

LEVEE VEGETATION

National Policy and Regional Issues

Seattle District
US Army Corps of Engineers

Mark Ohlstrom, PE
Chief, Engineering Division

Charles Ifft, PE
Levee Subject Matter Expert

May 12, 2012



US Army Corps of Engineers
BUILDING STRONG®



Public Safety Considerations

- The US Army Corps of Engineers (USACE) considers its levee vegetation management standards critical to flood risk reduction, project performance and reliability, and most importantly, life safety.
- Levees must be properly operated and maintained to reduce flood damage risk to communities living and working behind these levees.
- Inspections are conducted to determine whether levees are being properly operated and maintained.
- USACE standards are meant to provide guidance for the best possible functioning levee.
- Levees that meet these standards are eligible for Federal assistance under PL 84-99. This program is voluntary.

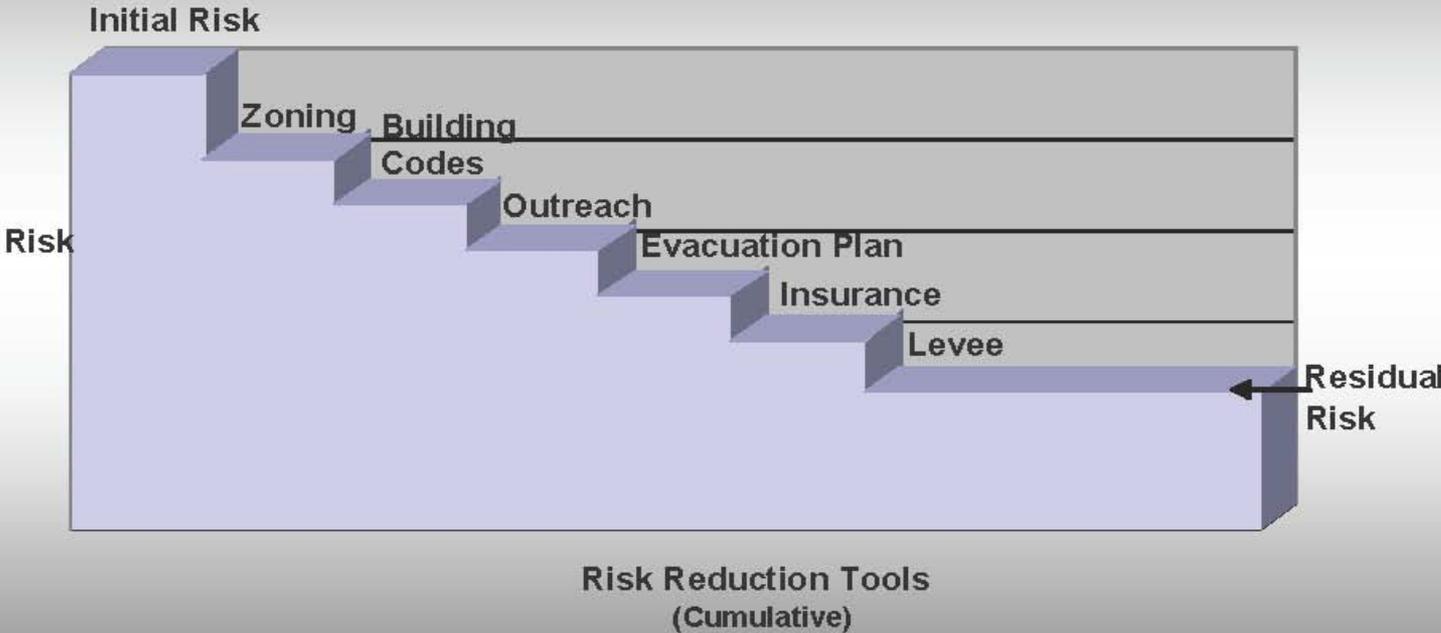


Levees and Risk



US Army Corps
of Engineers

FLOOD RISK MANAGEMENT: BUYING DOWN RISK



All stakeholders contribute to reducing risk!

