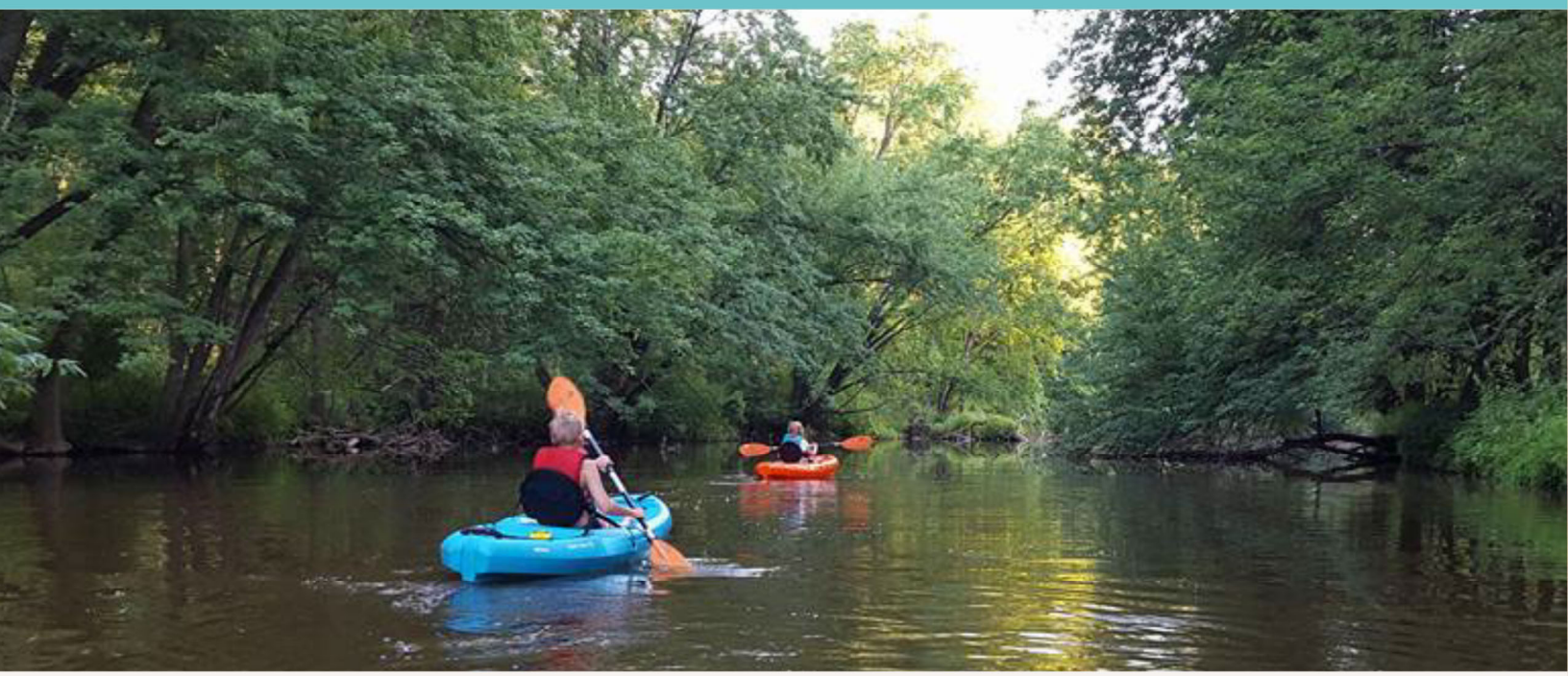
# Twin Rivers Water Trail Plan

## Manitowoc County, Wisconsin



**2018**

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# Twin Rivers
# Water Trail Plan

## A planning document for the expansion and enhancement of the Twin Rivers Water Trail

December 21, 2018


Prepared by:

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# Funding by:

**Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration, Office for Coastal Management under the Coastal Zone Management Act, Grant #NA17NOS4190035.**

WISCONSIN COASTAL MANAGEMENT PROGRAM

AND

**The Ruth St. John and John Dunham West Foundation**

**Manitowoc, WI**

**www.westfoundation.us**

AND

City of Two Rivers

www.two-rivers.org

AND

Village of Mishicot

www.mishicot.org

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## WHAT IS A WATER TRAIL?

A water trail, or blueway is a waterway route (a stretch of river, lake, or ocean shoreline) that has been mapped out, with access points identified, with the intent to create an experience for recreational paddlers. Water trails provide users with location information on legal access points to lakes, rivers, and oceans. Water trails are primarily oriented around non-motorized boating, but also serve other public recreational uses that require access to water (such as fishing, swimming, and sightseeing).

In addition to waterway access, a water trail often provides amenities for paddlers like parking, potable water (i.e. drinking water), power, restrooms, wayfinding signs, and camping. A complete water trail allows a boater to navigate a waterway with regular access to restrooms, parking, and easy on/off water access.

The delineation of water trails has become increasingly valuable in regions where public access to waterways is being compromised by the pressures of private development. Volunteers and public officials throughout Wisconsin have developed several water trails, including the Lake Michigan State Water Trail, the Lake Superior State Water Trail, the Fox-Wisconsin Heritage Parkway, the Milwaukee Urban Water Trail, the Menominee River Trail, Capital Water Trails, the Rhinelander Whitewater Trail, the Yahara Waterways Trail, the Lower Wisconsin State Riverway, the St. Croix National Scenic Riverway, and others.

## WHERE IS THE TWIN RIVERS WATER TRAIL?

The Twin Rivers Water Trail is comprised of the lower stretches of the West Twin River and the East Twin River in Manitowoc County in northeast Wisconsin. There may be opportunities in the future to extend the water trail to cover more of the length of both rivers, but for the scope of this plan, the focus is on the West Twin River from Lake Michigan in the City of Two Rivers upstream to the Shoto Dam in the Town of Two Rivers, and the East Twin River from Lake Michigan in the City of Two Rivers upstream to the Village of Mishicot (See map, Figure 1).

## INTRODUCTION

The Twin Rivers Water Trail Master Plan is not only an inventory and assessment of all access sites to the West Twin River and the East Twin River, but it is also a plan for the future of the water trail including the identification of opportunities for enhancement, expansion, and promotion of the trail.

The Bay-Lake Regional Planning Commission worked with the Twin Rivers Water Trail Steering Committee, a local stakeholder group, to establish the water trail on the East and West Twin Rivers (Table 1). The Twin Rivers Water Trail was developed with the goal of increasing and improving access to the lower stretches of the West and East Twin rivers for nonmotorized boaters such as canoeing and kayaking in Manitowoc County, Wisconsin. Using a collaborative process, over 34 public access sites were inventoried and surveyed along the West Twin River (from the Shoto Dam in the Town of Two Rivers

south to Lake Michigan in the City of Two Rivers), and the East Twin River (from the VFW Veterans Park in the Village of Mishicot south to Lake Michigan) (See map, Figure 1).

During the planning process, stakeholder and public meetings were held to review the sites. Both amenity and distance criteria were used to identify recommendations for improved access. From the analysis, 14 water trail access sites were identified as water trail access sites with either a launch or ramp available (seven sites) or carry-in access available (seven sites). An additional 20 sites were identified as potential sites that could be improved or modified to support safe public access (see map, Figure 2).

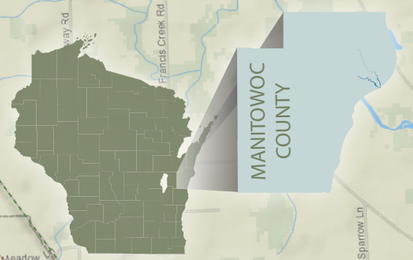
Due to various restrictions or limitations, such as limited parking opportunities or potential infringements on private property, 15 of the 20 potential sites were classified as "*Low Priority Undeveloped Public Access*" sites that are unlikely to receive improvements or modifications in the near future. However, the remaining five potential access sites present opportunities to improve access to the Twin Rivers Water Trail in the future.

***Table 1. Twin Rivers Water Trail Steering Committee***

| Name | Affiliation |
|---|---|
| Angela Kowalzek-Adrians | Bay-Lake Regional Planning Commission |
| Bonnie Timm | Roger Street Fishing Village Board |
| Don DeBruyn | Friends of the Twin Rivers |
| George Krause | Mishicot Village Board Chair and MAGIC (Mishicot Area Growth & Improvement Committee) |
| Greg Buckley | City of Two Rivers Manager |
| Janice VanDrisse | Roger Street Fishing Village Board |
| Jason Ring | Manitowoc Area Visitor & Convention Bureau |
| Jeff Dawson | Lester Public Library |
| Jim Knickelbine | Woodland Dunes Nature Center |
| Judy Goodchild | Two Rivers Parks & Recreation (retired) |
| Margaret Lutze | Interested Citizen |
| Mark Bittner | Two Rivers City Councilmember/Interested Citizen |
| Michael Ditmer | The Schwartz House |
| Pete Tarnowski | Manitowoc County |
| Stanley Palmer | Interested Citizen |
| Titus Seilheimer | UW Sea Grant |

# Figure 1

## Twin Rivers Water Trail
### Manitowoc County, WI




1. Village of Mishicot
Mishicot
Mishicot Dam
13. West Twin River County Park
Shoto Dam
14. Shoto Conservation Club
12. Woodland Dunes - Willow Trail
11. Scenic RiverStop-N-Dock
10. Woodland Dunes
9. Veterans Park
8. Riverside Park
6. Seagull Marina
5. Two Rivers Harbor
4. Harbor Park
3. Rogers Street Fishing Village
2. Paddlers Park
7. Lighthouse Inn
Point Beach State Forest
Francis Creek
East Twin River
West Twin River
Devil's River State Trail
Rawley Point Recreation Trail
Ice Age Trail
Bay Shore Manners Trail
LAKE MICHIGAN
Two Rivers
Neshotah Park
Woodland Dr.
Thiede Rd.
Davis St.
Parkway Blvd.

| River Distance (miles) | 1. Village of Mishicot | 2. Paddlers Park | 3. Rogers Street Fishing Village | 4. Harbor Park | 5. Two Rivers Harbor | 6. Seagull Marina | 7. Lighthouse Inn | 8. Riverside Park | 9. Veterans Park | 10. Woodland Dunes | 11. Scenic River Stop-N-Dock | 12. Woodland Dunes - Willow Trail | 13. Twin River County Park | 14. Shoto Conservation Club |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Village of Mishicot | | 9.2 | 9.7 | 10.0 | 10.3 | 10.1 | 11.0 | 10.7 | 10.8 | 11.5 | 11.5 | 12.7 | 15.1 | 15.3 |
| 2. Paddlers Park | 9.2 | | 0.4 | 0.8 | 1.1 | 0.9 | 1.8 | 1.5 | 1.6 | 2.3 | 2.3 | 3.5 | 6.0 | 6.2 |
| 3. Rogers Street Fishing Village | 9.7 | 0.4 | | 0.5 | 0.8 | 0.6 | 1.4 | 1.1 | 1.3 | 2.0 | 1.9 | 3.1 | 5.7 | 5.9 |
| 4. Harbor Park | 10.0 | 0.8 | 0.5 | | 0.3 | 0.1 | 1.0 | 0.7 | 0.8 | 1.5 | 1.5 | 2.7 | 5.1 | 5.3 |
| 5. Two Rivers Harbor | 10.3 | 1.1 | 0.8 | 0.3 | | 0.3 | 0.9 | 0.9 | 1.0 | 1.7 | 1.7 | 2.9 | 5.3 | 5.5 |
| 6. Seagull Marina | 10.1 | 0.9 | 0.6 | 0.1 | 0.3 | | 1.0 | 0.6 | 0.7 | 1.4 | 1.4 | 2.6 | 5.0 | 5.2 |
| 7. Lighthouse Inn | 11.0 | 1.8 | 1.4 | 1.0 | 0.9 | 1.0 | | 1.5 | 1.7 | 2.4 | 2.3 | 3.5 | 5.9 | 6.1 |
| 8. Riverside Park | 10.7 | 1.5 | 1.1 | 0.7 | 0.9 | 0.6 | 1.5 | | 0.2 | 0.9 | 4.6 | 2.0 | 4.4 | 4.6 |
| 9. Veterans Park | 10.8 | 1.6 | 1.3 | 0.8 | 1.0 | 0.7 | 1.7 | 0.2 | | 0.8 | 0.7 | 1.9 | 4.3 | 4.5 |
| 10. Woodland Dunes | 11.5 | 2.3 | 2.0 | 1.5 | 1.7 | 1.4 | 2.4 | 0.9 | 0.8 | | 0.7 | 1.9 | 4.3 | 4.5 |
| 11. Scenic River Stop-N-Dock | 11.5 | 2.3 | 1.9 | 1.5 | 1.7 | 1.4 | 2.3 | 0.8 | 0.7 | 0.7 | | 1.4 | 3.9 | 4.1 |
| 12. Woodland Dunes - Willow Trail | 12.7 | 3.5 | 3.1 | 2.7 | 2.9 | 2.6 | 3.5 | 2.0 | 1.9 | 1.9 | 1.4 | | 2.5 | 2.7 |
| 13. West Twin River County Park | 15.1 | 6.0 | 5.7 | 5.1 | 5.3 | 5.0 | 5.9 | 4.4 | 4.3 | 4.3 | 3.9 | 2.5 | | 0.2 |
| 14. Shoto Conservation Club | 15.3 | 6.0 | 5.7 | 5.3 | 5.4 | 5.2 | 6.1 | 4.6 | 4.5 | 4.5 | 4.0 | 2.6 | 0.2 | |

### ACCESS POINTS

- Carry In Site
- Dock and/or Ramp Site
- Lake Michigan Water Trail Access Point
- Trail

0.0 0.25 0.5 0.75 1.0
Miles

Wisconsin Coastal Management Program
BAY LAKE Regional Planning Commission | Since 1972
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December 2018 \\ Sources: WDNR, 2009; Manitowoc County, 2018; Bay-Lake RPC, 2018.

# Figure 2

## Twin Rivers Water Trail
"Potential Access Points"

TWIN RIVERS WATER TRAIL

MANITOWOC COUNTY

VFW Veterans Park
1. Village of Mishicot
Mishicot
Mishicot Dam
Sturm Road
Hillcrest Road
Maplewood Road/Eastwin Valley Golf Course
East Twin River
13. West Twin River County Park
Shoto Dam
14. Shoto Conservation Club
Manitowoc Co. Fish & Game Protective Association
West Twin River
CTH VV
Parkway Blvd Road End
SEE INSET
12. Woodland Dunes - Willow Trail
11. Scenic RiverStop-N-Dock
10. Woodland Dunes
9. Veterans Park
8. Riverside Park
2. Paddlers Park
3. Rogers Street Fishing Village
4. Harbor Park
5. Two Rivers Harbor
6. Seagull Marina
7. Lighthouse Inn
Point Beach State Forest
Neshotah Park
Two Rivers
LAKE MICHIGAN
Woodland Dr.
Davis St.
Parkway Blvd.
Thiede Rd.

### Inset

29th Street Road End
Washington Park
28th Street Road End
2. Paddlers Park
Chatterbox
26th Street Road End
25th Street Road End
23rd E Street Road End
23rd W Street Road End
3. Rogers Street Fishing Village
21st Street Road End
20th Street Road End
Hamilton Site
4. Harbor Park
East Street Viewing Platform
6. Seagull Marina
5. Two Rivers Harbor
Two Rivers Pier
7. Lighthouse Inn
0 500 1,000 Feet

### ACCESS POINTS

- Carry In Site
- Trail
- Dock and/or Ramp Site
- Lake Michigan Water Trail Access Point
- Potential Access
- Low Priority Potential Access

0.0 0.25 0.5 0.75 1.0 Miles

WISCONSIN COASTAL MANAGEMENT PROGRAM
BAY LAKE Regional Planning Commission Since 1970
Rotary Club of Two Rivers, WI

December 2018 \\ Sources: WDNR, 2009; Manitowoc County, 2018; Bay-Lake RPC, 2018.

## SITE ANALYSIS AND INVENTORY

Establishing the water trail started with an inventory of existing public access sites along the identified waterways. The inventory involved a search of the property listing and parcel records to identify roads and other access sites to the East and West Twin Rivers to determine the current ownership status of all potential access points. A field inventory and photographic survey were conducted to assess the physical characteristics of each site. GPS coordinates and geotagged photos were acquired for each site in order to develop a GIS and online database, as well as an ArcGIS Online Story Map detailing the amenities and appearance of each site.

The current conditions of each potential access site were assessed by gathering a site location inventory in GIS using the ESRI ArcGIS Collector app (Figure 3). Attribute data and a photo was collected for each access site. Collected attribute data included property ownership (i.e. public or private), parking, signage, launch fees, hours, site maintenance, camping, power, potable water, shelter, lighting, and potential user conflicts (e.g. conflicts that may arise when public access is very near adjacent private property).

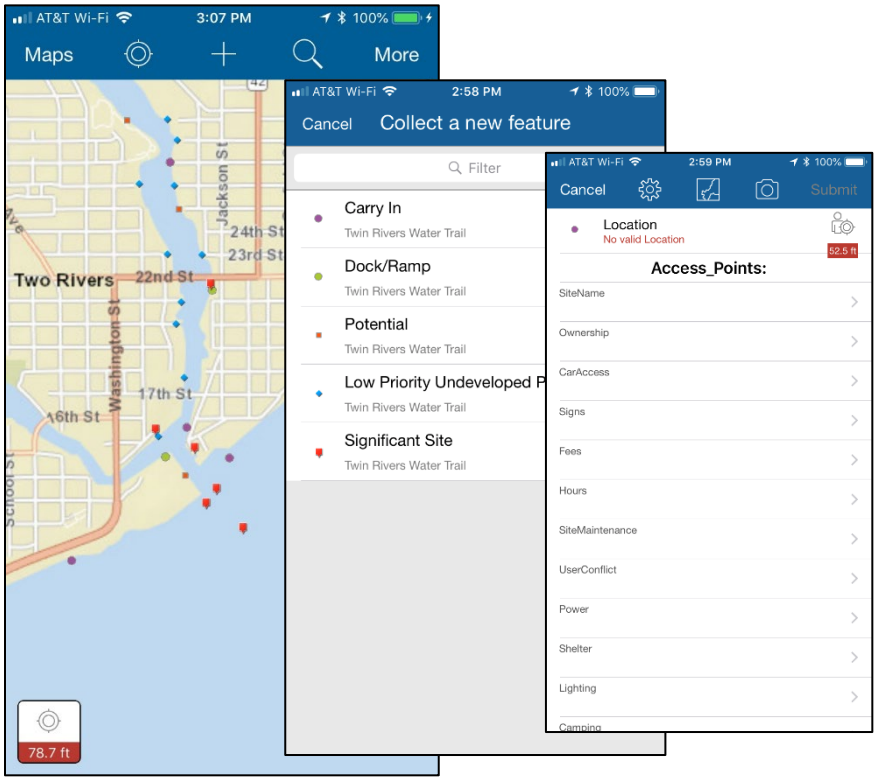



***Figure 3. ESRI ArcGIS Collector (mobile app) Screenshots***

## ACCESS CLASSIFICATION

Each access site was categorized based on the type of access. Access classification categories included ***Dock and/or Ramp*** and ***Carry In***. A Dock/Ramp site offers a public boat ramp or dock to aid the user in getting their craft into the water. A Carry In site offers a beach or seawall without a dock or ramp that would require the user to carry or lower their craft into the water.

In addition to the *Dock/Ramp* and *Carry In* sites, ***Potential Access*** sites were identified where there is access to the water, but the site does not provide safe access or the access is not clearly defined at the water's edge. These sites are considered potential sites as they could be improved or enhanced to offer additional access along the water trail.

***Low Priority Potential Access*** sites are access sites that are publicly owned and have potential to be improved; however, due to various restrictions or limitations, such as limited parking opportunities or potential infringements on private property, these sites would be much more difficult to improve and are unlikely to receive improvements or modifications in the future.

## ACCESS SITES – EAST TWIN RIVER

The following seven access sites are located on the West Twin River between the Village of Mishicot and Lake Michigan in the City of Two Rivers.

### *Village of Mishicot Access Site #1*

A public **Dock and/or Ramp** access site located in the Village of Mishicot. Amenities at this site include a dock, parking, and potable water. This access site is the northern most launch location on the East Twin River of the Twin Rivers Water Trail. From this site, there is a long river stretch of nine miles downstream to the next access site at Paddlers Park in the City of Two Rivers.

*Village of Mishicot Access Site #1*

***Paddlers Park Access Site #2***

A public ***Dock and/or Ramp*** access site located in the City of Two Rivers. There are no launch fees, but the park is closed from 11 PM to 3 AM. Amenities at this site include a dock with an attached kayak launch, parking, lighting, temporary restrooms, and a pavilion. From this site, there is a long stretch of nine miles upstream to the Village of Mishicot Access Site #1, and less than ½-mile downstream to Rogers Street Fishing Village Access Site #3.

*Paddlers Park Access Site #2*

***Rogers Street Fishing Village Access Site #3***

A public ***Dock and/or Ramp*** access site located in the City of Two Rivers. There are no launch fees. Amenities at this site include a dock with an attached kayak launch, parking, lighting, shelter, and restrooms. From this site, it is less than ½ mile upstream to Paddlers Park Access Site #2, and ½ mile downstream to Harbor Park Access Site #4.

*Rogers Street Fishing Village Access Site #3*

***Harbor Park Access Site #4***

A public ***Carry In*** access site located in the City of Two Rivers. There are no launch fees. Boaters must launch from the seawall. Amenities at this site include lighting, restrooms, showers, and a covered picnic area. From this site, it is less than ½ mile upstream to Rogers Street Fishing Village Site #3, 1,700 feet downstream to Two Rivers Harbor Access Site #5, and 680 feet downstream to Seagull Marina Access Site #6.

*Harbor Park Access Site #4*

***Two Rivers Harbor Access Site #5***

A public ***Carry In*** access site located on Lake Michigan in the City of Two Rivers. There are no launch fees. Amenities at this site include parking and temporary restrooms. From this site, it is 1,700 feet upstream to Harbor Park Access Site #4, and 1,650 feet upstream to Seagull Marina Access Site #6.

*Two Rivers Harbor Access Site #5*

***Seagull Marina Access Site #6***

A private ***Dock and/or Ramp*** access site located in the City of Two Rivers. There is a $5 launch fee, and access is limited to the hours of 7 a.m. to 6 p.m. Amenities at this site include a boat launch, parking, lighting, power, camping, showers, and restrooms. From this site, it is 680 feet upstream to Harbor Park Access Site #4, 1,650 feet downstream to Two Rivers Harbor Access Site #5, and just over ½ mile upstream to Riverside Park Access Site #8.

*Seagull Marina Access Site #6*

***Lighthouse Inn Access Site #7***

A private ***Carry In*** access site located on Lake Michigan in the City of Two Rivers. There are no launch fees. Amenities at this site include parking, lighting, shelter, potable water, restrooms, and kayak storage. From this site, it is approximately one mile to Two Rivers Harbor Access Site #5, and one mile upstream to Seagull Marina Access Site #6.

*Lighthouse Inn Access Site #7*

## ACCESS SITES – WEST TWIN RIVER

The following seven access sites are located on the West Twin River between Lake Michigan in the City of Two Rivers and the Shoto Dam.

### *Riverside Park Access Site #8*

A public ***Carry In*** access site located in the City of Two Rivers. There are no launch fees. Amenities at this site include parking, potable water, and restrooms. From this site, it is approximately one mile downstream to Seagull Marina Access Site #6, and 830 feet upstream and across the river to Veterans Park Access Site #9.

*Riverside Park Access Site #8*

### *Veterans Park Access Site #9*

A public ***Dock and/or Ramp*** access site located in the City of Two Rivers. There is a $5 launch fee. Amenities at this site include a dock, parking, lighting, restrooms, and shelter. From this site, it is 830 feet downstream to Riverside Park Access Site #8, less than one mile upstream on the opposite side of the river to Woodland Dunes Access Site #10, and less than one mile upstream to Scenic River Stop-N-Dock Access Site #11.

*Veterans Park Access Site #9*

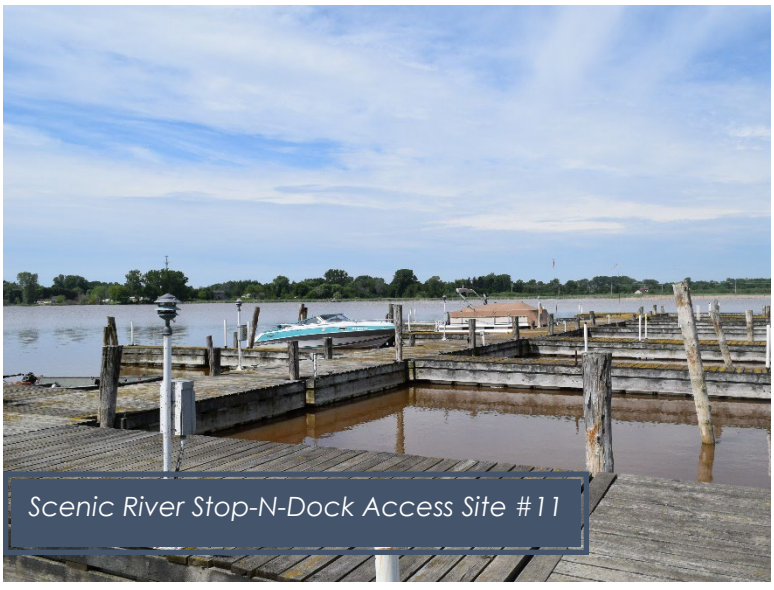
***Woodland Dunes Access Site #10***

A public ***Dock and/or Ramp*** access site located in the Town of Two Rivers. There are no launch fees. Amenities at this site include a dock with an attached kayak launch, parking, shelter, and restrooms. There is a short boardwalk hike from the parking area to the launch location. From this site, it is less than a mile upstream to Veterans Park Access Site #9, and less than a mile upstream and across the river to Scenic River Stop-N-Dock Access Site #11.

*Woodland Dunes Access Site #10*

***Scenic River Stop-N-Dock Access Site #11***

A private ***Dock and/or Ramp*** access site located in the City of Two Rivers. There are no launch fees. Amenities at this site include a dock, parking, lighting, power, shelter, potable water, kayak storage, and restrooms. From this site, it is less than one mile downstream to Woodland Dunes Access Site #10, less than one mile downstream to Veterans Park, and nearly 1.5 miles upstream to Woodland Dunes - Willow Trail Access Site #12.



*Scenic River Stop-N-Dock Access Site #11*

***Woodland Dunes - Willow Trail Access Site #12***

A public ***Carry In*** access site located in the Town of Two Rivers. There are no launch fees and no amenities at this site. This site is only a rest stop along the water trail, with no intentions to add any amenities. The launch location is at the end of Willow Trail in Woodland Dunes. From this site, it is nearly 1.5 miles downstream to Scenic River Stop-N-Dock Access Site #11, and 2.5 miles upstream to West Twin River County Park Access Site #13.

*Woodland Dunes – Willow Trail Access Site #12*

***West Twin River County Park Access Site #13***

A public ***Dock and/or Ramp*** access site located in the Town of Two Rivers. There is a $5 launch fee. Amenities at this site include a dock, parking, and temporary restrooms. From this site, it is 2.5 miles downstream to Woodland Dunes - Willow Trail Access Site #12, and 1,100 feet upstream to Shoto Conservation Club Access Site #14.

*West Twin River County Park Access Site #13*

***Shoto Conservation Club Access Site #14***

A private ***Carry In*** access site located in the Town of Two Rivers. There are no launch fees. Access and restrooms are limited to the hours of 5 a.m. to 11 p.m. Amenities at this site include parking and restrooms. From this site, it is 1,100 feet downstream to West Twin River County Park Access Site #13.

*Shoto Conservation Club Access Site #14*

## INTEGRATION WITH OTHER TRAILS

The Twin River Water Trail's connection to Lake Michigan presents a great opportunity for experienced paddlers to transition from the river to the Lake Michigan State Water Trail. Additionally, there are a number of nearby land-based trails that provide an opportunity to integrate paddling with hiking and biking.

The maps in Figures 1 and 2 show the land-based trails in green and the Lake Michigan State Water Trail denoted with red markers.

***Lake Michigan State Water Trail***

The Lake Michigan State Water Trail is Wisconsin's 523-mile segment of the Lake Michigan Water Trail, a continuous water route paralleling the shores of the four states around Lake Michigan (Wisconsin, Illinois, Indiana, and Michigan). The Wisconsin Department of Natural Resources provides an online mapping application that allows paddlers to locate and obtain information for access to Lake Michigan (https://dnrmaps.wi.gov/H5/?viewer=water_trail).

The Twin Rivers Water Trail can connect to the Lake Michigan State Water Trail along the Lake Michigan shore to the north and south of Two Rivers.

Just north along the Lake Michigan coast, the Twin Rivers Water Trail can connect to the Lake Michigan State Water Trail at the Neshotah Park access site, and further north to the Point Beach State Park access site.

A number of access sites south of Two Rivers along the Lake Michigan State Water Trail connect the Twin Rivers Water Trail to the City of Manitowoc.

***Land-based Trails***

There are a few land-based trails, ranging from short park trails to regional connector trails, that connect to or come close to connecting to stretches of the Twin Rivers Water Trail. As trail expansions are made, there are great opportunities to connect land-based trails and integrate them with water trails.

The Mariners Trail connects the Twin Rivers Water Trail to the City of Manitowoc at Lighthouse Inn Access Site #7. The Mariners Trail is a hard-surfaced 7-mile trail running along Lake Michigan between the cities of Manitowoc and Two Rivers.

The Rawley Point Recreation Trail comes close to connecting to the Twin Rivers Water Trail at Rogers Street Fishing Village Access Site #3. The Rawley Point Recreational Trail has a hard-packed limestone base and connects the City of Two Rivers with the Point Beach State Forest. From the water trail, access can be made to the Rawley Point Recreation Trail by hiking or biking along 21st Street to Pierce Street.

The Neshotah Beach Park Trail comes close to connecting to the Twin Rivers Water Trail at Two Rivers Harbor Access Site #5. From the water trail, access can be made to the Neshotah Beach Park Trail by hiking along the beach to Zlatnik Drive.

The Twin Rivers Water Trail provides a valuable asset to the communities along the trail. It currently offers a great recreational experience, but opportunities exist for trail connection improvements and site enhancements to make them even better.

## WATER TRAIL CONNECTIVITY IMPROVEMENTS

The greatest challenge faced by those working to improve the Twin Rivers Water Trail will be in closing some of the large gaps that exist between one access point and another along the trail. Figure 2 shows all the *Potential Access* points along the trail where there may be opportunities to add rest stops or access points to the water trail. Five sites were identified as potential sites that could be improved or modified to support safe access.

Additionally, fifteen sites were classified as "*Low Priority Undeveloped Public Access*" sites that are unlikely to receive improvements or modifications in the future due to various restrictions or limitations, such as limited parking opportunities or potential infringements on private property.

### *Gap on East Twin River between Mishicot and Two Rivers*

The largest gap on the water trail is on the East Twin River and stretches for nine (9) miles between the Village of Mishicot Access Site #1 and Paddlers Park Access Site #2 in Two Rivers.

An opportunity exists to close this gap at the potential access site at Maplewood Road/Eastwin Valley Golf Course. The landowner at the Maplewood Road/Eastwin Valley Golf Course is receptive to providing a rest area site, or potentially even a launch site.

An additional opportunity may exist for a rest stop along the nine mile gap on the East Twin River with the Jerold Brigham parcel (Parcel #01301001100300), a 7-acre parcel located at 9413 STH 147, just north of Sturm Road and south of Green Acres Greenhouse. When steering committee member, George Krause (Village of Mishicot Board Chair) approached Mr. Brigham about the water trail in January 2018, Mr. Brigham expressed interest in providing a rest stop on his property.

### *Gap on West Twin River between West Twin River County Park and Woodland Dunes*

The largest gap on the West Twin River is 2.5 miles long between the West Twin River County Park Access Site #13 and Woodland Dunes - Willow Trail Access Site #12 in the Town of Two Rivers.

