Contra Costa's experience with Low Impact Development for

Stormwater Treatment and Flow Control

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Outline

- Key insights into HMP requirements
- LID Design Procedures
- LID Design Details
- Example Site Designs
- Continuous Improvement of Contra Costa's Approach
- Applicability to other regions

What the permit requires

… post-project runoff discharge rates and durations shall not exceed estimated pre-project discharge rates and durations

where the increased discharge rates and durations will result in increased potential for erosion or other significant adverse impacts to beneficial uses…”

Insights from watershed analysis

- Most streams are incised and/or are already experiencing accelerated erosion.
- Geomorphic assessment has a variety of methods, and conclusions differ.
- Local government lacks the resources to conduct a comprehensive analysis of all stream reaches in the County.
- Extrapolating hydrologic characteristics from watershed to site (or from site to watershed) requires guesswork.

Contra Costa HMP Strategy

- Accept a presumptive standard that developments must match pre-project flows
- Assist developers with the technical means to comply with that standard
- Promote Low Impact Development (LID)
- Provide developers with options

Options for HMP Compliance

1. Show project does not increase total amount of impervious area
2. Use Low Impact Development Integrated Management Practices
3. Use a continuous-simulation model to show runoff will not exceed pre-project flow peaks and durations
4. Show projected increases in runoff peaks and durations will not accelerate erosion of receiving stream

LID Site Design

- Divide the site into Drainage Management Areas
- Use landscape to disperse and retain runoff where possible
- Route drainage from remaining areas to IMPs
- Design the IMPs to accommodate available space and hydraulic head

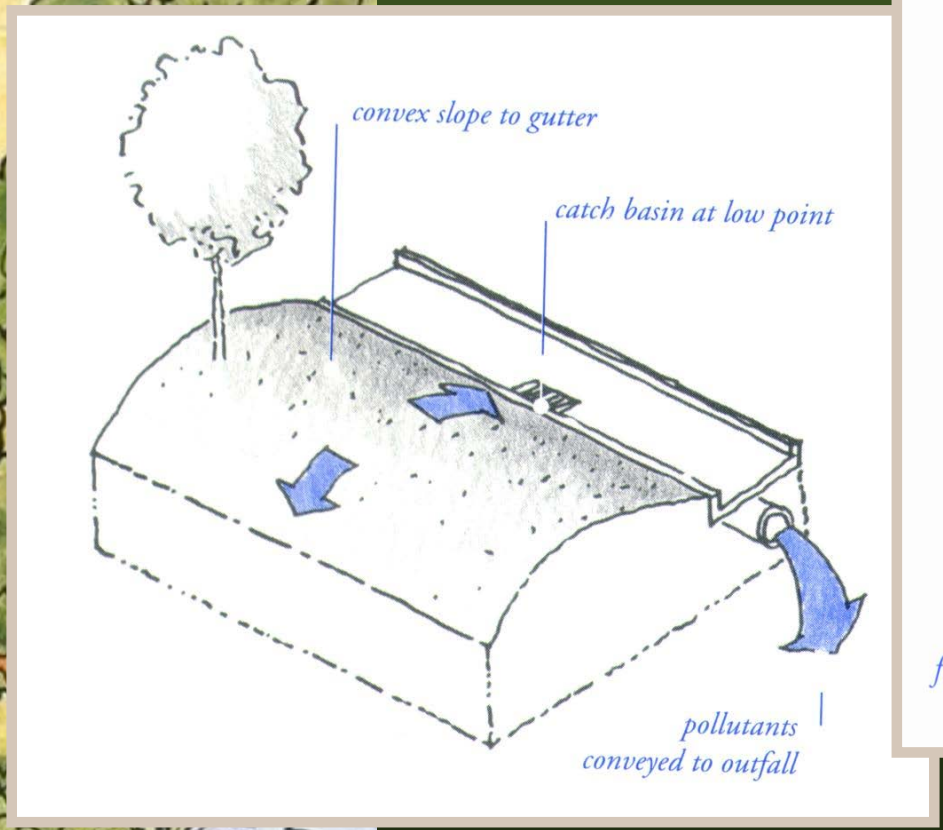
Drainage Management Areas

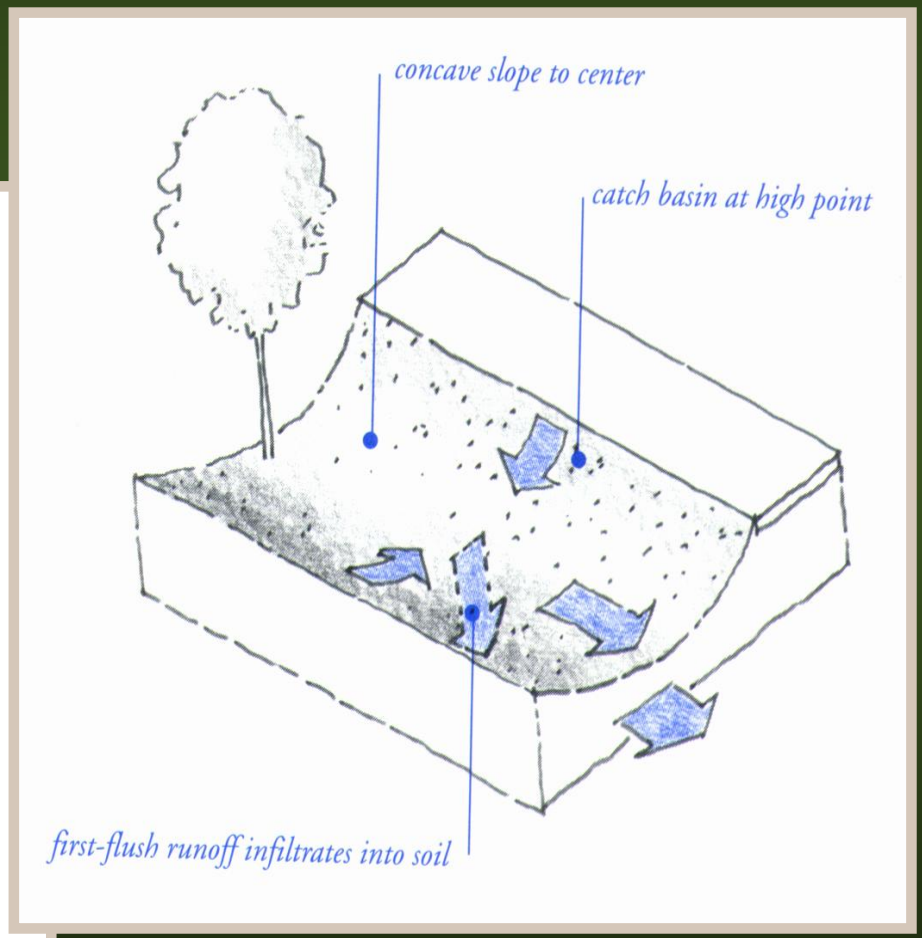
- Four Types of Areas
  - Self-treating areas
  - Self-retaining areas
  - Areas draining to a self-retaining area
  - Areas draining to an IMP
- Only one surface type within each area
- Many-to-one relationship between drainage areas and IMPs

Self-treating areas

- Must be 100% pervious
- Must drain offsite
- Must not drain on to impervious areas
- Must not receive drainage from impervious areas
- Must not drain to IMPs
- No treatment or flow control required
- No further calculations required

Self-retaining areas

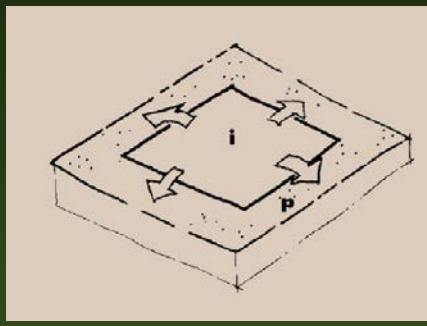




Self-retaining areas

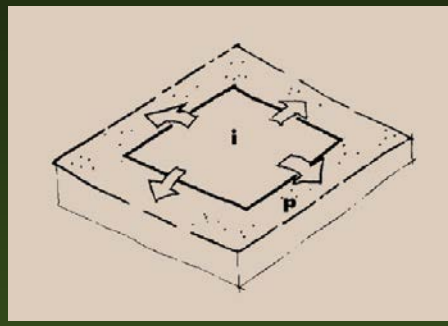
- Berm or depress grade to retain 1" rain
- Set area drain inlets above grade
- Amend soils
- Terrace mild slopes
- Have limited applicability in
  - Dense developments
  - Hillsides