One Team: Relevant, Ready, Responsive and Reliable

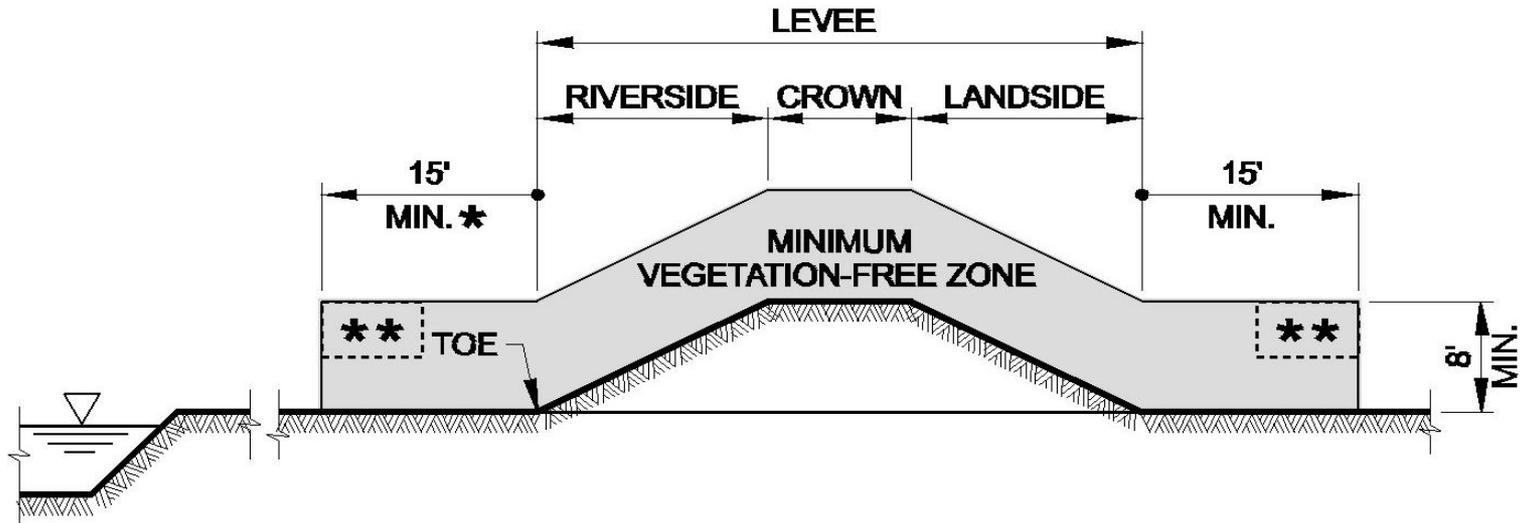


History of the USACE Standard

- **1971** – ETL 1110-2-113, requires engineering judgment, but prohibits vegetation on levee, or within 10 feet of landside toe.
- **1972** – EM 1110-2-301, adds that the structure must be vegetation-free and root-free (this would require a significant vegetation free zone (VFZ)). Dry-side planting berm allowed.
- **1993** – EM 1110-2-301, in addition to prior requirements, introduces explicit VFZ (15-foot minimum on both Land and River side).
- **1995** – Seattle District Variance Established
- **2000** – EM 1110-2-301, update, no change to VFZ
- **2009** – ETL 1110-2-571, clarification, no change to VFZ



USACE National Vegetation Standard



* 15' OR DISTANCE TO EDGE OF NORMAL WATER SURFACE, IF LESS

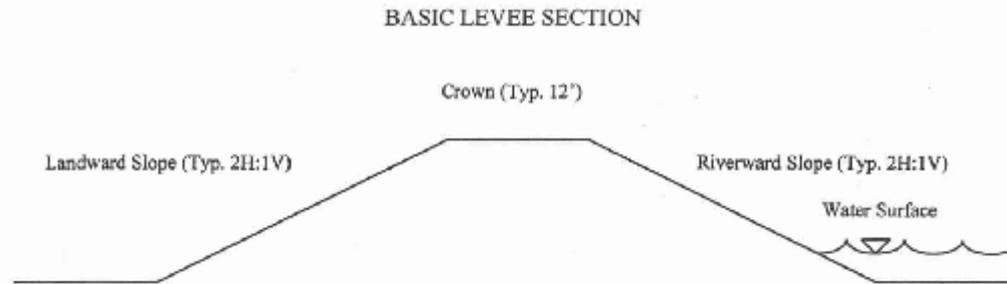
** IN THIS 4' X 7' TRANSITION ZONE, TEMPORARY OBSTRUCTION BY LIMBS AND CROWN IS ALLOWED DURING DEVELOPMENT OF NEW PLANTINGS, FOR UP TO 10 YEARS