There may be an opportunity to add a rest stop along this gap at the Manitowoc County Fish and Game Protective Association site (Parcels #01813400500200 (15.5 ac), #01813400200100 (31 ac), and #01813400100000 (40 ac)). These parcels consists of 86.5 acres along the West Twin River located at Township 20N, Range 24E, Section 34. The Manitowoc County Fish and Game Protective Association is a nonprofit, volunteer organization that started in 1907 as a hunting and fishing club. Contact can be made through their website at www.mantyfg.org.

## SITE IMPROVEMENTS/ENHANCEMENTS

Although the Twin Rivers Water Trail offers many access sites with easy accessibility, useful amenities, and great signage to guide paddlers, there are a number of sites where there are opportunities for improvements and enhancements.

### *East Twin River*

The following lists the sites and improvements/enhancements that are recommended along the East Twin River of the Twin Rivers Water Trail.

#### Village of Mishicot Access Site #1

As of the writing of this planning document, the Village of Mishicot Access Site #1 is under development. Amenities planned for the site include restrooms, parking, lighting, and a shoreland trail.

In additional to the planned amenities, recommendations for improvements and enhancements at this site include:

- Water access camping
- Kayak storage
- Power access
- Water trail interpretive sign

#### Paddlers Park Access Site #2

Recommendations for improvements and enhancements at this site include:

- Permanent restrooms
- Potable water
- Shelter
- Power access
- Determine if the "Adopt-a-Trail" sign located by the river is still valid for the Lakeshore Sea Kayakers in Two Rivers. If not, remove it.

#### Rogers Street Fishing Village Access Site #3

Recommendations for improvements and enhancements at this site include:

- Kayak launch
- Kayak storage
- Water trail interpretive sign

#### Harbor Park Access Site #4

Recommendations for improvements and enhancements at this site include:

- Kayak launch
- Kayak storage
- Water trail interpretive sign

**Two Rivers Harbor Access Site #5**

Recommendations for improvements and enhancements at this site include:

- Permanent restrooms

**Seagull Marina Access Site #6**

Recommendations for improvements and enhancements at this site include:

- Kayak storage

***West Twin River***

The following lists the sites and improvements/enhancements that are recommended along the West Twin River portion of the Twin Rivers Water Trail.

**Woodland Dunes Access Site #10**

Recommendations for improvements and enhancements at this site include:

- Explore moving the kayak launch closer to parking by utilizing the old detention pond adjacent to the nature center building

**Scenic River Stop-N-Dock Access Site #11**

Recommendations for improvements and enhancements at this site include:

- Kayak launch

**Woodland Dunes - Willow Trail Access Site #12**

Recommendations for improvements and enhancements at this site include:

- Remove brush/mow an access strip down to the shoreline

**West Twin River County Park Access Site #13**

Recommendations for improvements and enhancements at this site include:

- Permanent restrooms
- Shelter
- Kayak camping

**Shoto Conservation Club Access Site #14**

Recommendations for improvements and enhancements at this site include:

- Kayak launch
- Potable water

## FUNDING OPPORTUNITIES

In addition to private and community foundation grants, there are many opportunities available for funding improvements to the Twin Rivers Water Trail including state trail designation, and state and federal grants.

### *State Trail Designation*

To provide for long term recognition and presence, a state trail designation for the Twin Rivers Water Trail may be beneficial. This designation would allow for the use of state trail acquisition and development dollars.

### *State and Federal Grants*

The following grant programs focus on the acquisition of land or rights to land, restoration, or development of land for conservation and public outdoor recreation purposes and can be used to fund trails.

**State Programs**

Knowles-Nelson Stewardship Local Assistance Programs:

- Aids for the Acquisition and Development of Local Parks (ADLP)
- Urban Rivers Grants (UR)
- Urban Green Space Grants (UGS)
- Acquisition of Development Rights Grants (ADR)
- State Property Development Grants

**Federal Programs**

- Land and Water Conservation Fund (LAWCON)
- Recreational Trails Program (RTP)

In addition to individual site improvements, branding and marketing of the Twin Rivers Water Trail is an important element of developing a successful water trail. Across the country, communities are beginning to understand the economic value of developing trails, including talent attraction, tourism, and business development. However, in order to see this type of economic impact, it's not enough to just develop a water trail network. Communities and tourism departments need to attract users to their trails, develop and tailor small businesses to capture trail user spending, market destinations and events, and develop key sites. These are important aspects of using trails for economic development that trail advocacy organizations are not naturally suited to offer; therefore, strong partnerships between trail organizations and economic development organizations are essential.

The brand for a trail is crafted to provide a brand statement, imagery, and color palette to advance the awareness of the trail and foster successful implementation by building an identity. Branding and imagery should remain consistent throughout all materials, messaging, and representation of the trail.

Branding is a widely used term to describe the perception of a product or service in the target audience's mind. For a water trail, a brand includes user experience, logo, signage, web resources, printed materials, events, etc.

## LOGO

A logo for the water trail provides branding for the trail that can bring recognition. It also establishes a palette and look for marketing that will weave into all other elements of branding and marketing.

Members of the Twin Rivers Water Trail Steering Committee recruited some additional volunteers to assist with the development of a logo for the water trail (Figure 4). The logo appears on the water trail website, maps, Story Map, and signs.


***Figure 4. Twin Rivers Water Trail Logo***

## SIGNAGE

Developing consistent, recognizable signage is important to branding and marketing a water trail. Recommended signage for the Twin Rivers Water Trail includes large informational signs and small trail marker signs.

### *Informational Signs*

With funding from the Twin Rivers Rotary, informational signage was developed and permanently placed at nine locations along the water trail route (Figure 5), including Village of Mishicot Access Site #1, Paddlers Park Access Site #2, Rogers Street Fishing Village Access Site #3, Harbor Park Access Site #4, Veterans Park Access Site #9, Woodland Dunes Access Site #10, Woodland Dunes - Willow Trail Access Site #12, and West Twin River County Park Access Site #13.


***Figure 5. Water Trail Informational Sign***

***Trail Markers***

Trail markers (Figure 6) are smaller than informational signs and can be inconspicuous while offering helpful wayfinding, creating cohesiveness along the route, and providing additional brand recognition.


***Figure 6. Trail Marker Example***

## WEB RESOURCES

A website is a critical marketing tool for a water trail. It serves as the virtual equivalent of a physical business for internet users. It can help get the word out about the trail, as well as provide information about wayfinding and trip planning, and offer interesting educational information about the trail and surrounding area to enhance the user's experience.

Members of the Twin Rivers Water Trail Steering Committee recruited additional assistance to development a website for the water trail. The Twin Rivers Water Trail website is at www.www.twinriverswatertrail.org.


Responsibilities for maintenance of this website have not been established. It is recommended that this important role be filled. Some potential candidates include a volunteer, a non-profit organization (such as LNRP), the City of Two Rivers, the Village of Mishicot, Manitowoc County, or the Manitowoc Area Visitor & Convention Bureau.

### *Story Map*

A Story Map is a web application that combines maps with narrative text, images, and multimedia to inform and engage people about a project. A Story Map is a great way to "map" the water trail while also providing details about the available amenities and pictures of each site. A Story Map has been developed for the Twin Rivers Water Trail at https://arcg.is/1CLjfn. A link to the map is also available at the Twin Rivers Water Trail website.

## PRINTED MATERIALS

Printed materials such as brochures, guidebooks, postcards, and maps are great branding and marketing tools that can be distributed at tourism departments and local businesses to increase the usage of the water trail and provide useful information. Printed materials can also be used to promote user safety (on the water and off), and encourage users to minimize environmental impacts and utilize "*Leave No Trace*" principles.

A print map has been developed for the Twin Rivers Water Trail and is available at the Woodland Dunes Nature Center and the Manitowoc Area Visitor & Convention Bureau.


Additional printed materials are recommended for the water trail, especially to tell the interesting historical and ecological stories of the water trail, such as its rich Native American and maritime history.

## PLANNED EVENTS

Planned promotional events for the trail (e.g., races, regattas, river trips, etc.) are another important branding and marketing strategy to help raise awareness about the trail and increase its use. Additionally, periodic maintenance events (e.g., river sweeps and river clean-ups) are recommended to not only raise awareness about the trail, but to improve the resource and experience by clearing debris and hazards.

A well-attended open house/grand opening was held for the Twin Rivers Water Trail on May 14, 2018, at the Woodland Dunes Nature Center (Figure 7).


***Figure 7. Open House Flyer***

# ADDITIONAL RESOURCES

The following information has been included in the Twin Rivers Water Trail Master Plan to assist with future decision making efforts related to the water trail. The following resources include:

- Historical and ecological Information (obtained from the Twin Rivers Water Trail website, www.twinriverswatertrail.org)
- Guidance on water trail design and construction (Section 3 from *Developing Water Trails in Iowa*)
- Guidance on water trail signs (*Iowa Department of Natural Resources*)
- Guidance on designing launches (*Logical Lasting Launches: Design Guidance for Canoe and Kayak Launches*, NPS)

Since glacial ice melted away, people have inhabited the lakeshore area in and around, what are now known as, the East and West Twin Rivers. The Neshota (West Twin River) and the Michicot (East Twin River) were the names of two important native Chiefs from this area and until the 1930's were named accordingly. The native peoples were drawn to this area by the abundance of water, fertility of the soil, and plentiful wildlife. Native people established villages at Shoto, Two Rivers, and Mishicot.

In more recent times, the area north of the West Twin was referred to as "Canada" and was the territory of the Potawatomi people under Chief Mishicott or Mechigaud, while south of the river was known as "Mexico" and governed under Chief Waumegasako. Upon the arrival of European immigrants, the area was important in the fur trade and fishing. In 1795, Jaques Vieux established a trading post near Mishicot. In 1831 and 1833, treaties ceded the land to the United States. After that, timber was harvested from area forests, which were then converted to farmland. The rivers were dammed in a number of locations and mills established. The fishing village of Two Rivers became a manufacturing center and home to such industries as the wood type and cabinet business established by J.E. Hamilton in 1880. Throughout their watersheds, agriculture continues to be a major land use and industry. Increasingly, recreation and tourism are also important here, as the area looks back to the water which has shaped the region.

MORE INFORMATION

Photos by Nancy Nabak

The Neshota and Mishicot Rivers have a rich natural history, shaped by ancient glaciers that deposited and moved the soil, hundreds of plants, and thousands of species of animals and insects. Notable habitats along the shores include mixed hardwood forests, marshes, and sedge (grass-like) meadows, which are extensive along the Mishicot River.

Nearly 300 different birds have been sited and recorded along or near the rivers including bald eagles, ospreys, sandhill cranes, herons, ducks and geese. During migration periods, 100 species of birds can be seen feeding on insects or fish in or near the rivers, which lie within important migratory flyways, including the threatened Caspian, Forster's, and common terns. The forests and fields along the shores are home to more than 40 species of mammals, including otters, mink, fishers, badgers, coyotes, foxes, and even the occasional black bear. Dozens of species of fish inhabit the waters, including smallmouth bass and northern pike.Species such as common carp, and chinook and coho salmon were introduced and are commonly seen in fall. Dozens of species of freshwater mussels are also present.

Threats to the health of these rivers results from invasive species and nutrients and other substances present in runoff, and it is important to protect them to conserve wildlife and maintain their beauty and recreational value. A leisurely paddle is an outstanding way to view the wildlife of the Neshota and Mishicot Rivers, so bring binoculars, field guides, a notebook, and camera with you!

MORE INFORMATION




# 3 DESIGN DEVELOPMENT

Iowa's rivers are constantly shifting and changing and can be challenging places to design, construct, and maintain water trails. This section discusses aspects you will immediately encounter when developing a water trail: launches, parking areas, and trails. The intended users and expected use suggest how these amenities are designed and constructed. Water trails intended for extended families, for example, are designed differently from those intended for experienced paddlers on multi-day trips.

# 3 LIST OF FIGURES AND TABLES

# 3A WATER TRAIL LAUNCH DESIGN

## WATER TRAIL DESIGN DEVELOPMENT

State-designated water trails in Iowa are more than recreation resources. Water trails are developed and managed in ways that protect and enhance Iowa's aquatic and riparian resources. In this way, locating water trail amenities, such as launches, requires consideration beyond user convenience. For example, aquatic resources such as fish can be impacted differently based on how launches are designed and constructed. Likewise, streambank and launch stability is impacted by how drainage from newly created parking areas arrives at the stream. These guidelines reflect what has been learned in Iowa and similar locations about design and management of stream-edge infrastructure, including adaptation of traditional designs.

## WATER TRAIL LAUNCH DESIGN

This section describes design options and material choices for water trail launch construction. The goal in choosing among launch designs and construction approaches is to match launch design with the setting. Avoid adding stress or impact to streams and their biologic conditions and, where possible, to enhance conditions for fish and other aquatic species. Always consider the design alternative best matched to the launch site and region. Large, hard-surface launches and extensive earthwork are sometimes necessary on heavily impacted sites and can enhance stream conditions. However, on stable streams, choose launches without concrete or large equipment, as they are less expensive and have a lower impact on the stream.

This manual focuses on locating and designing launches that balance impact with the need to withstand the flashy water-level conditions and the high amounts of sediment often found in Iowa streams. While all launches on Iowa streams require maintenance, good design and construction can help some locations last longer with less maintenance.

Three things are important when designing and constructing a launch: where on the stream the launch is located, the angle of the launch relative to the stream, and the launch construction and materials. Each is important to minimize impact to a given stream and its biologic community. Launches are also the first experiences paddlers will have on Iowa water trails. Well-designed launches minimize stress for users shifting gear from vehicles to the water.

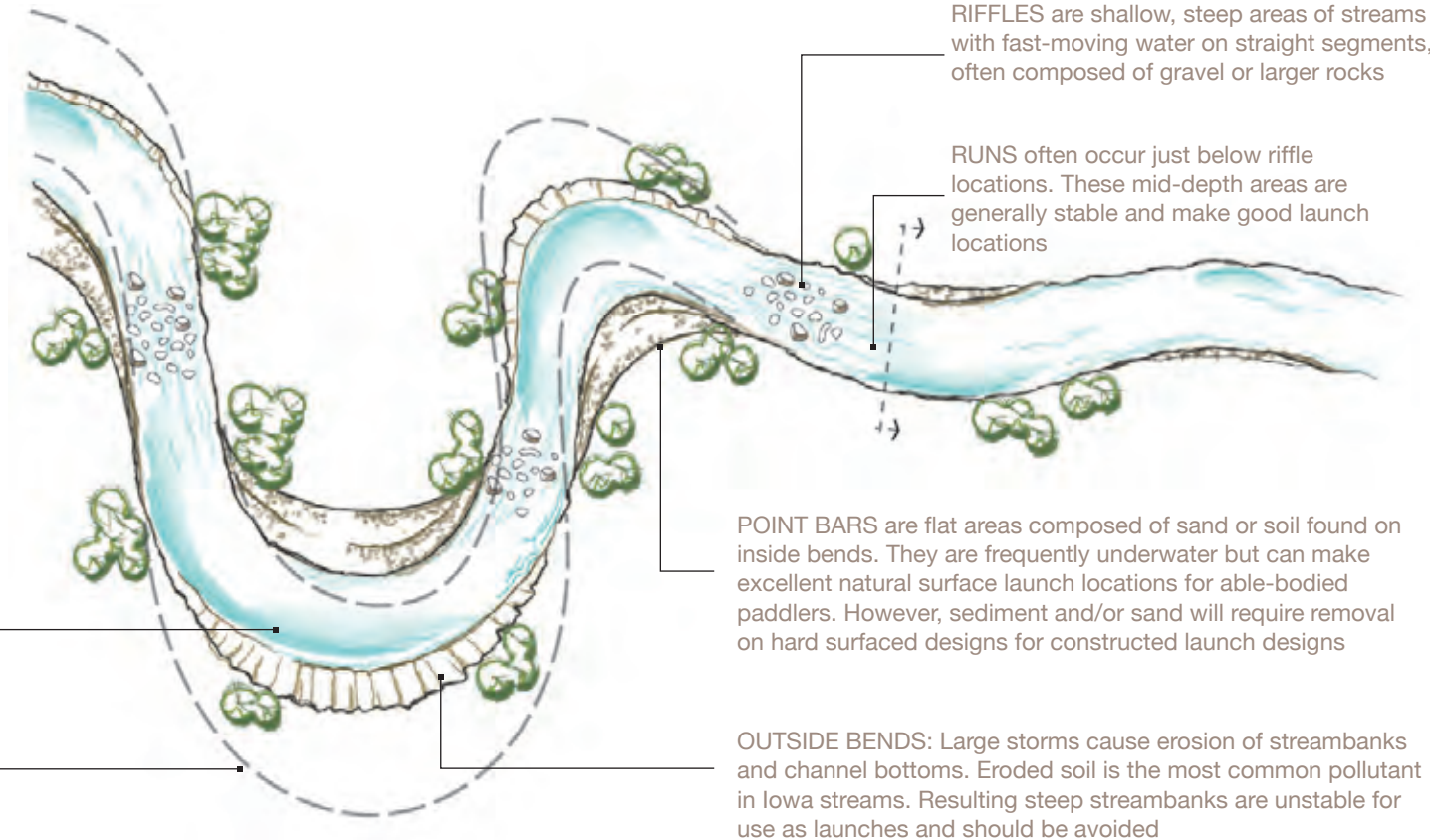
# WHERE TO LOCATE LAUNCHES

Consider three key features of streams when evaluating where to locate launches. The first aspect is the route of the stream across the land--whether it is curvy or straight. The second aspect is the shape of the streambanks and bottom. The third consideration in location is how accessible it will be for users and maintenance.

For the first aspect, consider that some sections of Iowa streams are curvy, while others are fairly straight (Figure 3A-1).

Straight stream sections with low streambanks are the most successful launch locations in terms of required maintenance, stream impact, and cost effectiveness. A curving stream section, particularly an outside bend, is the least successful location for a launch. Launches built on curving stream sections or with streambanks sloped more than 12 percent are much more likely to be damaged or washed out as the stream migrates or changes in alignment compared with straight sections.

**Figure 3A-1.**
Stream Dynamics Related to Successful Launch Locations

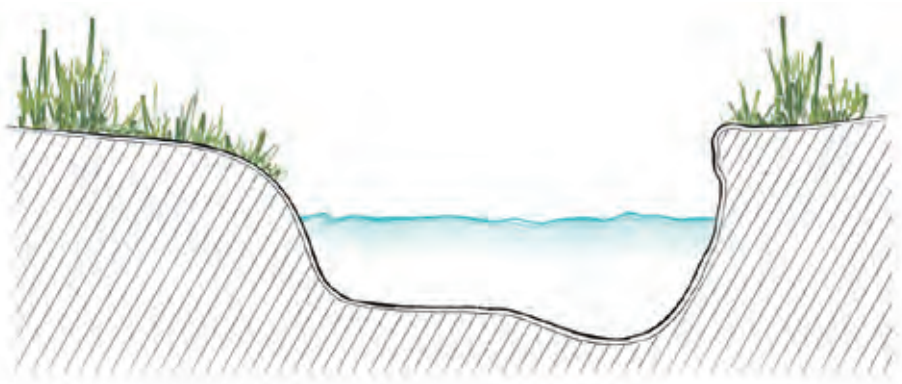


The second aspect is the shape of the streambanks and bottom. If a stream segment has steep banks on both sides with no low terrace (Figure 3A-2), it is unstable and will continue to widen and migrate. Unstable streambanks such as these are not appropriate for launch construction. Stream segments with a low terrace on at least one side (Figure 3A-3) are generally the most stable in terms of minimal launch maintenance and low-impact construction.

Stream depths at launch locations are critical for powerboats and somewhat less so for paddler-only launches. Streams typically include stretches of deep and shallow water. The easiest launches for paddlers are designed so boats can be loaded and launched with minimal wading. These spots are often located just below riffles.

Pool areas greater than 4 feet deep (normal flows) can be desirable concrete boat ramp locations if the banks are not too steep. Be aware that the deepest pools can be valuable fish habitat, especially for over wintering sensitive species such as channel catfish, and should be avoided. Steep drop-offs make poor canoe and kayak access because fluctuating water levels will change the height from the water surface to the top of the bank.

Finally, launch locations require consideration of future users and those maintaining the sites. Consider locations near public roads and near equipment that will be used to maintain the launch area. New launches also require adjacent space for a minimum of five off-road parking spaces. Identify flat areas near streams that do not flood frequently. Locate parking and driveways a minimum of 50 feet from the edge of the water. Sites that minimize tree removal and land reshaping are the most desirable for both launches and parking areas. Refer to Section 3B, Parking Area Design, for more information.



Midwest stream channels have various shapes. Incised segments have steep streambanks, often on both sides. These stream segments are the least suitable for launch construction because they are unstable and eroding.

**Figure 3A-2.**
Unstable Incised Streams

Some segments are more stable, with the bank on one side more gentle and the other side steeper. These segments offer both shallow and deeper water areas. The shallow side of a stream is often an excellent location for launch construction. Ensure sediment and/or sand deposition is not an issue before constructing launch.

**Figure 3A-3.**
Stable Streams

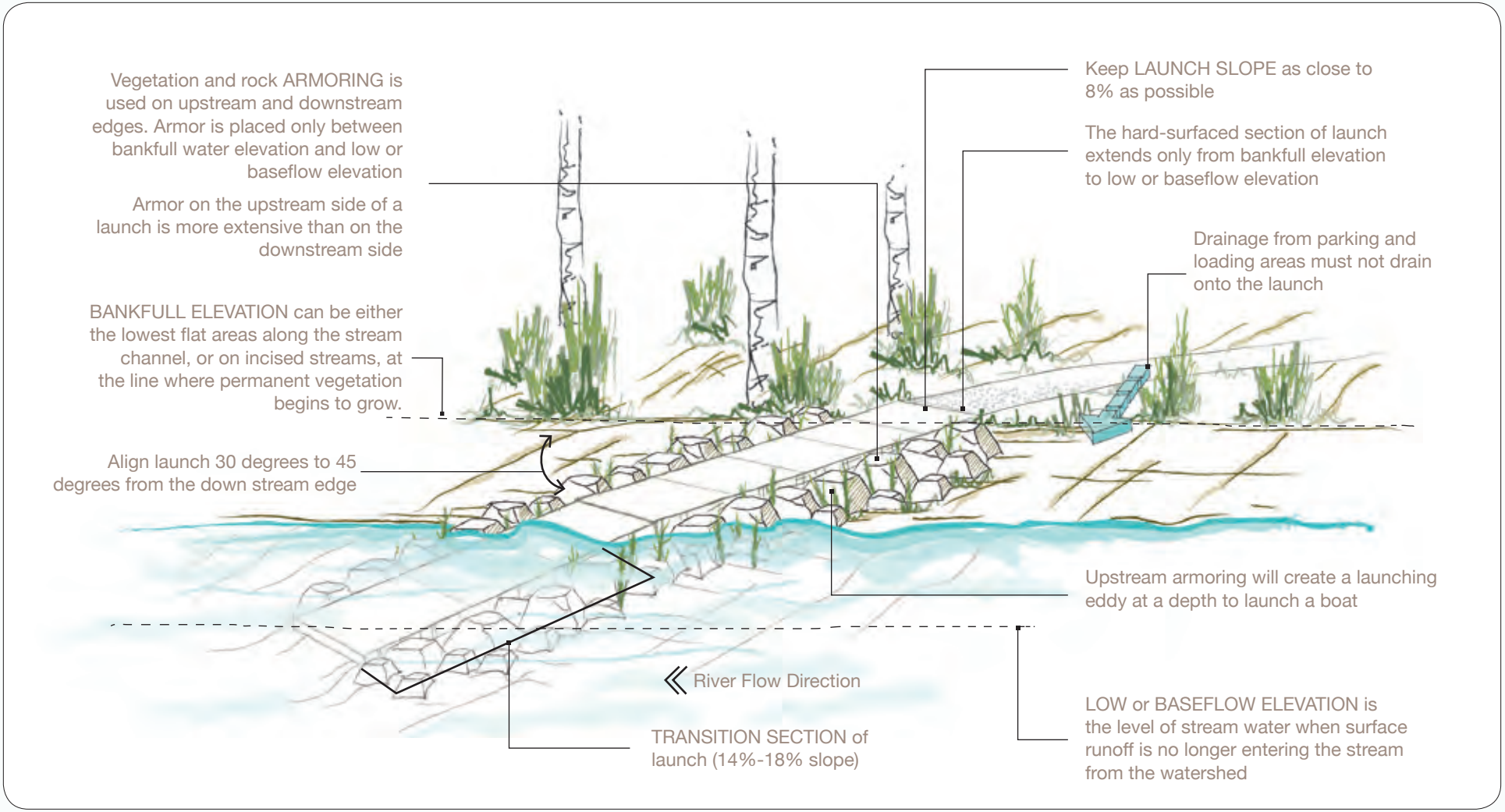



**Figure 3A-4.**
Typical Launch Design Components

## LAUNCH DESIGN SELECTION CRITERIA

The materials and design of a launch correspond with its location. Minimize disturbance to the stream, banks, and surrounding landscape. The most successful launches serve a wide variety of paddlers and physical abilities. Budget expectations for construction and maintenance are also important criteria. Launch materials in Iowa include cast-in-place concrete, pre-cast concrete, stair steps, and natural surfacing.

All launches require attention to five elements, regardless of launch type or location. These elements include armoring, the slope or steepness of the launch ramp, a push-in section, the horizontal alignment of the launch, and the height of the water at the launch location (Figure 3A-4).

- **Armoring:** Launch edges require protection from scour and erosion caused by stream currents and high flows. Vegetation (in the form of root density) is used in conjunction with specific-sized rock as armor to resist erosion and launch failure. (See Chapter 4.) Use the minimum amount of armoring necessary, as excessive rock is expensive and can impact river function and biology. Class D or E riprap is generally used. Specific native grasses, such as prairie cordgrass (Spartina pectinata), are also used above the bankfull elevation for slope stabilization.
- **Channel restoration practices:** If an existing launch fails because of movement of riprap, or if the developer wishes to improve river stability and minimize bank stress, incorporating natural channel design structures such as j-hooks can improve in-stream habitat while reducing the overall amount of rock required. Chapter 4 describes use of these practices in more detail. (See Rosgen 2006.)
- **Slope of launch ramp:** The change in elevation from the top of the launch to the bottom is described by percent of change. Percent slope is calculated by dividing the difference in height by the length of the launch (usually in feet). Water trail launch slopes should be as close to 8 percent as possible, with the exception of the lowest sections, known as push-in sections, which are steeper. The steeper the slope, the more important a roughened surface becomes for traction.

**Figure 3A-5.**
Launch Selection Criteria

| LAUNCH SITE CHARACTERISTICS | Concrete, Pre-Cast concrete, or Cut-Stone Design | Stair-Step Design | Natural-Surface Design |
|---|---|---|---|
| Point bar (sand, gravel) silt, mud point bars NOT recommended, (Figure 3B-1) | Poor | Poor | Good |
| Bedrock bank or stable slope bank (Figure 3B-3) | Fair | Fair | Good |
| Unstable, incised stream (Figure 3B-2) See Chapter 4 for suggestions on handling unstable sites | Poor | Fair<br>*Both extreme scour and deposition can be issues: re-shape bank and skew downstream* | Poor |
| Stable bank, slope <12% | Excellent | Fair | Good |
| Stable bank, slope <12%-18% | Good | Good | |
| Stable bank, slope <18%-50% | Fair<br>*Follow contours with bench-cut* | Good<br>*Couple with canoe slide* | |
| | Excellent | Good | Fair | Poor |

- **The push-in section** of the launch is the bottom-most section of the transition zone. It is made of either pre-cast concrete or concrete cast higher on the bank and then pushed into place with mechanical equipment. A push-in section may not be needed if a stream bed is rocky.
- **The transition zone** of a launch is the section transitioning from dry to submerged. The slope is steeper (14 percent to 16 percent, not to exceed 18 percent) for this section than for other parts of the launch.
- **The horizontal alignment** of the launch refers to the angle of the launch compared with the stream edge. For most stream applications, the launch edge should be constructed at a 30 degree to 45 degree downstream angle from the water flow. This alignment minimizes maintenance and creates a reasonable launching eddy. Launch alignment on lake edges can vary from this description as needed.
- **Launch elevation:** Constructing a launch at the proper elevation relative to bankfull elevation is critical to minimize future maintenance. Note that the hardened section of ramps and the armoring extend only between bankfull and baseflow elevations. A simplified way to determine bankfull elevation is to identify the level where permanent vegetation begins to grow. Bankfull is technically defined as the 1.5-year storm-recurrence elevation and can also be mathematically calculated using stream-gage data.

## LAUNCH CONSTRUCTION

Note that launch construction most often occurs when stream water level is at low or baseflow elevation—not at bankfull or higher water elevation. This condition most commonly occurs during summer months. A low water level during construction allows the transition zone section of the launch to be poured near or at the low-flow elevation, reducing construction costs. Construction at low-flow elevations may also reduce streambank erosion during construction.

Water trail launch construction, like all construction, includes consideration of federal, state, and local regulations limiting stormwater runoff and erosion during construction. See the Iowa Construction Site Erosion Control Manual (2006) for more information.

## LAUNCH DESIGN TYPES

Select launch design based on stream morphology—that is, the slope of the existing streambank and the streambank structure (Figure 3A-5). Hard-surface launches are the most durable and generally require the least intensive maintenance. Hard surfaces are also the most reliable for wheeled vehicles and for people, such as the elderly, with special needs. Drawbacks of hard surfaces include high construction costs, extensive site disturbance to allow mechanical equipment access, increased stormwater runoff and erosion, and undesirable aesthetics in remote settings.

# NATURAL-SURFACE LAUNCH DESIGN

Launch construction with natural soil surfaces works best with fine mineral soils, including clays and loams. Natural bedrock outcroppings can also act as highly functional launch sites. Crushed stone is used when subsoils are unstable. Blend launches and trails with existing topography as much as possible to minimize stream impact and construction costs (Figure 3A-6).

This type of launch construction can lend itself to volunteer efforts, increasing the sense of local ownership of the water trail. However, volunteer projects require the same level of design and planning by qualified professionals as other launch designs. Construction without appropriate professional guidance can quickly cause stream and habitat damage. Failed volunteer construction projects can also be problematic in terms of maintaining future interest and investment in the water trail.