Areas draining to self-retaining areas

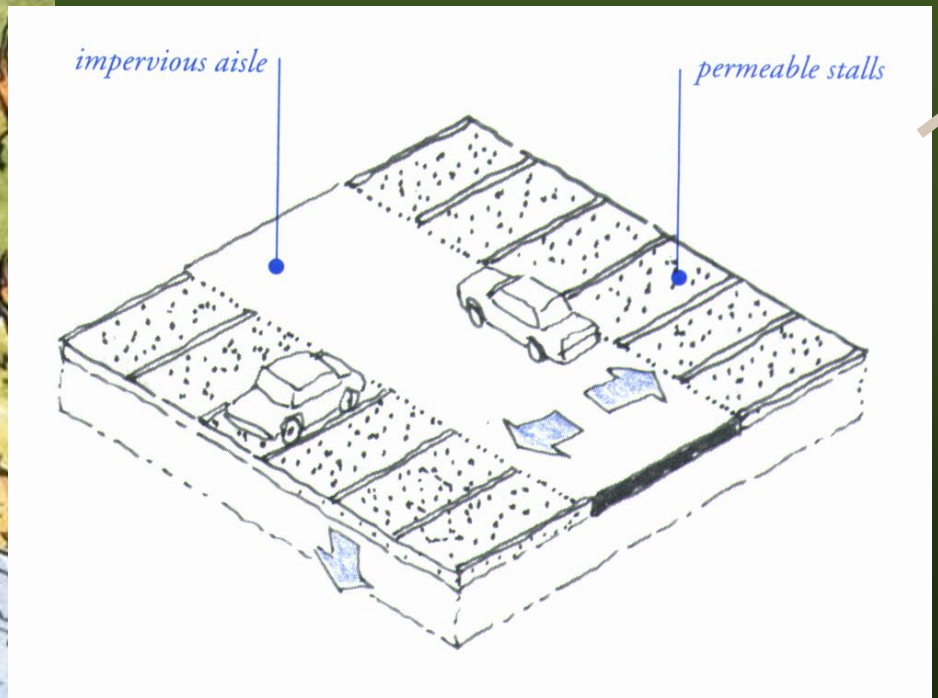


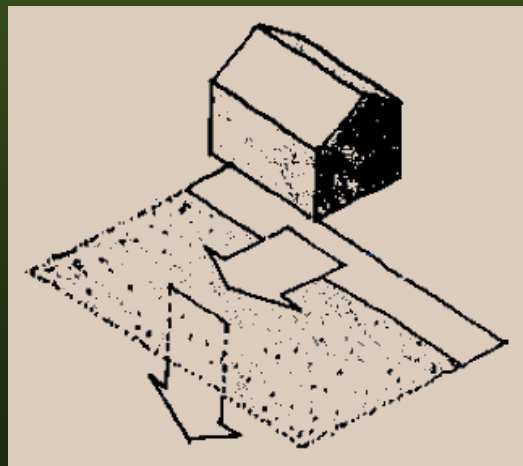
- Impervious areas can drain on to self-retaining areas
- Example: Roof leaders directed to lawn or landscape
- Maximum ratio is 1:1 impervious:pervious if flow control requirements apply to project
- Maximum ratio is 2:1 if treatment only requirements apply to project
- No maintenance verification required

Areas draining to self-retaining areas



$$\frac{\text{Impervious}}{\text{Pervious}} \leq 1$$





Areas draining to IMPs

- Areas used to calculate the required size of the IMP
- Where possible, drain only impervious roofs and pavement to IMPs
- Delineate any pervious areas separately
- Use the sizing tool

Integrated Management Practices

Advantages

- Detain and treat runoff
- Typically fit into setbacks and landscaped areas
- Accommodate diverse plant palettes
- Low-maintenance
- Don't breed mosquitoes
- Can be attractive

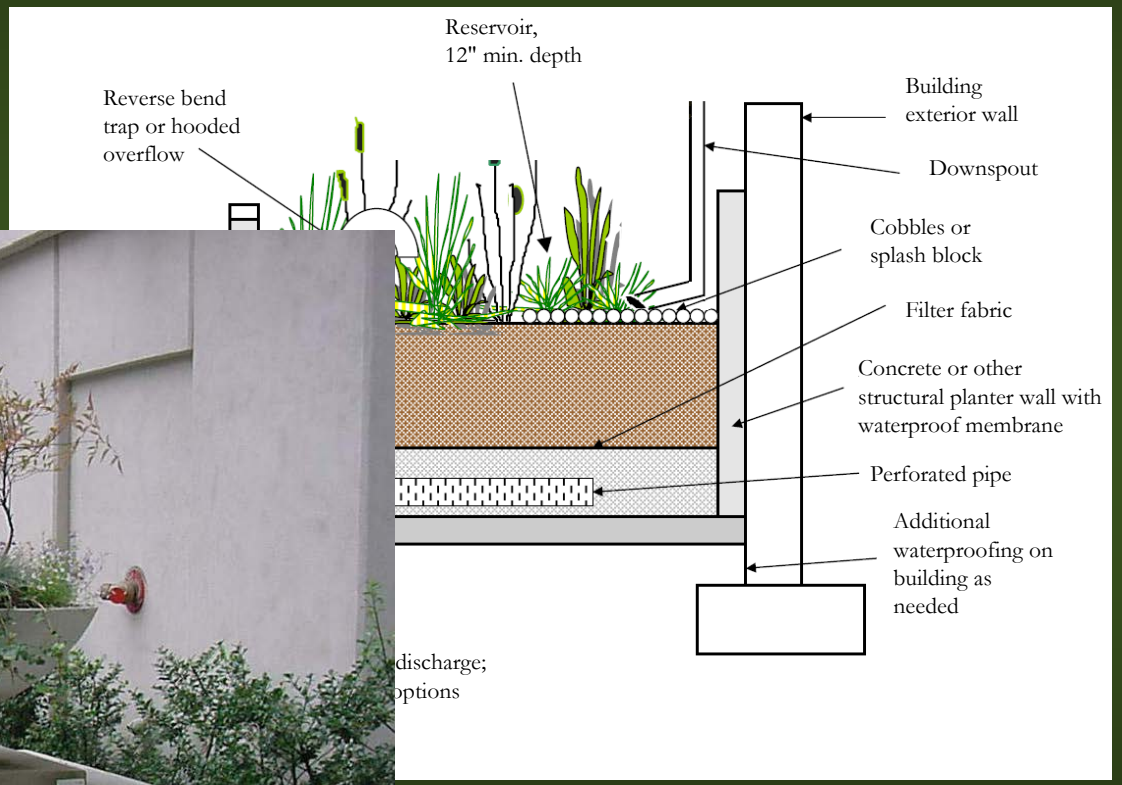
Challenges

- Soil surface must be 6-12" lower than surrounding pavement
- Require 3-4 feet of vertical "head"
- Can affect decisions about placement of buildings, roadways, and parking

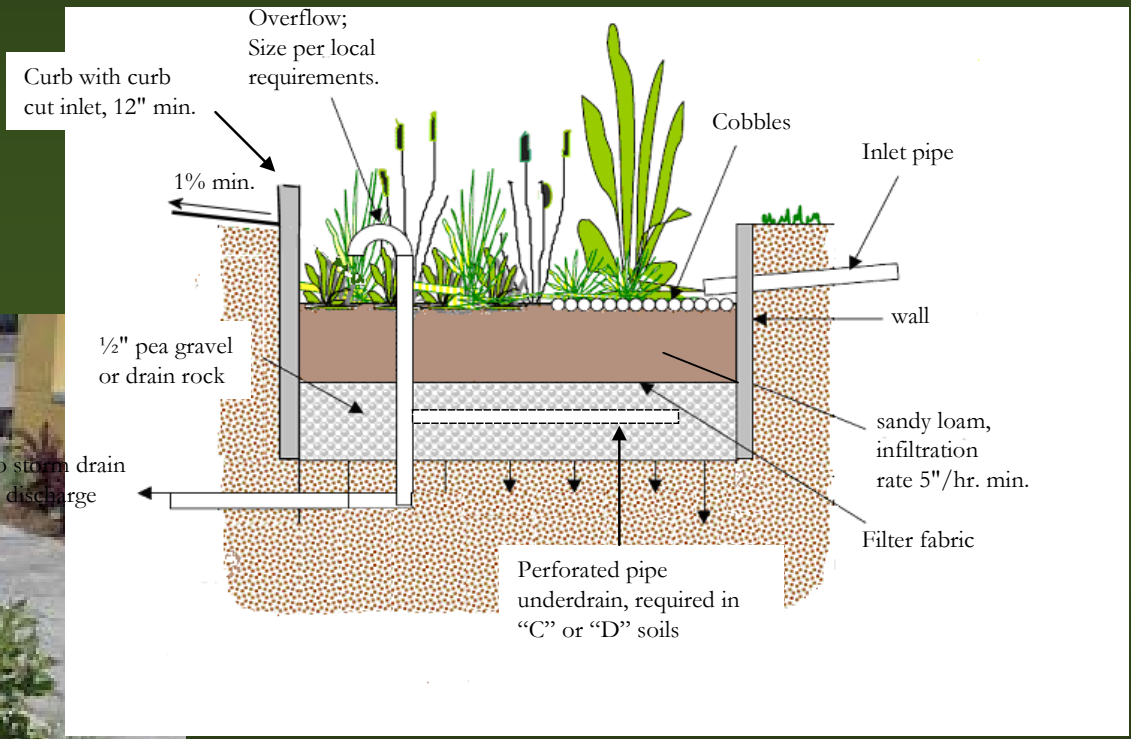
Implementing LID IMPs

- IMPs can be effective, attractive, and accepted by developers
- Incorporate IMPs in preliminary site, landscaping and drainage design drawings

