Surviving the storms with Best Management Practices

USDA Natural Resources Conservation Service

NRCS

Daniel Holtz
Agricultural Engineer
Escondido Field Office

Natural Resources Conservation Service (NRCS)

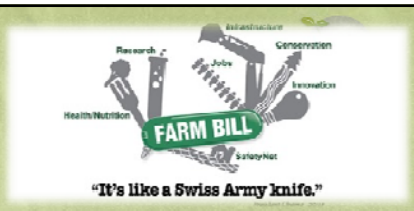
- Provides technical and financial assistance to help agricultural producers and others care for the land.
- Began as a result of 1930's Dust Bowl
- Partnership Approach
- Non-Regulatory

NRCS

Natural Resources Conservation Service (NRCS)

- 6 mission goals:
  - high quality, productive soils
  - clean and abundant water
  - healthy plant and animal communities
  - clean air
  - an adequate energy supply
  - working farms and ranchlands.

2014 Farm Bill



Conservation programs under the 2014 Farm Bill are:

- Financial Assistance
  - Agricultural Management Assistance Program (AMA)
  - Environmental Quality Incentives Program (EQIP)
  - **Conservation Stewardship Program (CSP)**
- Easements
  - Agricultural Conservation Easement Program (ACEP)
  - Healthy Forests Reserve Program (HFRP)
- Partnership
  - **Regional Conservation Partnership Program (RCPP)**
- Other Programs
  - Agriculture Conservation Experienced Services (ACES)
  - Conservation Innovation Grants (CIG)
  - Emergency Watershed Protection Program (EWP)
  - Small Watershed Rehabilitation Program
  - **Technical Service Providers (TSP)**
  - Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

Environmental Quality Incentives Program (EQIP)

- Must be an Agricultural Producer (food, feed or fiber)
- Financial and Technical Assistance – 50-90% Cost Share
- 1 – 10 Year Contract
- Ranking and Selection Process
- Beginning Farmer and Limited Resource Farmer Opportunities
- AGI Limitations

What Can NRCS Do:

- Conservation Activity Plans:
  - Nutrient Management Plans
  - Comprehensive Nutrient Management Plans
  - Irrigation Water Management Plans
  - Drainage Water Management Plans
- Conservation Practices
  - Irrigation Improvements
  - Pump Improvements (VFD's)
  - Flow Meters
  - Irrigation Water Management
  - Diesel to Electric
  - Access Roads
  - Fencing of Creeks
  - Etcetera!

EQIP FY2016 Timeline

- Sign Up for FY 2016 – **NO DEADLINE (Batches)**
- Resource Inventory / Planning – On going
- Screening & Program Ranking Worksheets – Early 2016
- Conservation Plan Development – Early 2016
- Project Implementation – After Contract is Signed
- Project Reimbursement – After Project Completion
- Practice Maintenance – Practice Life Span
- Contract Expiration - 1 Year After Last Practice is Completed

Ranking Criteria & Procedures

Payment Rates

- Mathematical break-down of all of the factors that determine how much projects typically cost
- Includes the expected costs for materials, equipment, labor, mobilization, and maintenance
- Designed to be roughly 50 – 75% of actual costs. But does not have to be.
- Payment Rate Structure

NRCS

See What's Possible:

Farm Bill Conservation Programs

Daniel Holtz
Agricultural Engineer
Escondido Field Office
760-745-2061
Daniel.Holtz@ca.usda.gov

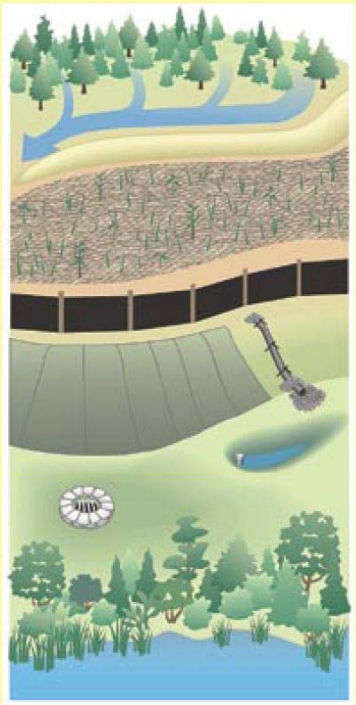
Cori Calvert- District Conservationist
Kelly Sypolt- Soil Conservationist
White Haraguchi- Soil Conservationist
Dan da Rosa- Soil Conservationist Tech
Elizabeth Tucker- Farm Bill Assistant
Shea Okeefe- Area Biologist
Ross Loucks- Forester

Opportunities for Private Landowners

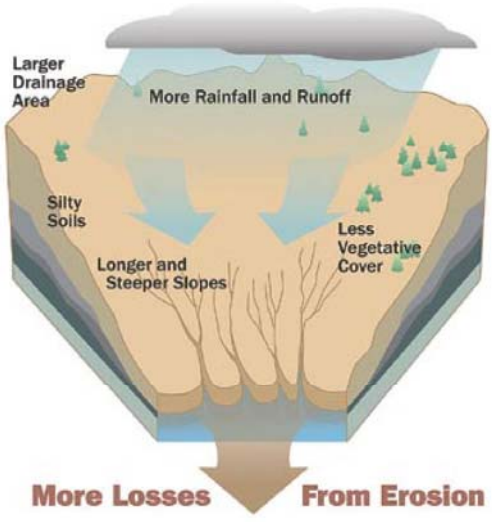
NRCS

Top 7 Ways to reduce erosion

- **Preserve existing vegetation**
- **Divert upland runoff around exposed soil**
- **Seed/mulch/ cover bare soil immediately**
- **Use sediment barriers to trap soil in runoff**
- **Protect slopes and channels from gullying**
- **Install sediment traps and settling basins**
- **Preserve vegetation near all waterways**



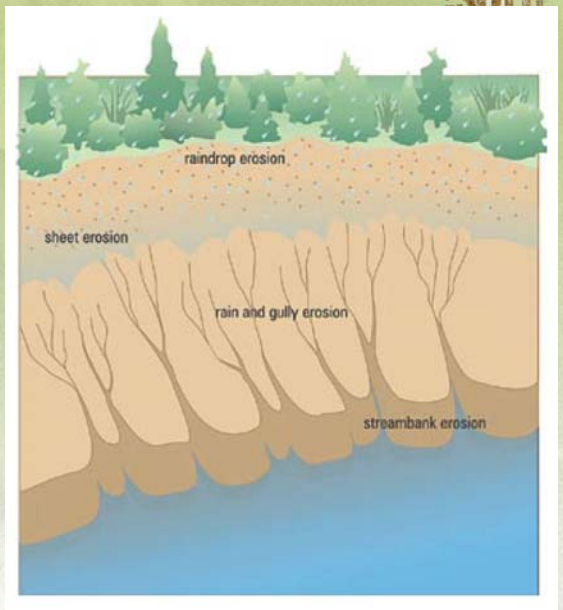
What contributes to erosion?