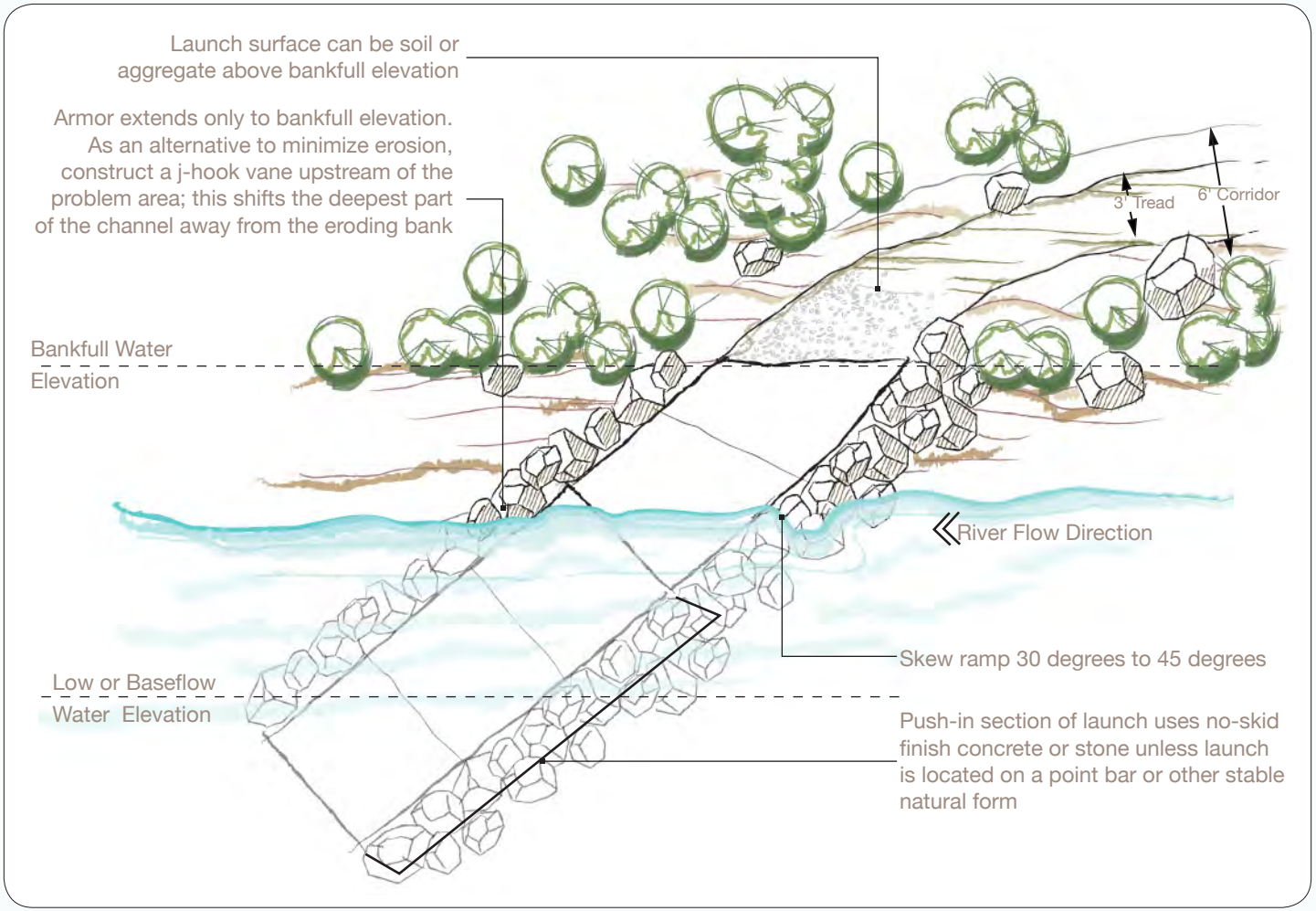


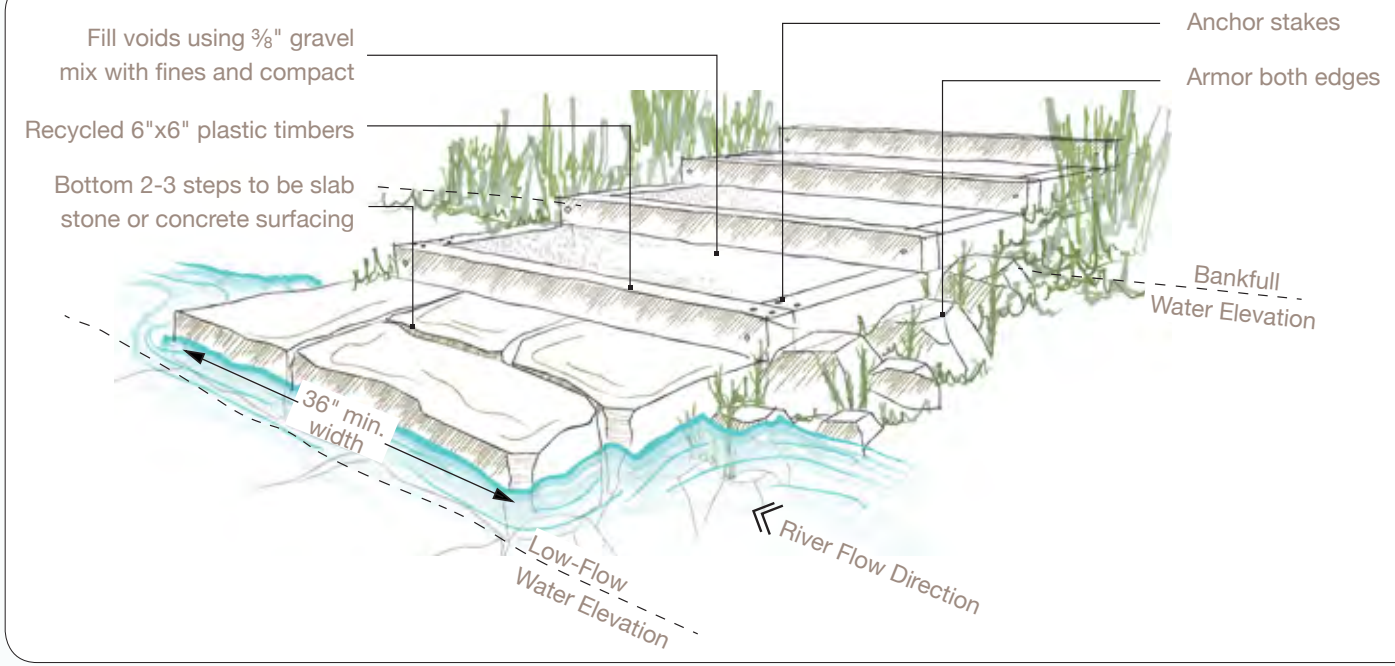

**Figure 3A-6.**
Natural-Surfacing Launch Design

# STAIR-STEP LAUNCH DESIGN

Stair-step design is most commonly used in steep streambank situations. Stair-step design is also a reasonable project for volunteer group construction. This design blends in with the stream setting and can prove durable when constructed on stable streambanks.This design requires users able to manage stairs and steep climbs. Sediment is likely to deposit on stair treads in high-sediment streams, requiring manual removal. This design is easily damaged by water when located on the outside bend of streams, where shear stress is the greatest (Figure 3A-7, Figure 3A-8).

Construct step treads with a 2 percent to 3 percent slope toward the stream to alleviate water ponding on the surface. Step treads should not be steepened to accommodate high streambanks. All stair treads should be the same width and length. Optional handrails benefit users needing support. Canoe slides can be built with two telephone poles or aluminum guardrails along steep slopes.

**Figure 3A-7.**
Stair-Step Launch Design



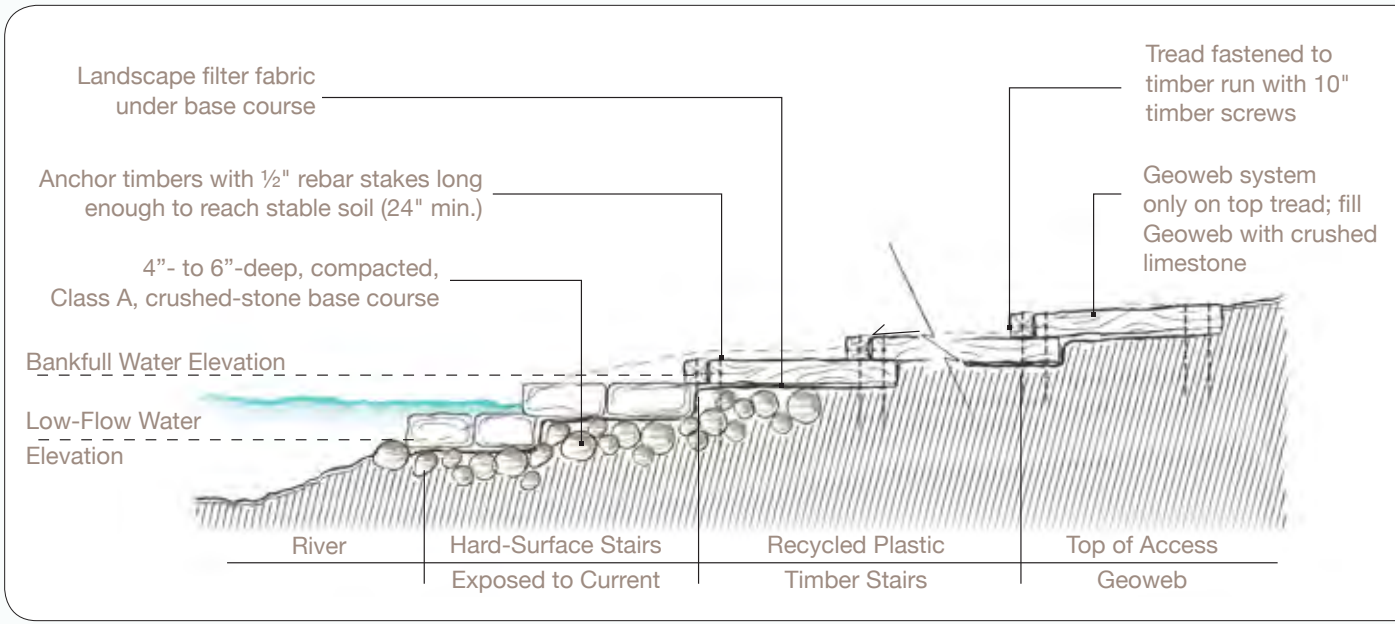




**Figure 3A-8.**
Stair-Step Launch Cross Section

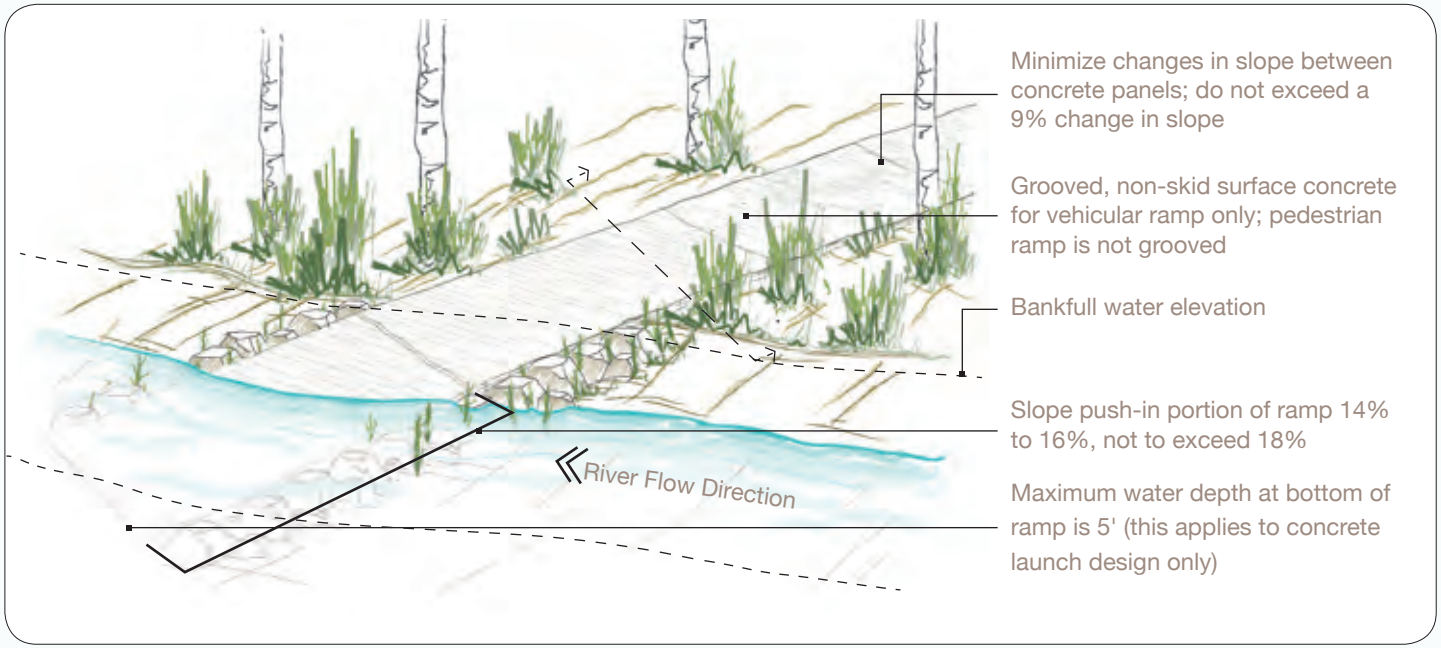
# CAST-IN-PLACE CONCRETE LAUNCH DESIGN

Launches formed from concrete poured on site typically cause the most impact and disturbance to near-stream areas because of the equipment needed. Constructing launches that match existing slopes minimizes construction costs, erosion, and the need for slope stabilization (Figure 3A-9). Use launches with a maximum slope of 8 percent whenever possible, with the exception of the push-in sections.

Concrete surfaces are also favored for ease of sediment removal, particularly if mechanical equipment is available. This design is commonly used for access for vehicles with boat trailers (Figure 3A-10). Carry-down trails with heavy use are also good candidates for concrete surfacing (Figure 3C-2 and 3C-5).

Use hardened launch surfacing with caution, however. Hardened surfaces generate the most stormwater runoff and erosion of all launch designs, impacting in-stream habitat and water quality. Concrete launches often are also highly visible from the stream and visually obtrusive. Consider tinting concrete with admixtures or imprinting natural patterns in wet concrete with rubber mats to mitigate visual impact.

**Figure 3A-9.**
Cast-In-Place Concrete Launch Design



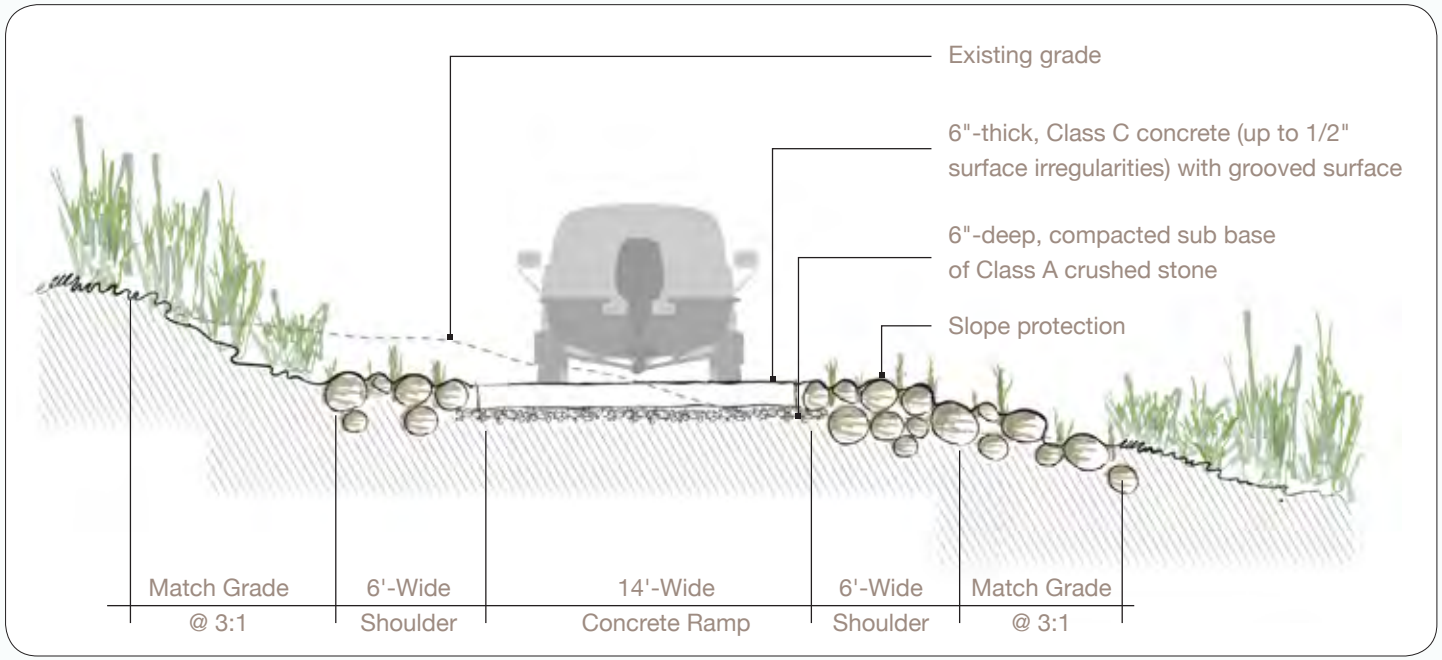




**Figure 3A-10.**
Cast-In-Place Design for Vehicle Access

# PRE-CAST CONCRETE SLAT LAUNCH DESIGN

Pre-cast slats are commonly used in livestock housing and are manufactured in Iowa. Slat units with slight imperfections, available from manufacturers at reduced prices, have been used successfully in Iowa for launch construction. Slat units are a durable alternative for cast-in-place concrete launches when sites are accessible to front-end loaders for placement (Figures 3A-11, 3A-12, 3A-13).

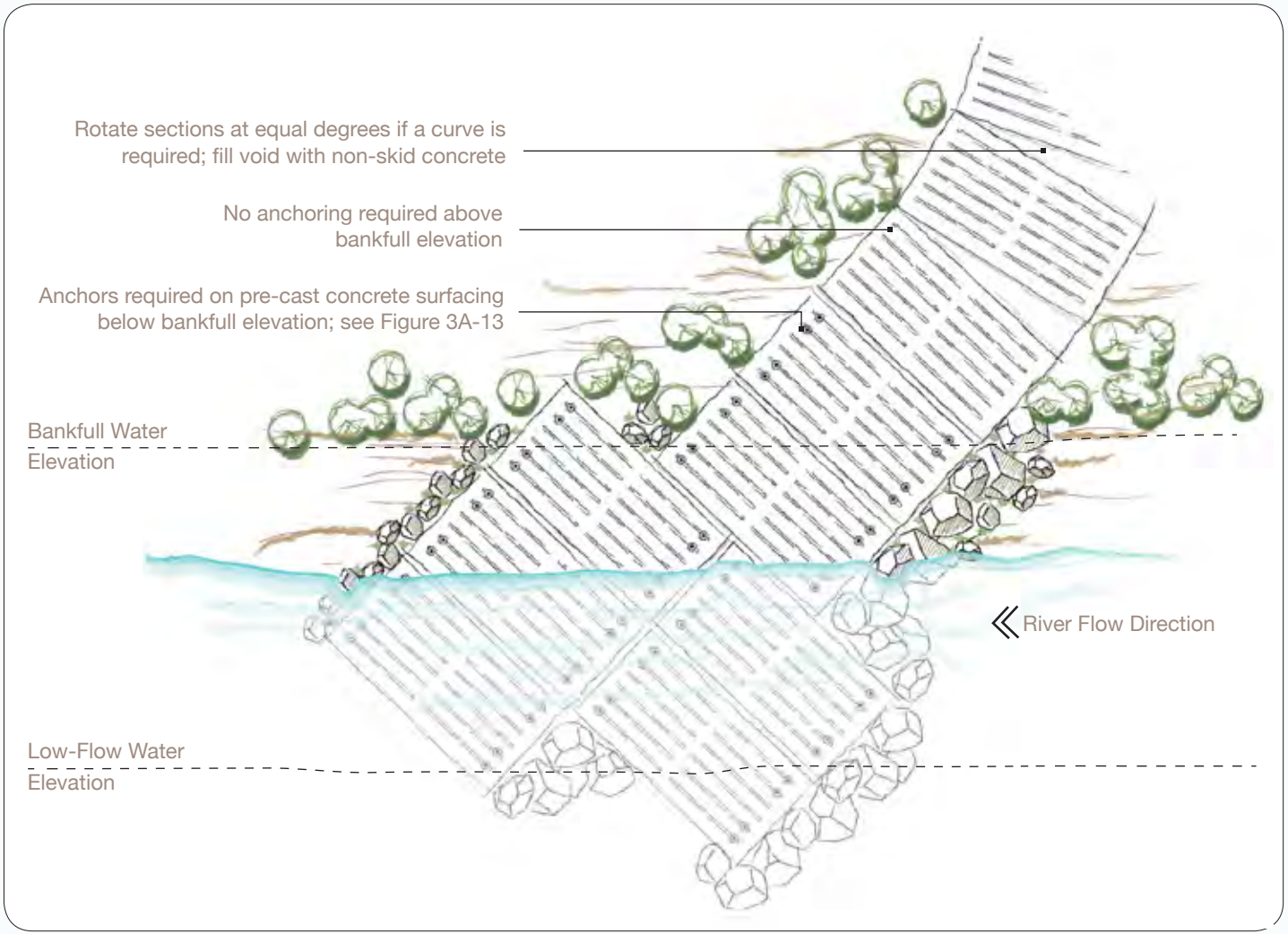



**Figure 3A-11.**
Pre-cast Concrete Launch Design

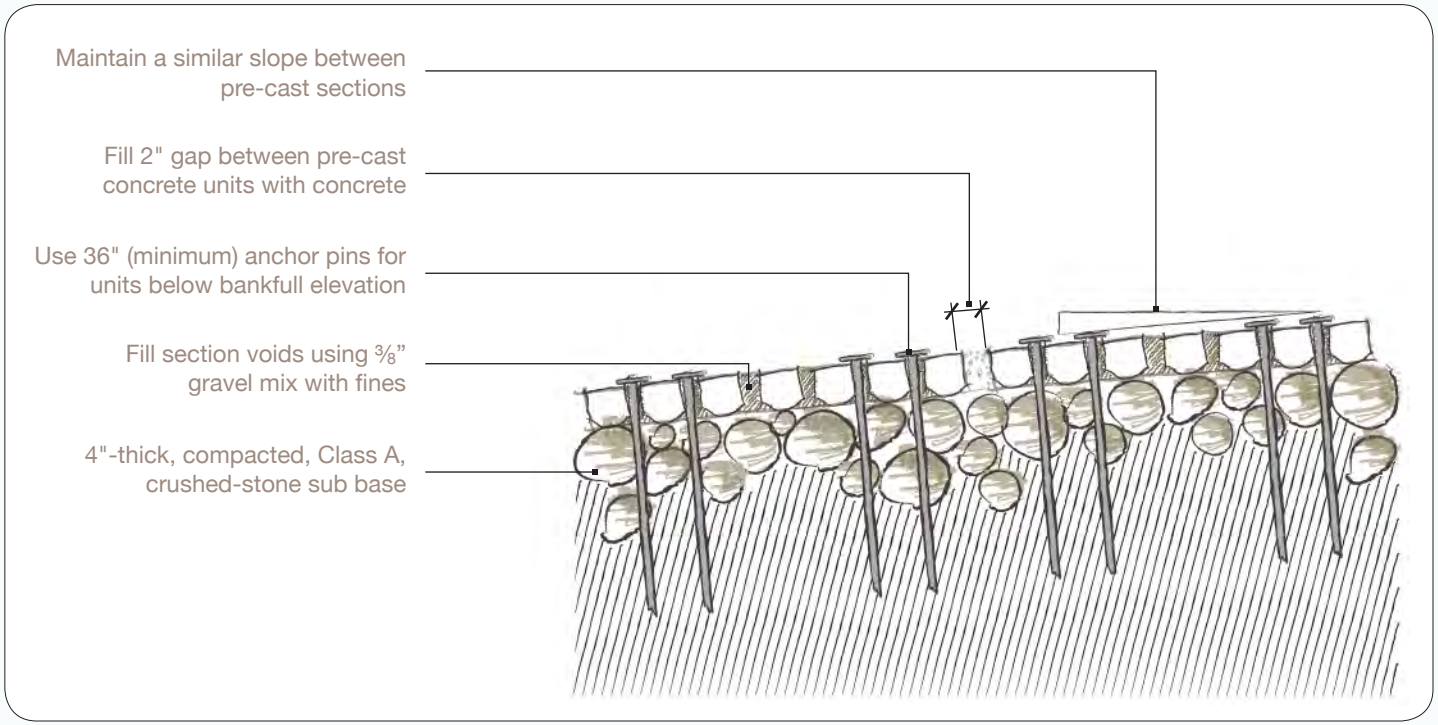



**Figure 3A-12.**
Pre-cast Concrete Anchoring Below Bankfull Stream Elevation

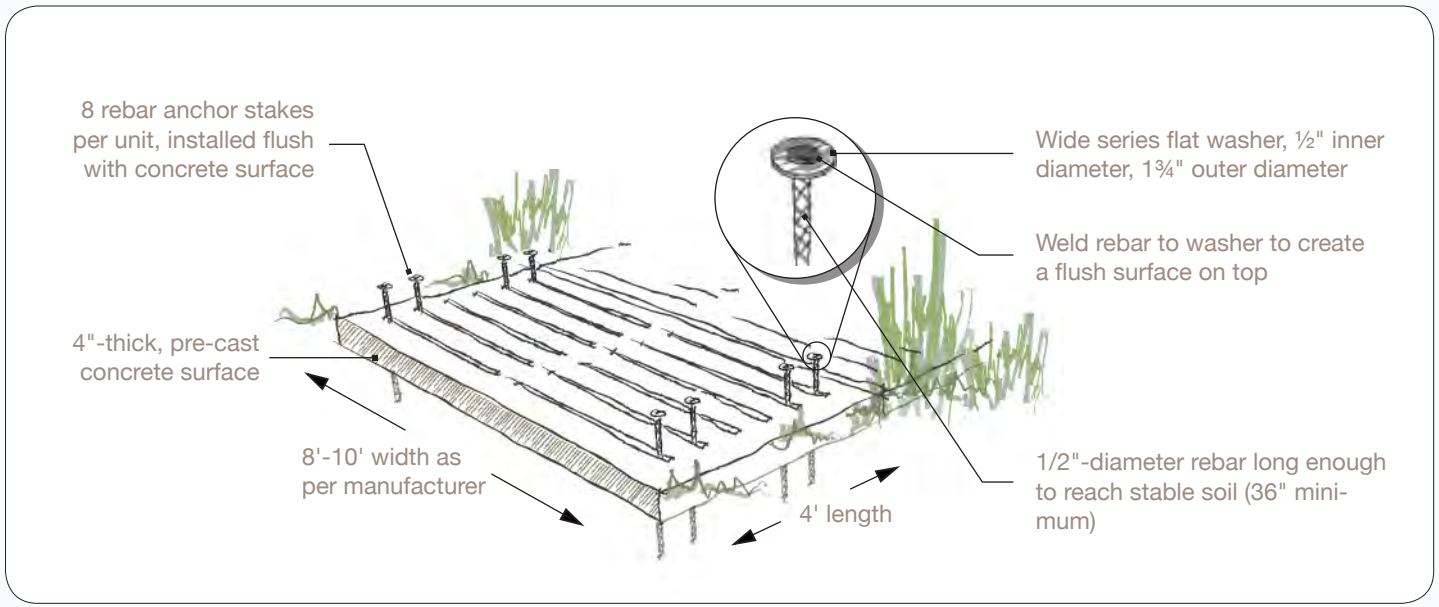



**Figure 3A-13.**
Pre-cast Concrete Anchoring Detail

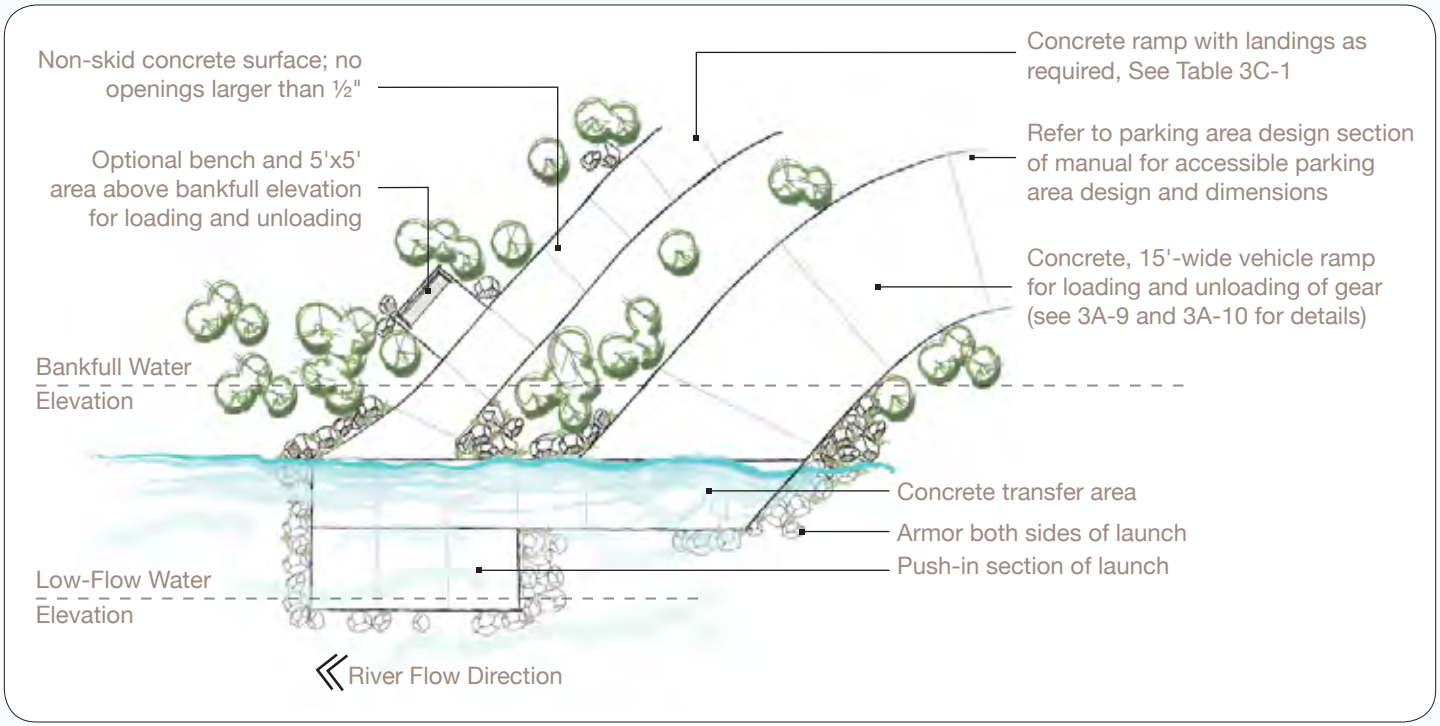
# UNIVERSAL LAUNCH DESIGN

Launches providing universal access are based on specifications included in the Americans With Disabilities Act (ADA), a set of Federal civil-rights laws. While Federal ADA standards do not currently exist for boat launch design, universal design principles are applicable and detailed in this section. Universal design practices seek to construct all facilities in ways that integrate users of varying abilities where possible. ADA standards for trail design do exist and are incorporated into universal design. The Iowa DNR encourages the use of these universal design standards when possible.

Universal launch design standards included in this manual recommend two side-by-side ramps, one for pedestrians and another for vehicles (Figure 3A-14). The hard-surfaced vehicle ramp adjacent to the pedestrian ramp allows delivery of boats, gear, and people at stream edges. The vehicle ramp is physically separated from pedestrian ramp, although both extend to meet with the near-level concrete transfer area at the stream edge.

Specifications include surface slope and smoothness, launch width, and near-water transfer areas (Figures 3A-14 and 3A-15).