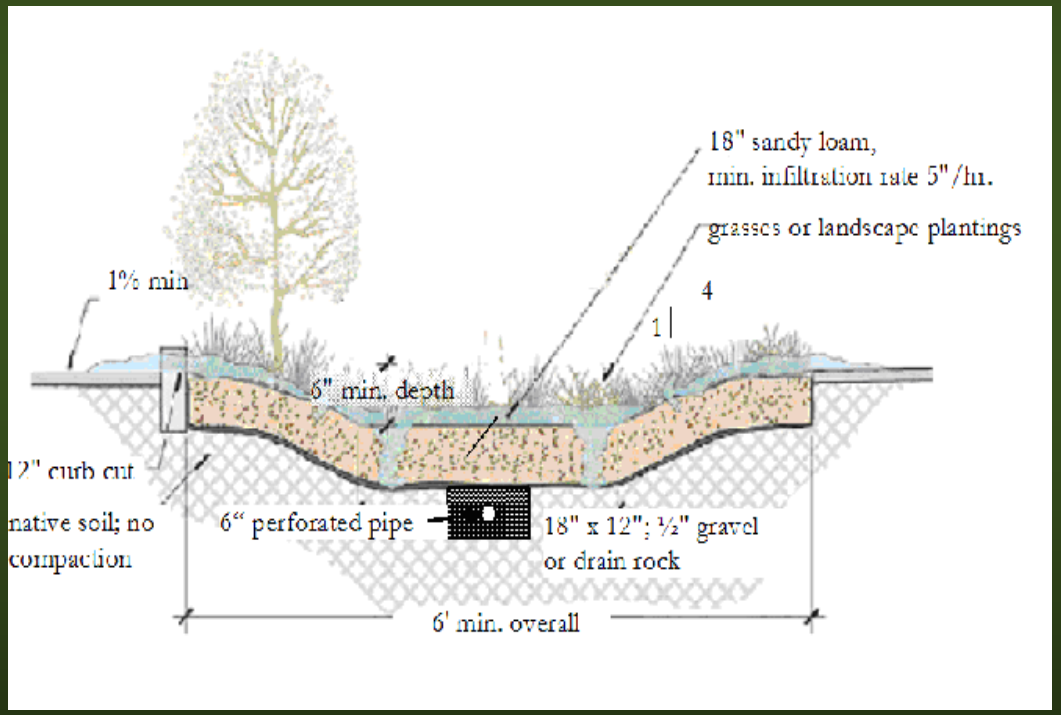
Flow-through Planter



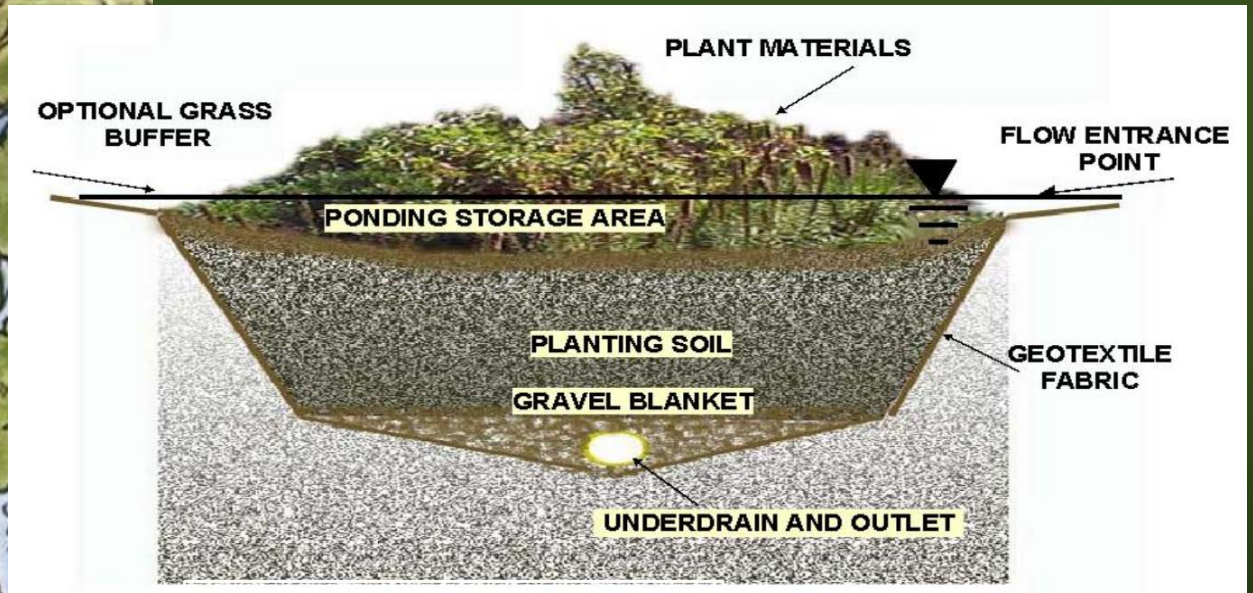
In-ground Planter



Vegetated Swale

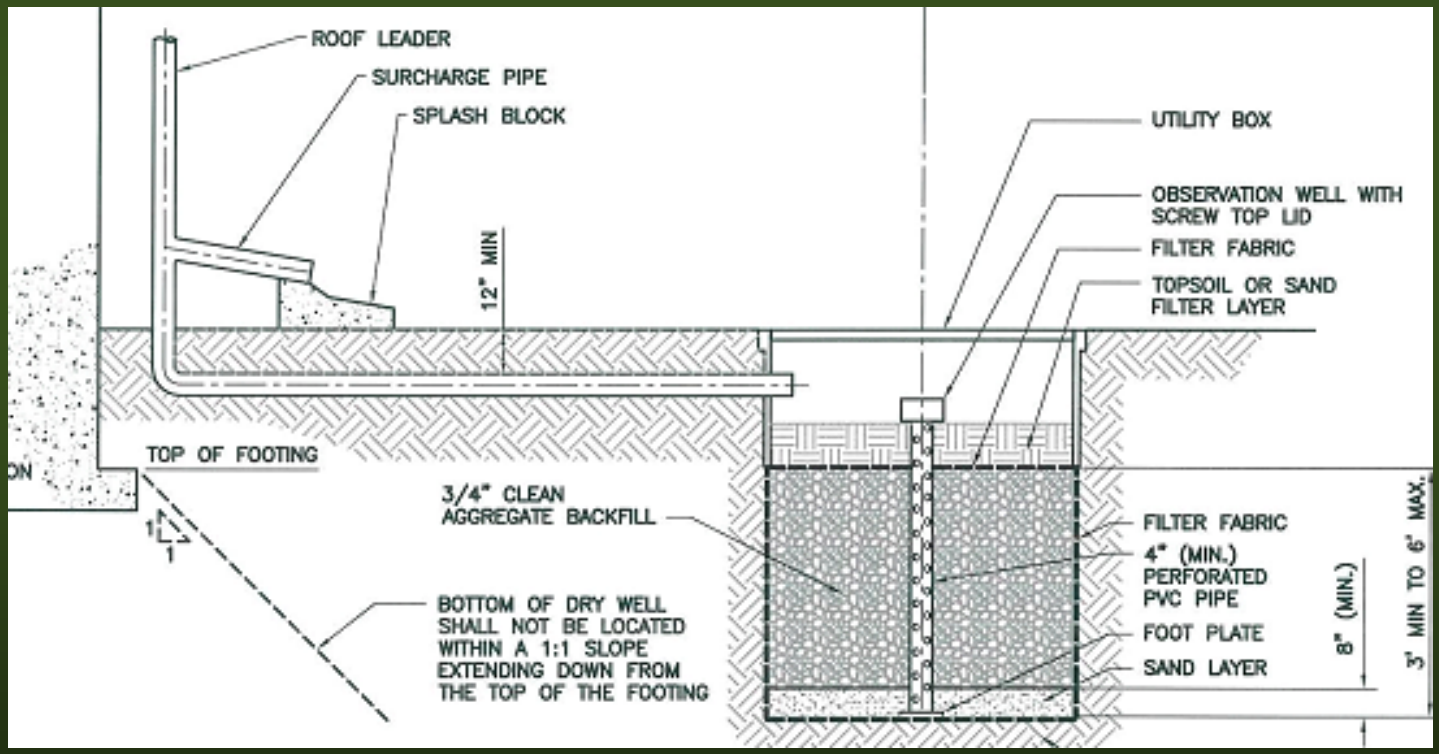


Bioretention Area



(Prince George's County 1993)

Dry Well

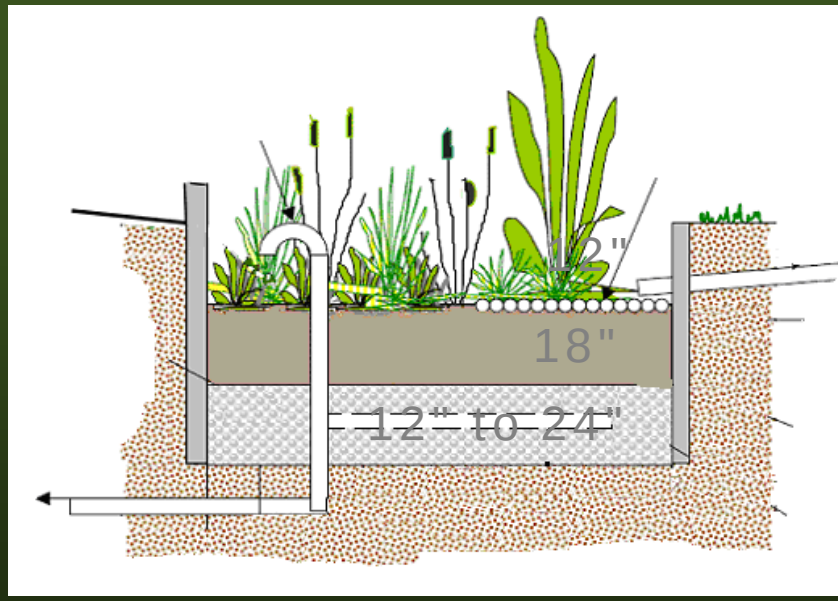

ROOF LEADER
SURCHARGE PIPE
SPLASH BLOCK
12" MIN
UTILITY BOX
OBSERVATION WELL WITH SCREW TOP LID
FILTER FABRIC
TOPSOIL OR SAND FILTER LAYER
TOP OF FOOTING
3/4" CLEAN AGGREGATE BACKFILL
1
1
BOTTOM OF DRY WELL SHALL NOT BE LOCATED WITHIN A 1:1 SLOPE EXTENDING DOWN FROM THE TOP OF THE FOOTING
FILTER FABRIC
4" (MIN.) PERFORATED PVC PIPE
FOOT PLATE
SAND LAYER
8" (MIN.)
3' MIN TO 6' MAX.