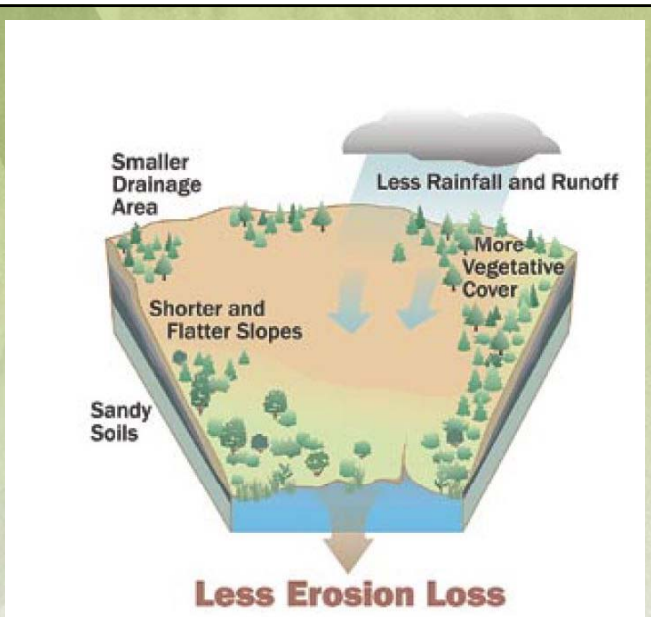


Factors influencing erosion. Heavy rainfall, steep slopes, removal of most existing vegetation, and erodible soils result in higher soil losses from erosion.

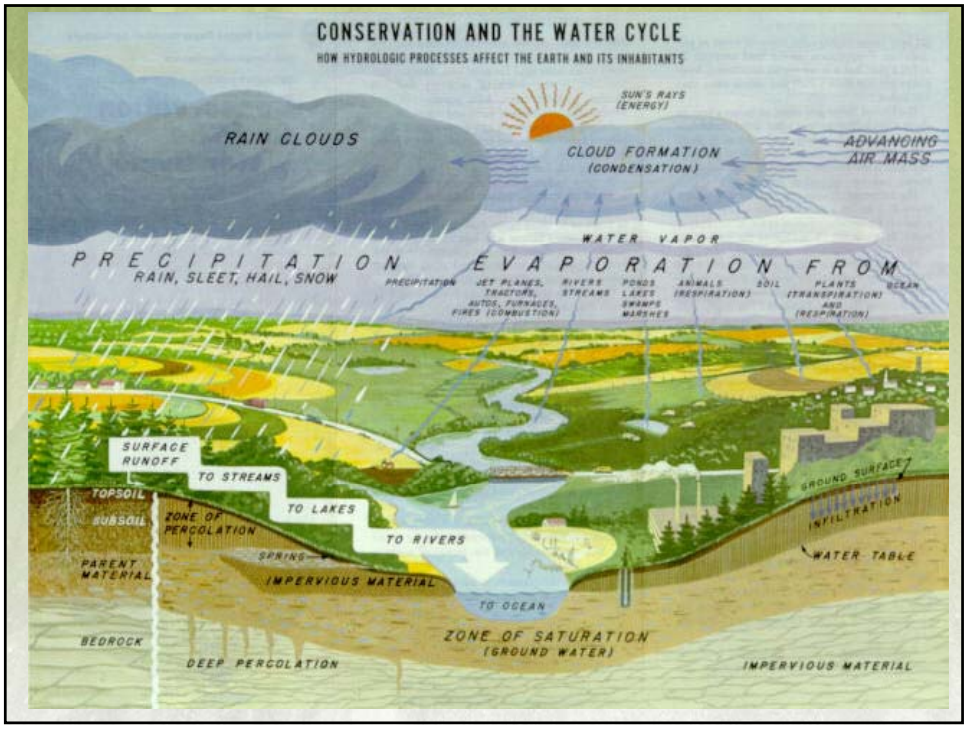
unlock the SECRETS IN THE SOIL

Types of Erosion





Lower rainfall amounts, flatter slopes, preserving existing vegetation, and less erodible soils result in lower soil losses from erosion.



What is Hydrology?

unlock the SECRETS IN THE SOIL

- The science that deals with the occurrence and behavior of water in the atmosphere, on the ground, and underground.
  - NEH, Part 630 - Chapter 22

- In the broadest sense, hydrology deals with the computation of how much water we could expect.
  - Hydrology Training Series Module 101 - Introduction to Hydrology

What is Hydraulics?

•…application of fluid mechanics and other sciences and engineering disciplines in the development of structures, projects and systems involving water resources.

– "Hydraulic Engineering" by Roberson, Cassidy, Chaudhry

•The aspect of engineering that deals with the flow of water in rivers and canals, and the works and machinery for conducting or using it.

– "Dictionary of Geological Terms", 3rd ed., American Geological Institute

What's the difference?

•Hydrology:

- how much water? when? how?

•Hydraulics:

- what does it do when it gets there?

Hydrology Calculations and Equations

•*Most natural hydrologic phenomena are so complex that they are beyond comprehension, or exact laws governing such phenomena have not been fully discovered. Before such laws can ever be found, complicated hydrologic phenomena (the prototype) can only be approximated by modeling.*

•*Ven Te Chow*

USGS Regression Equations

Sierra Region

$Q_2=0.24A^{0.88}P^{1.58}H^{-0.80}$

$Q_{25}=6.55A^{0.79}P^{1.12}H^{-0.52}$

$Q_{100}=15.7A^{0.77}P^{1.02}H^{-0.43}$

South Coast Region

$Q_2=0.14A^{0.72}P^{1.62}$

$Q_{25}=1.1A^{0.81}P^{1.81}$

$Q_{100}=1.95A^{0.83}P^{1.87}$

Northeast Region

$Q_2=22A^{0.40}$

$Q_{25}=84A^{0.54}$

$Q_{100}=125A^{0.59}$

Figure 1. Flood-frequency region map for California.

USGS Regression Equations

Capabilities/Limitations:

- Standard error of estimation ranges from 30-50%
- Peak discharge only
- Should not be used for estimates at sites where flood flow is materially effected by storage such as farm ponds or reservoirs

Rational Equation

$$Q = CiA$$

where: Q = design peak runoff rate, cfs (1 cfs = 448 gpm)

C = runoff coefficient

i = rainfall intensity, in/hr

A = watershed area, ac

Rational Equation

Tables of C factors

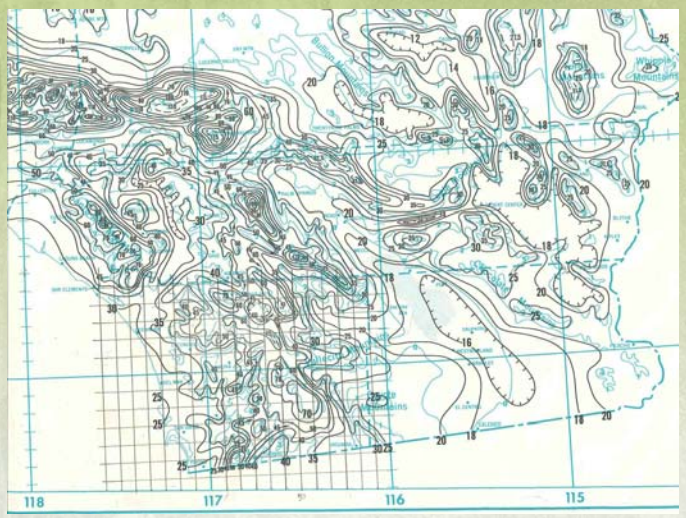
AGRICULTURAL AREAS: Runoff Coefficient, C by Soil Texture

	Topography and Vegetation	Open Sandy Loam	Clay and Silt Loam	Tight Clay
Woodland	Flat, 0-5% slope	0.10	0.30	0.40
	Rolling, 5-10% slope	0.25	0.35	0.50
	Hilly, 10-30% slope	0.30	0.50	0.60
Pasture	Flat	0.10	0.30	0.40
	Rolling	0.16	0.36	0.55
	Hilly	0.22	0.42	0.60
Cultivated	Flat	0.30	0.50	0.60
	Rolling	0.40	0.60	0.70
	Hilly	0.52	0.72	0.82