▽ NORMAL WATER SURFACE

ETL 1110-2-571 Vegetation-free Zone for Basic Levee Section



Seattle District Variance 1995



SLOPE	VEGETATION
LANDWARD SLOPE	Occasional woody vegetation less than 4" DBH. Spacing must allow for visual inspection of levee slope. 4' Dia. clumps of brush on 30' centers.
RIVERWARD SLOPE	Occasional woody vegetation less than 4" DBH. Spacing must allow for visual inspection of levee slope. 4' Dia. clumps of brush on 30' centers.
CROWN	Grasses which must be maintained for vehicle access. No woody stemmed vegetation.

NOTES::

1. Benches on the riverside of the levee can have unlimited growth as long as the root systems do not enter the levee prism.
2. Vegetation on all revetted riverward slopes designated as critical are limited to a maximum 4" DBH.
3. All levees will be managed to encourage herbaceous vegetation, shrubs and flexible stemmed type trees. (example: Hooker Willows)



USACE Initiatives

- The USACE is in the midst of three major actions related to the issue of vegetation management on levees:
 - ▶ **The first** is ongoing research by the U.S. Army Engineer Research and Development Center (ERDC) on the effects of woody vegetation on levees.
 - ▶ **The second** is a revised system-wide improvement framework policy (SWIF). This policy provides committed levee sponsors an opportunity to implement a comprehensive interagency approach to identify solutions that optimizes resources, prioritizes improvements, and corrective actions based on risk.
 - ▶ **The third** action is the revised draft vegetation variance request policy guidance, which outlines the process by which a levee sponsor may request a variance to its current vegetation standards. The revised document was posted in the Federal Register for a 60 day public comment period in February 2012 which ended April 2012.



Ongoing Research

- ERDC conducted a two-year, \$1.34 million research (Phase 1) effort to better understand some of these complex vegetation issues. The research included a global literature review, site characterizations and assessments, field data collection (root mapping, root strength and soil properties) and numerical model development. Specifically, the research team modified a root pull-out apparatus to measure root strength and applied non-intrusive methods to map tree roots. The team also modified or developed two-dimensional and three-dimensional computer models to help quantitatively define tree root impacts on levee slope stability and seepage.
- Additional (Phase 2) research is being scoped and will continue.



SWIF Policy

- USACE is committed to reducing risk to life safety by working with sponsors and stakeholders toward long-term, sustainable solutions to complex flood risk management challenges.
- USACE supports a “fix-the-worst-first” systems approach to flood risk management infrastructure to reduce risk to life safety, the economy, Tribes and the environment.
- USACE safety programs provide the foundation to make sure flood risk management decisions and activities are applied consistently for the benefit of all.
- Reducing flood risk is a shared responsibility with multiple federal, state, and local government agencies.
- Under the Levee Safety Program, consistent implementation of standards is emphasized.





Policy Guidance Letter (PGL)

- USACE issued draft policy about how a levee sponsor may request a vegetation variance from the existing USACE vegetation standard.
- USACE posted its draft vegetation variance request policy in the Federal Register (FR) for public comment in February 2010, with the comment period ending 26 April 2010.
- Following comment review, USACE determined additional overlap with existing authorities and a need to further coordinate with resource agencies at the national level, and delayed issuing the updated policy pending further review.
- A revised draft vegetation variance request policy was posted in February 2012 in the FR for a public comments. The revision reflects review and consideration of public comments; coordination with resource agencies at the national level; and synchronization with agency-wide approaches and policies implemented since the previous



Vegetation Impacts

- **Operational** Impacts of Vegetation

- ▶ inspection
- ▶ maintenance
- ▶ safety
- ▶ flood monitoring
- ▶ flood fighting
- ▶ emergency repair

- **Functional** Impacts of Vegetation

- ▶ Tree overthrow (wind or undercutting)
- ▶ Piping/Seepage
- ▶ Scour
- ▶ Slope stability
- ▶ Soil Density (organic matter)
- ▶ Conveyance





Storm takes out Cosi dam

By Rachel Thomson - The Daily World

Thursday, November 13, 2008 10:56 AM PST

...The Department of Ecology surveyed the area and determined that root balls from the fallen trees collapsed a three-foot by six-foot section of the dam....