**Figure 3A-14.**
Universal Launch Design



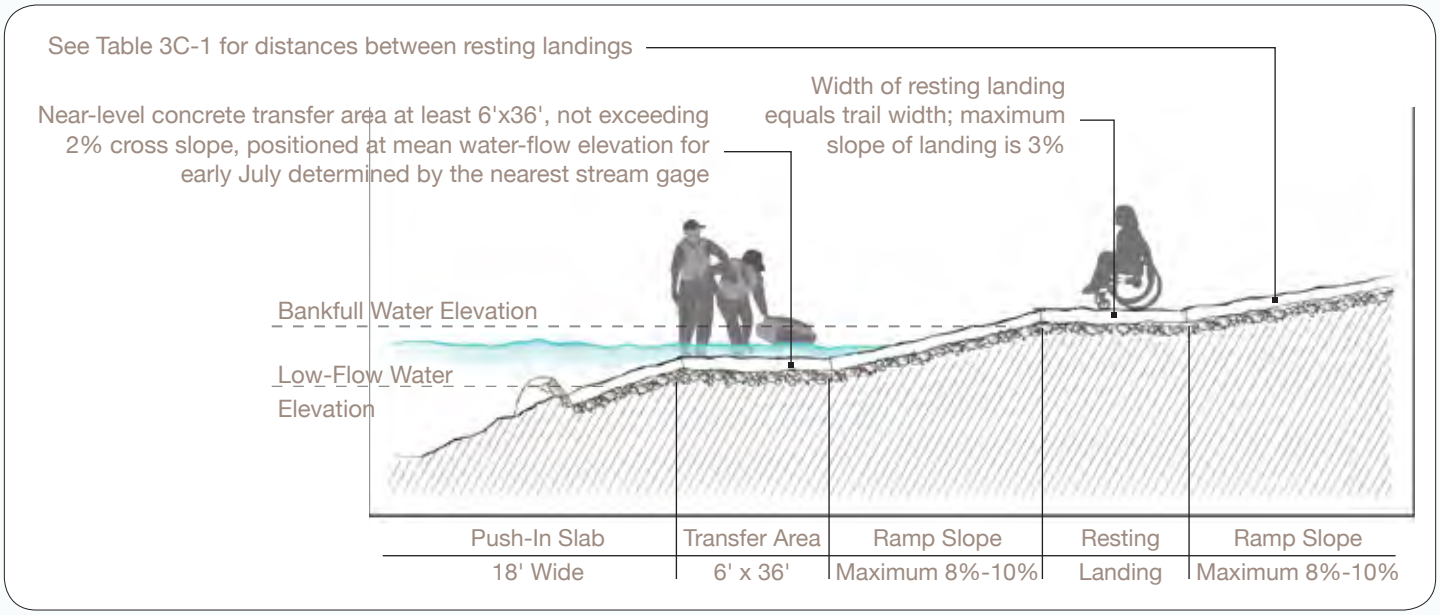




**Figure 3A-15.**
Universal Launch Cross Section

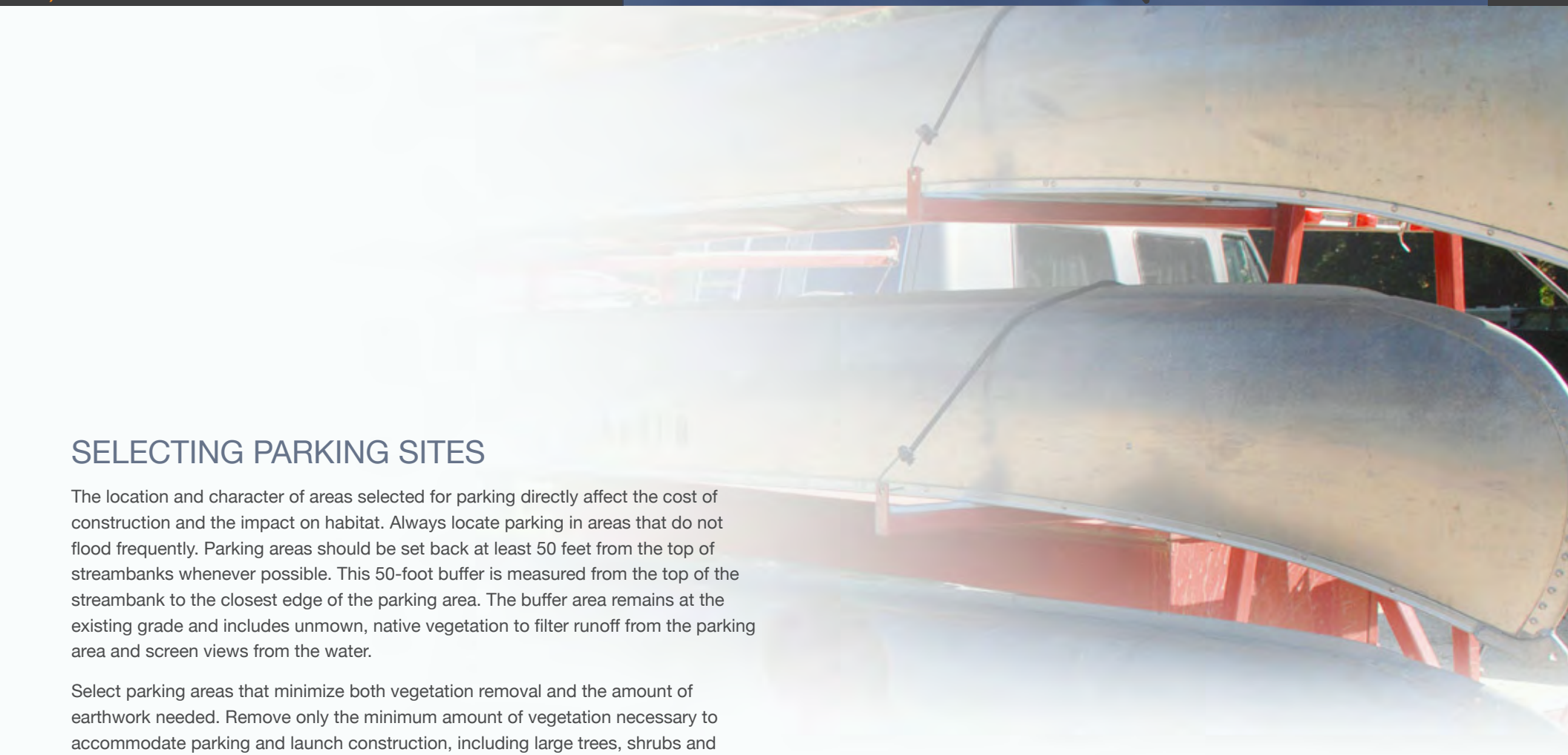
# 3B PARKING AREA DESIGN

All launch sites for state-designated water trails require designated off-road parking for a minimum of five vehicles. Note that due to safety issues, designated water trails should not encourage parking along roadsides. Iowa DOT will reject sign proposals that do not meet minimum off-road parking requirements. Parking on the road shoulder is unsafe for both water trail users and passers-by. Like other aspects of Iowa's water trail program, parking areas should be designed to minimize landscape disruption and stream impact while accommodating users.

To create paddler-friendly parking areas, designers should:

- Consider including loading lanes.
- Allow generous-sized parking stalls to ease movement between vehicles and water.
- Place staging areas either adjacent to parking or near the water's edge. These areas are used to assemble gear and put on personal flotation devices.
- Route walking trails between parking areas and launches that make it easy to carry gear and boats.

With these general guidelines in mind, this section provides more detail, including how to select parking sites, design guidelines of the parking area, stormwater management guidelines, and construction notes for parking areas.



## SELECTING PARKING SITES

The location and character of areas selected for parking directly affect the cost of construction and the impact on habitat. Always locate parking in areas that do not flood frequently. Parking areas should be set back at least 50 feet from the top of streambanks whenever possible. This 50-foot buffer is measured from the top of the streambank to the closest edge of the parking area. The buffer area remains at the existing grade and includes unmown, native vegetation to filter runoff from the parking area and screen views from the water.

Select parking areas that minimize both vegetation removal and the amount of earthwork needed. Remove only the minimum amount of vegetation necessary to accommodate parking and launch construction, including large trees, shrubs and groundcover layers. Avoid widespread clearing of vegetation and removal of forest leaf litter. Parking areas typically have slopes of 2 percent to 5 percent. Select sites with existing slopes in this range to reduce earthwork, cost, and impact.

Wetland areas are critical nodes in the remaining habitat in Iowa and are federally protected by the Clean Water Act. Like any other type of construction, water trail construction that disrupts wetlands requires mitigation if the wetland is more than 1/10 of an acre in size. Disruption includes filling, leveling, draining, or other manipulation that directs stormwater drainage into them. These wetlands along streams and at lake edges in Iowa are not always easy to identify. If wetland areas are common or suspected in the region, obtain a professional wetland determination report for the launch and parking areas before developing construction plans or seeking funding for construction. U.S. Army Corps of Engineers wetland scientists, as well as trained wetland delineation consultants, are available in Iowa.

## PARKING DESIGN

Drainage is a special concern in parking and launch areas. Reshape the land surrounding parking and launch areas so water from the rest of the site does not drain across these areas (Figure 3B-1). Also, drainage from the parking area or site in general should not drain into the stream through the launch ramp (Figure 3B-2). Ensure that parking area drainage is treated for water-quality enhancement before it reaches the stream by incorporating stormwater management practices included in this section of the manual.

Develop a plan to reestablish vegetation around the edges of the parking and launch areas disturbed during construction. Native vegetation, rather than lawn grasses, is recommended at launch sites. Information relating to vegetation is provided in Chapter 4 of this manual.

Drivers need clear delineation of the intended limits of parking areas. However, people prefer the visual appearance of rock and wood materials rather than concrete to create edges. Posts and cable are effective and visually non-obtrusive. Also use parking stops and other edging that disperse rather than concentrate stormwater flow.

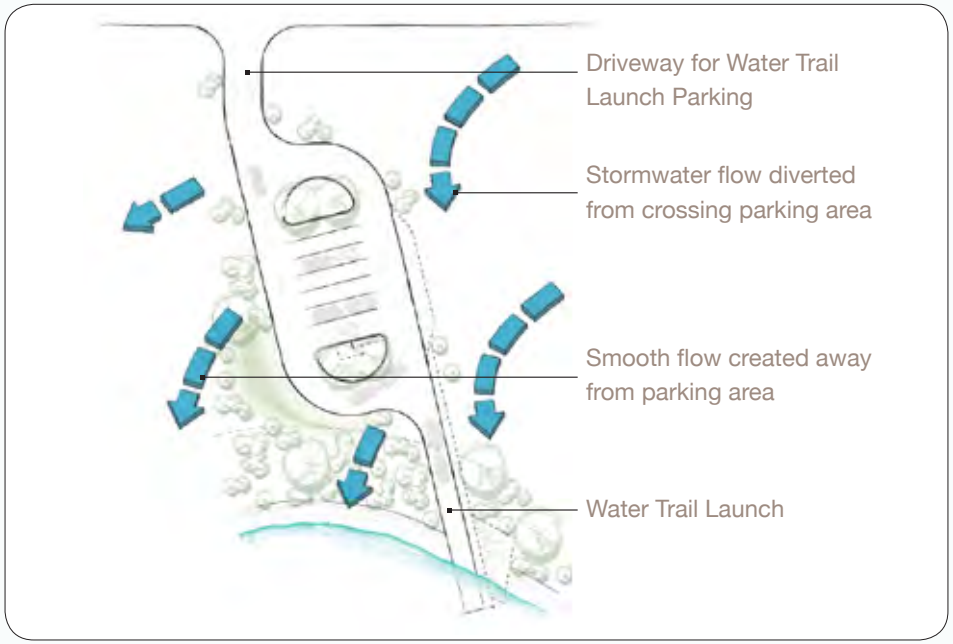



**Figure 3B-1.**
Stormwater Flow Near Parking Area

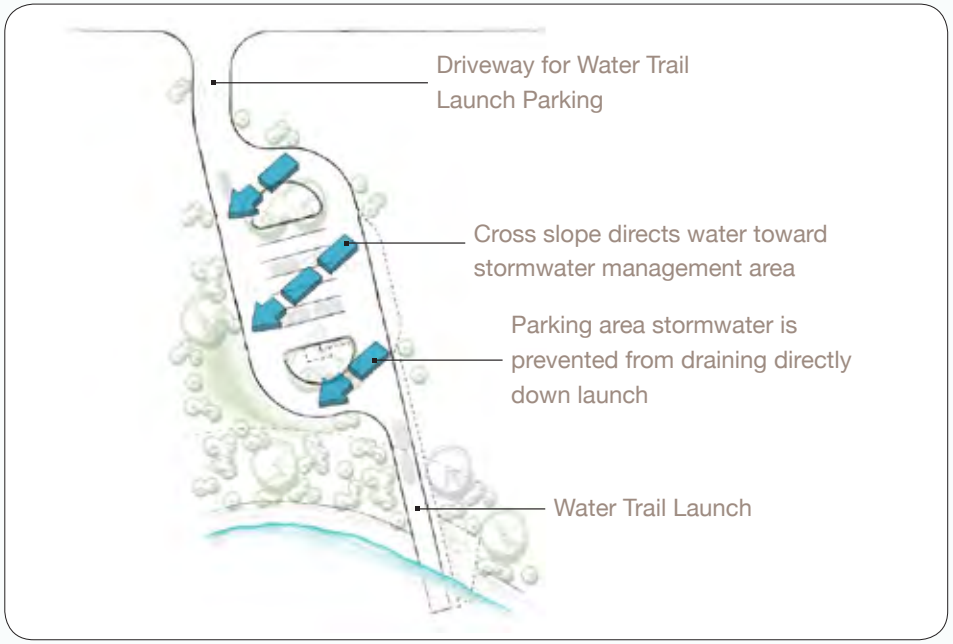



**Figure 3B-2.**
Stormwater Flow From Parking Area

Create generous-sized parking stalls to accommodate boats, gear, and people. Plan standard parking stalls to be 10 feet wide and 20 feet long. Design details are provided in this manual for carry-down water access, as well as for a traditional, trailered vehicle launch. Templates for 5- to 12-stall designs are included. Templates can easily be expanded to include additional cars based on specific site requirements. All public parking areas require a minimum of one designated, van-accessible parking stall meeting ADA requirements. Stalls meeting van-accessible ADA requirements must be 16 feet wide and 20 feet long. Parking areas serving universal design launches larger than 25 stalls require two or more van accessible stalls (Table 3B-1). Consider use of compacted limestone fines for accessible sections of parking areas not constructed with concrete or asphalt. Materials used successfully for this purpose include a gradation of ¾-inch rock to fines spread, compacted, and wetted in layers.

| Total Number of Stalls in Parking Area | Required Minimum Number of Van-Accessible ADA Spaces |
|---|---|
| 1 to 25 | 1 |
| 26 to 50 | 2 |
| 51 to 75 | 3 |
| 76 to 100 | 4 |

**Table 3B-1.**
Determining Parking Stall Counts

A staging area adjacent to either van-accessible ADA parking stalls or a loading lane is required at universal design launch areas (Figure 3C-6). This area accommodates unloading and loading of people, assistive devices, and gear.

Trailers carrying multiple kayaks or canoes are becoming common at state-designated launches. Note that all parking areas include a vehicle turnaround option and accommodate at least one parallel-parking stall for a vehicle with a trailer. The impact and cost of the parking surface added by these elements are minimal when compared with the safety hazards created when they aren't present. If they aren't accommodated within a parking area, trailered vehicles will unload and park on adjacent road shoulders and drive entrances, creating unsafe conditions for other drivers, as well as pedestrians.

## MINIMUM PARKING AREA DESIGN WITH BOAT CARRY-DOWN ACCESS

Consider mown grass or aggregate surfacing for parking surface to increase stormwater infiltration rates, particularly in remote and other low-use areas (Figure 3B-3).

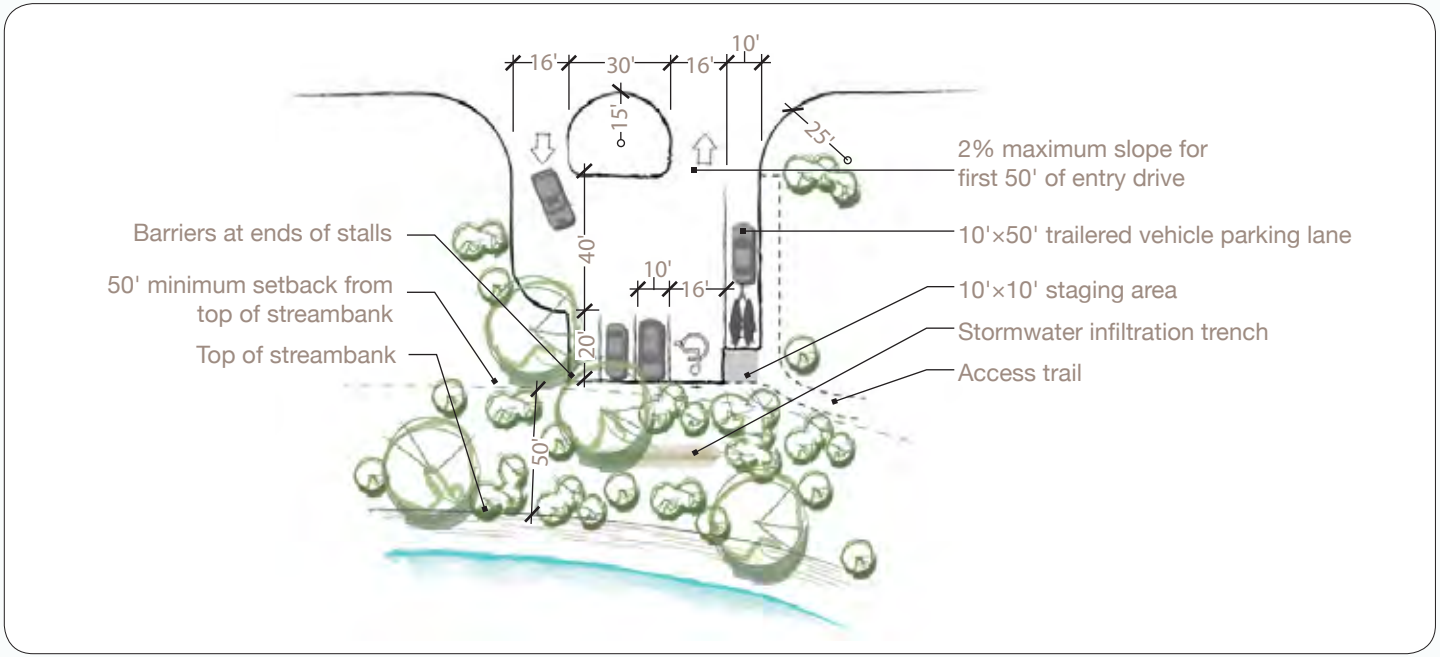
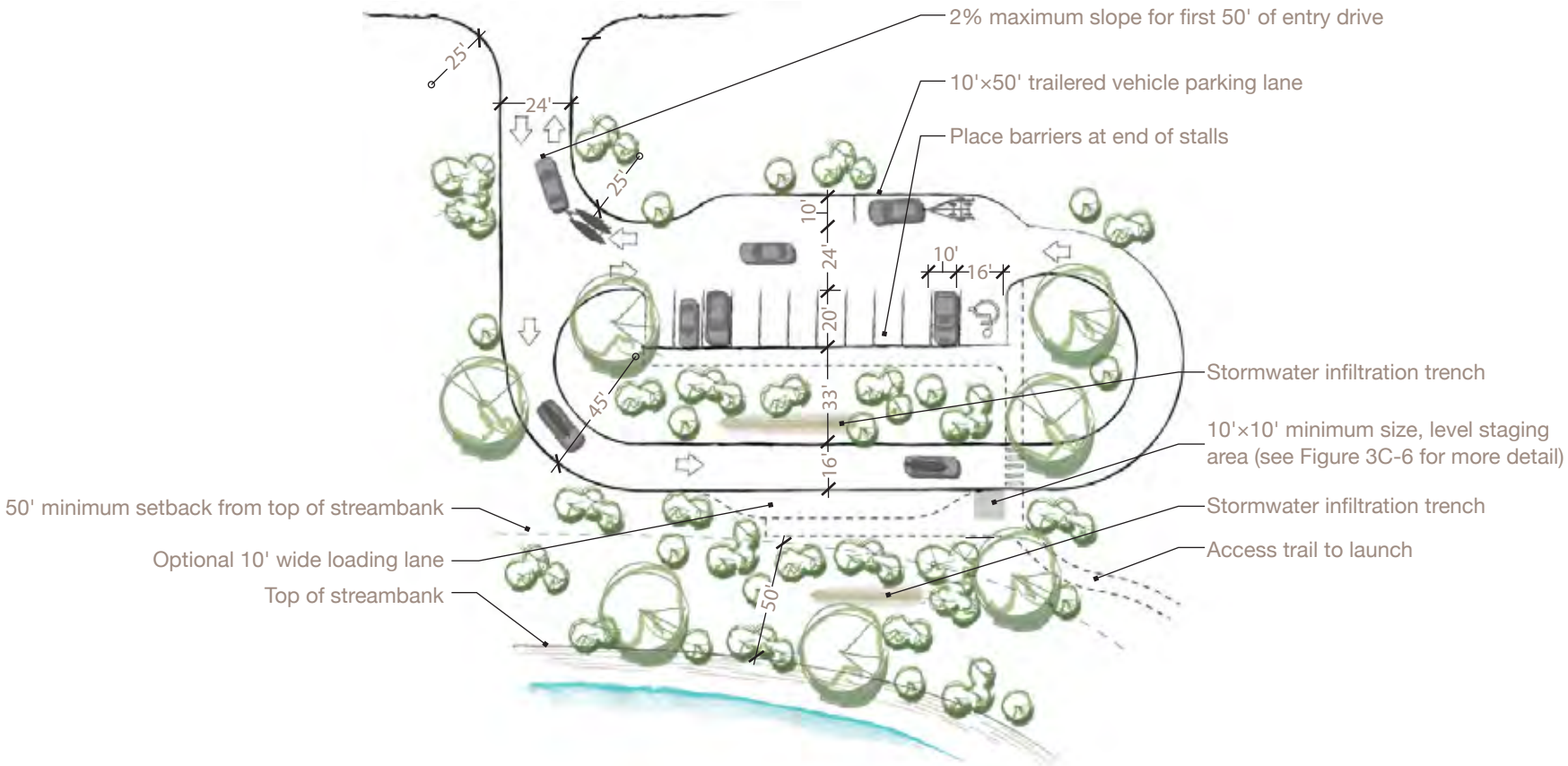



**Figure 3B-3.**
Minimum Parking Area Design with Boat Carry-Down Access

# 12-VEHICLE PARKING AREA DESIGN WITH LOADING LANE

Loading lanes allow vehicles to unload gear and people before parking and without blocking traffic. This lane is particularly useful for paddlers when parking cannot be accommodated near the stream. This design is also desirable because it avoids dead-end parking (Figure 3B-4).

**Figure 3B-4.**
Vehicle Parking Area Design with Loading Lane



# 7- OR 12-CAR PARKING AREA, VEHICLE LAUNCH DESIGN

This design configuration allows either traditional vehicle parking or boat trailer pull-through parking. An optional tie-down lane is recommended at high-traffic launches. Ensure that drives and parking areas use a minimum 45-foot outside turning radius to accommodate a bus with trailer for drop-off and pickup, as well as emergency vehicles (Figure 3B-5).

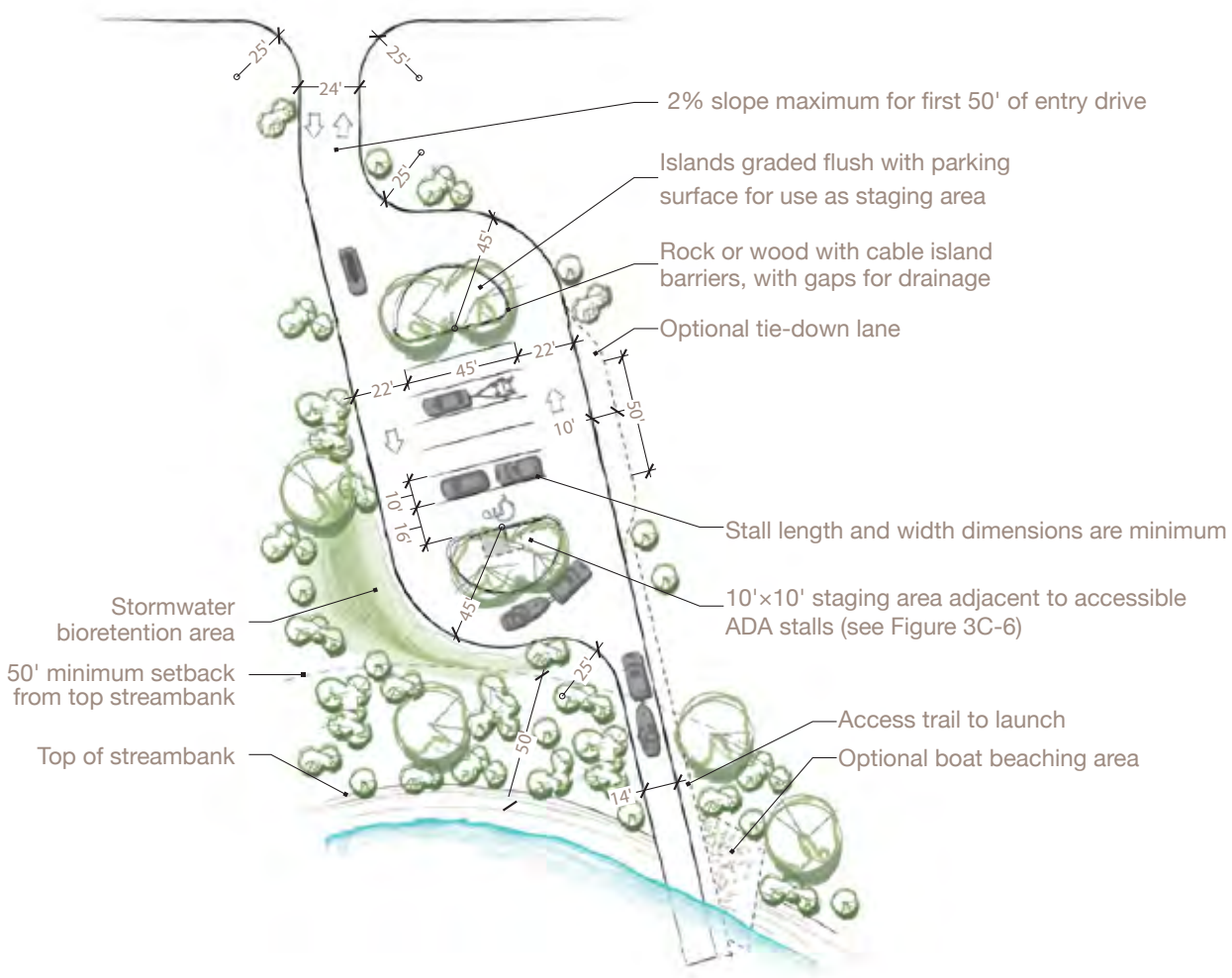



**Figure 3B-5.**
7- or 12-Car Parking Area, Vehicle Launch Design

## STORMWATER MANAGEMENT ON-SITE

The goal of the Iowa Water Trail program is to minimize impact to water resources from construction of amenities serving water trail recreation. Changes in drainage resulting from parking areas, even gravel or mown grass surfaces, impact streambank and channel stability, particularly when located in near-stream areas. The goal is to capture and treat water from parking areas during 1.25-inch storm events before it reaches streams when site conditions permit. This amount of runoff is known as the water-quality volume and in Iowa is the most common type of rain event containing the majority of pollutants from surfaces such as parking. Stormwater management design is based on the Iowa Urban Stormwater Manual engineering standards.

Stormwater can be either infiltrated, where conditions allow, or filtered before reaching adjacent water bodies. Infiltration and filtration areas can be located within the 50-foot buffer between parking and the top of the streambank. Use Table 3B-2 to determine which alternative is most appropriate.

**Table 3B-2.**
Site Conditions for Stormwater Management

| Infiltration is Most Appropriate | Vegetated Filter is Most Appropriate |
|---|---|
| Seasonal water table is > 4’ deep | Seasonal water table is < 4’ deep |
| Does not flood frequently | Floods frequently |
| Surface and underlying soils are NRCS Hydrologic Group A, B, or C | Surface and underlying soils are NRCS Hydrologic Group D |
| Slope is < 15% | Slope is > 15% |

## INFILTRATION DESIGN

Final calculated size and design of infiltration structures use Iowa Stormwater Management Manual formulas and processes. Two infiltration designs are generally applicable to standard water trail launch conditions: infiltration trenches (Figure 3B-6 and Chapter 2E-2 Iowa Stormwater Management Manual) and bioretention areas (Figure 3B-7 and Chapter 2E-4 Iowa Stormwater Management Manual).

An estimate of the size of the area needed to infiltrate the water-quality volume from a parking area can be calculated using the following process:

(Size of parking area in square feet x runoff volume coefficient x designated rain volume storage in inches) / 12 = cubic feet of water storage space needed

The following example assumes a 12,400-square-foot parking area with aggregate surfacing (runoff coefficient of 0.95) and 1.25 inches of rainfall volume:

(12,400 x 0.95 x 1.25) / 12 = 1,227 cubic feet of storage needed to accommodate the water quality volume.

For **underground infiltration trench treatment** (Figure3B-6), convert cubic feet needed to size of area needed using the following process:

Cubic feet of water storage volume needed / (aggregate void space x trench depth in feet) + (infiltration rate in inches/hour x drain time in hours) / 12

The following example uses 1,227 cubic feet in needed storage from above and assumes an 8’ deep trench, a 0.35 aggregate void space, a soil infiltration rate of 0.5 inches/hour, and a 72-hour drainage time:

1,227 / [(0.35 x 8) + (0.5 x 72/12)] = 211 sq. ft. (a 10’ x 21’ area, for example)

For **planted bioretention infiltration treatment** (Figure 3B-7), convert cubic feet of water storage volume to basin size by selecting a basin depth. The following example uses 1,227 cubic feet in needed storage from above and assumes an 8” (0.67 feet) deep basin:

1,227 / 0.67 = 1831 sq. ft. (a 10’ x 183’ area, for example)

Both forms of infiltration require construction of a stable drainage outflow to accommodate overflow exceeding the design capacity. Drainage would use this outflow when storms exceed the 1.25-inch design.

Native plants suitable for bioretention basins are included in Table 3B-3.