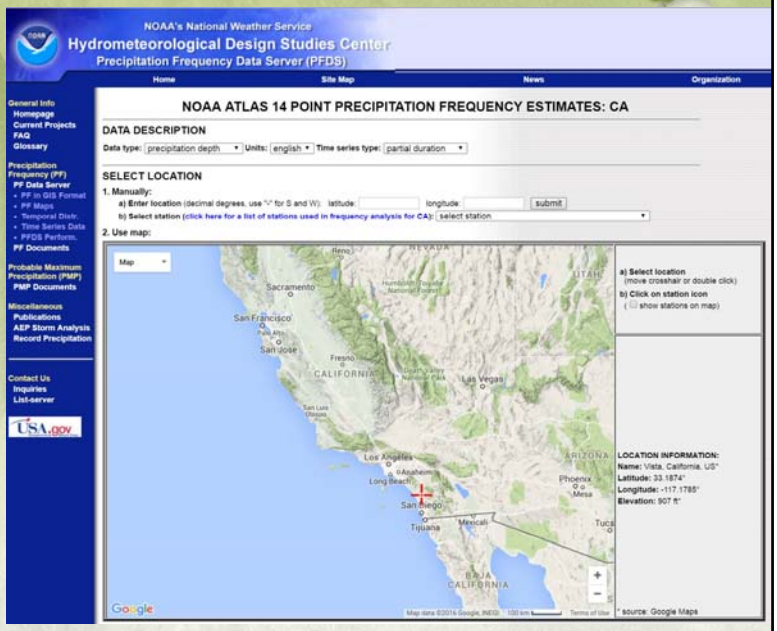
Source: HTS206D, Peak Discharge -Other Methods, NEDC-SCS, [NRCS]-USDA, January 1991Source

Rational Equation

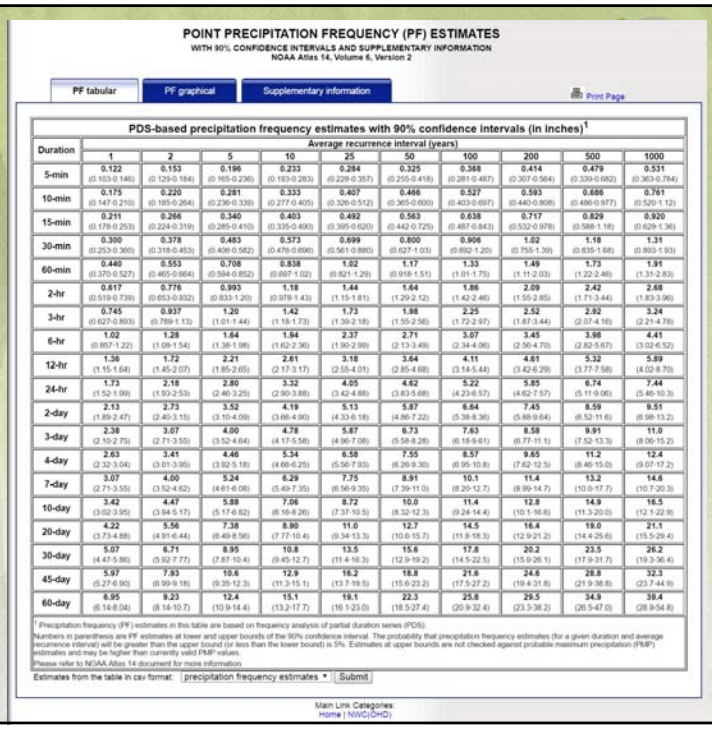
i: in/hr



i: in/hr

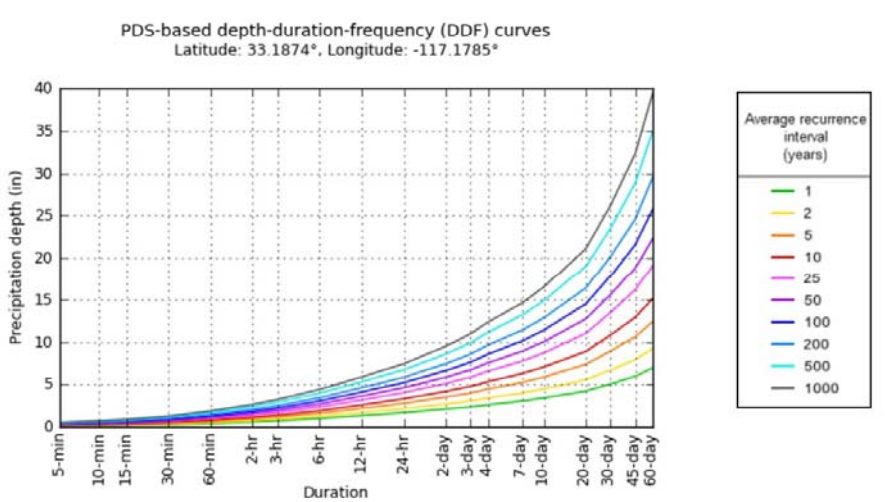

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)
Home
Site Map
News
Organization
NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA
DATA DESCRIPTION
SELECT LOCATION
1. Manually:
2. Use map:
Sacramento
San Francisco
San Jose
Fresno
Las Vegas
Los Angeles
San Diego
Tijuana
Phoenix
Tucson
CALIFORNIA
NEVADA
UTAH
ARIZONA
BAJA CALIFORNIA
LOCATION INFORMATION:
Name: Vista, California, US*
Latitude: 33.1874°
Longitude: -117.1785°
Elevation: 907 ft*
* source: Google Maps