A series of floods hit the Harbor yesterday causing thousands of dollars in damage and road closures countywide. Officials say although this is the beginning of storm season, the punch is already being felt.

"The water has just been everywhere," said Aberdeen Deputy Police Chief Dave Timmons. "This is the worst I've seen it in a long time."

Cosmopolites are facing at least half a million dollars of damage, according to public works director Darrin Raines.

Howling winds and pummeling rains toppled trees along a bank at Mill Creek, causing a dam to break, flooding nearby residential areas. Water washed out the pedestrian foot bridge as well.

"It looks like a total loss and there's really no way to save that," Raines said.

The Department of Ecology surveyed the area this morning and determined dislodged root balls from the fallen trees collapsed a three-foot by six-foot section of the dam. No homes were evacuated and no injuries were reported, ecology officials said. However, city officials said as many as 12 residences in Cosmopolis may have sustained some flooding where water was "above the sidewalk" said Police Chief Casey Stratton.

Roglin's construction placed 22 concrete blocks at the site to control the flooding, according to Raines, but it would only be a "temporary fix" and permanent repairs to the dam wouldn't be made until sometime this summer.

Raines said to repair the structure could mean extending the remainder of the dam from the damaged point to the bank beyond where the breach occurred. He also said replacing the entire dam could be a possibility.



KATHY QUIGG | THE DAILY WORLD The Mill Creek dam burst Wednesday morning, breaking the pedestrian bridge at the north end of the Mill Creek Pond, and flooding nearby residential areas.