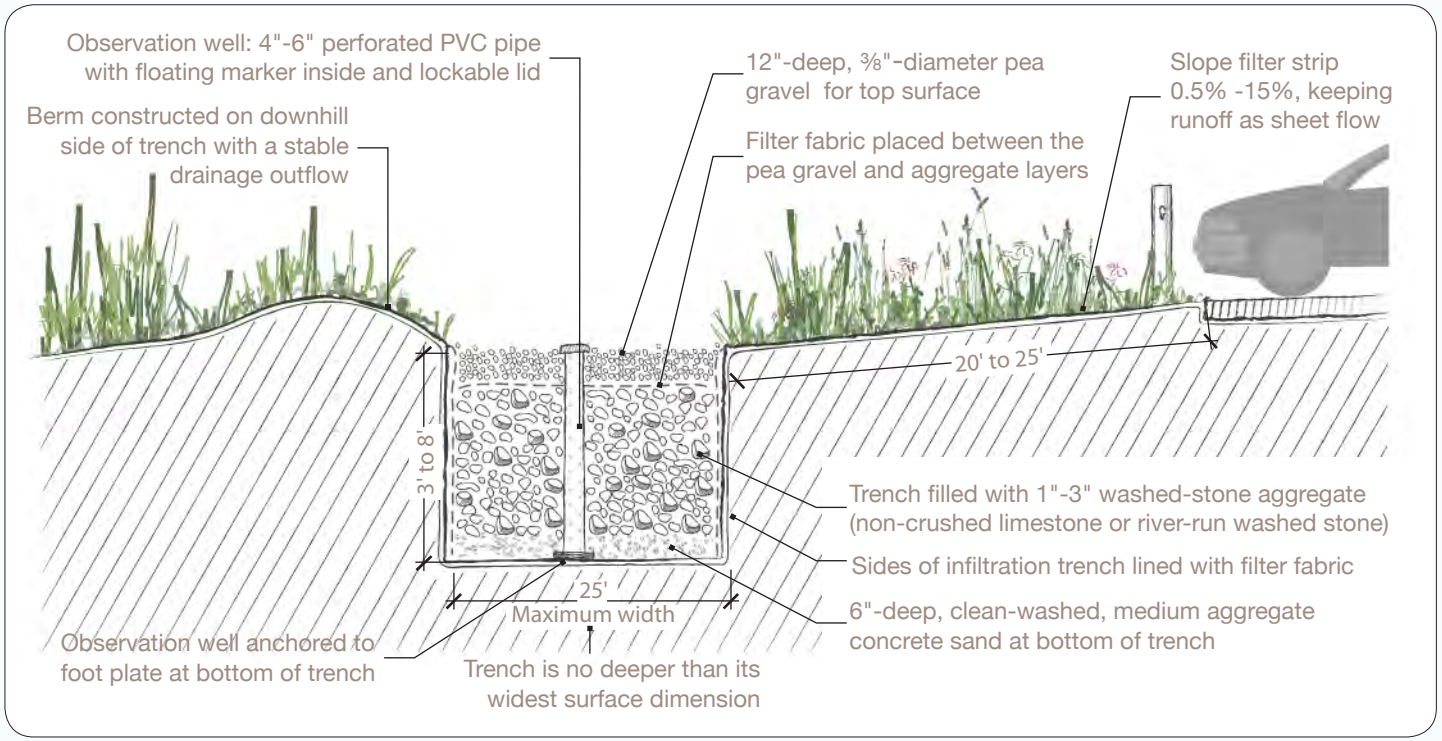



**Figure 3B-6.**
Infiltration Trenches

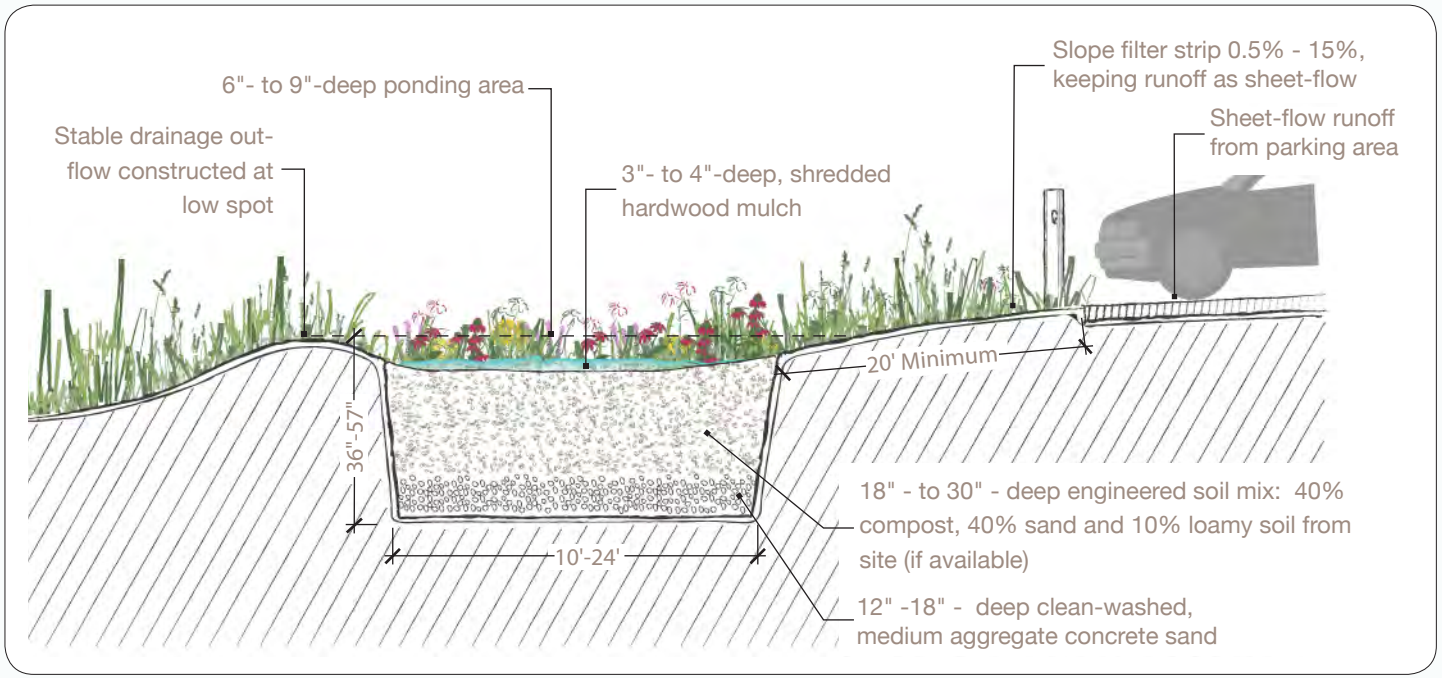



**Figure 3B-7.**
Bioretention Areas

## Plants for Bottom (Low Spot) of Bioretention Basin, Most Wet Soils in Vegetated Filter Strips

| Common Name | Botanical Name | Exposure | Height |
|---|---|---|---|
| Buttonbush | Cephalanthus occidentalis | Sun, Part Shade | 48" – 72" |
| Elderberry | Sambucus canadensis | Sun | 48" – 72" |
| Big bluestem | Andropogon gerardii | Sun | 48" – 72" |
| Sweet joe-pye weed | Eupatorium purpureum | Sun, Part Shade, Shade | 48" – 72" |
| Switchgrass | Panicum virgatum | Sun | 48" – 72" |
| Goldenglow | Rudbeckia laciniata (nitida) | Sun, Part Shade | 48" – 72" |
| Indian grass | Sorghastrum nutans | Sun | 48" – 72" |
| Tall purple rue | Thalictrum dasycarpum | Part Shade, Shade | 48" – 72" |
| Swamp milkweed | Asclepias incarnata | Sun, Part Shade | 36" – 48" |
| Blue false indigo | Baptisia australis | Sun, Part Shade | 36" – 48" |
| Ox-eye sunflower | Heliopsis helianthoides | Sun, Part Shade | 36" – 48" |
| Meadow blazing star | Liatris ligulistylis | Sun, Part Shade | 36" – 48" |
| Prairie blazing star | Liatris pycnostachya | Sun | 36" – 48" |
| Bee balm | Monarda didyma | Sun, Part Shade | 24" – 48" |
| Common ironweed | Vernonia fasciculata | Sun, Part Shade | 36" – 48" |
| Lady fern | Athyrium filix-femina | Part Shade, Shade | 24" – 36" |
| Fringed sedge | Carex crinita | Sun, Part Shade, Shade | 24" – 36" |
| Common fox sedge | Carex stipata | Sun, Part Shade, Shade | 24" – 36" |
| Brown fox sedge | Carex vulpinoidea | Sun, Part Shade | 24" – 36" |
| Turtlehead | Chelone glabra | Sun, Part Shade, Shade | 24" – 36" |
| Cardinal flower | Lobelia cardinalis | Part Shade, Shade | 24" – 36" |
| Great blue lobelia | Lobelia siphilitica | Sun, Part Shade | 24" – 36" |
| Bottlebrush sedge | Carex comosa | Sun | 12" – 24" |
| Palm sedge | Carex muskingumensis | Part Shade, Shade | 12" – 24" |
| Broom sedge | Carex scoparia | Sun | 12" – 24" |
| Common rush | Juncus effusus | Sun, Part Shade | 12" – 24" |
| Ohio spiderwort | Tradescantia ohioensis | Sun, Part Shade | 12" – 24" |
| Path rush | Juncus tenuis | Sun | 6" – 12" |

**Table 3B-3.**
Native Plants for Bioretention and Filter Strips

**Table 3B-3 continued.**
Native Plants for Bioretention and Filter Strips

## Plants for Bioretention Side Slopes and Combination Wet/Dry Soils in Vegetated Filter Strips

| Common Name | Botanical Name | Exposure | Height |
|---|---|---|---|
| American hazelnut | Corylus americana | Sun, Part Shade | 10’ – 15’ |
| American cranberrybush | Viburnum opulus var. americanum | Sun, Part Shade | 10’ – 15’ |
| Blackhaw viburnum | Viburnum prunifolium | Sun, Part Shade | 10’ – 15’ |
| Arrowwood viburnum | Viburnum dentatum | Sun, Part Shade | 6’ – 10’ |
| Black chokeberry | Aronia melanocarpa var. elata | Sun, Part Shade | 36” – 72” |
| Big bluestem | Andropogon gerardii | Sun | 48” – 72” |
| White goat’s beard | Aruncusdioicus | Sun, Part Shade | 48” – 72” |
| Sweet joe-pye weed | Eupatorium purpureum | Sun, Part Shade, Shade | 48” – 72” |
| Switchgrass | Panicum virgatum | Sun | 48” – 72” |
| Ninebark | Physocarpus opulifolius | Sun, Part Shade | 48" – 72" |
| Indian grass | Sorghastrum nutans | Sun | 48" – 72" |
| Blue false indigo | Baptisia australis | Sun, Part Shade | 36" – 48" |
| Ox-eye sunflower | Heliopsis helianthoides | Sun, Part Shade | 36" – 48" |
| Prairie blazing star | Liatris pycnostachya | Sun | 36" – 48" |
| Gray-headed prairie coneflower | Ratibida pinnata | Sun, Part Shade | 36" – 48" |
| Purple coneflower | Echinacea purpurea | Sun, Part Shade | 24" – 48" |
| Lady fern | Athyrium filix-femina | Part Shade, Shade | 24" – 36" |
| Brown fox sedge | Carex vulpinoidea | Sun, Part Shade | 24" – 36" |
| Rough blazing star | Liatris aspera | Sun | 24" – 36" |
| Great blue lobelia | Lobelia siphilitica | Sun, Part Shade | 24" – 36" |
| Little bluestem | Schizachyrium scoparium | Sun, Part Shade | 24" – 36" |
| Showy goldenrod | Solidago speciosa | Sun, Part Shade | 24" – 36" |
| Common yarrow | Achillea millefolium | Sun | <6" – 24" |
| Aromatic aster | Aster oblongifolius | Sun, Part Shade | 12" – 24" |
| Sideoats grama | Bouteloua curtipendula | Sun | 12" – 24" |
| Wild geranium | Geranium maculatum | Part Shade, Shade | <6" – 24" |
| Goldenrod cultivars | Solidago cultivars | Sun, Part Shade | 12" – 24" |

**Table 3B-3 continued.**
Native Plants for Bioretention and Filter Strips

## Plants for Top Edge of Bioretention Side Slopes and Driest Soils in Vegetated Filter Strips

| Common Name | Botanical Name | Exposure | Height |
|---|---|---|---|
| Black chokeberry | Aronia melanocarpa var. elata | Sun, Part Shade | 36” – 72” |
| Ninebark | Physocarpus opulifolius | Sun, Part Shade | 48” – 72” |
| Boltonia | Boltonia asteroides | Sun | 36” – 48” |
| Purple coneflower | Echinacea purpurea | Sun, Part Shade | 24” – 48” |
| Leadplant | Amorpha canescens | Sun | 24” – 36” |
| Butterfly milkweed | Asclepias tuberosa | Sun, Part Shade | 24” – 36” |
| Narrow-leaved coneflower | Echinacea angustifolia | Sun | 24” – 36” |
| Little bluestem | Schizachyrium scoparium | Sun, Part Shade | 24” – 36” |
| Prairie dropseed | Sporobolus heterolepis | Sun | 24” – 36” |
| Common yarrow | Achillea millefolium | Sun | 12” – 24” |
| American columbine | Aquilegia canadensis | Sun, Part Shade | 12” – 24” |
| Heath aster | Aster ericoides | Sun | 12” – 24” |
| Aromatic aster | Aster oblongifolius | Sun, Part Shade | 12” – 24” |
| Sideoats grama | Bouteloua curtipendula | Sun | 12” – 24” |
| Blue grama | Bouteloua gracilis | Sun | 12” – 24” |
| Purple prairie clover | Dalea purpurea | Sun | 12” – 24” |
| Goldenrod cultivars | Solidago cultivars | Sun, Part Shade | 12” – 24” |
| Wild petunia | Ruellia humilis | Sun, Part Shade | <6” – 12” |
| Purple poppy mallow | Callirhoe involucrata | Sun | <6” |

# FILTRATION DESIGN —VEGETATED FILTER STRIP

Filter strips are located on the contour and perpendicular to the direction of flow (Figure 3B-8). Ideally filter strips are located on 2 percent to 6 percent slopes. The entire width of the parking area must be drained evenly across the filter-strip width. A maximum width of 75 feet of parking area can be drained across a properly sized filter strip. Parking area drainage in excess of 75 feet requires multiple filter strips.

The minimum width of filter strips is 20 feet. See Table 3B-4 for required dimensions. The goal for vegetation in the filter strip is to include the densest arrangement of plant stems possible. Native grasses are excellent on sites with full sun exposure. Shady sites require a combination of native tree, shrub, and herbaceous plant species.

Native plants suitable for vegetated filter strips are listed in Table 3B-3.

**Table 3B-4.**
Vegetated Filter Strip Design Width (adapted from Table 1, Chapter 2I-4, Iowa Stormwater Management Manual).

| | Slope of Filter Strip Site | | |
|---|---|---|---|
| | < 2% | Between 2% and 6% | >6% |
| Minimum filter strip width | 20’ | 25’ | 40’ |

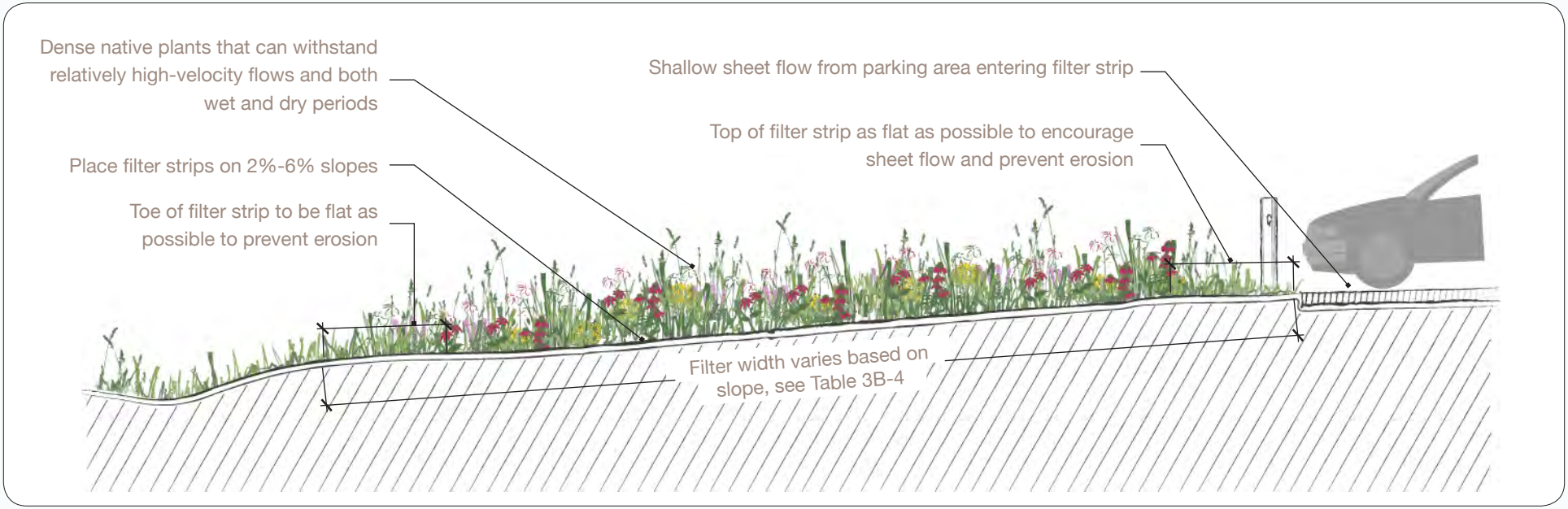



**Figure 3B-8.**
Vegetated Filter Strip

## DRAINAGE SWALES AND OUTFLOW DESIGN

Protect existing drainage patterns in the launch site. Alter swales only to the extent required to slow stormwater runoff and to reduce erosion created by the launch sites. If existing wetlands are identified adjacent to the launch site, ensure that stormwater is separated and not directed into these areas.

Use of piped stormwater conveyance is to be avoided at water trail launch sites, with the exception of culverts at the launch entrance drive. Use open drainage swales, rather than pipes and culverts, to convey drainage across the site toward the water body. Drainage swales are sized using Iowa Statewide Urban Designs and Specifications for open channels. Maximum swale slope is 6 percent. A mixture of warm- and cool-season grasses is recommended for establishment in swales.

Swales at slopes steeper than 6 percent require either V-notched weir, check dams, or drop structures. Willow-wall check dams and slope stabilization with vegetation and rock combination are described in Chapter 4.

## PARKING AND LAUNCH CONSTRUCTION

To minimize impact, construction should be completed as quickly as possible once it has begun. Organize construction so the amount of bare ground exposed at any one time is as small as possible and is exposed for the least amount of time. Establish permanent vegetation immediately after construction. All sediment from the construction area must be intercepted and removed before it reaches the stream or lake. Iowa regulations for construction-site erosion control are applicable for all water trail construction, including silt fence and mulching. Refer to Iowa Construction Site Erosion Control Manual for complete information.

## CONTACTS AND RESOURCES

Wetland Determination: Obtain a wetland determination report for potential launch sites before applying for funding. This work requires a trained wetland delineator who will determine whether any wetlands are present at or near the construction site. The U.S. Army Corps of Engineers provides this service free of charge and also maintains a list of trained consultants. Contact information:

U.S. Army Corps of Engineers District, Rock Island
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004
309-794-5376

Trail slope or steepness depends on existing topography. In general, the greater the slope, the more likely it is to cause erosion. Erosion can be significantly reduced by constructing trails that traverse slopes, rather than run down them. Low-slope segments are also friendlier than steep trails for water trail users.

- Parking-to-launch trail maximum slope should be 10 percent to the extent possible
- Portage trail maximum slope should be 12.5 percent to the extent possible
- Maximum trail cross slope should be 2 percent to the extent possible

Most trails, even those with low slopes, change surface drainage and have the potential to cause soil erosion. Eroded soil is one of the most common water pollutants in Iowa. While no trail design eliminates the possibility of introducing erosion, some design characteristics minimize the chance. Avoid using drainage culverts because they concentrate stormwater and form gullies. Use hard-surface crossings for small drainage amounts or small aboveground structures for larger volumes as alternatives. Establishing dense vegetation downslope of trails is advised because it slows and decreases stormwater runoff and increases stormwater infiltration.

Minimize the length of trail that drains to a specific low point, known as a dip (Figure 3C-1).

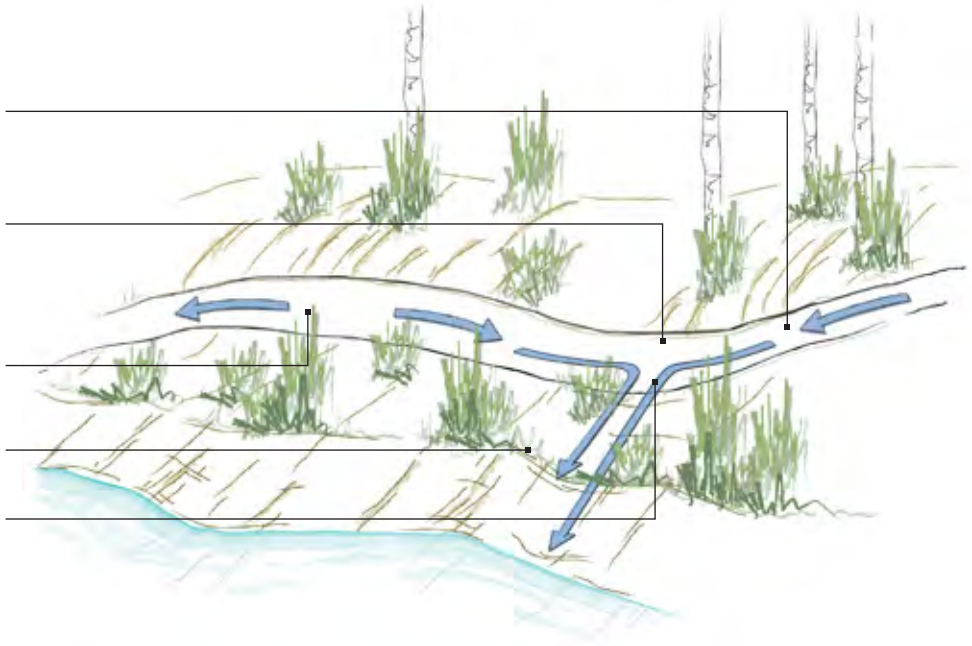



**Figure 3C-1.**
Trail Dip

Trails must accommodate water trail users carrying gear, boats, and safety devices. A trail width of 3 feet is the minimum needed to accommodate foot traffic in a single direction. A width of 6 feet better accommodates side-by-side passing and walking.

Trail surface material is typically selected based on the type of setting and management of the public land area, existing erosion issues or soil type issues, who will use the launch, the expected volume of use, and the construction budget. Natural-surface and aggregate trails are desirable when site conditions and volume of use are appropriate (Figure 3C-3). Hard-surface trails withstand heavy pedestrian use and are also the most accommodating to elderly and other users with mobility limitations (Figure 3C-2). Hard surfaces are also the most likely of any surface to generate erosion from stormwater runoff and are the most expensive to construct.

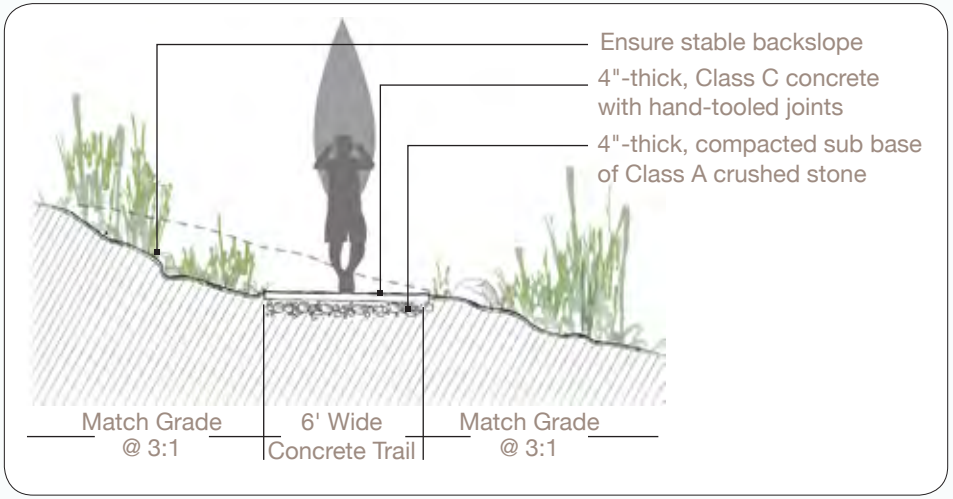
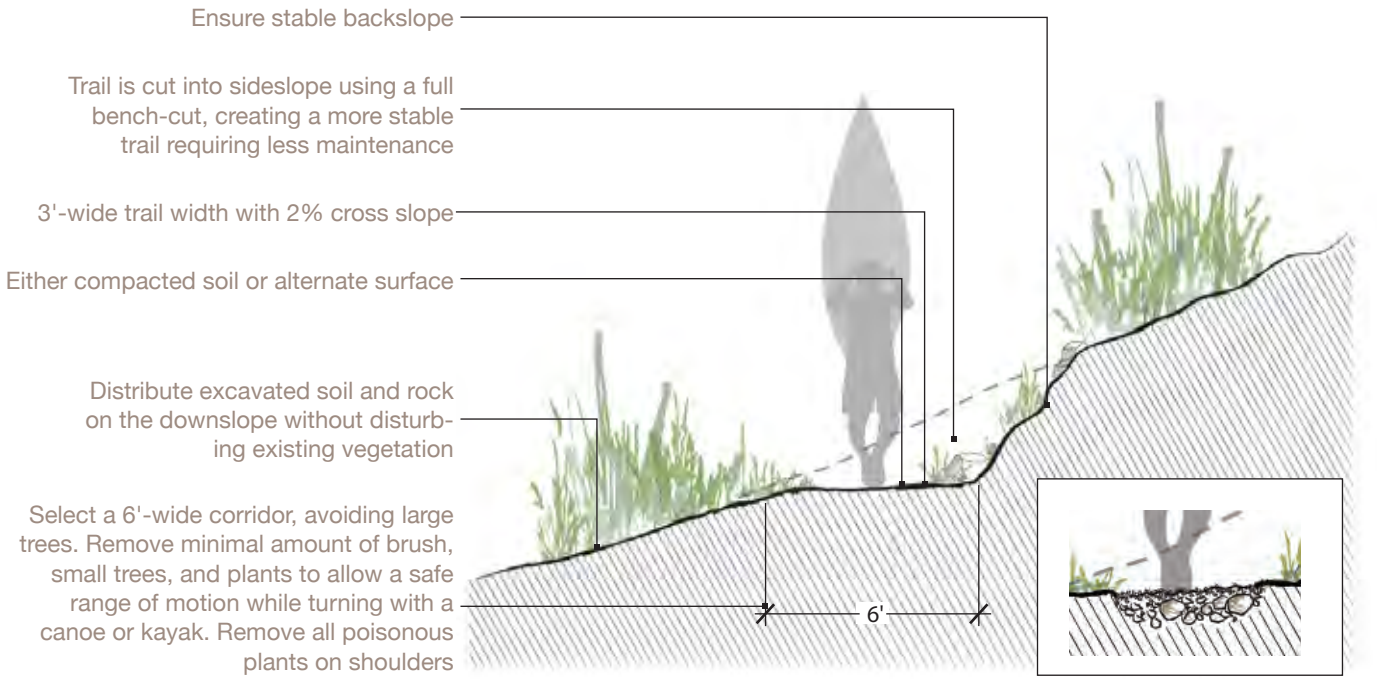



**Figure 3C-2.**
Typical Cast-In-Place Concrete Trail




**Alternate Aggregate Surface:**
Compact a 1" layer of 3/8" and finer limestone screenings over a 1" layer of 1" roadstone for tread surface over a 4-6" compacted base of 2-3" diameter roadstone, depending upon soil composition (loose composites needing the most depth)

**Figure 3C-3.**
Typical Full Bench-Cut Trail, Natural or Aggregate Surface

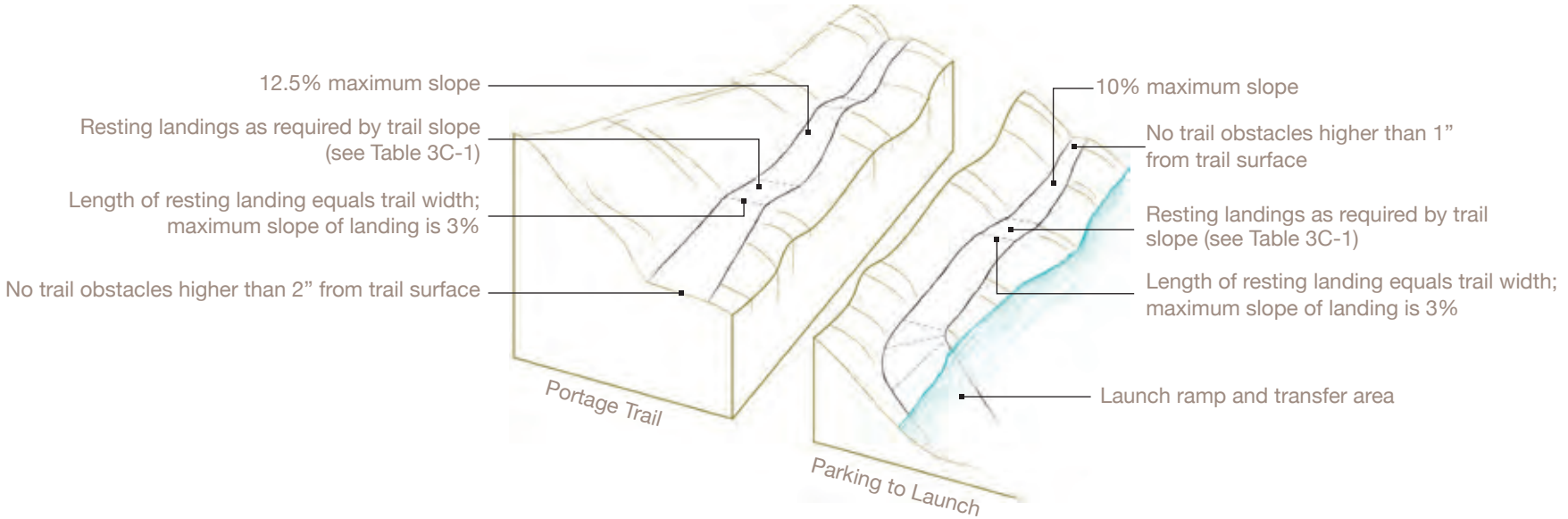



**Figure 3C-4.**
Accessible ADA Standards for Trail Slope

Water trail developers are encouraged to design and construct trails to meet Accessible ADA standards. Differences between accessible and non-accessible trails include slope, resting intervals, tread width, and height of protrusions. Figures 3C-4 and 3C-5 illustrate trail elements designed to meet ADA standards for accessible design.

Required resting intervals are a notable difference between accessible and non-accessible trails design. Resting intervals are near-level surfaces placed at varying distances based on trail slope (Table 3C-1). On water trail launches designed to meet universal design standards, a hard-surface staging area is required adjacent to either the accessible parking stalls or the loading lane (Figure 3C-6).