i: in/hr


POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2
PF tabular
PF graphical
Supplementary information
Print Page
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]
Average recurrence interval (years)
Duration
1 2 5 10 25 50 100 200 500 1000
5-min 0.122 (0.103-0.146) 0.153 (0.129-0.184) 0.196 (0.165-0.236) 0.233 (0.193-0.283) 0.284 (0.228-0.357) 0.325 (0.255-0.418) 0.368 (0.281-0.487) 0.414 (0.307-0.564) 0.479 (0.339-0.682) 0.531 (0.363-0.784)
10-min 0.175 (0.147-0.210) 0.220 (0.185-0.264) 0.281 (0.236-0.339) 0.333 (0.277-0.405) 0.407 (0.326-0.512) 0.466 (0.365-0.600) 0.527 (0.403-0.697) 0.593 (0.440-0.808) 0.686 (0.486-0.977) 0.761 (0.520-1.12)
15-min 0.211 (0.178-0.253) 0.266 (0.224-0.319) 0.340 (0.285-0.410) 0.403 (0.335-0.490) 0.492 (0.395-0.620) 0.563 (0.442-0.725) 0.638 (0.487-0.843) 0.717 (0.532-0.978) 0.829 (0.588-1.18) 0.920 (0.629-1.36)
30-min 0.300 (0.253-0.360) 0.378 (0.318-0.453) 0.483 (0.406-0.582) 0.573 (0.476-0.690) 0.699 (0.561-0.880) 0.800 (0.627-1.03) 0.906 (0.692-1.20) 1.02 (0.755-1.39) 1.18 (0.835-1.68) 1.31 (0.893-1.93)
60-min 0.440 (0.370-0.527) 0.553 (0.465-0.664) 0.708 (0.594-0.852) 0.838 (0.697-1.02) 1.02 (0.821-1.29) 1.17 (0.918-1.51) 1.33 (1.01-1.75) 1.49 (1.11-2.03) 1.73 (1.22-2.46) 1.91 (1.31-2.83)
2-hr 0.617 (0.519-0.739) 0.776 (0.653-0.932) 0.993 (0.833-1.20) 1.18 (0.979-1.43) 1.44 (1.15-1.81) 1.64 (1.29-2.12) 1.86 (1.42-2.46) 2.09 (1.55-2.85) 2.42 (1.71-3.44) 2.68 (1.83-3.96)
3-hr 0.745 (0.627-0.893) 0.937 (0.789-1.13) 1.20 (1.01-1.44) 1.42 (1.18-1.73) 1.73 (1.39-2.18) 1.98 (1.55-2.56) 2.25 (1.72-2.97) 2.52 (1.87-3.44) 2.92 (2.07-4.16) 3.24 (2.21-4.78)
6-hr 1.02 (0.857-1.22) 1.28 (1.08-1.54) 1.64 (1.36-1.98) 1.94 (1.62-2.36) 2.37 (1.90-2.99) 2.71 (2.13-3.49) 3.07 (2.34-4.06) 3.45 (2.56-4.70) 3.98 (2.82-5.67) 4.41 (3.02-6.52)
12-hr 1.36 (1.15-1.64) 1.72 (1.45-2.07) 2.21 (1.85-2.65) 2.61 (2.17-3.17) 3.18 (2.55-4.01) 3.64 (2.85-4.68) 4.11 (3.14-5.44) 4.61 (3.42-6.29) 5.32 (3.77-7.58) 5.89 (4.02-8.70)
24-hr 1.73 (1.52-1.99) 2.18 (1.93-2.53) 2.80 (2.46-3.25) 3.32 (2.90-3.88) 4.05 (3.42-4.88) 4.62 (3.83-5.68) 5.22 (4.23-6.57) 5.85 (4.62-7.57) 6.74 (5.11-9.06) 7.44 (5.46-10.3)
2-day 2.13 (1.89-2.47) 2.73 (2.40-3.15) 3.52 (3.10-4.09) 4.19 (3.66-4.90) 5.13 (4.33-6.18) 5.87 (4.86-7.22) 6.64 (5.38-8.36) 7.45 (5.88-9.64) 8.59 (6.52-11.6) 9.51 (6.98-13.2)
3-day 2.38 (2.10-2.75) 3.07 (2.71-3.55) 4.00 (3.52-4.64) 4.78 (4.17-5.58) 5.87 (4.96-7.08) 6.73 (5.58-8.28) 7.63 (6.18-9.61) 8.58 (6.77-11.1) 9.91 (7.52-13.3) 11.0 (8.06-15.2)
4-day 2.63 (2.32-3.04) 3.41 (3.01-3.95) 4.46 (3.92-5.18) 5.34 (4.66-6.25) 6.58 (5.56-7.93) 7.55 (6.26-9.30) 8.57 (6.95-10.8) 9.65 (7.62-12.5) 11.2 (8.40-15.0) 12.4 (9.07-17.2)
7-day 3.07 (2.71-3.55) 4.00 (3.52-4.62) 5.24 (4.61-6.08) 6.29 (5.49-7.35) 7.75 (6.56-9.35) 8.91 (7.39-11.0) 10.1 (8.29-12.7) 11.4 (8.99-14.7) 13.2 (10.0-17.7) 14.6 (10.7-20.3)
10-day 3.42 (3.02-3.95) 4.47 (3.94-5.17) 5.88 (5.17-6.82) 7.06 (6.16-8.26) 8.72 (7.37-10.5) 10.0 (8.32-12.3) 11.4 (9.24-14.4) 12.8 (10.1-16.6) 14.9 (11.3-20.0) 16.5 (12.1-22.9)
20-day 4.22 (3.73-4.88) 5.56 (4.91-6.44) 7.38 (6.49-8.56) 8.90 (7.77-10.4) 11.0 (9.34-13.3) 12.7 (10.6-15.7) 14.5 (11.8-18.3) 16.4 (12.9-21.2) 19.0 (14.4-25.6) 21.1 (15.5-29.4)
30-day 5.07 (4.47-5.86) 6.71 (5.92-7.77) 8.95 (7.87-10.4) 10.8 (9.45-12.7) 13.5 (11.4-16.3) 15.6 (12.9-19.2) 17.8 (14.5-22.5) 20.2 (15.9-26.1) 23.5 (17.9-31.7) 26.2 (19.3-36.4)
45-day 5.97 (5.27-6.90) 7.93 (6.99-9.18) 10.6 (9.35-12.3) 12.9 (11.3-15.1) 16.2 (13.7-19.5) 18.8 (15.6-23.2) 21.6 (17.5-27.2) 24.6 (19.4-31.8) 28.8 (21.9-38.8) 32.3 (23.7-44.9)
60-day 6.95 (6.14-8.04) 9.23 (8.14-10.7) 12.4 (10.9-14.4) 15.1 (13.2-17.7) 19.1 (16.1-23.0) 22.3 (18.5-27.4) 25.8 (20.9-32.4) 29.5 (23.3-38.2) 34.9 (26.5-47.0) 39.4 (28.9-54.8)
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.
Estimates from the table in csv format: precipitation frequency estimates
Submit
Main Link Categories:
Home | NWC(OHD)

Rational Equation

i: in/hr



Rational Equation

Assumptions

- Rainfall occurs at a uniform intensity for a duration at least equal to the time of concentration for the watershed
- Rainfall occurs at a uniform intensity over the entire area of the watershed

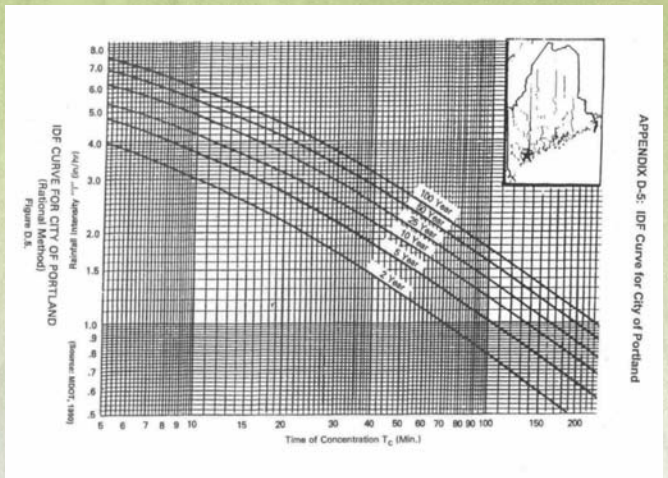
Rational Equation

C factor

- C is based on soil, topography, vegetation and land use and many attempts have been made to refine these values, but variations still remain quite large
- Typical C factors representative of the 5- to 10-year return interval