Infiltration Trench

Infiltration Basin

Size, depth and head

- Size
  - Determined by sizing factors
  - Required dimensions should be shown on C.3 plan or grading and drainage plan
- Depth
  - Reservoir
  - Soil Layer
  - Drainage Layer



LID and Hydraulic Head

Collect and convey

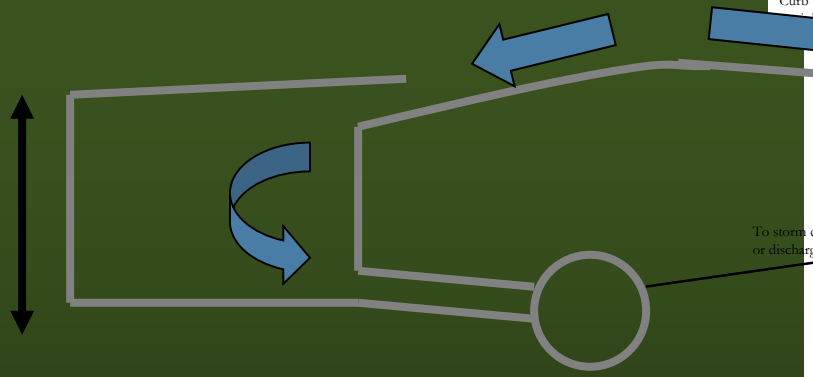
Disperse to landscape

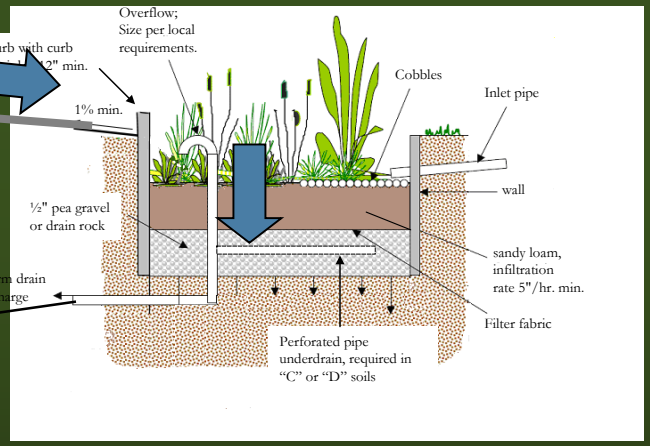
- Saves space
- Concentrates flows
- "Drop" at inlet

- Keeps flows dispersed
- Requires space
- "Drop" through soil filter

LID and Head

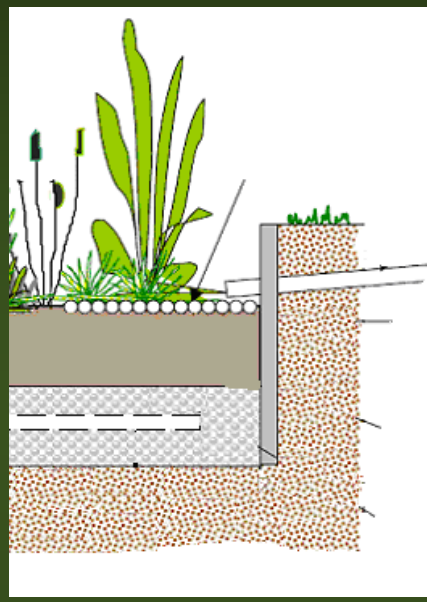
Watch
your
head




Overflow;
Size per local
requirements.
Curb with curb
1% min.
Cobbles
Inlet pipe
wall
½" pea gravel
or drain rock
sandy loam,
infiltration
rate 5"/hr. min.
To storm drain
or discharge
Filter fabric
Perforated pipe
underdrain, required in
"C" or "D" soils

Fill Materials

- Soil layer
  - Infiltration rate ≥ 5"/hour
  - Clay < 5%
  - Current spec:
    - 50-60% construction sand
    - 20-30% compost
    - 20-30% topsoil
  - Looking for a "branded" mix
- No filter fabric between layers
- Gravel drainage layer
  - "Class 2 Perm"
  - Caltrans Manual 68-1.025



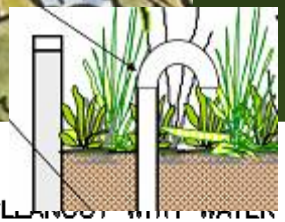
Inlets

Overflows

Install IMPs level

Overflows

Overflow



) FT GREATER THAN PIPE
A. HOT-DIP GALVANIZED
PLATE AFTER HOLES HAVE
BEEN DRILLED.

Min 6" (Typ)

3" (Typ)

INFLOW PIPE

1/2" MAXIMUM

ORIFICE DIAMETER (DIA)
SIZED PER DESIGN CRITERIA

¾" DIA HOLE (TYP)

LENGTH (L) X
SIZE AREA PER
DISCHARGE REQ

2B FLOW CONTROL ORIFICE PLATE

TIGHT CAP ABOVE
PONDING DEPTH

DESIGN STORM,

PONDING DEPTH

(SEE DETAIL 1A)

PLANTING MEDIUM

CONCRETE OR OTHER
STRUCTURAL PLANTER WALL
WITH WATERPROOF MEMBRANE

Hd

OUTFALL PIPE

DISCHARGE TO AN
APPROVED LOCATION

ONE-WAY
CONNECTIONS

PERFORATED PIPE
(UNDERDRAIN)
MIN SLOPE=0.5%

DRAINAGE LAYER

ORIFICE DRILLED
INTO VAULT WALL
(SEE DETAIL 1A)

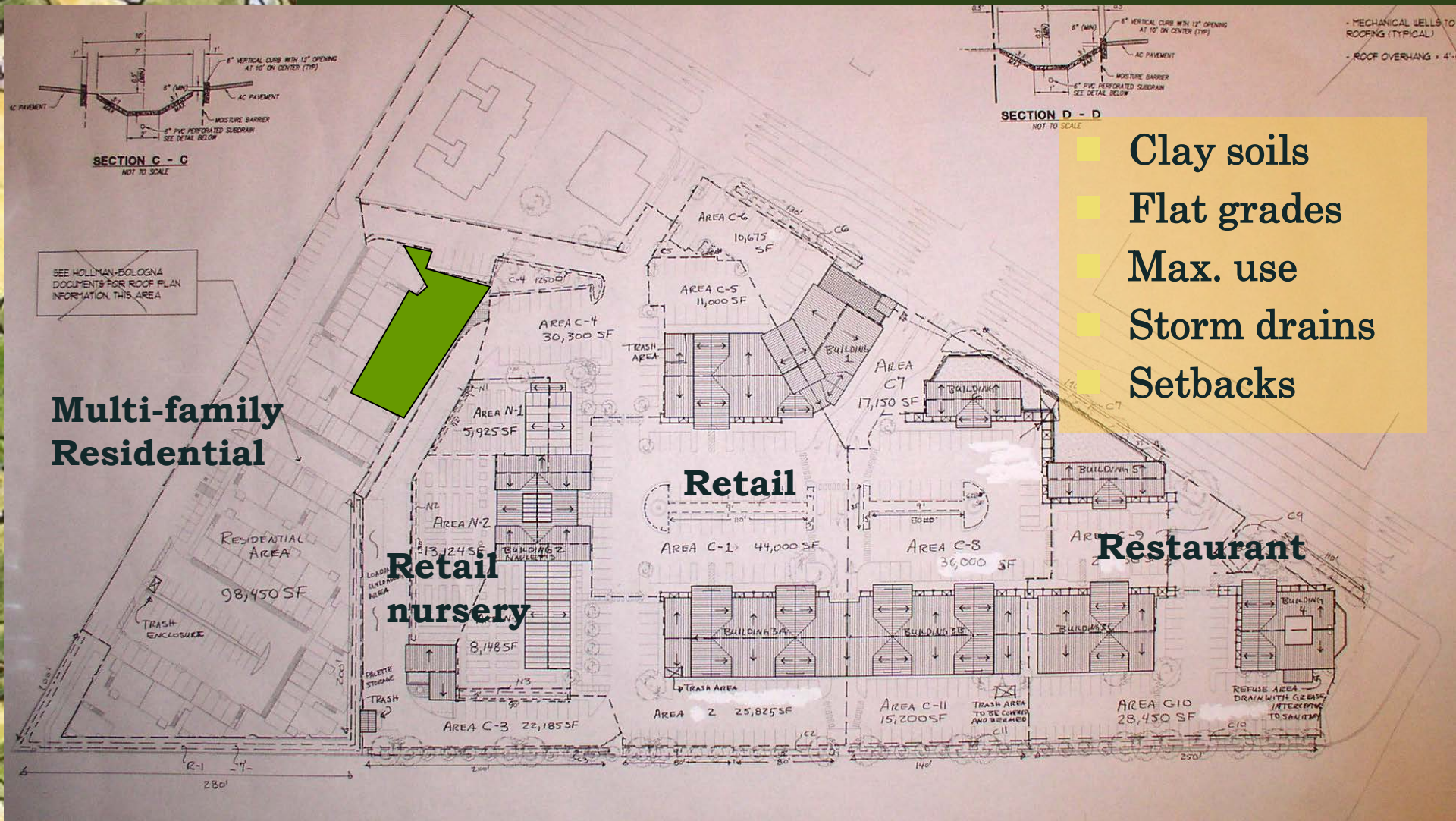
GALVANIZED STEEL BOLTED
TO THE BOX INTERIOR
SEE DETAIL 1A