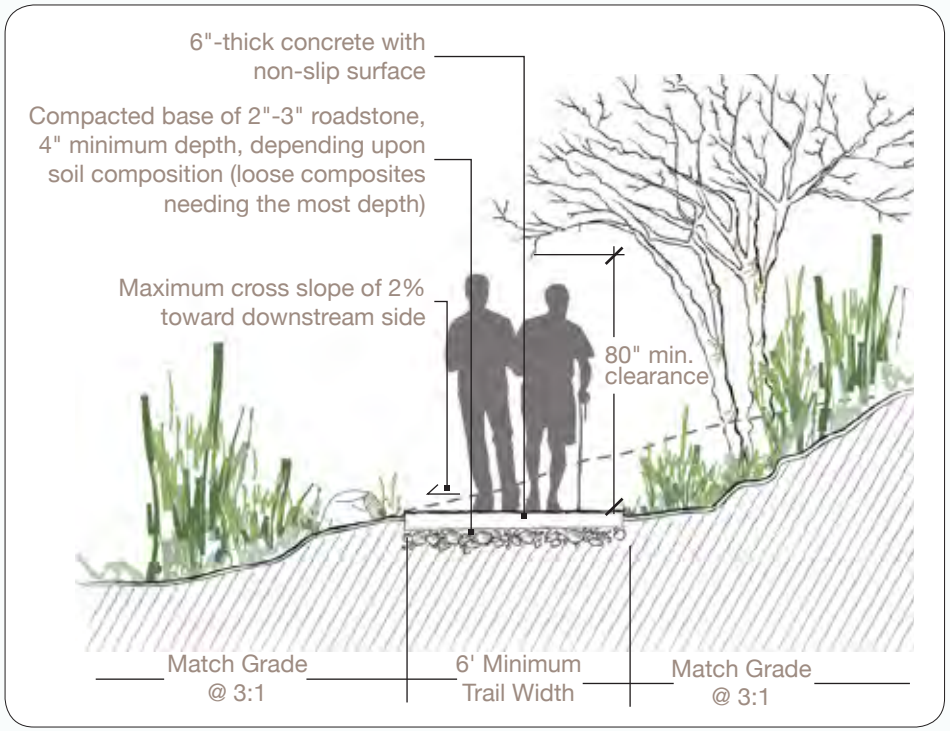



**Figure 3C-5.**
Typical Accessible ADA Trail

| Running Slope of Segment | Trail Types | | Maximum Length of Segment Before Resting Interval |
|---|---|---|---|
| | Parking to Launch Trail | Portage Trail | |
| 1%-5% | X | X | No resting intervals required |
| 5%-8% | X | X | 50' |
| 8%-10% | X | X | 30' |
| 10%-12.5% | | X | 10' |

**Table 3C-1.**
Trail Resting-Interval Standards for Accessible ADA Design

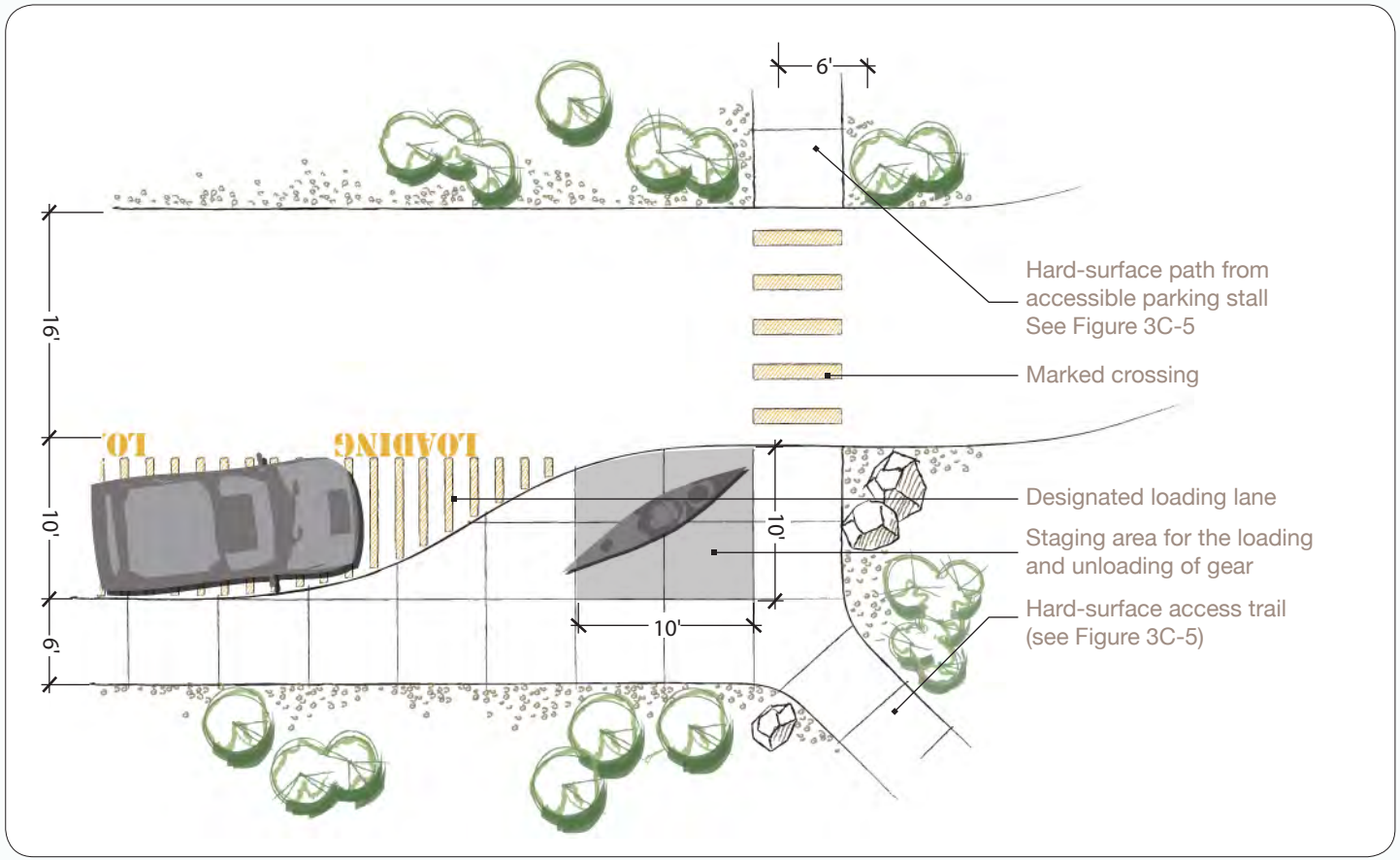



**Figure 3C-6.**
Staging Area for Universal Design Launch Areas

# 3D
# WATER ACCESS
# CAMPSITE GUIDELINES

## WATER TRAIL CAMPSITE LOCATIONS

Campsites should only be located in areas that are difficult to reach except by water and not near dwellings, or be within boundaries of an actively managed public recreation area such as a state or county park.

Campsites are to be located ¼ mile or more from all roads, or on opposite side of river to discourage non water trail use.

Traits of desirable sites: a) A short hike up a ridge via a sustainably designed trail can provide a drier site with breezes, fewer insects, and a nice view. b) Low terraces outside of the active floodplain can offer spots for large clusters. c) View and sound of water d) floods infrequently

Amenity level should correspond to desired experience type, although often infrequent maintenance and lack of restroom would put it in the Challenge or Wilderness category.

Use care not to disturb sensitive native species

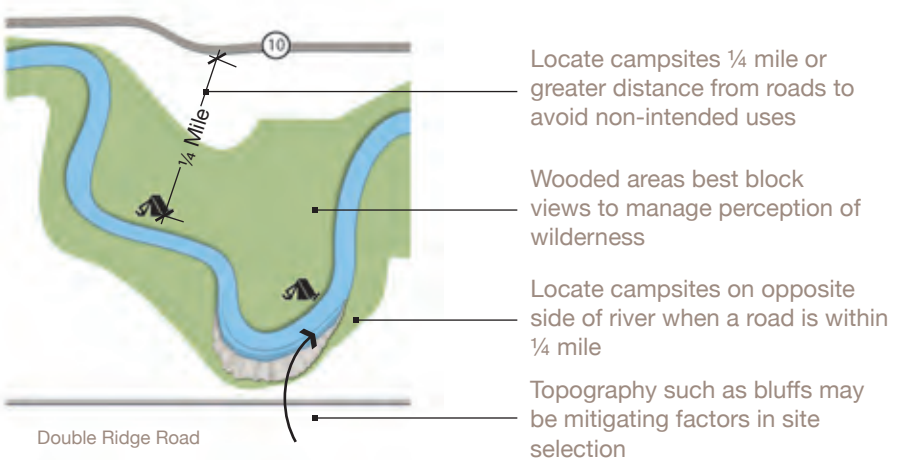



**Figure 3D-1.**
Water Access Campsites

## CLUSTER CAMPSITES

Clusters of shared amenities (fire ring, lantern post, benches, picnic tables, etc.) in a common area have side paths to secluded tent pads. A rolling-dip style trail (3' wide in this case) follows contours and minimal grades from the water's edge to generally flatter area on a ridge, under a wooded canopy, with the sound of rushing water at a riffle below. Campers will not walk through each other's areas to get to their own tents, and the trail does not bring traffic between the tent pads and their views.

Latrines or composting toilets may be considered if use is expected to be more than 200 visitors per season. Must be set back 200 feet from waters edge and out of the 100-year floodplain. Locate them away from common areas or tent pads. Usually, these would be open-air, perhaps with an intentionally planted vegetative screen or privacy fencing, depending upon the setting and experience type goals

Tent pad sites are to be a flat area with sizes between 5'×8' up to 14'×14'. These sites are to be grubbed and initally mulched with woodchips.

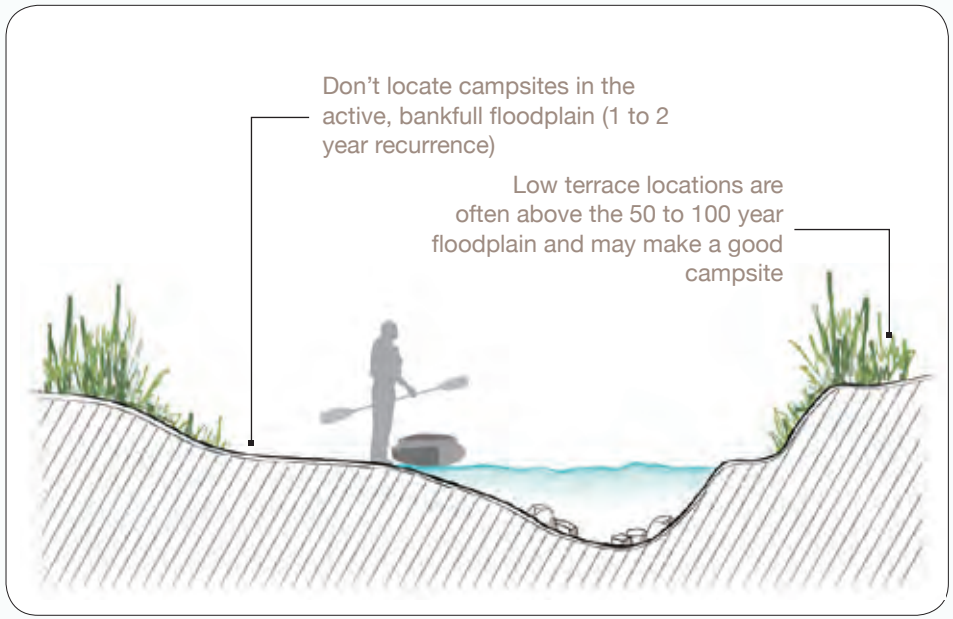



**Figure 3D-2.**
Campsite Location on Stable Streams

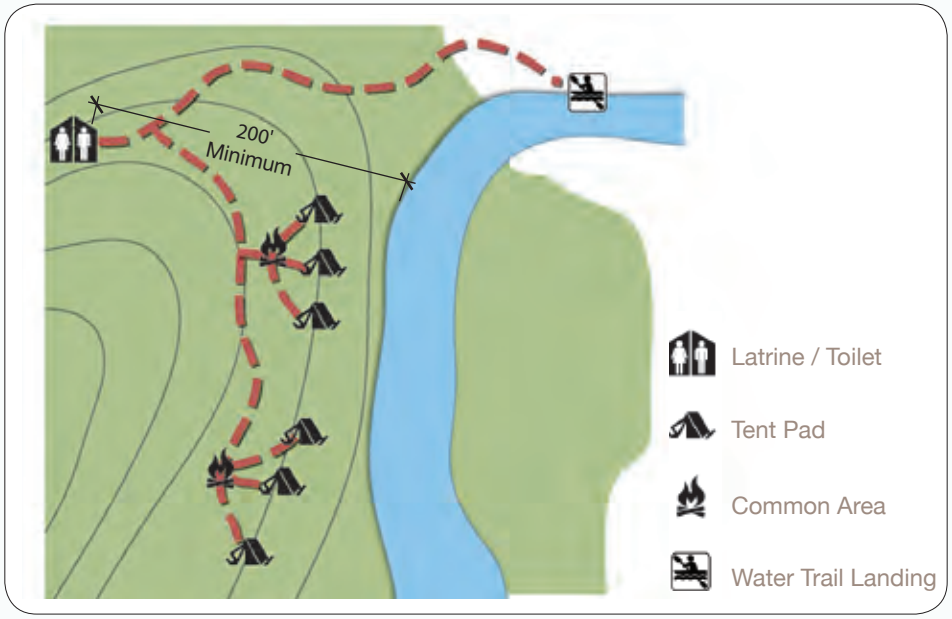



**Figure 3D-3.**
Cluster Campsites

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# Iowa Water Trails Program Sign Manual


Iowa Department of
Natural Resources

# Water Trail Sign Notes

For **state highways**, plan to work with the Iowa DOT for custom designed signs that meet specific typeface criteria. DOT will also install these signs. Both services are free, however, the signs themselves must be purchased by the water trail developer either from Prison Industries, a third-party vendor, or the Iowa DOT (~$8.50 per square foot).

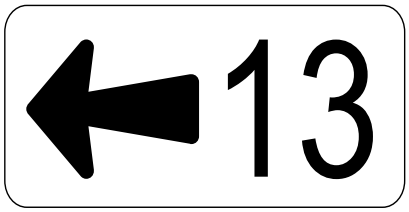
**Posts** should follow standards of the local public area. For example, all state parks require wooden posts. Many city parks use U-channel posts. Dam warning signs appear to be particularly prone to vandalism, and “DANGER DAM” signs should be fixed to posts a distance of 10 feet above the ground to avoid being easily scratched or marked. Purchase either 14” or 16” posts for that purpose.

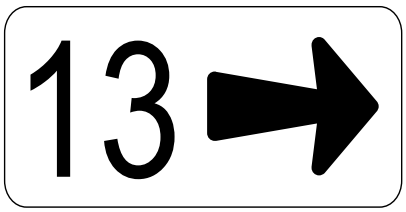
**Sign placement at dams** require special guidance. See illustrations on page 7.

For water trail developers, a **list of prices** is available from Prison Industries for budgeting purposes. Send an e-mail to watertrails2@dnr.state.ia.us to receive the most current version. Note that for developers using **Federal Recreational Trails** grants, Iowa DOT does not allow Prison Industries purchases and commercial sign vendors must be used.

Sign: Water Trail Name
Size: 12”x18”
Color: Blue, Pantone300C; Green, Pantone348C; Orange, 1665C
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 6”
Placement: At launch, or at intersections sharing post with wayfinding arrows for city/county roads


Sign: Wayfinding left and right arrows
Size: 12”x6”
Color: black on white
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 1”
Placement: at intersections sharing post below Water Trail Name sign for county/city roads

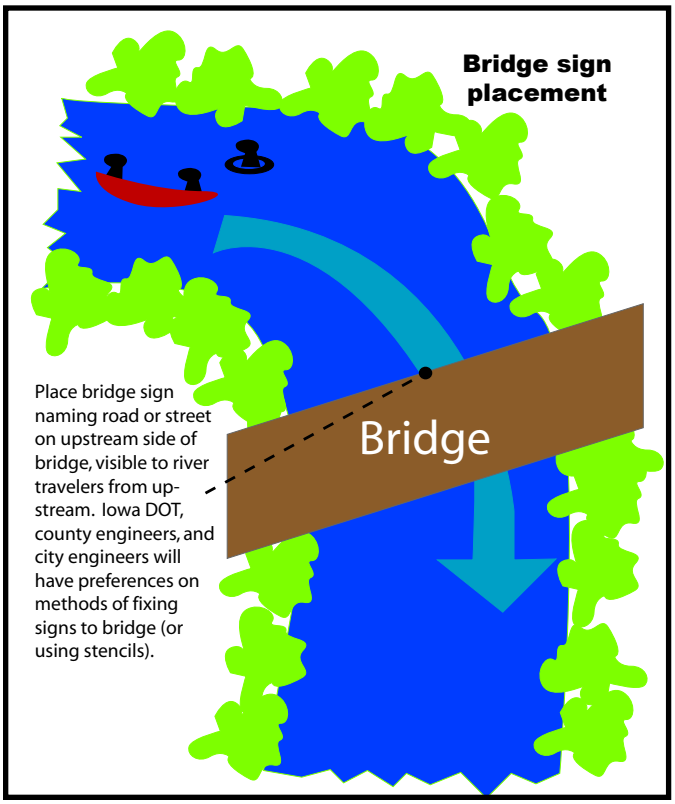




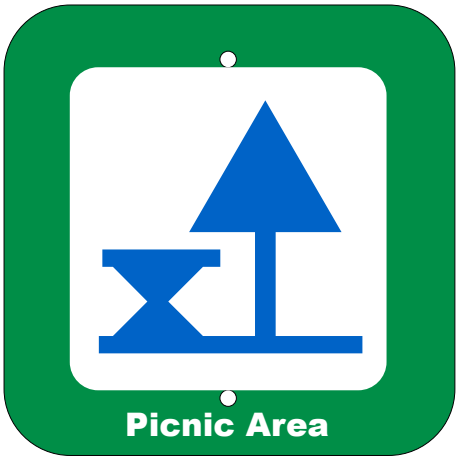
Sign: Access name/Distance to Next Access
Size: 12”x12”
Color: Blue, Pantone300C; Green, Pantone348C, on White
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 6”
Options: Canoe-only, or canoe with powerboat
Placement: At launch, can share post with Water Trail Name sign

# Martin Luther King Memorial Parkway



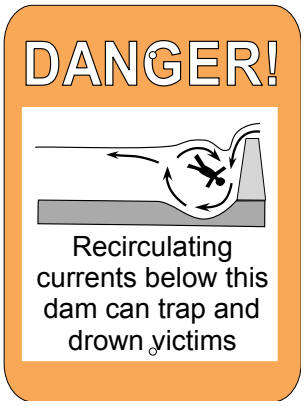

Sign: Bridge sign
Size: 66”x20”
Color: black on white
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: N/A
Options: Sign size may be adjusted for less or more text; Stencils may be used in lieu of this sign;



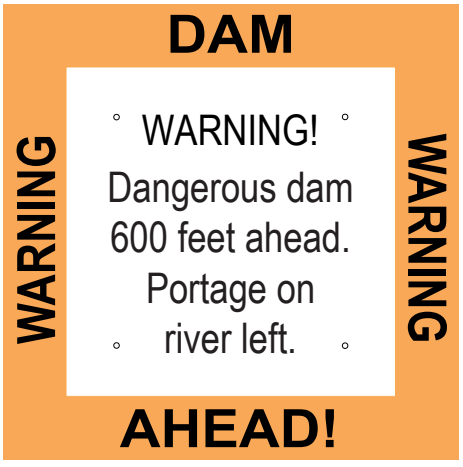



Sign: Amenities
Size: 12”x12”
Color: Blue, Pantone300C; White; (Red); on Green, Pantone348C
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 9”
Options: Canoe-only, or canoe with powerboat
Placement: At launch, can share post with Water Trail Name sign


Sign: DAM
Size: 36”X36”
Color: Orange, Black on White
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 9” from each side
Placement: Place near dam to be visible a minimum of 300 feet upstream; may be placed on cables across rivers or on posts if visible

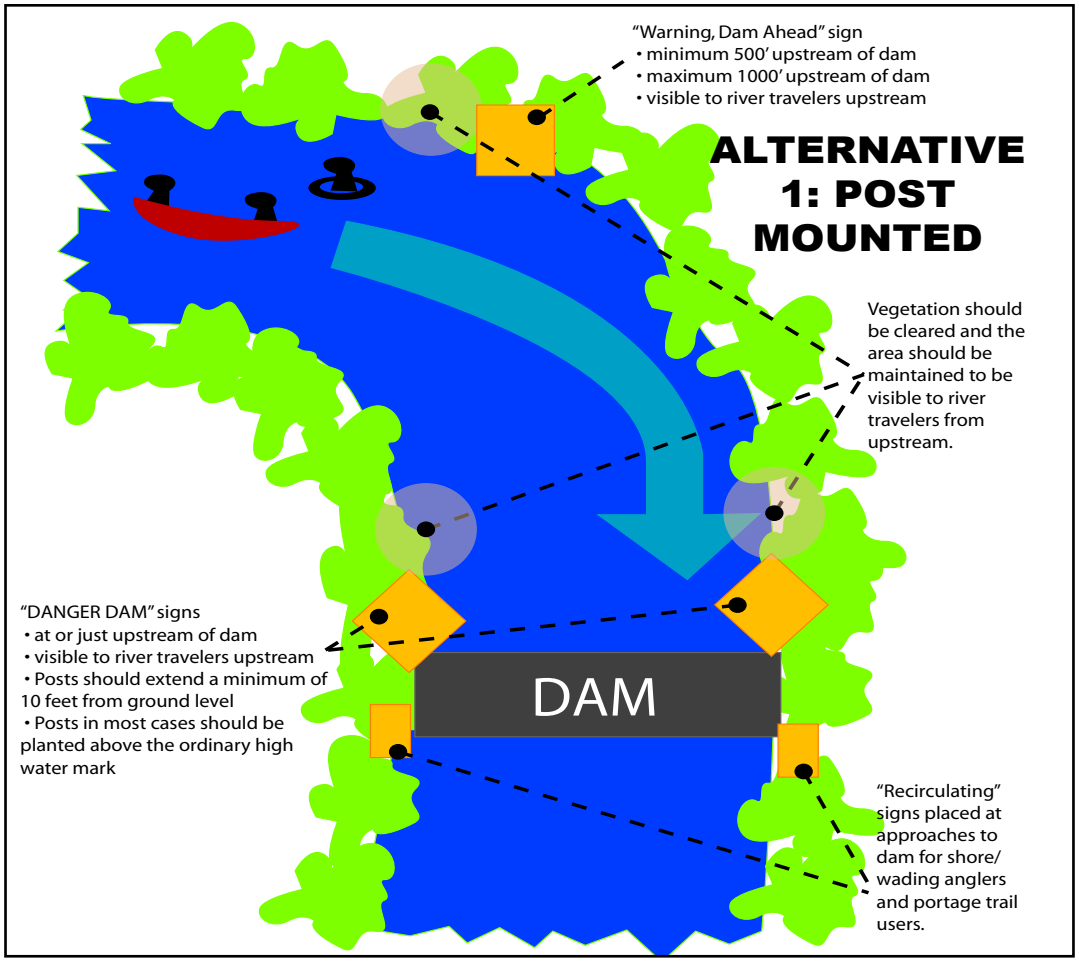


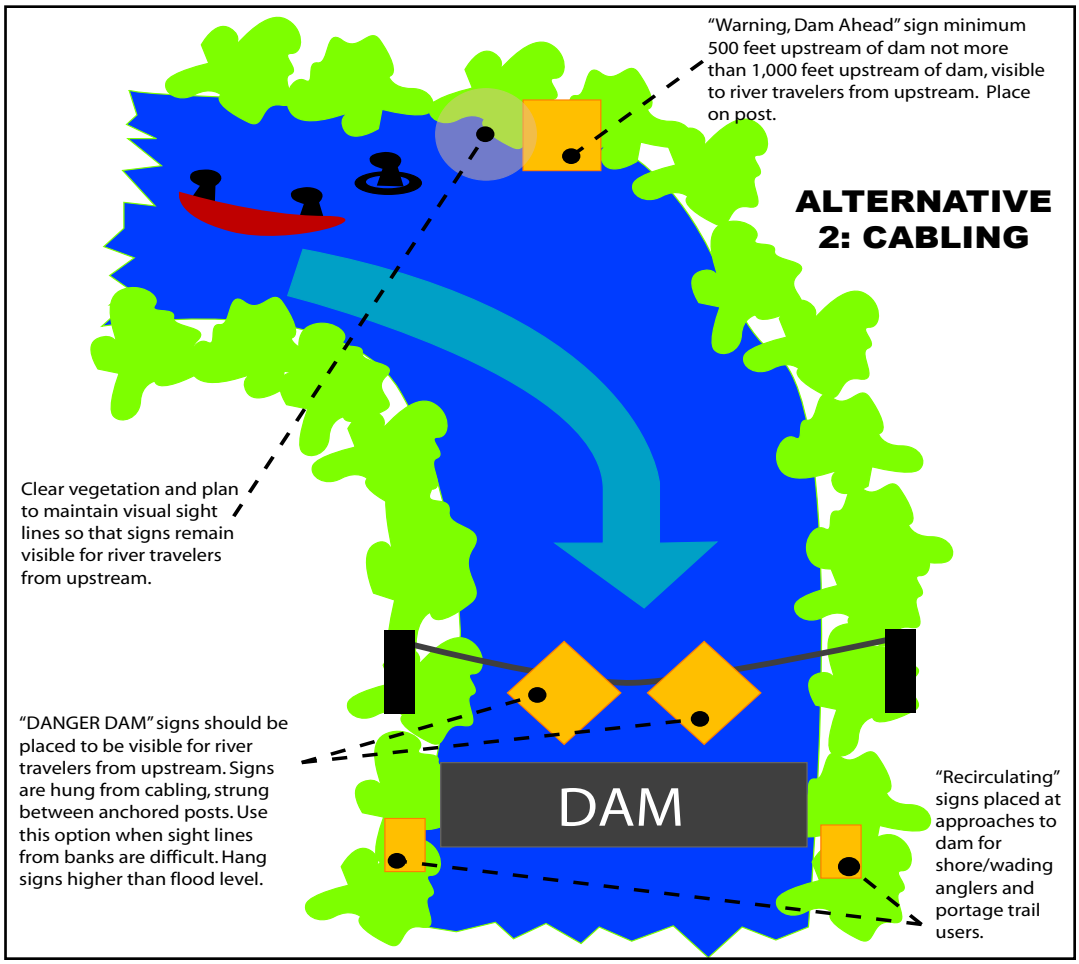

Sign: Dam, Recirculating
Size: 18”X24”
Color: Orange, Black on White
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 10”
Placement: At dam, visible from portage routes and to anglers using the dam.

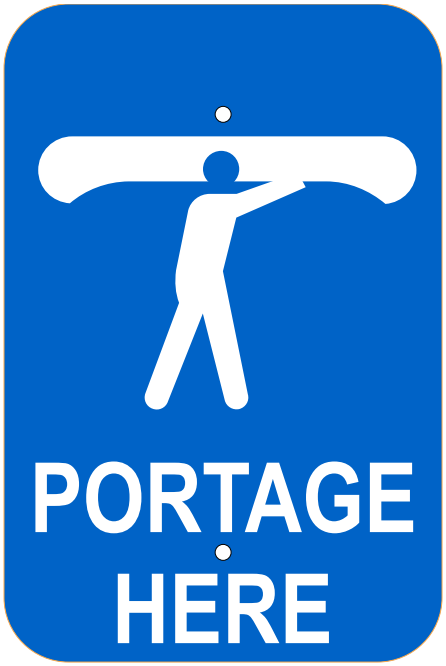



Sign: Warning Rapids/Dam ahead
Size: 36”X36”
Color: Orange, Black on White
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 9” from each side, 2 posts
Options: Custom distances & messages are available from Water Trails coordinator.
Placement: Visible from river well upstream of hazard.

# DAM SAFETY SIGN PLACEMENT GUIDELINES

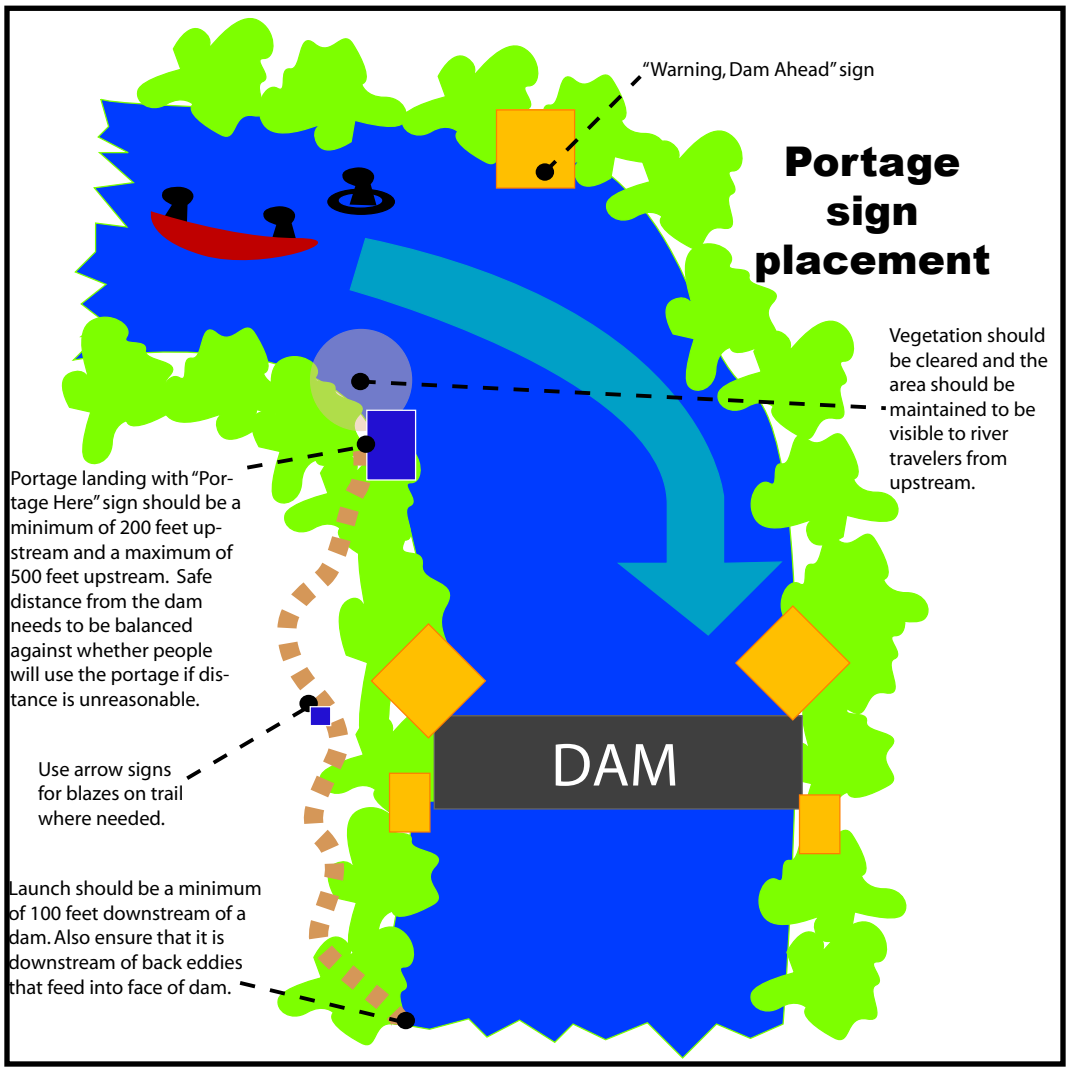





Sign: Portage
Size: 12”X18”
Color: White on Blue, Pantone300
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 12”
Placement: Visible upstream of landing, guiding users to landing for land trail. Ensure these are a reasonable distance upstream of dams or other hazards.

Sign: Portage arrows (left, right, up)
Size: 8”x8”
Color: White on Blue, Pantone300
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 6”
Placement: Use as trails blazes on the portage trail.




Sign: Rules
Size: 12”X12”
Color: White on Blue, Pantone300; Green, Pantone348C
Thickness: .080
Material: Aluminum
Reflective: Yes
Hole size: 7/16”
Centers: 9”
Placement: At accesses, especially where landowner relations are sensitive, or where there have been other problems

# LOGICAL LASTING LAUNCHES

## DESIGN GUIDANCE FOR CANOE AND KAYAK LAUNCHES

National Park Service
Rivers, Trails & Conservation Assistance Program
Spring 2004

# ACKNOWLEDGEMENTS

The National Park Service wishes to acknowledge the following individuals and organizations who contributed their expertise and resources to the development of this publication:

Written and produced by: Caroline Wolf, Student Conservation Association
with assistance from the WASO Rivers team of NPS Rivers, Trails & Conservation Assistance program: Chris Brown, Joan Harn, Corita Jones, and Charles Stockman

Ken Allen, Mark Anderson, Jack Andre, Rose Bayless, Karl Beard, Julie Bell, Gary Boughton, Don Bruns, Russ Cohen, Kevin Colburn, Jim Flanagan, Jon Fleischman, Phyllis Garcia, Jill Harding, Mike Harvey, Carol Hunter, Julie Isbill, Kevin Keeler, Scott Keller, Dennis Kincer, Gary Lacy, Roger Lewis, Dana Lockett, Jim Logan, Gary Mechanic, Rich Misplon, Kathryn Nichols, Thomas O'Keefe, Tim Palmer, Stew Pappenfort, Mike Passo, Ken Phillips, Tom Potter, Jason Robertson, Kay Salazar, Michelle Schneider, Nita Settina, Don Smith, Diane Steinbrook, Carl Stockman, Linda Stonier, Angie Tornes, Caroline Tan, Charles Tracy, Reed Waite, Rob White, Thomas Wolf, and Janet Zeller

American Whitewater
Arkansas Water Trust
Chicago Access Project
City of Eureka, California
Colorado State Parks
Delaware Department of Fish and Wildlife
Housatonic River Restoration Project
Hudson River
Illinois Department of Natural Resources
Lower Colorado River Authority
Maryland Department of Natural Resources
Minnesota Division of State Parks
Montana State Design & Construction Bureau
North Carolina Department of Natural Resources
Openlands Project
Rivers,Trails & Conservation Assistance Program, National Park Service
Washington Water Trails Association
Wisconsin Department of Natural Resources
West Virginia Department of Natural Resources

# TABLE OF CONTENTS

# INTRODUCTION

This publication offers guidance in designing canoe and kayak launches for a variety of access sites. Descriptions, designs, and photos of launches are grouped into eleven chapters, according to type, with focus on the *point of entry* onto the water.

Comprehensive designs for access facilities (e.g., restrooms, parking, and signage) and legal issues are not fully addressed here. Resources for information on these topics and related issues are provided throughout the guide and in the bibliography.