Rational Equation

IDF Curves

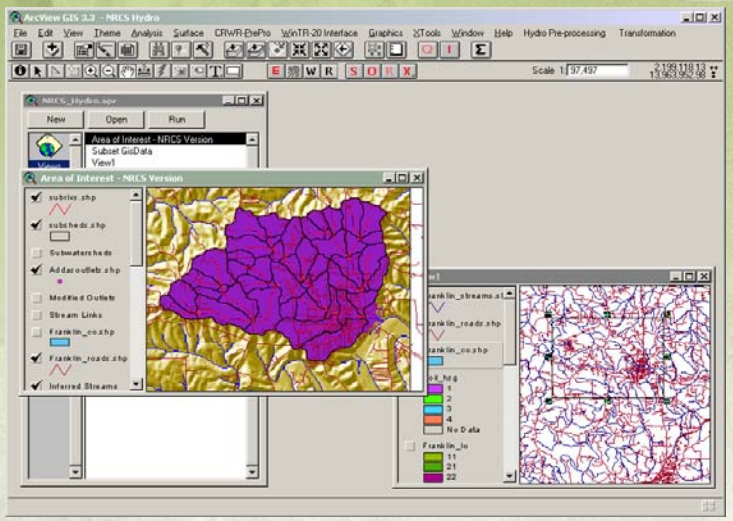


Rational Equation

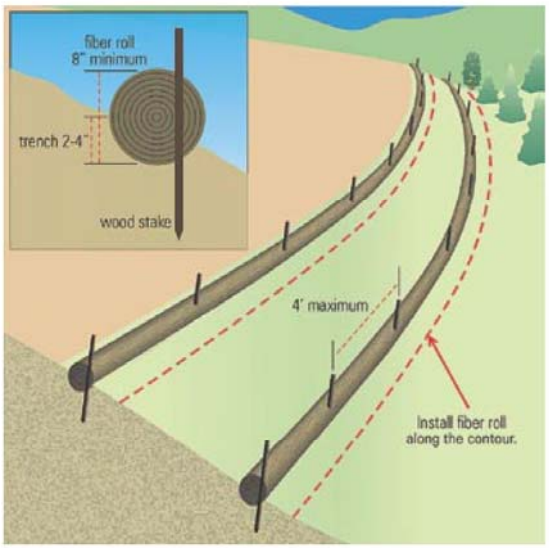
Capabilities/Limitations

- Most appropriate for smaller urban watersheds, parking lots, roofs.
- IDF's for most cities and counties are available.
- Simple and quick to use.

NRCS Hydro / Autocad / Etc



Waddles/ Fiber Rolls = Expensive



Fiber rolls can be used to break up runoff flows on long slopes. Install on the contour and trench in slightly. Press rolls firmly into trench and stake down securely. Consult manufacturer's instructions for expected lifespan of product, slope limits, etc. As always, seed and mulch long slopes as soon as possible.

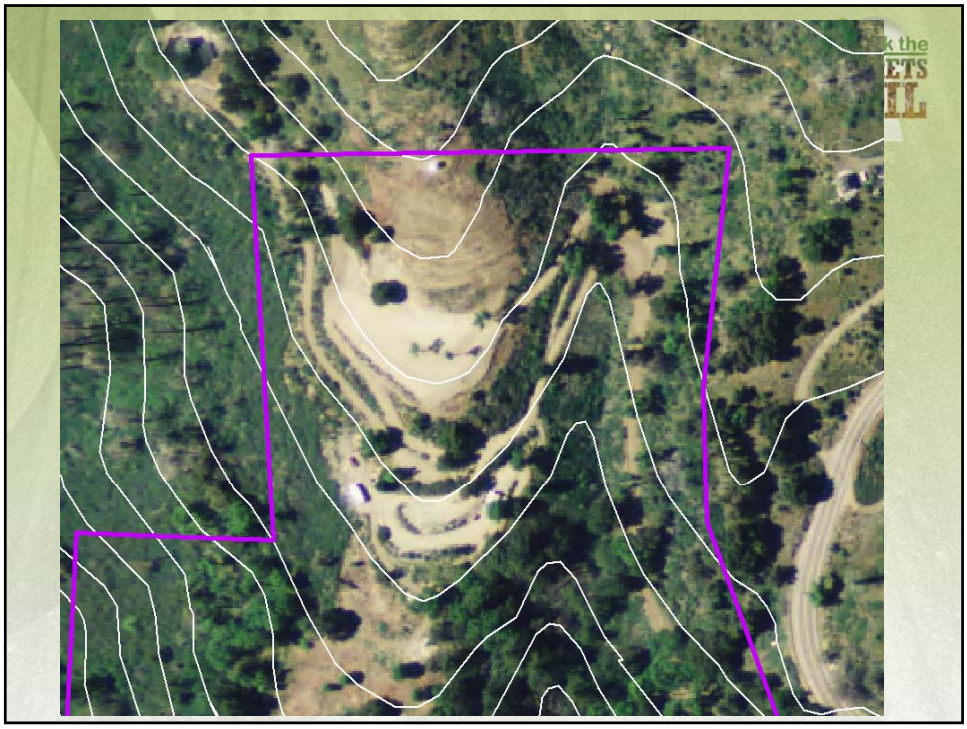
Hydro Seeding/mulching = Expensive

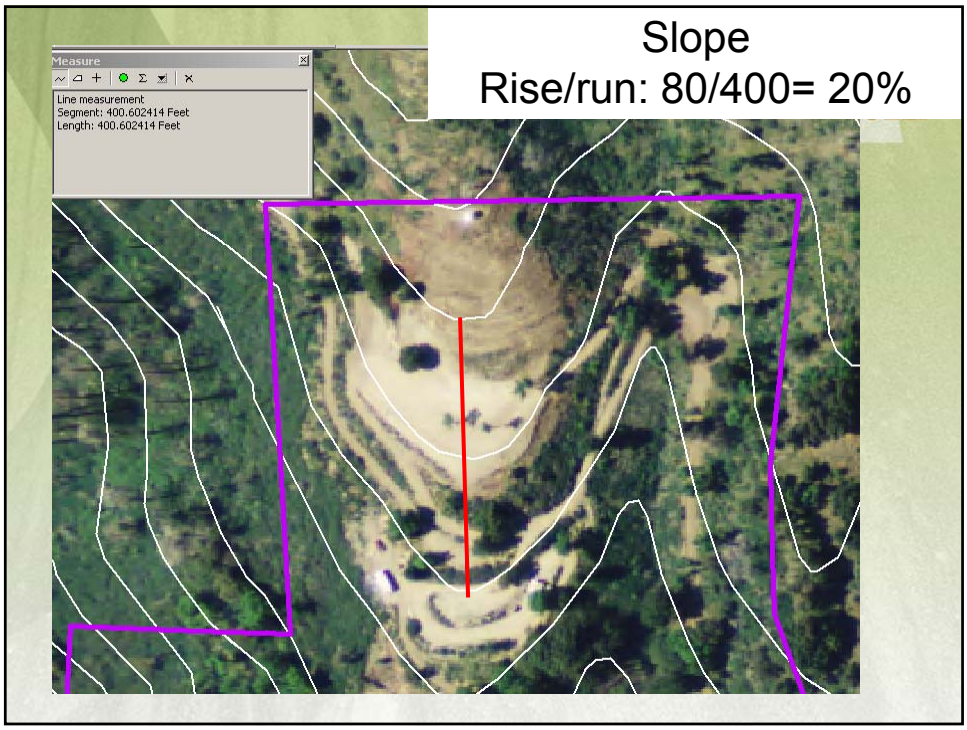

Mulching


Problem?

Mulching

ACCESS ROADS - 560




Slope
Rise/run: 80/400= 20%
Measure
Line measurement
Segment: 400.602414 Feet
Length: 400.602414 Feet

Slope
Rise/run: 80/200= 40%

3 types of roads
Crown, outslope, inslope (requires ditch and culverts)

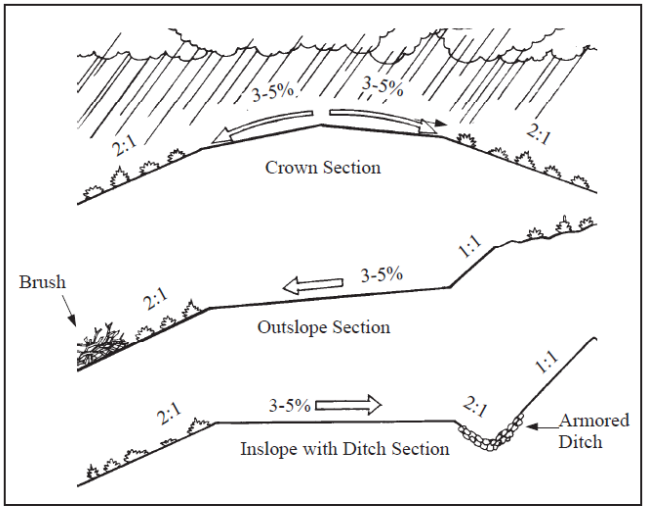


Figure 7.1 Typical road surface drainage options.