VAULT
MAY BE CONSTRUCTED
OUTSIDE OF THE PLANTER BOX

Example Site Designs

Rose Garden

9-acre, mixed use



- Clay soils
- Flat grades
- Max. use
- Storm drains
- Setbacks

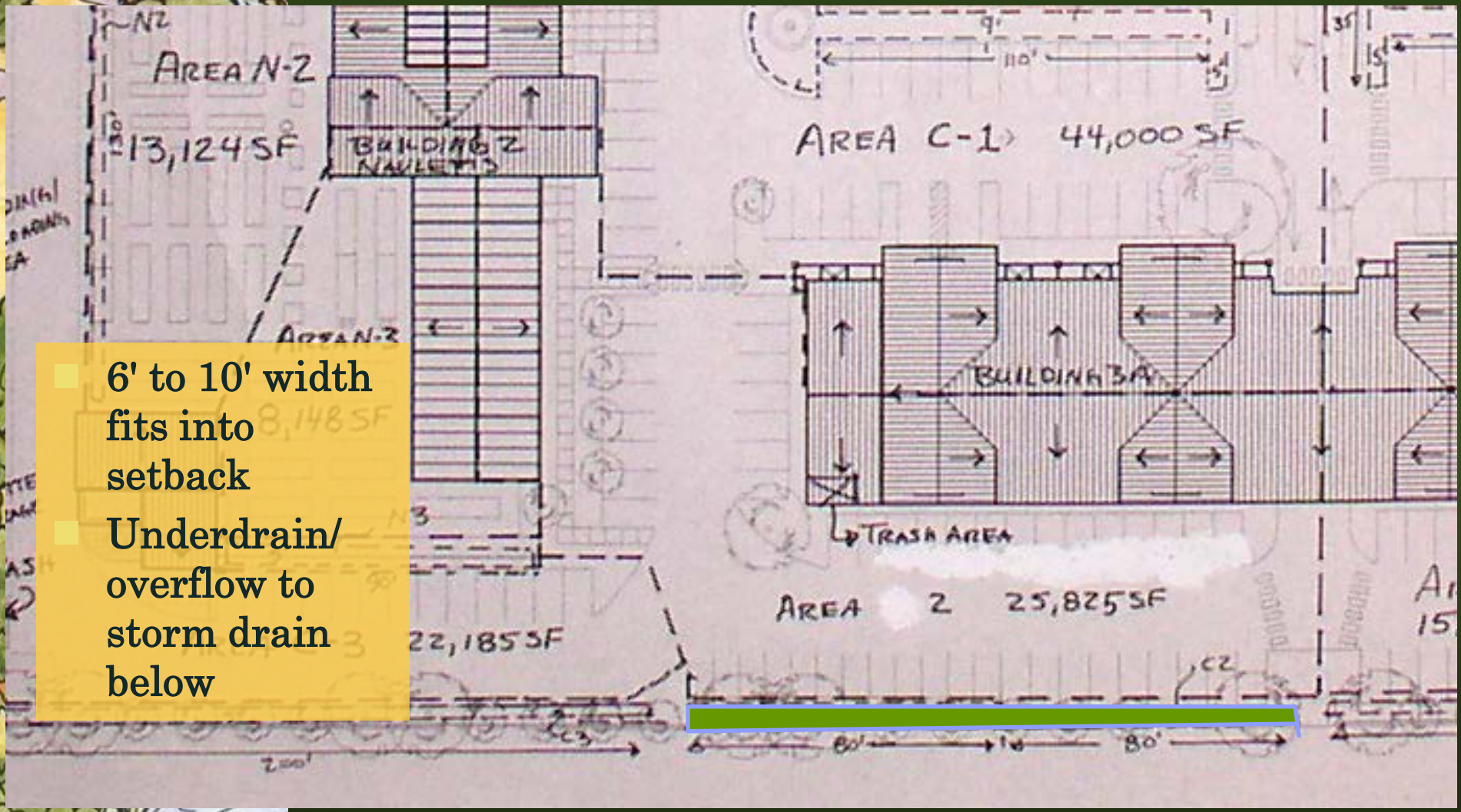
Multi-family Residential

Retail

Retail nursery

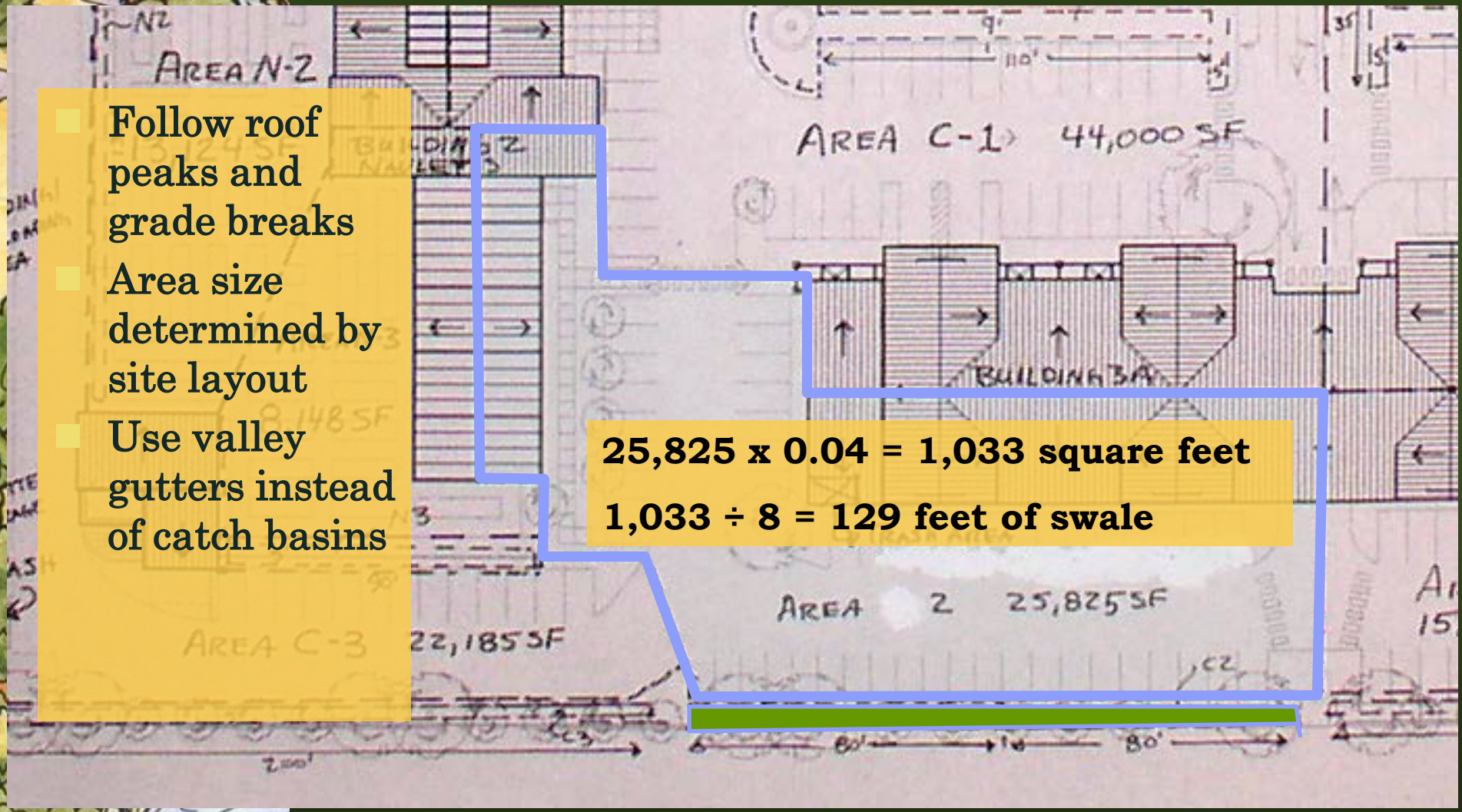
Restaurant

Swale “C-2”



- 6' to 10' width fits into setback
- Underdrain/ overflow to storm drain below

Area “C-2”

