defined in the table and its footnotes. Cropstage periods and **EI** monthly distribution data are generally not necessary where perennial vegetation has become established and there is no mechanical disturbance of the soil.

Available soil loss data from undisturbed land were not sufficient to derive table 10 by direct comparison of measured soil loss rates, as was done for development of table 5. However, analyses of the assembled erosion data showed that the research information on values of **C** can be extended to completely different situations by combining subfactors that evaluate three separate and distinct, but interrelated, zones of influence: (a) vegetative cover in direct contact with the soil surface, (b) canopy cover, and (c) residual and tillage effects.

Subfactors for various percentages of surface cover by mulch are given by the upper curve of

TABLE 10.—*Factor* **C** *for permanent pasture, range, and idle land*[1]

Vegetative canopy		Cover that contacts the soil surface						
Type and height[2]	Percent cover[3]	Type[4]	Percent ground cover					
			0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall weeds or short brush with average drop fall height of 20 in	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

[1] The listed **C** values assume that the vegetation and mulch are randomly distributed over the entire area.

[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4] G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep.

W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

TABLE 12.—*Factor* **C** *for mechanically prepared woodland sites*

Site preparation	Mulch cover[1]	Soil condition[2] and weed cover[3]							
		Excellent		Good		Fair		Poor	
		NC	WC	NC	WC	NC	WC	NC	WC
	Percent								
Disked, raked, or bedded[4]	None	0.52	0.20	0.72	0.27	0.85	0.32	0.94	0.36
	10	.33	.15	.46	.20	.54	.24	.60	.26
	20	.24	.12	.34	.17	.40	.20	.44	.22
	40	.17	.11	.23	.14	.27	.17	.30	.19
	60	.11	.08	.15	.11	.18	.14	.20	.15
	80	.05	.04	.07	.06	.09	.08	.10	.09
Burned[5]	None	.25	.10	.26	.10	.31	.12	.45	.17
	10	.23	.10	.24	.10	.26	.11	.36	.16
	20	.19	.10	.19	.10	.21	.11	.27	.14
	40	.14	.09	.14	.09	.15	.09	.17	.11
	60	.08	.06	.09	.07	.10	.08	.11	.08
	80	.04	.04	.05	.04	.05	.04	.06	.05
Drum chopped[5]	None	.16	.07	.17	.07	.20	.08	.29	.11
	10	.15	.07	.16	.07	.17	.08	.23	.10
	20	.12	.06	.12	.06	.14	.07	.18	.09
	40	.09	.06	.09	.06	.10	.06	.11	.07
	60	.06	.05	.06	.05	.07	.05	.07	.05
	80	.03	.03	.03	.03	.03	.03	.04	.04

[1] Percentage of surface covered by residue in contact with the soil.

[2] *Excellent* soil condition—Highly stable soil aggregates in topsoil with fine tree roots and litter mixed in.

Good—Moderately stable soil aggregates in topsoil or highly stable aggregates in subsoil (topsoil removed during raking), only traces of litter mixed in.

Fair—Highly unstable soil aggregates in topsoil or moderately stable aggregates in subsoil, no litter mixed in.

Poor—No topsoil, highly erodible soil aggregates in subsoil, no litter mixed in.

[3] NC—No live vegetation.

WC—75 percent cover of grass and weeds having an average drop fall height of 20 in. For intermediate percentages of cover, interpolate between columns.

[4] Modify the listed **C** values as follows to account for effects of surface roughness and aging:

First year after treatment: multiply listed **C** values by 0.40 for rough surface (depressions >6 in); by 0.65 for moderately rough; and by 0.90 for smooth (depressions <2 in).

For 1 to 4 years after treatment: multiply listed factors by 0.7.

For 4+ to 8 years: use table 6.

More than 8 years: use table 7.

[5] For first 3 years: use **C** values as listed.

For 3+ to 8 years after treatment: use table 6.

More than 8 years after treatment: use table 7.

meadow, the selected seedbed soil loss ratio is multiplied by a factor from table 5-D. If mulch is applied, a subfactor read from the upper curve of figure 6 is multiplied by the residual subfactor to obtain **C**. When canopy develops, a canopy subfactor from figure 5 is also included.

SUPPORT PRACTICE FACTOR (P)

In general, whenever sloping soil is to be cultivated and exposed to erosive rains, the protection offered by sod or close-growing crops in the system needs to be supported by practices that will slow the runoff water and thus reduce the amount of soil it can carry. The most important of these supporting cropland practices are contour tillage, stripcropping on the contour, and terrace systems. Stabilized waterways for the disposal of excess rainfall are a necessary part of each of these practices.

By definition, factor **P** in the USLE is the ratio of soil loss with a specific support practice to the corresponding loss with up-and-down-slope culture. Improved tillage practices, sod-based rotations, fertility treatments, and greater quantities of crop residues left on the field contribute materially to erosion control and frequently provide the major control in a farmer's field. However, these are considered conservation cropping and management practices, and the benefits derived from them are included in **C**.

Contouring

The practice of tillage and planting on the contour, in general, has been effective in reducing erosion. In limited field studies, the practice provided almost complete protection against erosion from storms of moderate to low intensity, but it provided little or no protection against the occasional severe storms that caused extensive breakovers of the contoured rows. Contouring appears to be the most effective on slopes in the 3- to 8-percent range. As land slope decreases, it approaches equality with contour row slope, and the soil loss ratio approaches 1.0. As slope increases, contour row capacity decreases and the soil loss ratio again approaches 1.0.