Shed vs. concentrate

Shed: get water off often, avoid large erosive flows

Concentrate it: you must handle it. Handling it requires pr .

Spacing of structures

If inadequate cross drains, the inboard ditch will erode. Depends on soil and slope.

Table 7.1
Recommended Maximum Distance Between Rolling Dip or Culvert Cross-Drains (meters)

Road Grade %	Low to Non-Erosive soils (1)	Erosive Soils (2)
0-3	120	75
4-6	90	50
7-9	75	40
10-12	60	35
12+	50	30

Table 7.2
Recommended Water Bar Spacing (meters)

Road/Trail Grade %	Low to Non-Erosive soils (1)	Erosive Soils (2)
0-5	75	40
6-10	60	30
11-15	45	20
16-20	35	15
21-30	30	12
30+	15	10

Note: (1) **Low Erosion Soils** = Coarse Rocky Soils, Gravel, and Some Clay
(2) **High Erosion Soils** = Fine, Friable Soils, Silt, Fine Sands

Adapted from Packer and Christensen (1964) & Copstead, Johansen, and Moll (1998)

Rock Outlet (previously known as rip rap)

The outlets of pipes and ditches need energy dissipation. Stop gullies and head cuts.

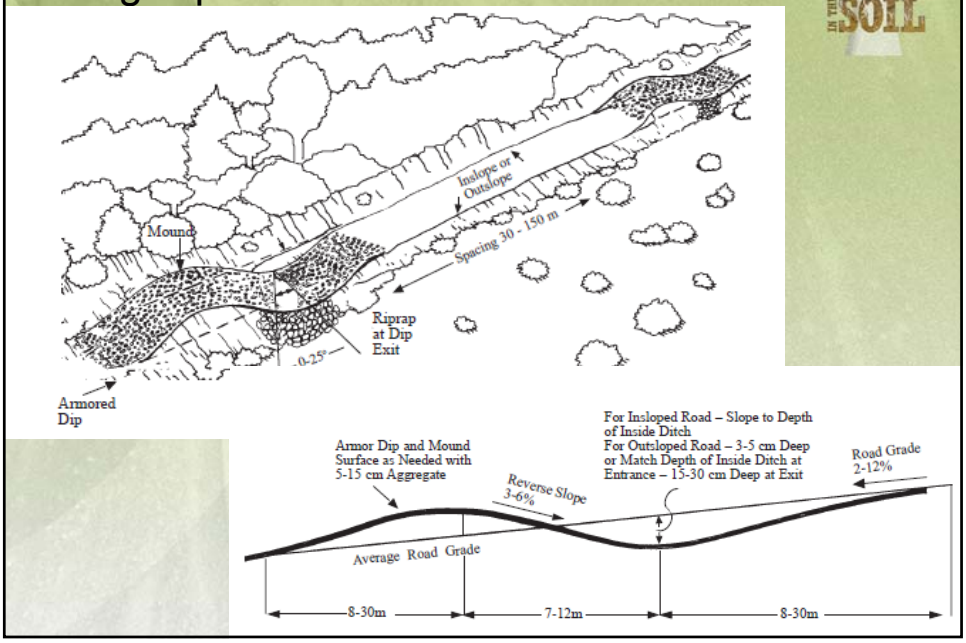
Maintenance vs. rehab to reduce/stop erosion.

TYPICAL LOW-VOLUME ROAD DESIGN STANDARDS

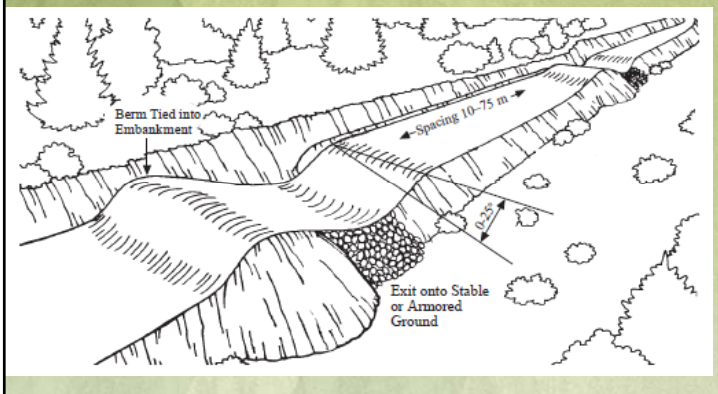
Design Element	Rural Access Road	Collector Road
Design Speed	25-35 kph	45-60 kph
Road Width	3.5-4.5 m	4-5.5 m
Road Grade	15% max.	12% max.
Curve Radius	15 m min.	25 m min.
Crown/Shape	outslope/inslope (5%)	in/outslope or crown (5%)
Surfacing Type	native or gravel	gravel, cobble-stone or pavement

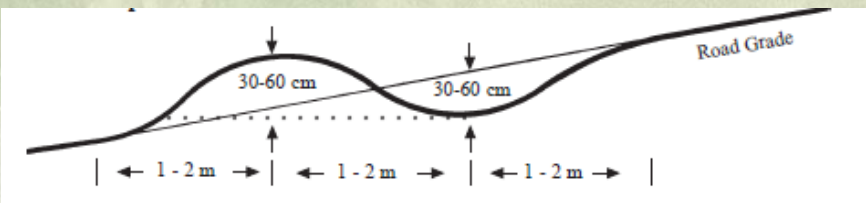
Maintenance is key! Ditches, culverts, and other structures require sediment and debris to be cleaned out regularly. (usually before the rainy season starts)