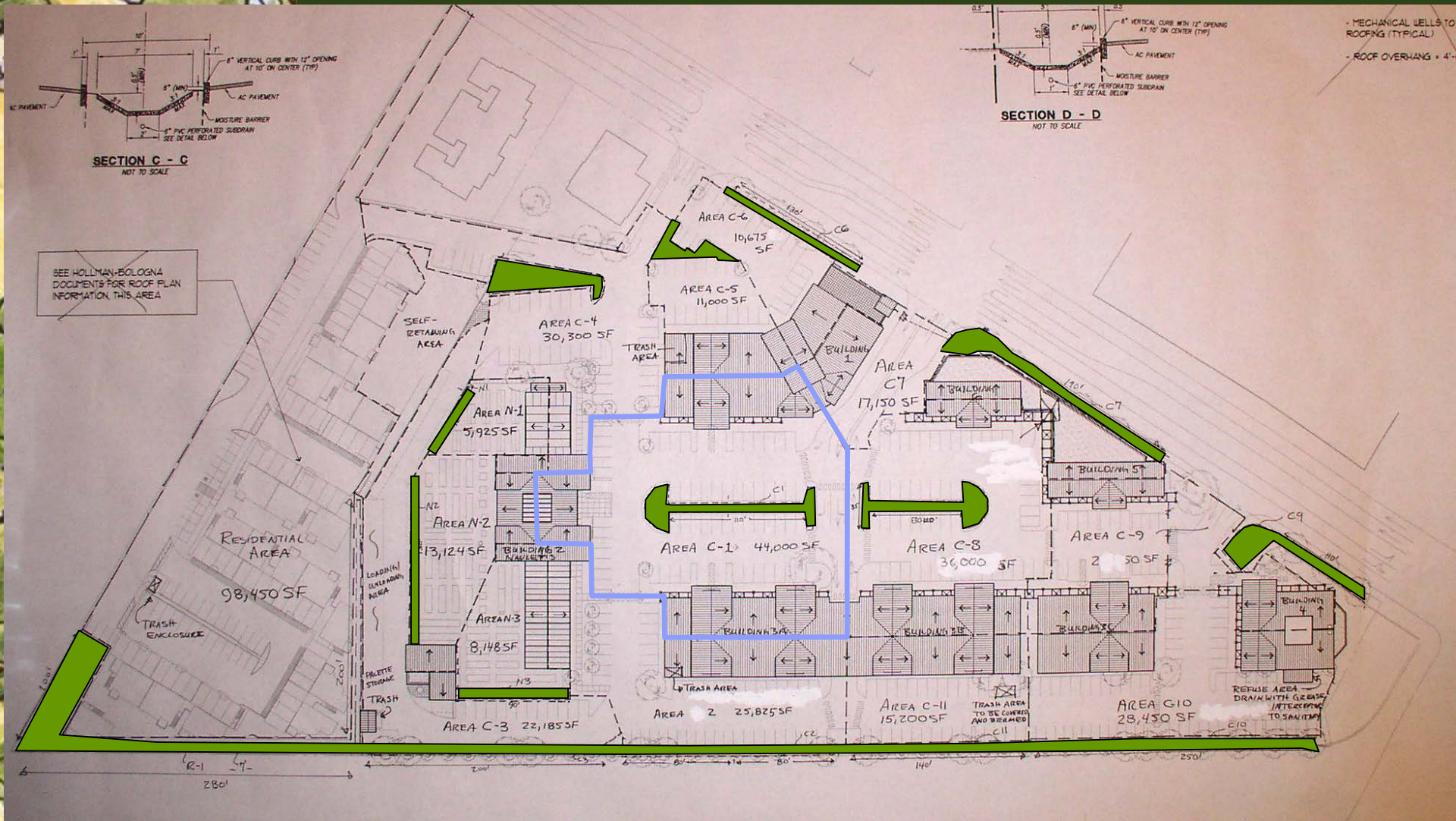


- Follow roof peaks and grade breaks
- Area size determined by site layout
- Use valley gutters instead of catch basins

25,825 x 0.04 = 1,033 square feet

1,033 ÷ 8 = 129 feet of swale

15 areas; 15 swales

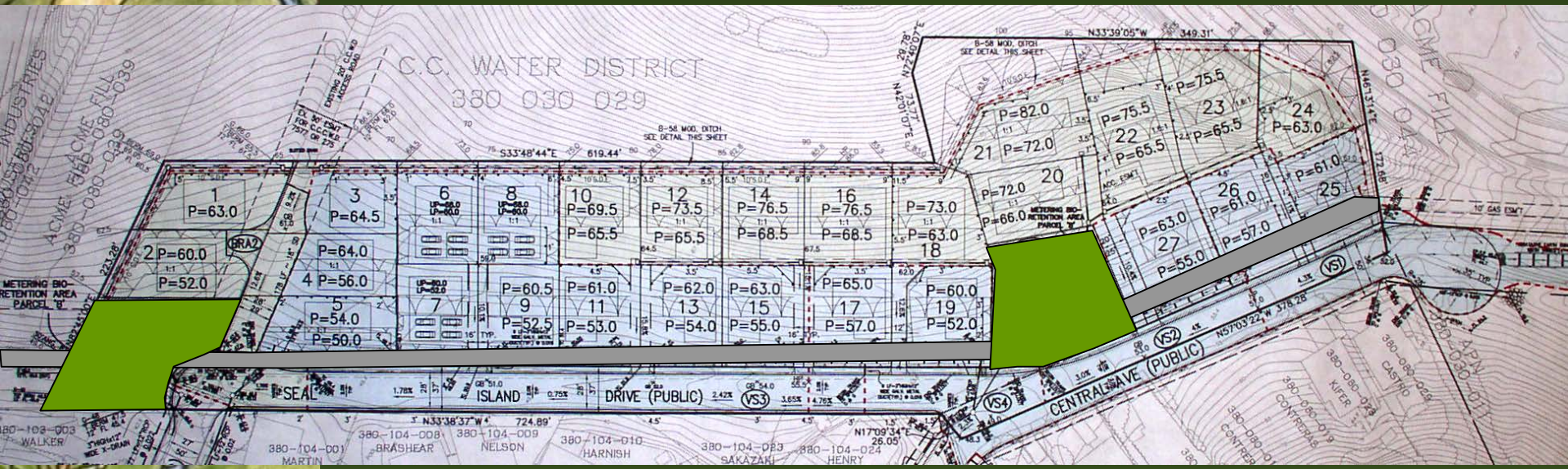


Lessons

- Possible to incorporate stormwater treatment BMPs without sacrificing usable area
- Use roof plan *and* grading plan to draw drainage areas
- Overland drainage to BMPs can be a challenging design problem on flat sites

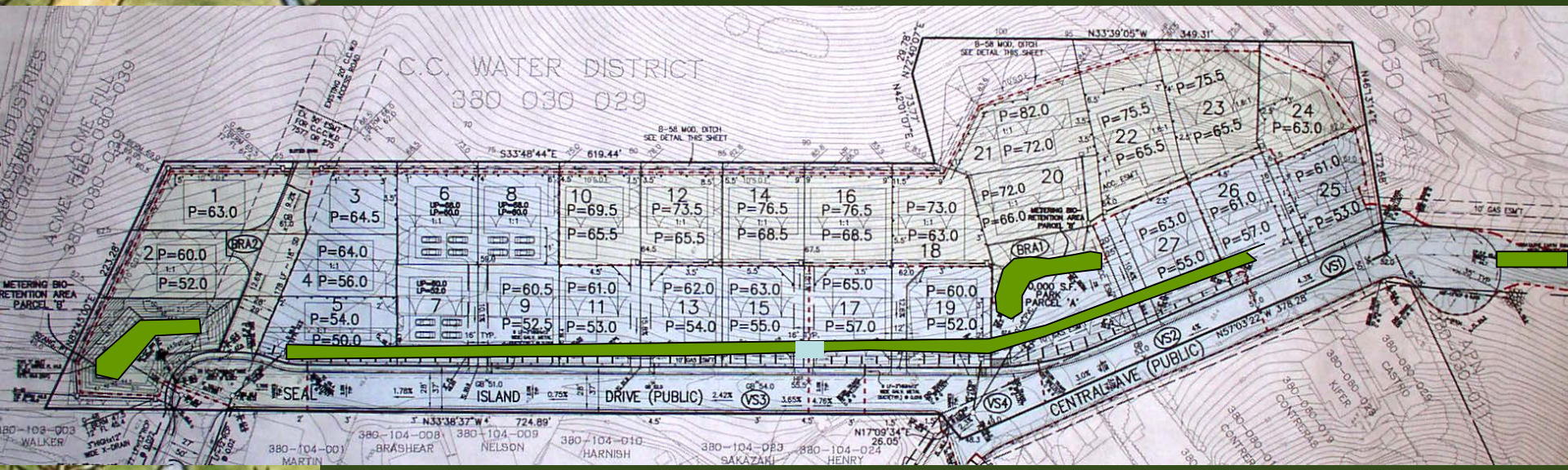
Seal Island Estates

27 lots on a hillside



- Hillside
- Clay soils
- Steep driveways
- Undulating terrain
- New streets
- Pocket parks
- Pipeline easement
- Tentative Map

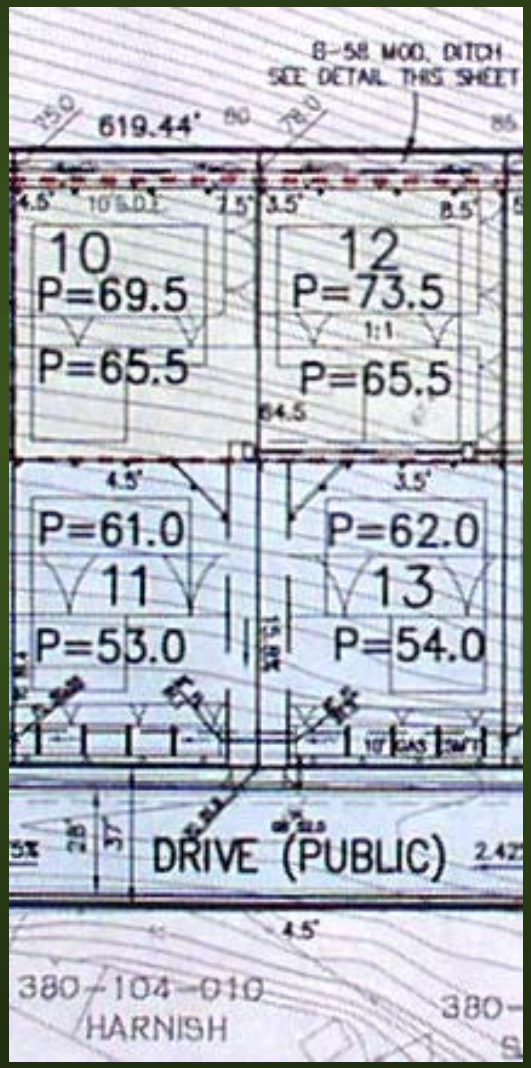
27 lots on a hillside



- Ditch upslope runoff around development
- Collect and pipe runoff from upper lots to bioretention area
- Cross-slope streets toward development
- How to provide for maintenance in perpetuity?