While this guide provides general assistance with choosing suitable launch types for particular sites, each body of water's unique characteristics require individual consideration in regard to launch use and design. Development of any access point should involve local experts who can provide information on legal matters, hydrology and dynamics, riparian ecology, and other relevant factors.

Accessibility to paddlers with disabilities must be considered throughout the design and construction processes. The 1990 Americans with Disabilities Act (ADA) requires that "new construction and alterations of facilities [which include canoe and kayak launch facilities] are readily accessible to and usable by individuals with disabilities." Standards applied to boating and other recreation facilities may be found in the ADA Accessibility Guidelines (ADAAG) issued in 2002. These guidelines are not limited to federally funded facilities; they apply to all public recreation facilities. See Chapter III for more information.

## *How to use this guide*

Chapter I introduces essentials to designing a logical and lasting launch. This chapter presents five important factors to consider when designing a launch and discusses the relevance of location and water body characteristics to choosing an appropriate launch type for a particular access site.

Chapter II provides a quick reference chart to assist with choosing a launch type that can accommodate conditions or characterictics specfic to an access site. In some cases, designs can be altered or combined to provide more effective access.

Chapters IV-X provide the following information for each launch type:
A. General description
B. Materials used
C. Design specifications/variations
D. Advantages
E. Disadvantages
F. Case examples, designs, photos - where these launch types have worked!

Chapter XI discusses several design options for access in environmentally sensitive areas.

# CHAPTER I:

# THE ABCS OF LOGICAL, LASTING LAUNCHES

## Considerations for design, location, and type of water body

### ◊ *What makes a launch logical and lasting?*

A logical, lasting launch provides safe and easy access for paddlers while accommodating the topographic, climatic, and ecological characteristics of its location. Ideally, its construction is cost-efficient and durable and has little impact on the environment and riparian ecology.

### ◊ *The ABCs, Ds and Es of launch design*

It is important to consider a variety of factors when developing a launch design.
Consider the following goals:

**Accessible** **Best-suited** **Cost-effective and Durable** **Environment-friendly**

#### *Accessible to all paddlers*

Paddlers of all abilties want to launch and land smoothly without capsizing or damaging their boats. They need firm surfaces that support their movements and sufficient space to accommodate the length of their boats during put-in and take-out. Paddlers must be able to stabilize their boats during transition to and from the water. Climbing in and out of boats can be especially challenging when there is significant height difference between seat levels and shoreline. Additionally, federal law requires that all boating facilities provide access to paddlers with disabilities whenever possible (*see Chapter III for details*).

General recommendations for designing an accessible launch

- **Height above water:** Between 9" and 2' from highest expected water level
- **Width:** At least 5' wide, preferably 6' to 12'
- **Length:** At least 25' to allow paddlers “dry” access to entire length of their boats
- **Slope:** ADA Accessibility Guidelines require that slopes not exceed 8.33% whenever possible; A slope exceeding 15% will make transition from land to water difficult for any paddler
- **Support:** Handrails or other support structures, including step-down designs or ropes, help paddlers balance their weight during put-in and take-out
- **Location:** Ideally in areas without heavy flow, erosion, exposure to elements, heavy boat traffic, or fragile riparian habitats

### *Best-suited*

The type of launch chosen should be suitable for a particular access location, meaning that it should be the most sensible choice considering the characteristics of the water body, as well as relevant climatic and ecological factors.

General recommendations

*A launch that is "best-suited":*

- Is constructed in accordance with any applicable regulations
- Provides safe access, away from potential river hazards, especially at different flow level
- Can withstand flow levels, currents, and exposure to elements at a particular site
- Accommodates paddlers in varying water depths
- Provides a firm surface for launching, despite changes in sedimentation levels
- Will not be easily damaged due to climatic or seasonal conditions
- Does not cause damage to riparian habitats or vegetation during its construction and is unlikely to have environmental impacts over time and through usage
- Is not constructed in an area vulnerable to erosion
- Is constructed with consideration to its intended uses and frequency of use

### *Cost-effective and Durable*

Existing natural sites (e.g., banks, rocks, beaches) are preferable, as they cost nothing to develop; however, they may not be durable and can require reinforcement over time. Minimal construction will keep costs low and help maintain a natural appearance along a shoreline. If construction is necessary, using durable materials reduces the need for later repairs or replacements, yet the speed at which materials weather will depend on climatic factors and level of exposure to currents and winds.

In some cases, existing docks used by motorized boats can provide stable surfaces for paddleboat access, but many standard docks rise too far above the surface of the water to enable a safe and easy put-in for paddlers. Some boat docks may be modified or easily improved to make them more paddler-friendly; for example, they can be lowered, lengthened, or widened. Ramps can be made less steep or step-downs may be added, along with handrails, cleats, or windbreaks. Shoreline features, such as boardwalks and bulkheads, can be combined with floating docks to enable hand-launching.

*The Humboldt Bay Trails Feasibility Study* is an example of a detailed assessment conducted by the Redwood Community Action Agency of existing launch facilities around Humboldt Bay in Eureka, CA. The study offers recommendations on simple improvements that can be made to launch areas to make them more paddler-friendly. The study can be downloaded online at http://www.rcaa.org/baytrails/ from the Redwood Community Action Agency's website.

General recommendations

- Use construction only when absolutely necessary. In many cases, an actual launch structure may not be needed; firm or sandy banks, level rocks, and beaches can often provide sufficient access (*see Chapter IV*); kayakers may only need a hardened bank for access
- Choose access sites with minimal exposure to winds and heavy currents, preferably near calmer areas of water, such as near eddies; if this is not possible, consider creating a vegetative or other type of buffer to provide protection from the elements
- To reduce construction needs and costs, make modifications to existing boat docks or shoreline structures to make them more "paddler-friendly"
- Construct launches that serve multiple purposes, such as mitigating erosion or restoring wetland vegetation; simple ramps or implanted beaches may help to stabilize a fragile bank or provide "soft treatments" while also enabling access

## *Environment-friendly*

Use of low-impact designs and non-toxic materials is essential to watershed health, from protecting water quality, vegetation, and riparian habitats to enabling sustainable recreation. In many states, environmental regulations must be considered prior to, and during, launch construction.

General recommendations

- Investigate any applicable regulations; develop launch designs in accordance with these regulations
- Use structures requiring minimal construction or alteration to the shoreline (*see Chapter XI for information on low-impact designs)*
- Consult with local natural resource specialist during the planning and construction phases to screen for the presence of ecologically sensitive nesting sites, rookeries, spawning areas, or endangered species; an optimal put-in site may not be feasible for ecological reasons
- Merge the needs of natural functions and the desired recreational uses of the water; with rivers and streams, avoid making any channel modifications and preserve in-stream habitats as much as possible
- Monitor watershed conditions and changes in stream morphology continually
- Gather data from local or state agencies that monitor water levels and flows to develop a launch that will accommodate the conditions of the water body over time
- Avoid using hard reinforcements (e.g., concrete, steel, rock) where shorelines are eroding; use bioengineering methods, such as developing a riparian buffer planted with native species, to protect vegetation and habitats and stabilize shorelines while sheltering the launch area from the elements; along streams, wider buffers can allow space for lateral movements and can help to re-establish meander over time -- these methods allow plant species to become self-sustaining and can also improve aesthetics
- Avoid using toxic or hazardous materials or items that have contained these materials

## *Additional considerations*

Additional factors to consider in launch design are preservation of historic or cultural landscapes, as well as aesthetics. Historic sites may have particular characteristics or regulations that influence where a launch can be constructed or what types of materials may be used. See Chapter XI for an example of environmental assessments conducted to protect an historic canoe launch at Fort Clatsop National Memorial.

## ◊ *Location, location, location*

Whether or not a launch will be effective and be able to provide sustainable access depends largely upon its location and the characteristics of the water body it is on.

General recommendations

*Access is preferable in areas that have:*

- Minimal exposure to strong currents and winds, such as river eddies or in a cove or inlet
- No physical barriers, such as impassable sections, dams, or weirs
- Distance from other boat traffic, so that paddlers do not have to cross heavy traffic areas
- Water levels enabling year-round use
- Good water quality
- Little lateral movement that could erode the riverbank
- Visibility from both river and shore, allowing paddlers to locate the launch site easily

Natural resource specialists should be consulted throughout the planning, design, construction, and maintenance phases.

American Whitewater (http://www.americanwhitewater.org) provides detailed guidance on choosing and developing access areas, including information on legal considerations, in their *Acquisition & Management Guide*.

The Openlands Project (http://www.openlands.org) also offers a *Launch Site Facilities Checklist* (http://www.openlands.org/template.asp?pgid=185 ) that provides useful information on planning for access facilities.

## ◊ *Considerations for different water bodies: Rivers, Whitewater and Swiftwater Rivers, Tidal Estuaries and Coastal Areas, Lakes*

### *Rivers*

It is best to access a river in an area with little current, located on the inside of a meander bend, or, along straighter sections of a channel, below a meander on the opposite side from a river's cutting side. Areas of heavy flow should be avoided, since strong currents cause wearing on the site over time and can be hazardous to paddlers. Having some movement in the water, however, may prevent excessive sediment accumulation that could cause a canoe or kayak to get stuck. Ideally, there would be a moderate level of deposition that forms a natural beach area suitable for launching.

High/low flow rivers can change character dramatically when water levels fluctuate with seasons or rainfall. For example, water levels can rise rapidly due to spring melting or heavy rains. They can also rise with varying dam releases. Rocks, snags, low trees, and other hazards may be disguised during high flow, making them difficult to avoid; they may also be dangerous to paddlers at low flow. Some rivers turn into mudflats during low flow, which can make access nearly impossible unless there is a firm surface with sufficient water depth for launching.

Meander bends on large floodplain rivers may be temporary features, given the dynamic nature of flows, therefore launch design should take into account possible channel migration over time. Aerial photos over a period of years may be available from the U.S. Geological Survey (USGS) and can be helpful resources in analyzing channel migration.

Federal and state government agencies, such as USGS, the U.S. Army Corps of Engineers, and state water surveys, can usually provide information on average water heights. These are important statistics to know before constructing a launch on any site.

Since no two rivers are identical, building an effective launch will depend on a river's individual characteristics and on a range of topographic, ecological, and climatic factors. Stream channel patterns are impacted by stream flows, sediment depositions, climatic conditions, and landforms. Bank erosion rates, bed stability, slopes, riparian vegetation and habitats also affect a river's structure and behavior. Similarly, no two points along a river are the same. Rivers also change character along their courses and over time; occurrences on one segment affect what happens downstream.

### *Whitewater and Swiftwater Rivers*

Rivers that experience dramatic differences in flow and water level with seasonal changes or varying dam releases require launch areas that can withstand these extreme fluctuations and accommodate paddlers in a wide range of circumstances.

Access to whitewater and swiftwater rivers is preferable near eddies or calmer sections, but heavy flows may still destroy built launch structures in these areas. For this reason, natural shoreline areas that can be easily and cheaply reinforced are typically the best option for launching. Level beaches, flat rock outcrops, and sturdy banks may be sufficient. Some launch structures, such as concrete staircases, may withstand heavy flows provided that undercutting does not cause erosion at the site. Concrete strips can also be used to divert runoff from a launch area (*see Chapter VIII* ).

Banks adjacent to bridges, provided that access is permitted in these areas, may provide consistent access during changing flows. Access from the road to these areas are often convenient, and the armoring used to protect bridges can also protect the launch area.

### *Tidal Estuaries and Coastal Areas*

As with rivers, access in coastal areas is preferable in areas protected from waves and winds. Tidal water bodies may experience dramatic changes in water level with the tides. Similar to high/low flow rivers, a deep channel can become a muddy flat within a period of hours. Tidal changes can pose risks to paddlers when rocks or other hazards are exposed in lower water levels. Launches need to be built to withstand tidal fluctuations and possible impacts caused by floating debris or aquatic life carried in or left behind by tidal currents. Materials used to construct launches should be salt-resistant.

Vegetated banks with informal launch and take-out sites can be fragile and subject to trampling by paddlers, who may be unaware of their impact. Rocks or other natural materials may be placed in a way that directs paddlers toward specified launch areas and paddlers can be educated about their impacts. Maintaining natural grasses along these banks will help control erosion and preserve wildlife habitat.

Environmental factors specific to salt water areas should also be considered. For example, the level of sunlight needed by marsh and marine grasses should be taken into account when choosing a launch location or type. Some structures that block light may prevent vegetation from receiving sufficient light for growth. Additionally, using piles or other support structures on sandy estuary bottoms may cause sediment displacement.

### *Lakes*

Built launch structures may not be needed on lake sites where shorelines are less vulnerable to heavy currents and fluctuating water levels. However, access is still recommended in relatively protected areas with minimal exposure and erosion problems. Shallow, marshy areas should be avoided, as they are difficult to navigate and likely to host fragile wetland ecosystems. Lakes can vary greatly in size, character, and behavior. The Great Lakes, for example, behave like tidal water bodies. Launch sites suitable for coastal areas should be considered in these areas.

## CHAPTER II:

## QUICK REFERENCE GUIDE TO LAUNCH TYPES AND USES

| If you have… | Consider using … | as long as… |
|---|---|---|
| "Naturally" suitable areas, e.g.:<br>▪ Shorelines with sturdy banks<br>▪ Stable rock outcrops<br>▪ Beach areas with firm substrates | ▪ Existing site, with slight modifications, if necessary (e.g., adding sand or gravel to improve drainage) | ▪ Shoreline or riparian area is not vulnerable to erosion<br>▪ Space is sufficient to launch and maintain balance |
| ▪ An area with minimal current or exposure to elements | ▪ Reinforced natural site (*see Chapter IV)*<br>▪ Simple gravel ramp<br>▪ Floating launch<br>▪ Pipe or pile launch<br>▪ Cantilever launch | ▪ Access is hazard-free<br>▪ Environmental impact is minimal<br>▪ Water depth is sufficient for launching |
| ▪ Steep shoreline | ▪ Step-downs, timber steps, handrails, or rope supports<br>▪ Connecting structure or structures (e.g., gangways) with floating or pile launch<br>▪ Timber, concrete, or metal stairs<br>▪ Added soil to level slope (least favorable choice) | ▪ Slope is reduced to enable safe transition to water (and to meet ADA standards, if possible)<br>▪ Space is sufficient for safe launching |
| ▪ Shoreline with slippery slope | ▪ Corrugated/aggregate ramp<br>▪ Added gravel or other surface to provide traction<br>▪ Concrete mats | ▪ Added traction does not prevent access to paddlers with disabilities |
| ▪ Steep drop-off from shore | ▪ Concrete, timber, or metal steps/stairs with handrails and boat slide<br>▪ Concrete or other type of ramp with corrugated surface to provide traction | ▪ Area is protected from hazards, strong currents, and winds<br>▪ Launching area at water level is sturdy and provides sufficient space for launching |

| If you have… | Consider using … | as long as… |
|---|---|---|
| ▪ Eroding shoreline | ▪ A different site!<br>▪ Native vegetation, along with gravel or rock, to help stabilize bank<br>▪ Vegetative or other buffer to protect shoreline<br>▪ Timber staircase that also reinforces bank | ▪ Alternative access locations are not available |
| ▪ Marshy areas | ▪ Boardwalk or fixed pier<br>---<br>▪ Elevated walkway leading to floating launch or ladder (*see Chapter V*) | ▪ Construction will not cause damage to wetland habitat or jeopardize integrity of the shoreline<br>---<br>▪ Walkway is either placed on above-ground supports or uses posts that are not placed too closely to the edge of the bank |
| ▪ Bulk-headed shoreline | ▪ Floating launch<br>▪ Implanted beach area (*see Chapter IV*) | ▪ Area is not too exposed<br>▪ Traffic is not heavy |
| ▪ Boardwalk | ▪ Floating launch<br>▪ Concrete ramp | ▪ Water depth is sufficient<br>▪ Area is not too exposed<br>▪ Traffic is not heavy |
| ▪ Launch site is adjacent to a wash or streambed carrying excessive flows and silt deposits | ▪ Natural materials to repair launch inexpensively<br>▪ Concrete buffer strip to break up the impact of flow (*see Chapter VIII*) | ▪ Site is maintained and screened for potential hazards after high flows |
| ▪ Environmentally sensitive area | ▪ A DIFFERENT SITE!! | ▪ Alternative sites exist |
| ▪ Environmentally sensitive area that is the ONLY possible access location | ▪ Materials with least toxicity and require the least disruption during installation<br>▪ Elevated walkway to protect riparian areas and allow vegetation to grow (*see Chapter V*) | ▪ Natural resource specialist,(and any relevant agencies) are an integral part of site planning, construction, and maintenance<br>▪ Integrity of shoreline is not jeopardized |

| If you have… | Consider using … | as long as… |
|---|---|---|
| ▪ Budget constraints | ▪ Simple launch using native materials<br>▪ Makeshift construction (consider aesthetics here)<br>▪ Pile or pipe launch | ▪ Site safety, environmental health, and sustainability of launch is not compromised by using low-cost materials |
| ▪ Silt problems/low flow | ▪ Pile, pipe, or cantilever launch that extends to an area of sufficient depth/flow | ▪ Area is protected from hazards, strong currents, and winds |
| **In the following circumstances, floating launches can be effective as long as:**<br><br>**(*see Chapter V)*** | **1) At least 9" exists between the launch and the highest water level**<br><br>**2) Water level changes are not too rapid or dramatic** | **3) Water depth is sufficient for launching**<br><br>**4) Launch is removed during freezing or flooding** |
| ▪ Fluctuating water levels or tides | ▪ Floating launch<br>▪ Beach area or sturdy bank<br>---<br>▪ Pile or pipe launch | ▪ Current is not too strong<br>▪ Water depth is at least 2' to 3'<br>---<br>▪ Water level remains below height of deck at all times |
| ▪ Periodic flooding | ▪ Removable floating launch or ramp (aluminum/metal)<br><br>---<br>▪ Concrete stairs that can be easily maintained | ▪ Launch is removed when flooding occurs and before mudflats are exposed<br>---<br>▪ Location is not vulnerable to damage by excessive debris or currents |
| ▪ Shallow water | ▪ Pile or pipe launch extending to deeper water<br>▪ Gangway or other connecting structure attached to floating launch | ▪ Structures are installed with minimal disturbance to wetlands; non-toxic or treated materials used |
| ▪ Busy launch area shared with motorized boats | ▪ Floating launch | ▪ Launch is located away from heavy motor boating traffic |
| ▪ Icing | ▪ Removable or modular launch, such as a floating or pipe launch<br>▪ Pile launch made of alternative wood product that will not damage in ice | ▪ Launch is removed before freezing begins<br>▪ Launch is monitored throughout ice season |

## NOTES

## DEFINITION OF TERMS

- **Abutment:** A masonry structure that supports pressure of an arch or bridge; *for purposes of this guide*: a wedge-shaped anchor that connects the end of a floating launch with the top of a launching ramp or connecting structure

- **Aggregate:** Sum of many heterogeneous things taken together; *for purposes of this guide:* a combination of materials (e.g., sand, gravel, slag) mixed with a cementing material to form concrete, mortar, or plaster; helps to increase traction

- **Bioengineering:** The use of live plants and plant parts as building materials for erosion control and landscape restoration

- **Buffer strip:** Strip of vegetation implanted along a stream or other water body that offers protection to a vulnerable area of shoreline from climatic elements and currents

- **Bulkhead**: A retaining wall along a shoreline or waterfront

- **Cleat**: A fitting device where a rope may be tied to provide support or anchoring; frequently has two projecting parts

- **Fender**: A protective device used on the edges of a launch to lessen shock and prevent damage to boats

- **Gabion**: A strong and flexible steel wire cage, filled with rocks, designed to abate erosion; may also house macro-invertebrates and provide shade and eddies for fish habitats

- **Gangway**: A removable passageway of planks enabling continuous access; often used to connect two structures or to connect a launch or other structure to the shoreline

- **Pile**: A long, slender column, typically made of timber, steel, or reinforced driven into the ground and used as a support for a launch or other horizontal platform

- **Pile guides:** Anchored pile holders that allow for vertical movement of a floating launch while maintaining its connection to another structure or shoreline anchor; are typically hoops made of welded steel bolted or welded to the frame of a launch

- **Ramp:** A sloped surface enabling traffic to move from one level to another; a slope for launching boats

- **Rebar:** Rod of steel placed into concrete as a reinforcement

- **Rip-rap:** A foundation or retaining wall made of stones, used to prevent erosion, that is often placed on aor around an embankment

- **Stringers:** Support devices, usually made of wood, aluminum, or steel, used as a series of uniform pieces,to reinforce decking on a launch structure

## NOTES

# CHAPTER III:

# DESIGNING ACCESSIBLE LAUNCHES IN ACCORDANCE WITH AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES

The 2000 U.S. Census reports that over 49 million Americans have one or more disabilities and that a significant number of these individuals participate in outdoor recreation activities including canoeing, kayaking, and other boating activities.

In 1990, in order to provide an equal opportunity for individuals with disabilities, Congress enacted the Americans with Disabilities Act (ADA). The ADA mandates that individuals with disabilities must be given an equal opportunity to access public facilities and that reasonable accommodations must be made to account for physical and mental limitations of individuals with disabilities.

Guidelines for newly designed, constructed, and altered recreation facilities issued by the ADA in 2002 require that all public boat launches, *which include fixed and floating structures of all sizes*, comply with ADA Accessibility Guidelines (ADAAG) standards. Copies of ADAAG for recreation facilities are available online at http://www.usdoj.gov/crt/ada/stdspdf.htm and may be downloaded as an Adobe PDF file.

This chapter addresses ADAAG standards that apply to launch structures and does not discuss operational issues related to boating facilities, such as accessible parking, exterior routes, and restroom facilities. *A Guide to Boating and Canoe Access Development in Illinois* (IL DNR, 1998) provides information on developing accessible land-side facilities. Accessibility recommendations for trails and access routes may be found at http://www.access-board.gov/outdoor/outdoor-rec-rpt.htm in the Access Board's *Proposed Guidelines for Outdoor Developed Areas.*

When providing an equal opportunity for participation in boating activities, different types of disabilities must be taken into account. Physical disabilities necessitate reasonable modification of the structural environment to provide access to the shore or launch site, as well as the watercraft. Developmental disabilities necessitate methods of effective communication to provide directions to sites and instructions for safe usage; these may include signage and alternative formats for informational materials.

Due to fluctuating water levels and varying terrain at different access sites, innovative ways to adapt or customize launch sites may be needed. This chapter discusses important considerations that must be made when providing access for paddlers with disabilities.

The Access Board, which develops and maintains criteria for accessibility, provides basic design requirements for recreation and recreation facilities through the following three websites:

- http://www.access-board.gov/recreation/final.htm
- http://www.access-board.gov/recreation/guides/boating.htm
- http://www.access-board.gov/adaag/html/adaag.htm#15.2%20Boating%20Facilities

## Access Board Guidelines for Boat Launches

The Access Board's guidelines for accessible recreation facilities are as follows:

ADAAG require that boat launches be equipped with at least one accessible route to boat launches that complies with ADAAG standards for:

- location
- width
- passing space
- head room
- surface slope
- level changes
- doors
- egress
- areas of rescue assistance

ADAAG standards *must be met* if the accessible route connects a fixed launch to the shore or if the accessible route connects a fixed launch to another fixed structure, unless they are modified by specific provisions outlined by the Access Board.

*Exception: Gangways connecting floating structures*

If the accessible route uses a gangway connecting to a floating structure, exceptions to ADAAG may be made to accommodate varying water levels and other factors. Gangways should be designed with the least possible slope and, if possible, designed so as not to exceed a slope of 8.33% or a ratio of 1:12. Since the slope of a gangway will rise and fall with changing water levels, its slope may, in some cases, exceed 8.33%. This is acceptable as long as the gangway is at least 30 feet long. Gangways are required to be at least 80 feet long if the vertical distance between the lowest water level and the point where the gangway connects to land is 10 feet.

Any other sloped surface must comply with ADAAG requirements:

### *Transition plates*

These are sloped surfaces located at the end of a gangway. If the slope of a gangway is greater than 1: 20 (or 5%) it must be equipped with a landing at the non-gangway end of the transition plate and comply with ADAAG ramp requirements.

### *Handrails*

Handrails are required on sloped surfaces that have a rise of less than 6 inches or a projection less than 72 inches, or a slope of 1:20 (5%) or less. Since the surface may be moving with changes in the water handrail extensions do not need to be parallel to ground or floor surfaces.

*Cross slope*
The cross slope of a structure refers to the slope perpendicular to the structure's "running" slope or slope spanning the length of the structure. The cross slopes of gangways, transition plates, and floating piers that are part of an accessible route must be designed and constructed to not exceed a maximum of 2% or a slope of 1:50. Gangways and piers that are part of an accessible route are expected to be designed and constructed to meet the 2% requirement. Once placed in the water, measurements, absent live loads, are to be made from a static condition (i.e., absence of movement that results from wind, waves, etc.). Where floating piers are grounded due to low water conditions, slope requirements would not apply.

While many launches built prior to ADA's issuing of accessibility guidelines are not accessible to paddlers with disabilities, they may be retrofitted with features that make them accessible.

When designing or retrofitting a launch to meet ADAAG, it is important to ensure that design alterations do not prevent paddlers without disabilities from also using them. It is possible that placement of handrails or other modifications made for accessibility can prevent able paddlers from using them. Launch designs should consider the needs of all paddlers.

## Design considerations from a paddler's point of view

Michael Passo, an experienced paddler who uses a wheelchair, recommends the following design accommodations in order to provide access for paddlers with disabilities:

### *Access route*
Surface, grade, width, and cross slope need to be as accessible as a particular location will allow. Surface should be as even and level as possible (not exceeding 8.33% slope or 2% cross slope) and without gaps or interruptions. The route should be clearly marked.

### *Level and stable landing/loading area*
There should be an area adjacent to the loading area that is level, stable, and at least 60" x 60". This can be anywhere adjacent to the loading area, including in water up to 12" deep. An accessible back country canoe launch might incorporate a large, flat rock surface (provided that it is not slippery) that is 8" to 12" under the surface of the water and has a gradual access route made of native soil. The transfer from a wheelchair on that rock to a floating canoe could be nearly level.

### *Transfer assistance*
The greatest challenge to using a launch, once a paddler is beside the canoe, can be getting down into the seat of the boat. Whether it is on a highly developed launch or the bank of a lake, it is difficult to transfer to a moving boat. Making the transfer easier will help paddlers considerably.

Options to facilitate transfer from the launch area into a boat include:

- A **transfer step** or moveable structure approximately 8" to 12" high that assists paddlers who have difficulty bending or squatting and provides wheelchair users with an intermediate step between their chair and the ground. A carpet-covered box or large, stable rock may be used.

- A **transfer board** is a board that slides out from the launch, over the top of the canoe, and allows a person to slide out over the canoe before sitting down on the seat. If located at gunwale level, it can both support a person's weight and stabilize the boat as legs are moved around and adjustments are made.

- **Overhead handles, grab bars, etc.** The transfer between land and boat can be extremely difficult to maneuver, especially when moving from a canoe seat to a higher launch platform. Alternative grab points can mitigate the complicated procedure of getting oneself onto a launch from a boat so that the boat is not the sole anchor point.

- **Surface textures** on a launch, including those added to provide extra traction, should be practical for wheelchair use. Surface gaps should not exceed 0.5" since the widths of most wheelchair tires and caster tires are between 0.75" and 1". Innovations in adaptive gear, which include devices to improve traction and maneuverability, do exist and can make off-road surfaces much easier to navigate. Nevertheless, launches should be built to accommodate basic wheelchair treads.
  The website http://www.titaniumarts.com offers commercial examples of adaptive gear.

Passo also recommends the book *Canoeing for Disabled People* by Geoff Smiley as a useful resource on accessible designs (*see Bibliography*).

## ADA accessible launches: Case examples, designs, photos

1) Bonnie Gool Guest Dock, Humboldt Bay, Eureka, California

Built about 10 years ago, the Bonnie Gool Guest Dock maintains a consistently accessible slope of 8.33% for about 90 percent of the time. Only during extreme low tides does the slope become too steep. The launch is composed of several connecting parts. A fixed dock at the shoreline connects to an intermediate approach ramp at a 90 degree turn. This intermediate ramp, designed to be flexible, has a "certain" elevation, meaning that its slope will never exceed 8.33%; it is secured with locks and piles that give it a set minimum height. The ramp is surfaced with non-skid, expanded metal (aluminum alloy) that provides traction when the slope becomes steep; it connects to a floating launch at a 90 degree turn.