Rolling Dip

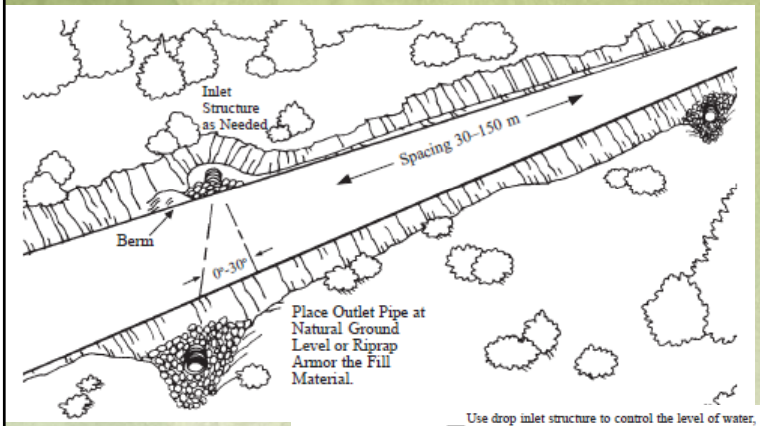


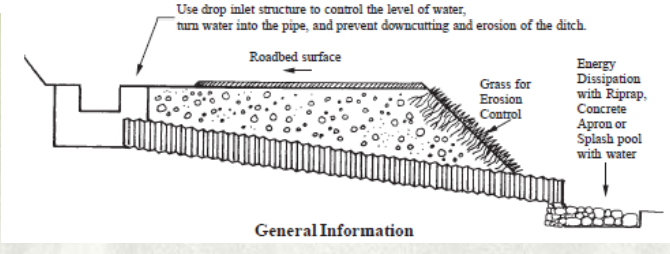
Water Bar





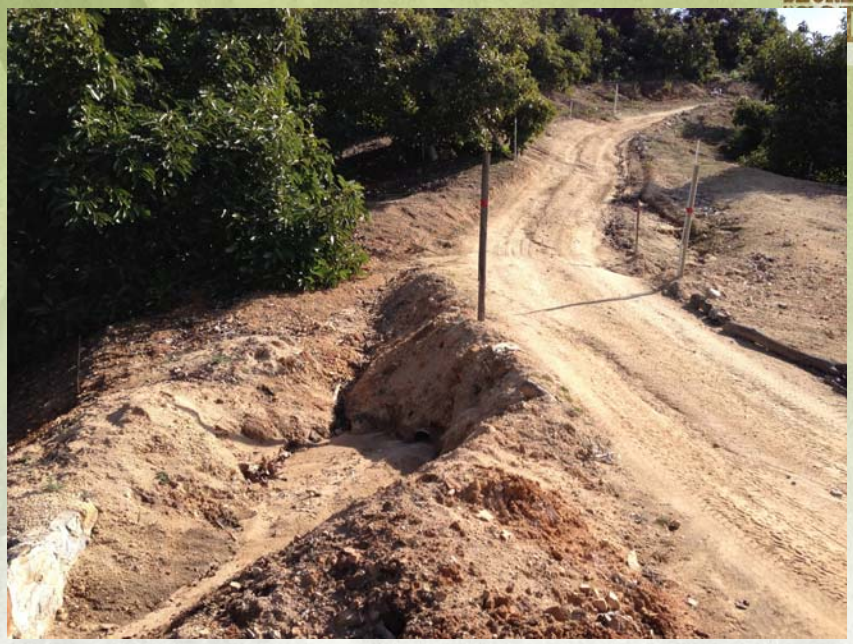
Culvert





Slope Drain = Underground outlet

Rolling Dip with culvert



Culvert

Conical Trash Rack Prevents plugging

Grassed Waterway

Zorro Fescue
And
Blando Brome

Rock Energy Dissipator

Good placement and construction of rock apron at high-flow culvert outlet. If flow from culvert enters a channel, make sure channel is lined with grass, and blankets or mats, if necessary, to prevent erosion.

Excellent placement and construction of rock apron to dissipate flows from culvert outlet. Area needs seeding and mulching.

unlock the SECRETS in the SOIL

Rock Energy Dissipator

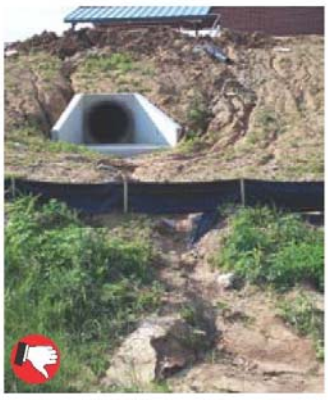
Poor rock apron placement and construction at culvert outlet; poor seeding and slope protection (right side).

Poor slope protection, no rock apron or flow dissipater at culvert outlet. Silt fence must not be used across ditches or channels; do not put sediment traps at culvert outlets.

Rock Energy Dissipator

Poor seed and mulch application, slopes badly eroding. No rock apron or flow dissipater at culvert outlet. Culverts clogged with sediment and rock.

Very poor outlet protection. No slope protection or seeding, no rock apron or flow dissipater at culvert outlet. Misapplication of silt fence across ditch. Flow bypass.



USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Managing Sediment

The Soil Health Roadmap to Productive, Sustainable Farming in the 21st Century and Beyond

NRCS - HELPING PEOPLE HELP THE LAND

Managing Sediment

Soil erosion and sediment deposition are primary contributors to lowered surface water quality from farmlands. In areas where there are steep slopes, erodible soils, and intense storm characteristics, sediment delivery from farmlands can be relatively high. Roads and other areas of disturbed ground where bare soils are susceptible to the erosive action of water and wind can also be major contributors of sediment to waterbodies.

Upstream/Upslope Land Use

S1. Is your property affected by sediment from upstream/upslope land uses?

✓ **Yes** ☐ **No**

Notes:

Practices to Manage Sediment from Upstream/Upslope

	Used or could be helpful	Location(s)	Year(s) used						
			2002	2003	2004	2005	2006	2007	2008
A structure to collect the sediment is installed and maintained									
Sediment Basin #350	✓	NE end of hillside field		✓	✓	✓	✓	✓	✓
Water and Sediment Control Basin #638									
A structure to divert the sediment is installed and maintained	✓	N edge of property	✓	✓					
Diversion #362									
Grassed Waterway #412	✓	Sediment basin outlet		✓	✓	✓	✓	✓	✓
Lined Waterway #468									
Open Channel #582									
Structure for Water Control #587									
Surface Drainage #607 & #608									
Underground Outlet #620	✓	Main road						✓	✓
Vegetation is established to filter the sediment									
Conservation Cover #327									
Filter Strip #393									
Tree/Shrub Establishment #612									

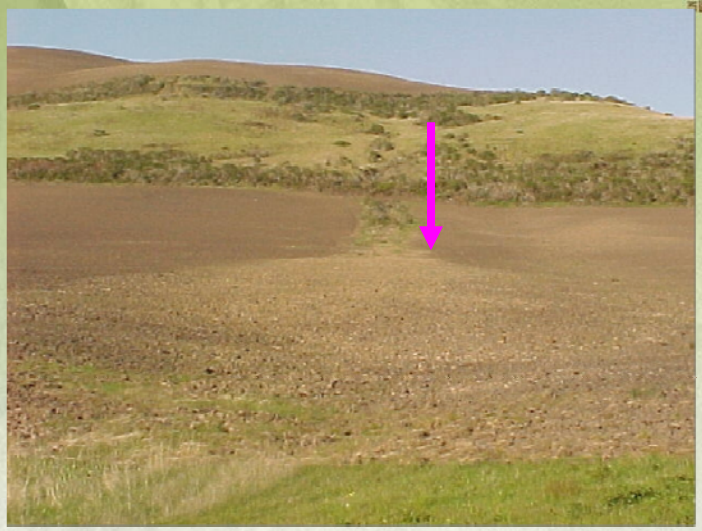
unlock the SECRETS IN THE SOIL

Assessment of Sediment and Erosion From:

- Upstream/Upslope Land Use
- Fields and Other Growing Areas
- Container Grown Plants/Hydroponics
- Roads and Roadside Ditches
- Non-Cropped & Non-Road Areas
- Sediment Leaving the Operation

Upstream / Upslope Land Use

Upslope Land Uses



Sediment and runoff from uphill property

Natural Forces (Past Land Use?)

Sediment delivered downhill from gully

Management Practices to Collect Sediment

Sediment Basin or Water & Sediment Control Basin

Management Practices to Divert Sediment Laden Water

- **Diversion – Intercepts sheet flows**
- **Grassed Waterway – Carry concentrated flows**
- **Lined Waterway – Concentrated flows of higher capacity**
- **Open Channel – For largest capacity of water flow**
- **Structure for Water Control – To prevent water flows from degrading channels**
- **Surface Drainage – Collect water on flat areas**
- **Underground outlet – For steep areas where surface conveyance is not appropriate**

Management Practices to Divert Water to Stable Outlet

Lined Waterway

Management Practices to Filter Sediment

- Conservation Cover – Used on non-cropped areas
- Filter Strip – Used above or below a field
- Tree/Shrub Establishment
  - Used along the perimeter of a field or property usually with less ground cover than a filter strip

Management Practices to Filter Sediment

Filter Strip

Fields and Other Growing Areas

Erosion From Fields

- Steep or long sloping fields
- Bare soils or sparse cover
- Irrigation systems
- Wind

S2: Do you notice soil erosion from fields and other growing areas with steep slopes or long length of run?