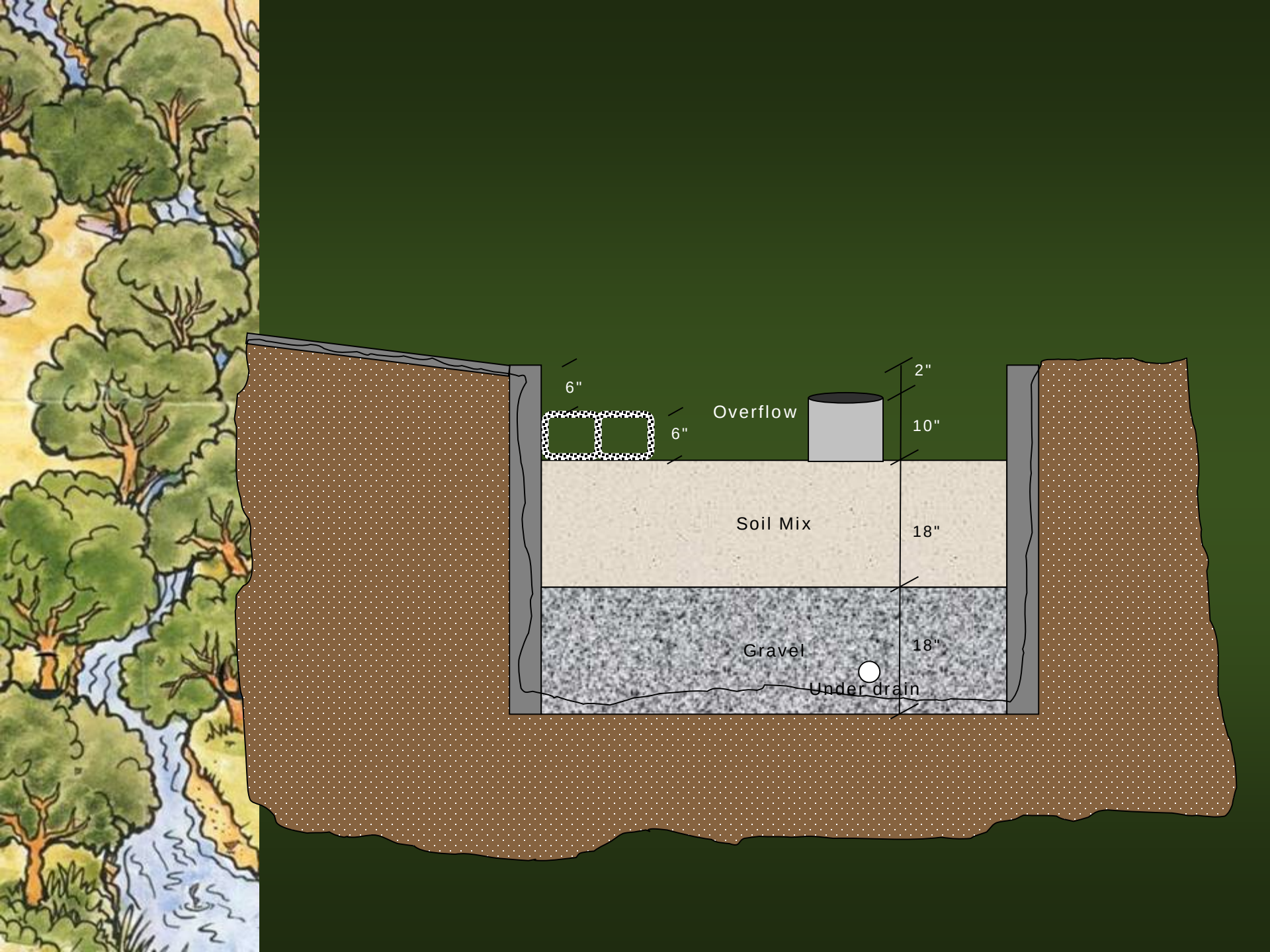
Grading and Terracing

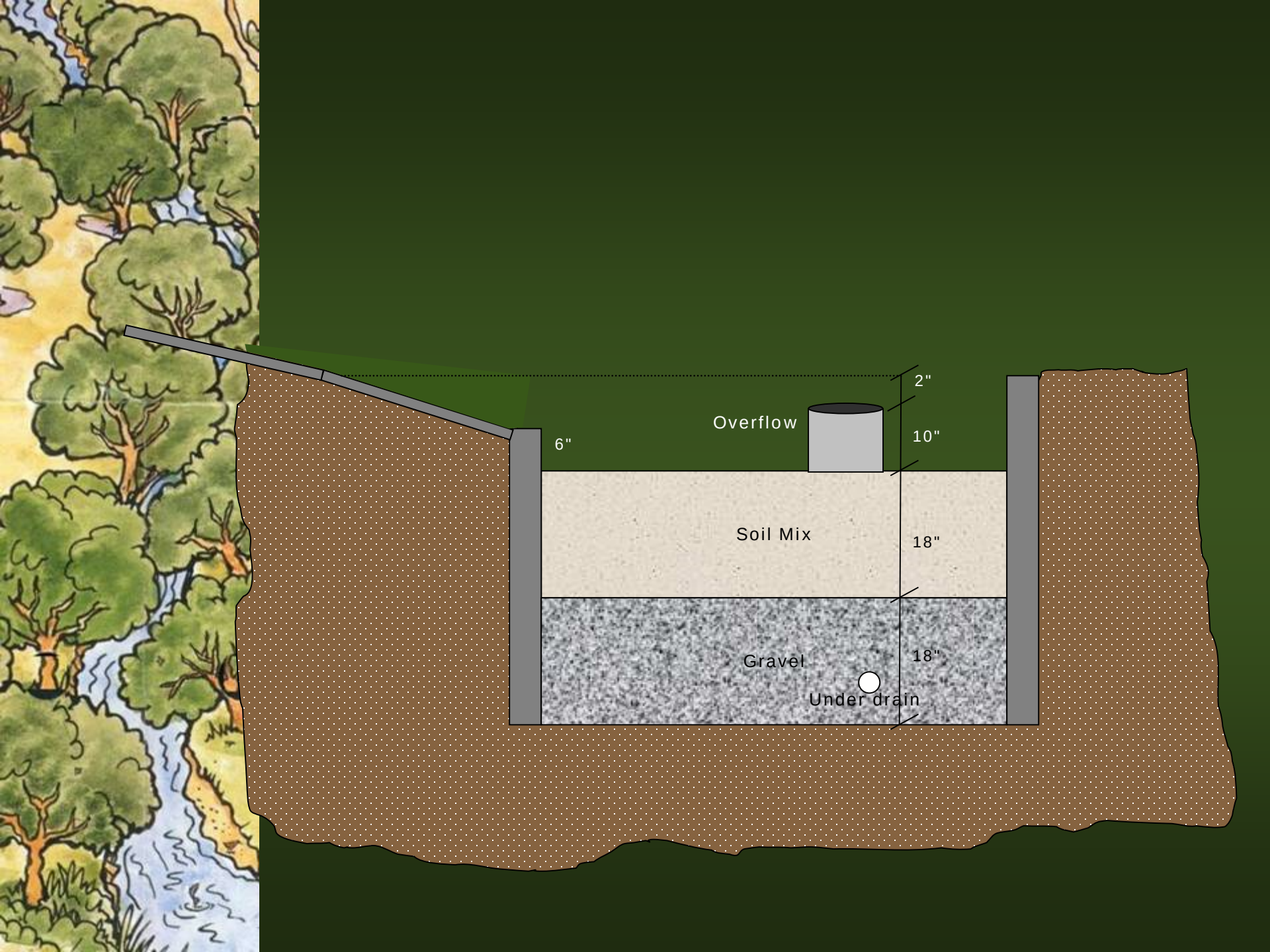
- 16% driveway slope
- Building pads separated by 1:1 or 2:1 slopes
- Can't make these pervious areas "self-retaining"
- Slopes are a potential source of sediments
- Best solution:
  Terrace slopes with low retaining walls