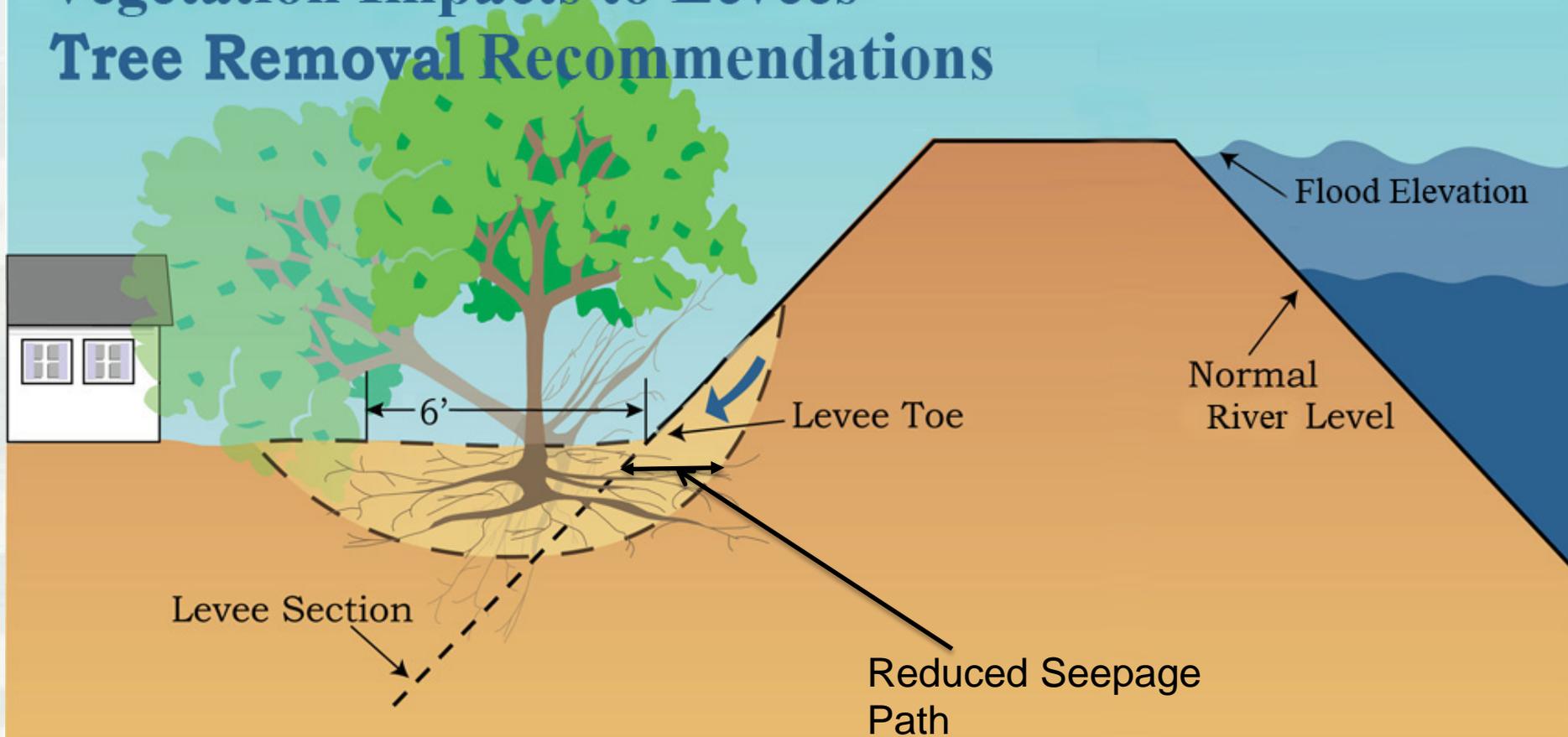
Functional Impacts

- The impacts of vegetation on the function of a levee depend on species, age, health, location, soil type, geometry and river characteristics.
- Vegetation has variable properties over time.
- Roots can lose more than 1/3 of their diameter under dry conditions as they elongate, setting up possibility of piping. *Coder, K.D. 1998. Tree Root Growth Control Series.*
- Root tip pressure varies from 130-215 psi.



Vegetation Impacts to Levees

Tree Removal Recommendations



Roots of trees beyond the levee often extend into the levee section.
Roots ripped out weaken the levee, leaving paths for water to erode.