Erosion from Steep or Long Slopes

Management Practices to Minimize Row Grade

Contour Farming, Row Arrangement, Access Road Placement & Land Smoothing

Management Practices to break up Long Runs

Diversion with an Associated Underground Outlet

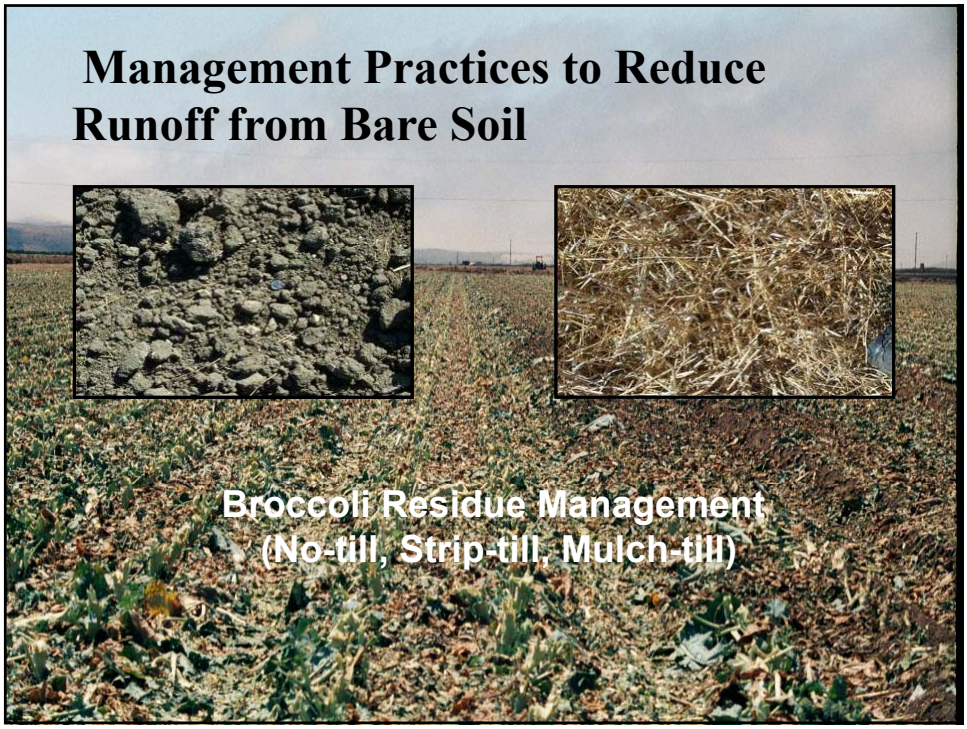
Water safely delivered to sediment basin below

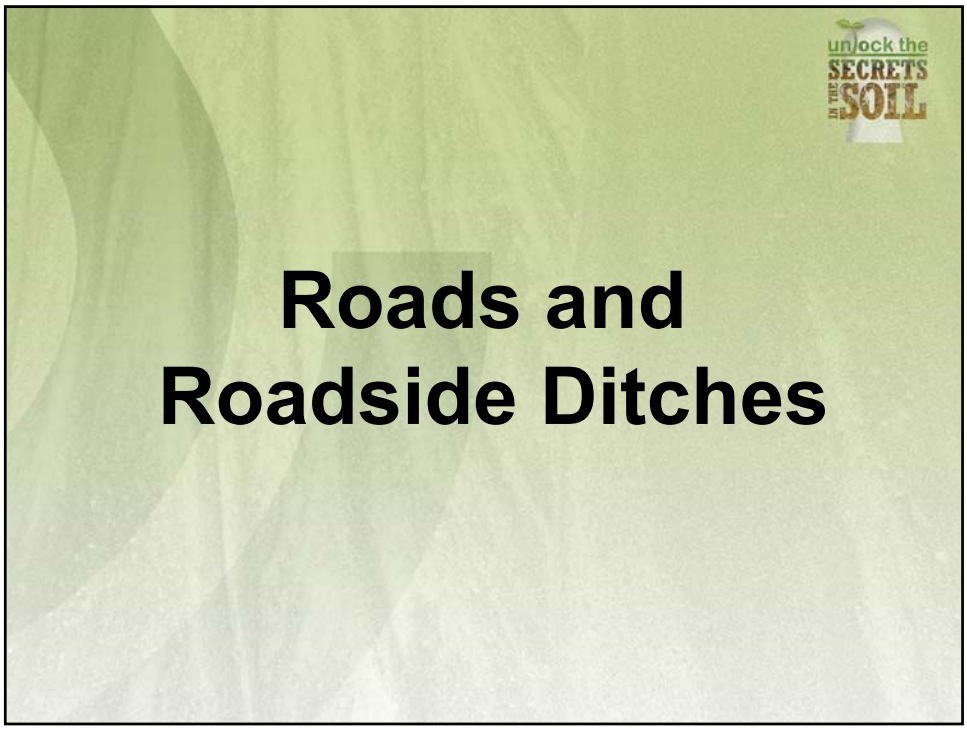
S3: **During rain events, do you notice soil erosion from fields with bare soil or sparse ground cover?**

Sheet erosion and ephemeral gully formation

Management Practices to Reduce Runoff from Bare Soil

Cover Cropping


Management Practices to Reduce Runoff from Bare Soil
Broccoli Residue Management
(No-till, Strip-till, Mulch-till)

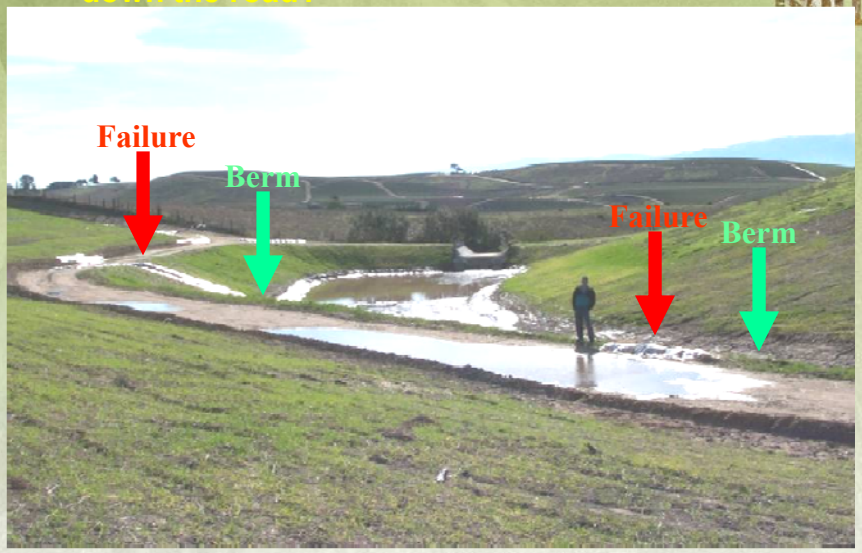

unlock the
SECRETS
IN THE
SOIL
Roads and
Roadside Ditches

S7: Do you notice rills, gullies, or headcuts running down the road?

Rills and Gullies Developed on Roads

Flows accumulate to cause rill and gully erosion

S9: Is an outboard berm channeling water down the road?



Berms channel the water down the road!