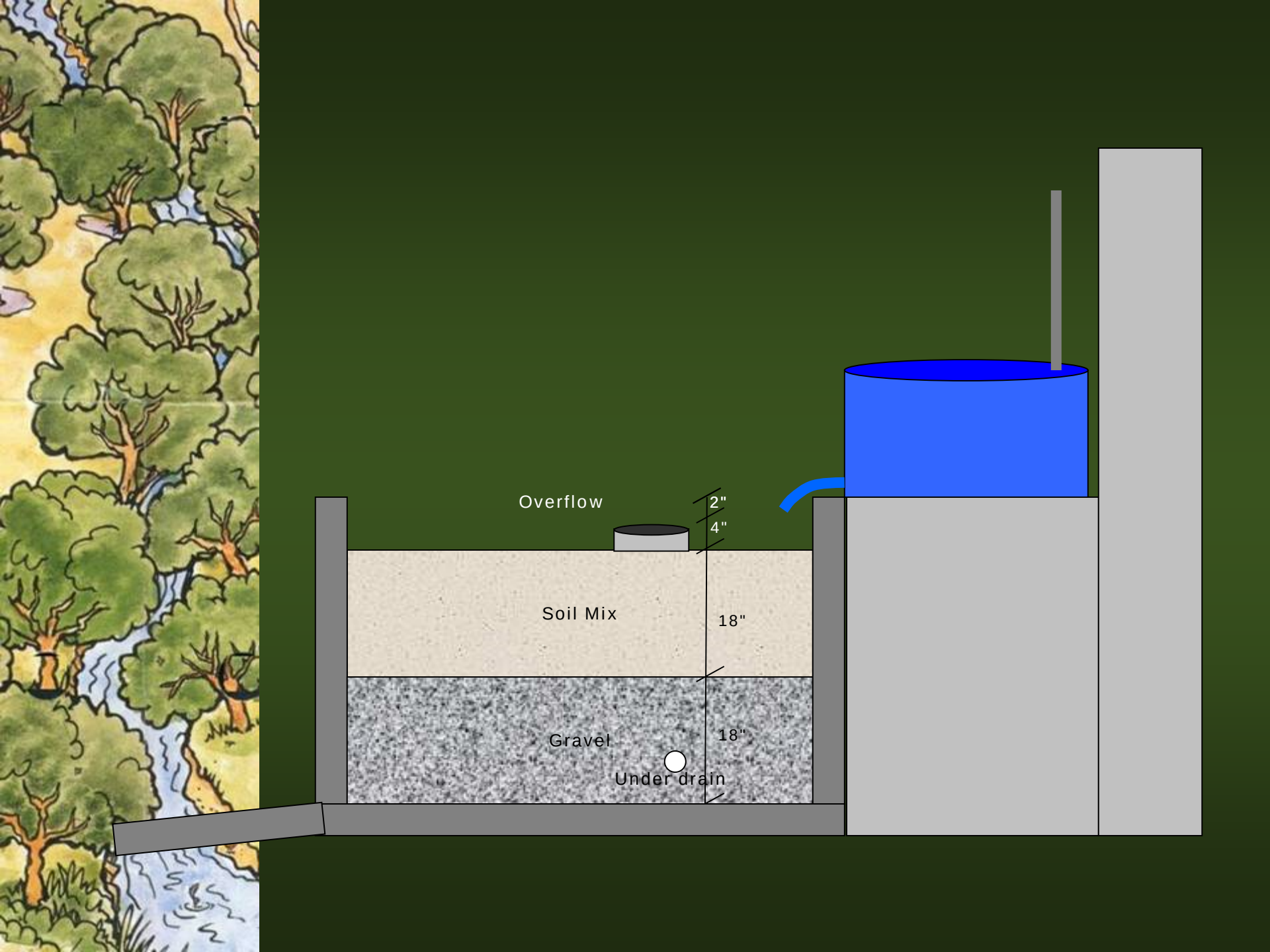


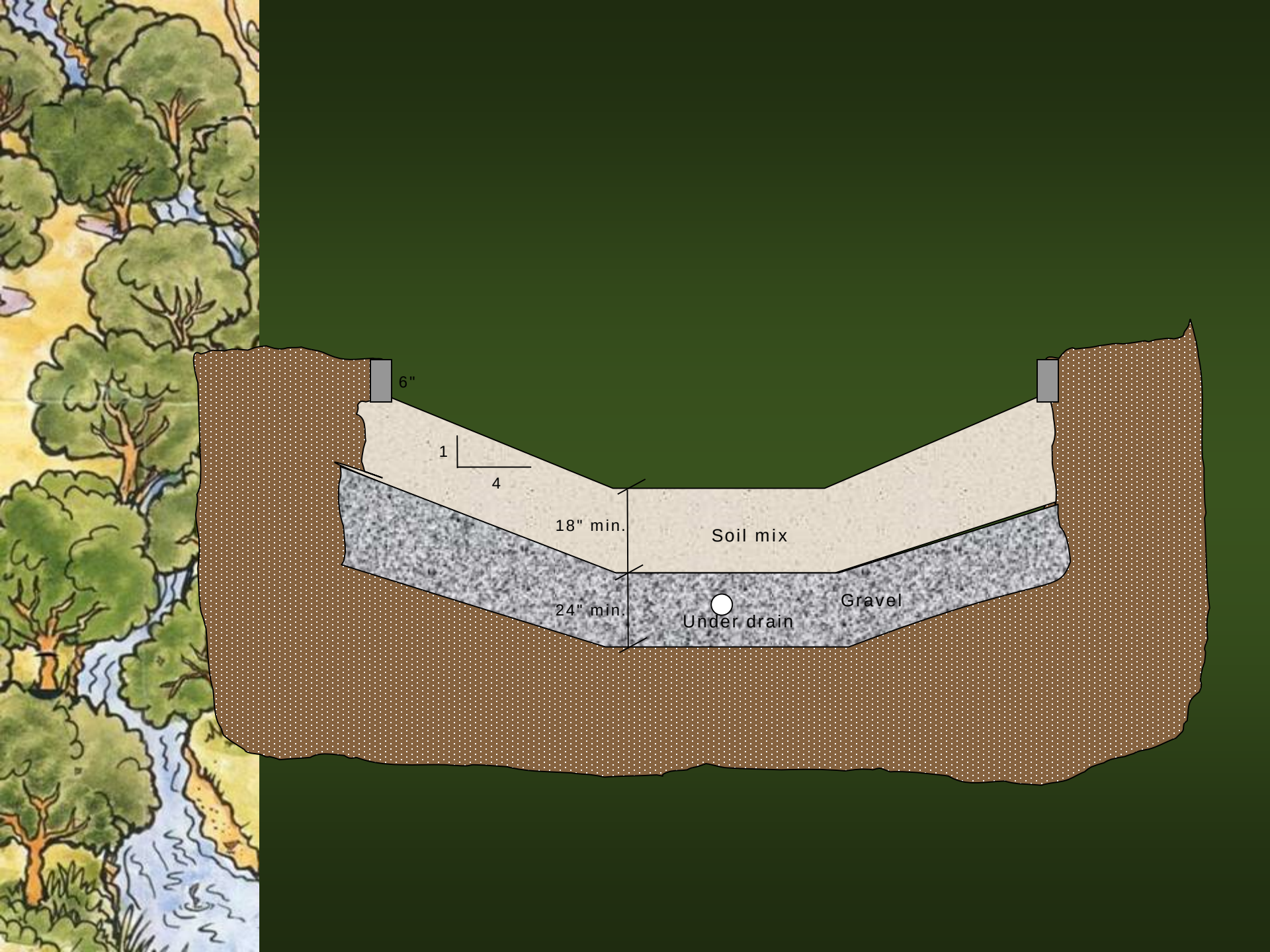
Continuous Improvement

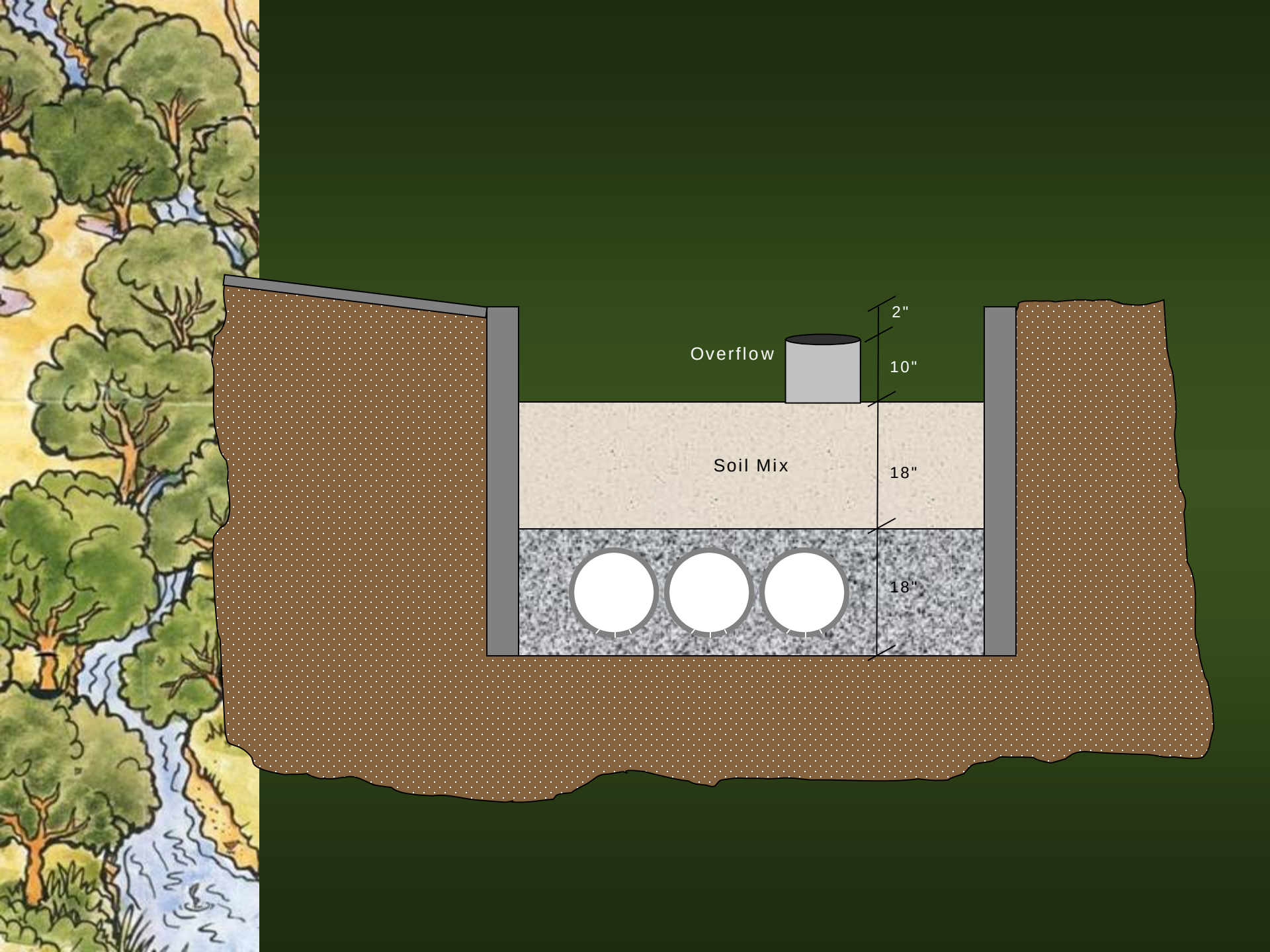
- More and better IMP designs
  - Smaller sizing factors
  - Safe and constructable
    - Fill materials and outflow details
  - Good-looking and salable
  - Engaging the development community
- Consistent application of requirements throughout Contra Costa County
- Validating modeled IMP outflows


6"
6"
Overflow
2"
10"
Soil Mix
18"
Gravel
18"
Under drain


2"
Overflow
10"
6"
Soil Mix
18"
Gravel
18"
Under drain


Overflow
2"
4"
Soil Mix
18"
Gravel
18"
Under drain


6"
1
4
18" min.
Soil mix
24" min.
Under drain
Gravel


Overflow
2"
10"
Soil Mix
18"
18"

Adapting to other regions

- Most aspects are the same:
  - Regulations are similar
  - Can use same suite of IMPs
  - Modeled stage-storage-discharge relationships are the same
  - *Stormwater C.3 Guidebook* format and "Stormwater Control Plan" submittal concept has already been reused in Sonoma and Alameda counties
- Would need to customize by:
  - Using local rainfall record to calculate regional sizing factors and adjustments