Windthrow Pullout



Overthrow



Slope Failure caused by a Tree
Carbon River (Ski Park Levee) - August 2007



Eccentric Loading



River Undercutting



River Undercutting



Bridge to Mouth Levee
Right Bank

Tolt River



River Undercutting



Localized Scour



Green River

Tree Group induced
Scour in Levee
Embankment



Localized Scour



Seepage



Piping/Seepage



Danube Dike 1988



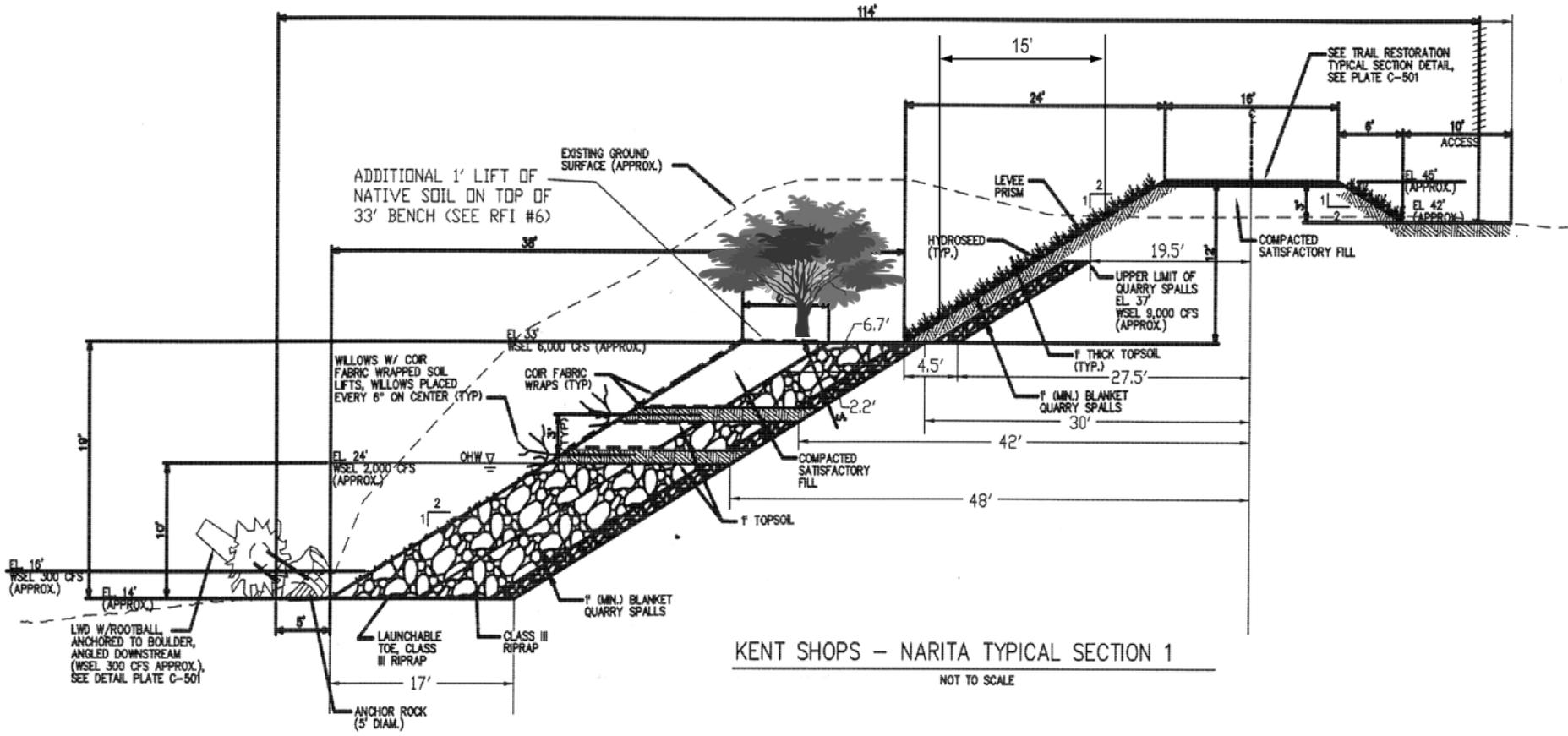
Piping



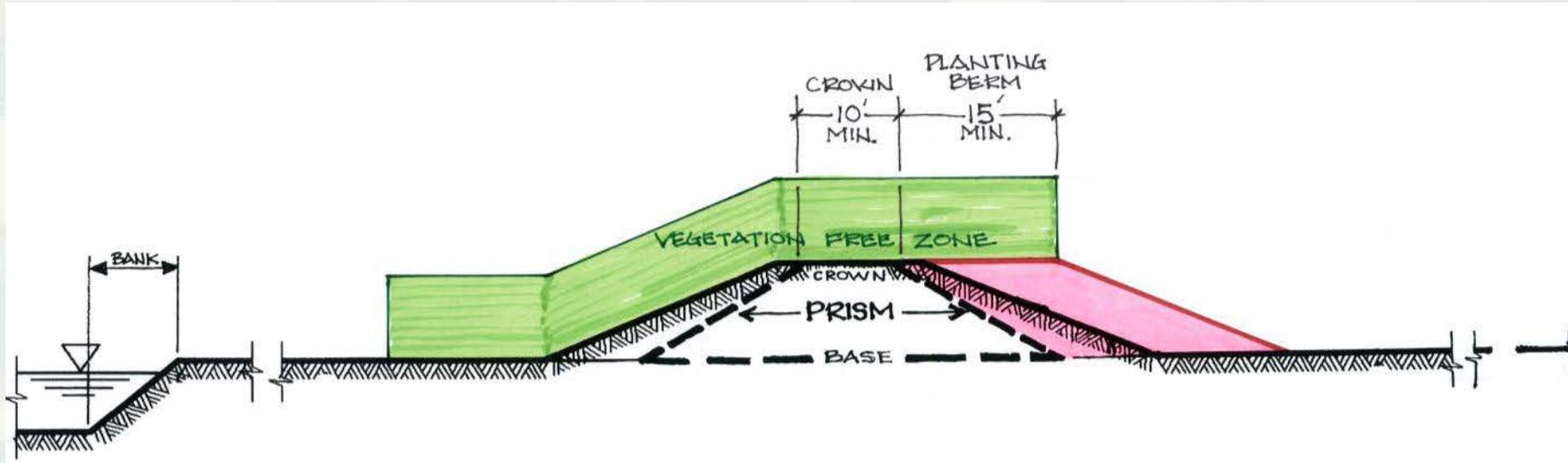
Seepage/Stability



Example Section w/ Veg



Example Section



Landside Planting Berm, shown in red, landward of the *prism*. Such a *Berm* may be approved at the discretion of the USACE district, and does not require a variance. The example shown here assumes a basic levee, with no appurtenant structures.



Questions?