**Photos 3A, 3B: An approach ramp, with a fixed slope of 8.33%, connects floating launch to the shore**

Photos courtesy of Gary Boughton, City of Eureka

The following designs show details of the Bonnie Gool Guest Dock, as built:

**DIAGRAM 3A: North elevation, Bonnie Gool Guest Dock**

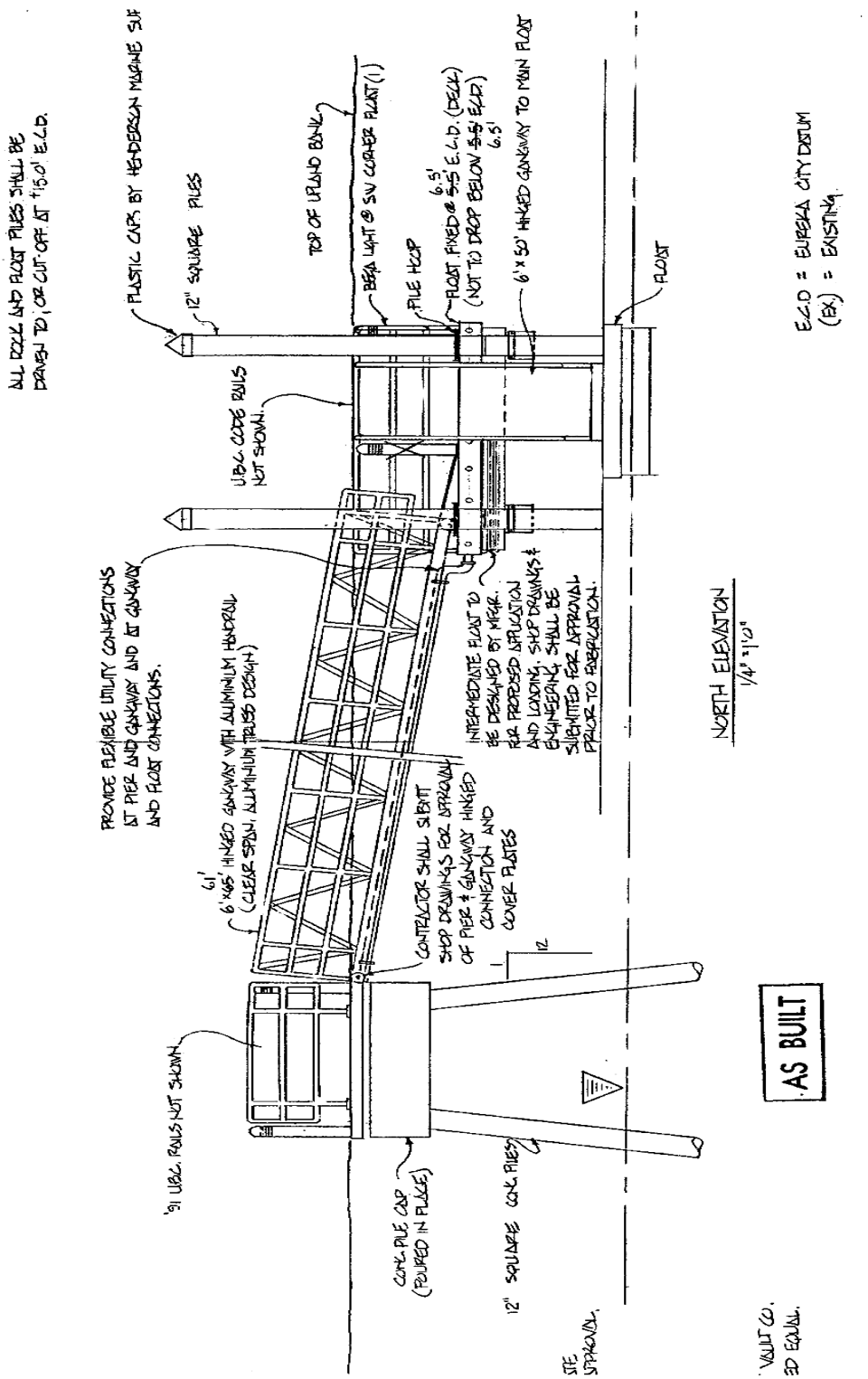


**DIAGRAM 3B: East elevation, Bonnie Gool Guest Dock**

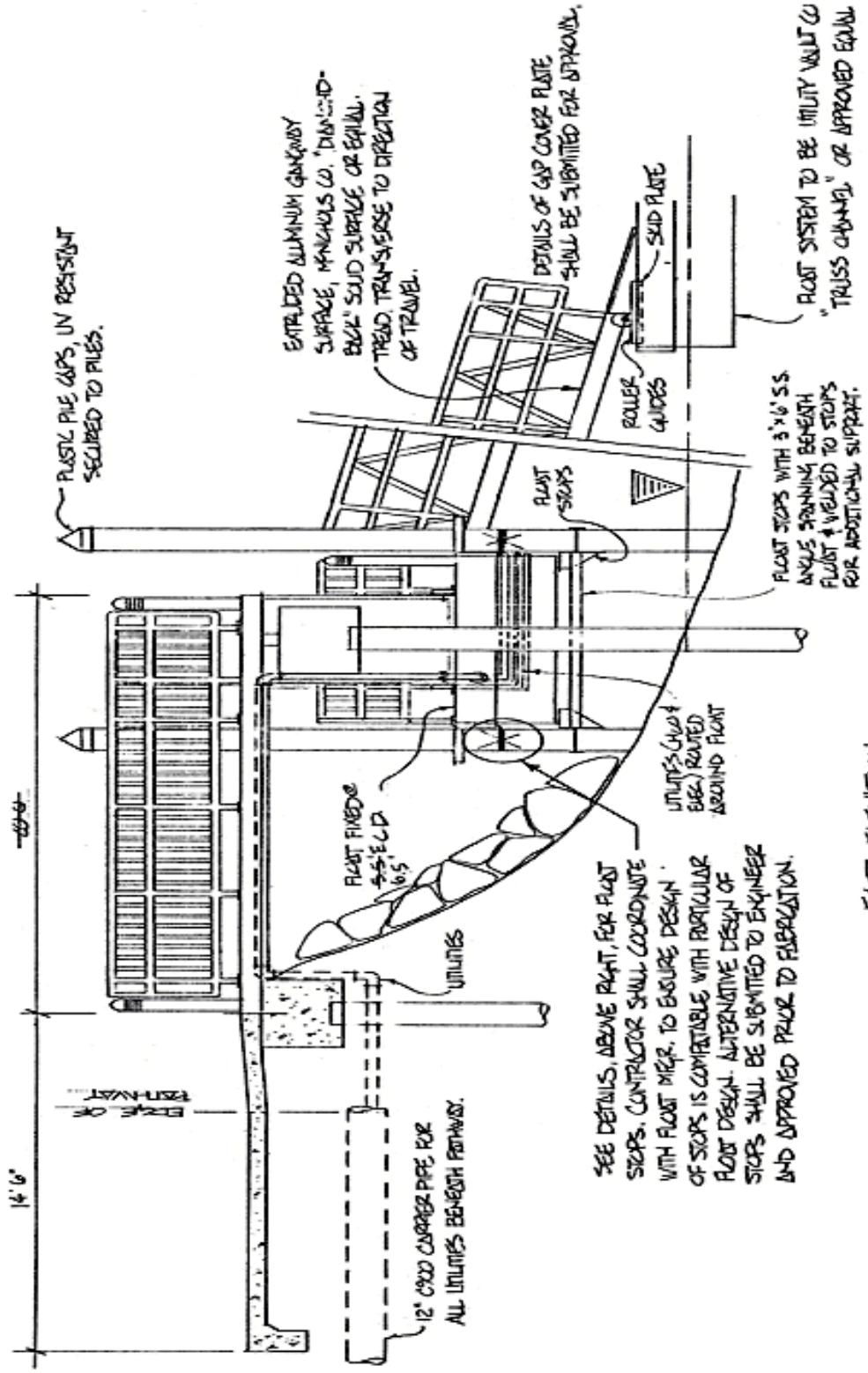


**DIAGRAM 3C: Approach slab and pile cap detail, Bonnie Gool Guest Dock**

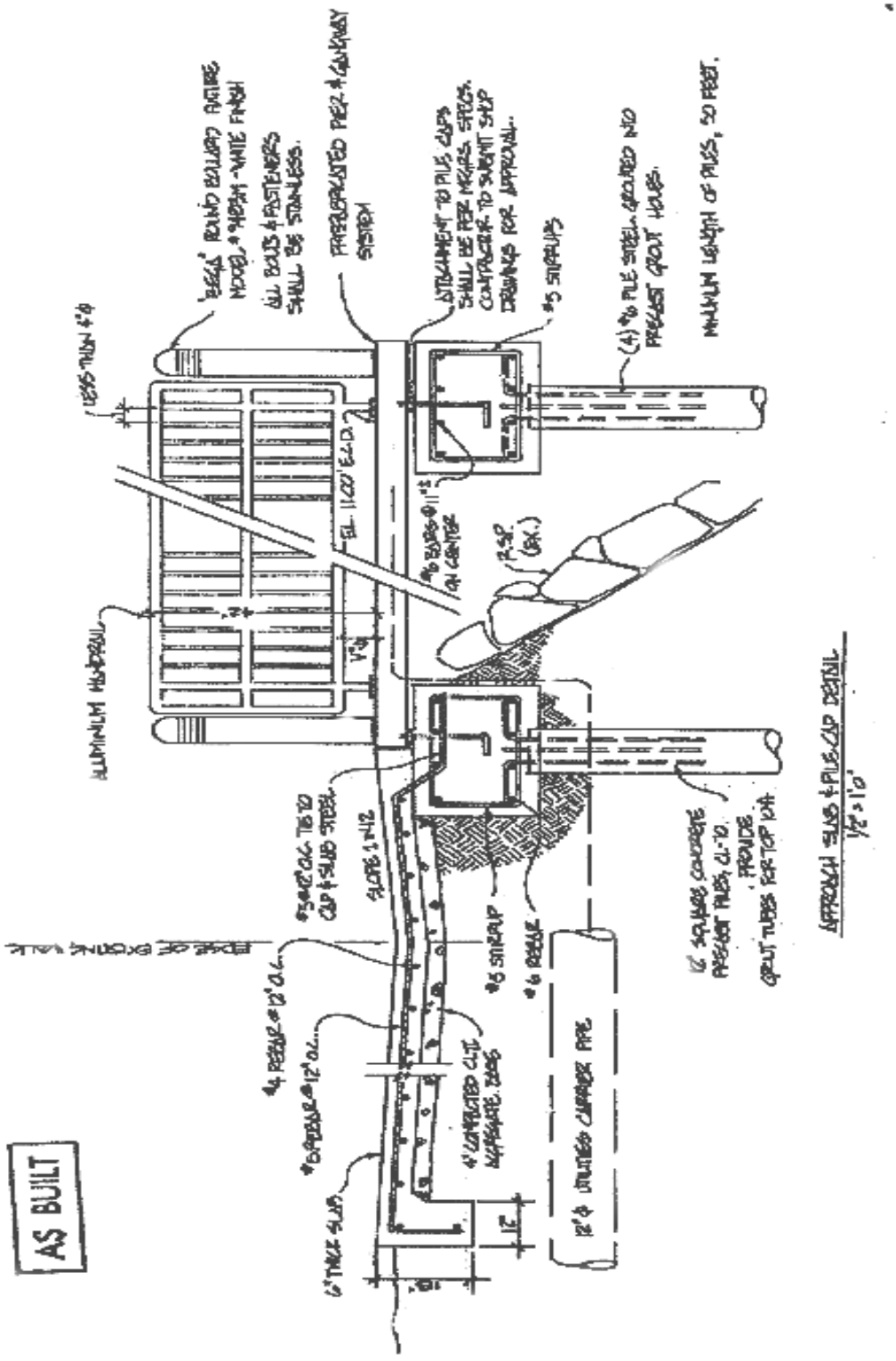
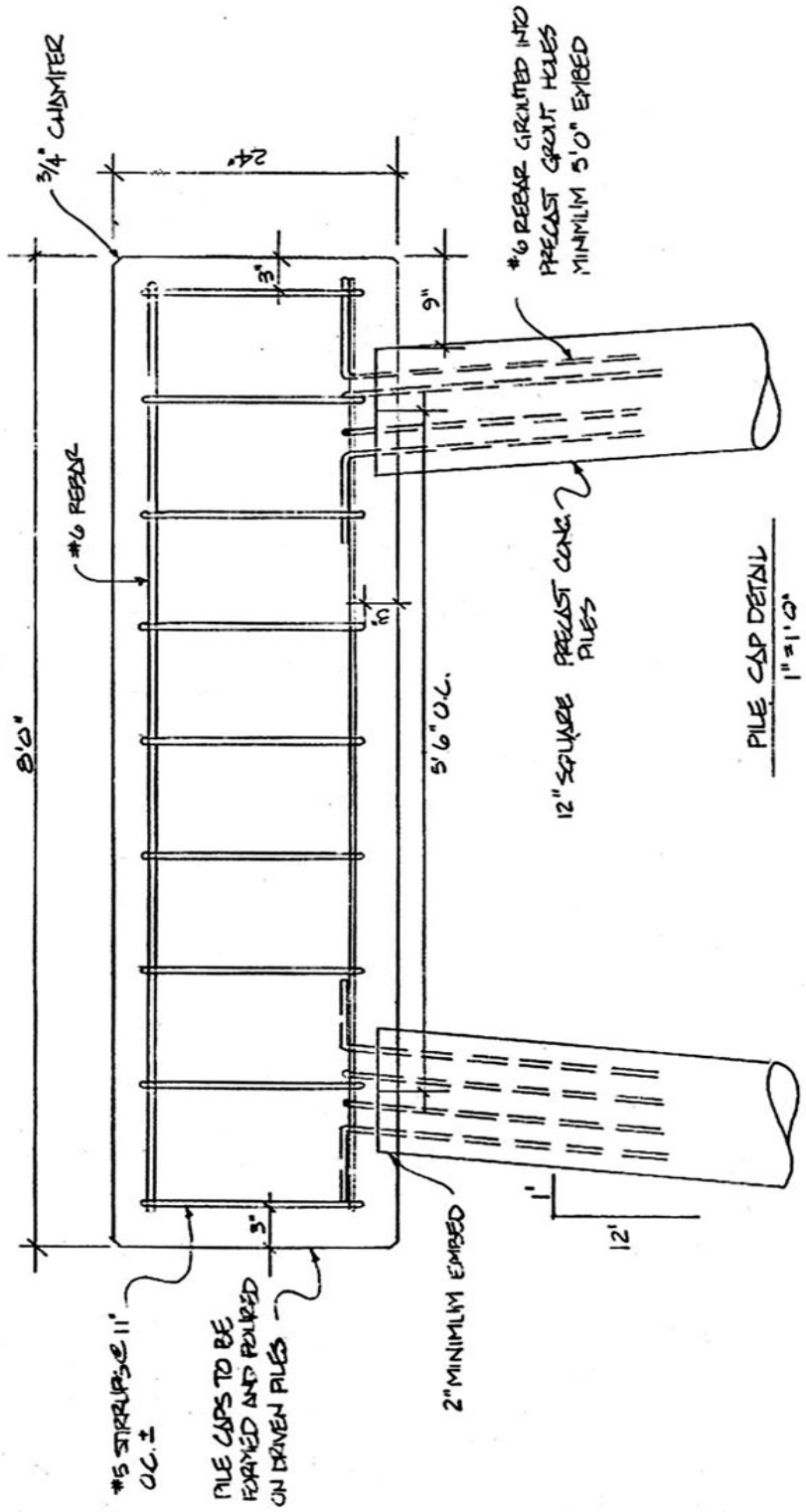


**DIAGRAM 3D: Pile cap detail, Bonnie Gool Guest Dock**



2) Canoe launch, Camp For All, Burton, Texas

Situated on an 8-acre lake, this launch provides access for children with disabilities. The 20' x 16' wooden structure attaches to a concrete surface on the shoreline via an aluminum gangway approximately 12' long. Two 3.5' tapered ramps allow canoes to slide up onto the launch, easing transition to the water for those in wheelchairs. A railing around the perimeter of the launch, made of double 2' x 4' wooden pieces, helps keep wheelchairs from sliding off the launch and also provides an anchoring device for boats.

Photos courtesy of Roger Lewis
Lower Colorado River Authority

**Photos 3C, 3D: ADA accessible wooden floating launch has two tapered ramps that allow canoes to slide up onto the deck**

3) "F" Street Floating Dock, Humboldt Bay, Eureka, California

The "F" Street floating dock is one of several launch structures on Humboldt Bay that provides access to paddlers with disabilities. An aluminum gangway just over 80' long connects to a floating launch made of treated wood and concrete floats. Galvanized steel connectors hold the dock's components together. Concrete floats provide maximum stability and are extremely durable (*see Chapter VIII*).

Photo courtesy of Gary Boughton, City of Eureka, CA

**Photo 3E: Aluminum gangway serves as a ramp to floating launch**

## NOTES

# CHAPTER IV: SIMPLE LAUNCHES

## Natural and Existing Shorelines, Beaches, and Simple Ramps

### A. General Description

The simplest and most cost-effective launches require little or no construction. Paddlers may use "natural" features (e.g., riverbanks, rock outcrops, banks adjacent to bridges) or existing shorelines with decks, bulkheads, or boardwalks. Any of these can suffice as long as: currents in the area are not too strong, water depth allows for stable launching without damage to boats, and the vertical space between the shore and surface of the water is not excessive. Paddlers must also have enough space to place their boats in the water and easily step in or out of them.

### B. Materials

- Native soil, sand, gravel, or vegetation may be added to improve drainage and control erosion; fist-sized rip-rap can be added to trap sediment and fill in over time
- Natural materials, unique to a particular area, may blend with the natural landscape and be most easily accessible (e.g., in the Chesapeake Bay region, native crushed oyster shells may be used to rein force surface landings)
- Flat rocks can sometimes provide firm surfaces, however pointed or jagged rocks are not recommended, as they are unstable surfaces that can damage boats or injure paddlers
- Beaches with firm substrates; matting can be used to temporarily stabilize a sandy beach
- Gravel can be used to form simple ramps, preferably in areas of minimal wave action or water level fluctuation
- Braided rope, tied to a tree or other shoreline anchor, can serve as a makeshift handrail
- Existing shoreline configurations (e.g., bulkheads, boardwalks, uneven rocks) can be converted into beach areas by adding firm sand substrates and/or gravel; these are called "implanted" beaches

### C. Design variations/specifications

- Graded banks are preferable, 12' wide at water line tapered to 9' wide at top by 15' long (length will depend on water levels and shoreline stability)
- Launch area should be at least 20' at sites that are used for both rafting and paddling
- Preferred slopes meet ADA accessibility standards of 8.33%; slopes should not exceed 15%
- Water level should be deep enough to enable launching without damaging boat (preferably at least 2'); kayakers may want at least 4' to permit rolling

## D. Advantages

- Cost-effective/low maintenance -- native materials can be easily added or shifted to suit needs and changing conditions of launch area
- Less environmental impact due to little or no construction
- Can be combined with simple construction to restore habitats or control erosion
- Aesthetically pleasing; minimal visual alteration to natural shoreline
- Shorelines and beaches provide can provide easy anchorage

## E. Disadvantages

- May not be accessible to physically challenged paddlers
- May not be consistently accessible due to varying flows, water levels, amount of exposure, or climatic factors
- Can be slippery or difficult to manage when wet
- Can be steep
- Could cause damage to wetland habitats, depending on frequency of use
- Not easily spotted from rivers – paddlers may pass them by if there is no signage or clear indication of the access site
- Gravel ramps can erode easily and can scratch boats if paddlers do not land properly
- Chemicals from railroad ties or treated wood may pollute water where leaching occurs

## F. Case examples, designs, photos

1) Rincon launch site, Arkansas River, Salida, Colorado

Photo by Caroline Wolf

**Photo 4A: Rocky beach provides river access**

2) Clear Creek, Golden, Colorado

**Photo 4B: Kayaker launches from a level bank**

3) Clear Creek, Golden, Colorado

Photos by Caroline Wolf

**Photo 4C: Kayaker prepares to launch from flat rock outcrops**

4) Missouri River, below confluence with Niobrara River, Nebraska

Photo by Tim Palmer

**Photo 4D: Sandy beach provides access to the river**

5) Sauk River, Washington

Photo by Thomas O'Keefe

**Photo 4E: River is accessible from a gravel road**

6) Delaware River, Narrowsburg, New York

Photo by Tim Palmer

**Photo 4F: Canoes are easily launched from a sandy bank**

7) Restored river bank, Arkansas River, Salida, Colorado

Photo by Caroline Wolf

**Photo 4G: Restored bank with rock outcrops enables access at varying water levels**

## NOTES

# CHAPTER V: FLOATING LAUNCHES

## A. General description

Floating launches are structures that provide access while floating on the water. Typically composed of a deck, frame, and floats, they are anchored to the shore. Paddlers launch from the deck, which is supported by the frame, while the floats beneath the frame provide buoyancy. Anchoring devices help to stabilize the launch and protect it from the elements. Pile guides are often used, permitting launches to adjust to changing water levels while keeping their decks horizontal and steady. When floating launches attach to connecting structures with varying heights(e.g., gangways), pile guides can help to maintain a relatively small cross slope, making launches more likely to be accessible to paddlers with disabilities.

Floating launches are most effective when used on water with little debris and minimal exposure to strong currents or waves. In general, they can withstand flow rates up to 0.25 feet per second, although those launches using stronger anchors may be able to handle stronger flows. Floating launches should be removed and secured during flooding or high flow events, and, unless they are specifically designed to endure ice formation, they should be removed before any freezing occurs.

## B. Materials

A variety of materials may be used for decks, frames, and floats:

### *1. Decks*

- Wood is simple and inexpensive to use; pine, redwood, cedar, and cypress are common choices but will rot unless treated with a preservative *(see notes on treated wood below)*
- Metal decking, such as aluminum, is used mainly for heavy-use launches that also serve motorized boats; metal grating provides effective drainage and traction
- Alternative materials include wood/plastic composites, vinyl, and various plastics made of recycled materials that are made to look like wood; these materials can be more expensive and usually require additional support devices, but they are more resistant to damage and warping than wood and will require less maintenance

### *2. Frames*

- Wood is often used, but will last only 2 to 3 years if untreated
- Metal, either lightweight aluminum or galvanized metal
- Plastic, which will not decay in water as rapidly as other materials
- Steel tubing may be used both as floats and frames; attaches to deck with brackets; steel can be coated to increase durability

### 3. *Floats*

- Polyethylene, the most frequently chosen plastic, can function as both frame and float; they may have grooves and brackets that attach easily to shoreline structures or floats may have built-in cleats, which facilitate anchoring

*Since additives used during manufacturing many types of plastics may affect their durability, the durability needs for the launch site should be considered when choosing materials.

- When expanded polystyrene foam (EPS) is used, the best choice is the extruded closed cell (Styrofoam is a common brand name) because it has the strongest inner structure; it must be used with a protective covering to prevent damage from chemicals, water, and debris
- Plastic float drums made of rotationally molded polyethylene are more durable than EPS and provide protection from impact damage, animals, and the effects of solar radiation; these are most effective when filled with EPS, which act as shock-absorbers and protect drums from losing buoyancy if damaged
- Fiberglass float drums are not as strong as plastic float drums or as readily available, but they are lightweight and also have resistant qualities
- Foam-filled tires provide effective stabilization in areas with heavy debris or current; these can be made of recycled tires filled with EPS and capped with plywood; commercial versions are available, which are more reliably sealed and attached
- Recycled 50-gallon cooking oil drums can also be used but must be cleaned professionally to safe guard against contamination; motor oil drums or any drums that have held noxious or hazardous materials should never be used
- Concrete floats are sturdy and stable but also costly and heavy
- High-density polyethylene (HDPE) can be used for both flotation and for framing

* This information is provided by the U.S. Forest Service publication entitled *Floating Trail Bridges and Docks*, which is available online at http://www.fs.fed.us/na/wit/WITPages/bridgecatalog/materials/index.htm

### *Treated Wood*

When using any type of treated wood, serious caution should be taken in regard to the environment and to the health of those involved in construction. While treated wood can last up to five times as long as untreated wood, it is important to understand the risks involved in using different wood preservatives and chemical treatments. The USFS publication mentioned above includes details about treated wood (see pp. 5-6) as does the Student Conservation Association publication, *Lightly on the Land*. Additionally, the Western Wood Preservers Institute (http://www.wwpinstitute.org/pdffiles/bmpsinaquatic.pdf) offers best management practices for using treated wood.

Several manufactured materials made to look like and act like treated wood provide non-toxic alternatives. Trex (http://www.trex.com) is one popular commercial choice. It is not as structurally rigid as wood and will need more support. For example, if a 2' x 6' planking needs support every 2', then an alternative material such as Trex may need a support approximately every 16" to 18". Another factor to consider is expansion and shrinkage. While wood swells and shrinks across the grain with moisture gain or loss, respectively, Trex may expand and shrink in all dimensions.

## C. Design variations/specifications

*A floating launch:*

- May be used in combination with bridges, gangways, fixed piers, or bulkheads to enable paddlers to put-in at water of sufficient depth; any of these structures may be attached with hinges and used across shallow areas to provide access to a floating dock; they should have slopes of less than 20 degrees (or no more than 8.33% to meet ADA accessibility) and should remain horizontal at high water levels; they provide maximum stability when equipped with handrails
- May be used in combination with elevated walkways or geotextile mats in environmentally sensitive areas, in order to prevent damage to riparian areas (*see Chapter XI for further information*)
- May be used in combination with motorized boat ramps to enable hand-launching
- Needs a deck that rises at least 2 feet above water to enable safe access
- Should float on at least 3 feet of water
- Should not rest too high above the surface of the water, as this can make transitions from canoes and kayaks difficult

## D. Advantages

- Adjusts to fluctuating water levels – (it's always the "right" height)
- Provides a sturdy surface, as a solution to unsafe conditions or inconvenient access
- Has few long-term environmental effects
- Is easily removable in inclement weather or heavy flows, therefore requires less maintenance and may last longer
- Provides an alternative to gravel ramps that will erode in areas of strong waves or currents
- Is easy to purchase and assemble; allows for flexibility in design
- When wet, is not as slippery as lacuches with sloped surfaces
- Is unlikely to scratch boats
- Keeps feet dry during cold weather paddling

## E. Disadvantages

- Not "appropriate" for all access locations; use should be limited to areas where: the minimum water depth at all times is 3 feet, changes in water level are slow and long-term, and there is minimal expo sure to the elements
- May not consistently meet ADA accessibility guidelines, since slopes of connecting structures may alter with changing water levels; locks and piles may be used in some situations to create a "certain" elevation or minimum height for a structure that will not deviate – this keeps the cross slope to a minimum
- In order for the launch to be in water of sufficient depth, it may be exposed to stronger currents than it can withstand; additional structures may be needed
- The anchoring process must be carefully considered, as it must take into account particular climatic and site conditions; when placing anchor piles, the combination of wind, wave, current, and impact forces should be accounted for
- Not effective for use in areas where tidal fluctuations are rapid and extreme; floats may be "beached" at low tide or floats can disrupt sediments as they rise with high tide

## F. Case examples, designs, photos

1) Newport Boat Ramp, Christina River, Newport, Delaware

*Problem:* This site on the Christina River, a tidal river flowing into the Atlantic Ocean, was initially accessible from a 32' wide x 105' long concrete ramp that connects to a concrete anchor pier. The site experiences heavy traffic from both paddlers and motorized boaters, and the shoreline at the access area has a steep slope of approximately 30 percent grade making it difficult to transport boats to the water.

*Solution:* The concrete anchor pier and ramp remain at the site and two parallel transfer plates have been connected by 3" hinges to either side of the ramp, along its longer edge, allowing for easier access to the water and increasing the amount of launching space. One of the plates, which is composed of three aluminum sections (two sections are 21' 3" long and one is 27' 9" long), is 8' wide and a total of 70'3" long and provides an accessible route, with an 8.33% 1:12 or slope, to an aluminum floating launch serving both paddlers and motorized boaters. The 32' x 10' aluminum floating launch, which has a 10' x 4' inset designated as a canoe station, is located about 12' from the shoreline (at low tide) in an area with a minimum water depth at low tides of 4' to 5'. The canoe station is built on the back side of the launch, where the area is protected from heavy currents, so that paddlers can launch separately from other boaters.

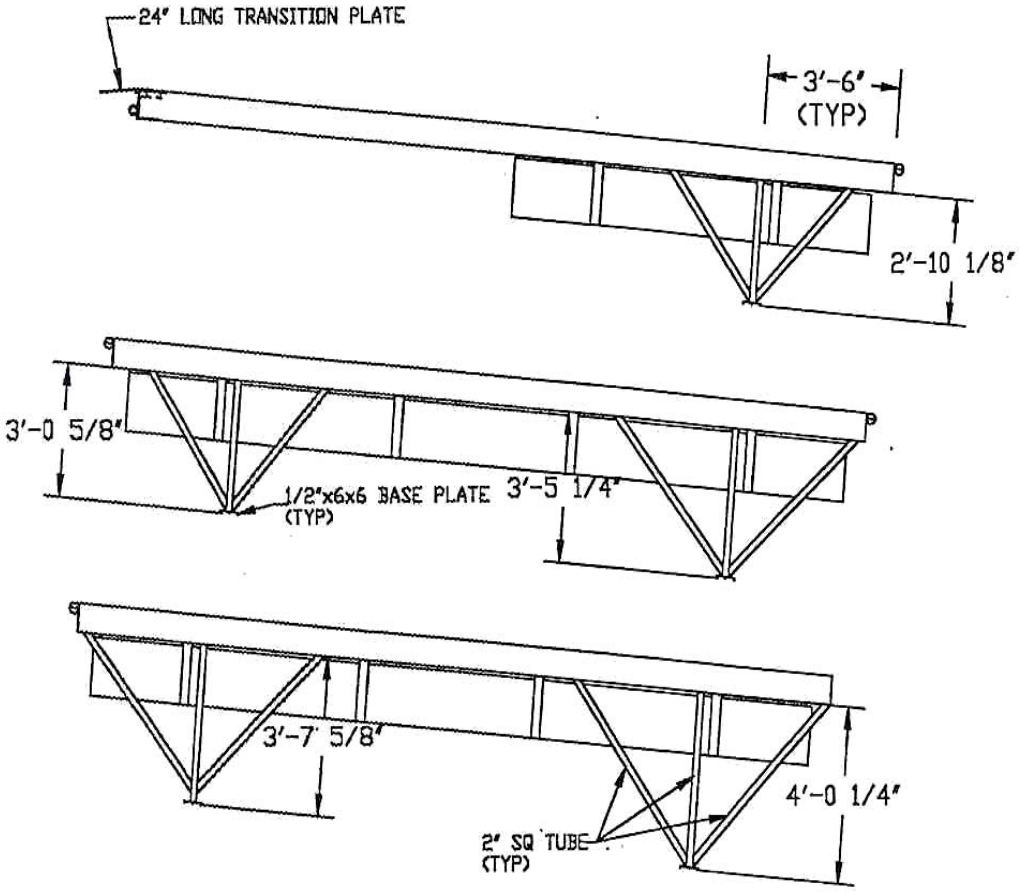
Delaware DNR has used this type of launch for about 15 years and has found that it requires relatively little maintenance, as aluminum can be welded relatively inexpensively every few years to reinforce areas that have worn. Floating launches are removed each year before the first icing, however several structures remain on the water year-round to accommodate waterfowl fisherman. Delaware DNR has retrofitted several launches, using similar aluminum designs, to accommodate more paddlers, including those with disabilities.

Specifications:

*Deck:* 9" thick ribbed, marine-grade aluminum (treated alloy 60-61 with salt protection)
2" square tube stringers
*Frame:* Treated pine fender; 3" square curbing at canoe station
*Floats:* 15" and 18" pontoons filled with urethane foam
supported by 24" x 7'6" pontoon at its base
*Anchors:* Pile guides
*Handrails*: 12" high x 10' long x 1½" wide at canoe station
*Supports:* Roller pile guides
*Transition plate:* Three hinged aluminum sections, two are 8' x 21'3" and one is 8' x 27'9"

Designs for Newport Boat Ramp follow, courtesy of Lacy Nichols
Delaware Department of Natural Resources and Jon Fleischman of Gator Dock & Marine, INC.:

**Diagram 5A: Detailed elevation of transition plates, Newport Boat Ramp**




STANCHION DETAILS

**DIAGRAM 5B: Elevation of transition plates, showing 1:12 slope**
**Newport Boat Ramp**

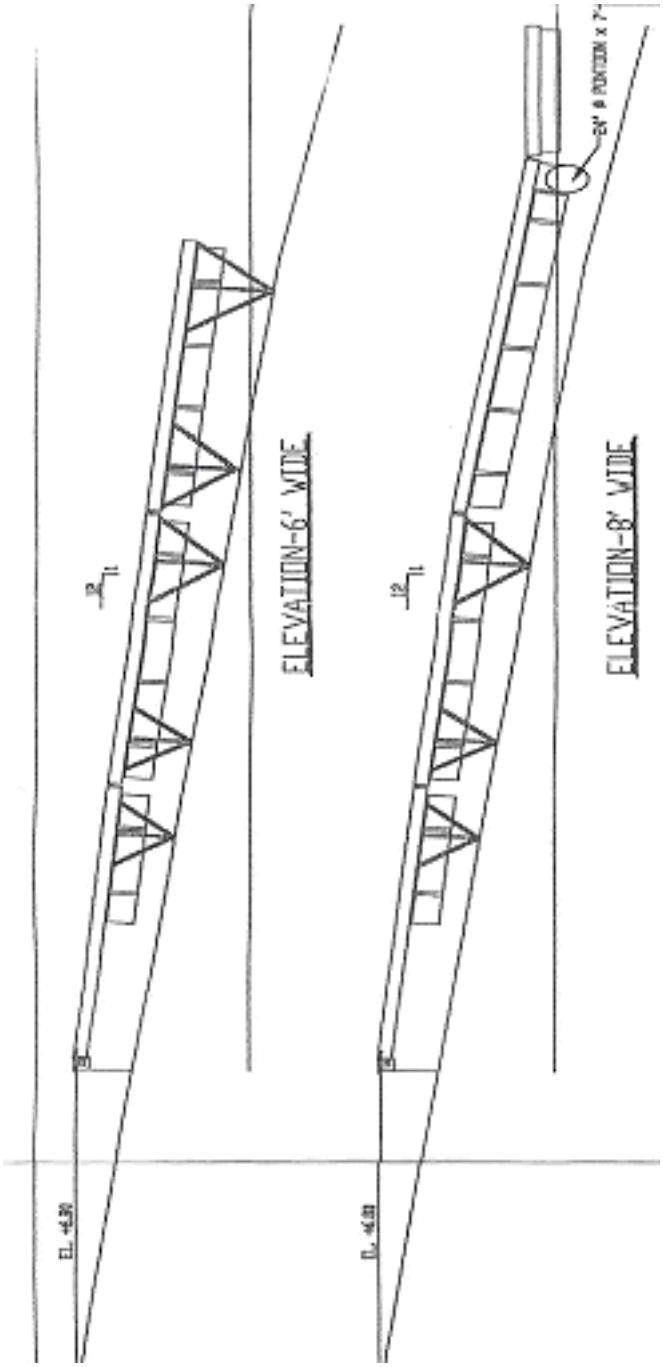


**DIAGRAM 5C: Plan view of deck and canoe station**
**Newport Boat Ramp**

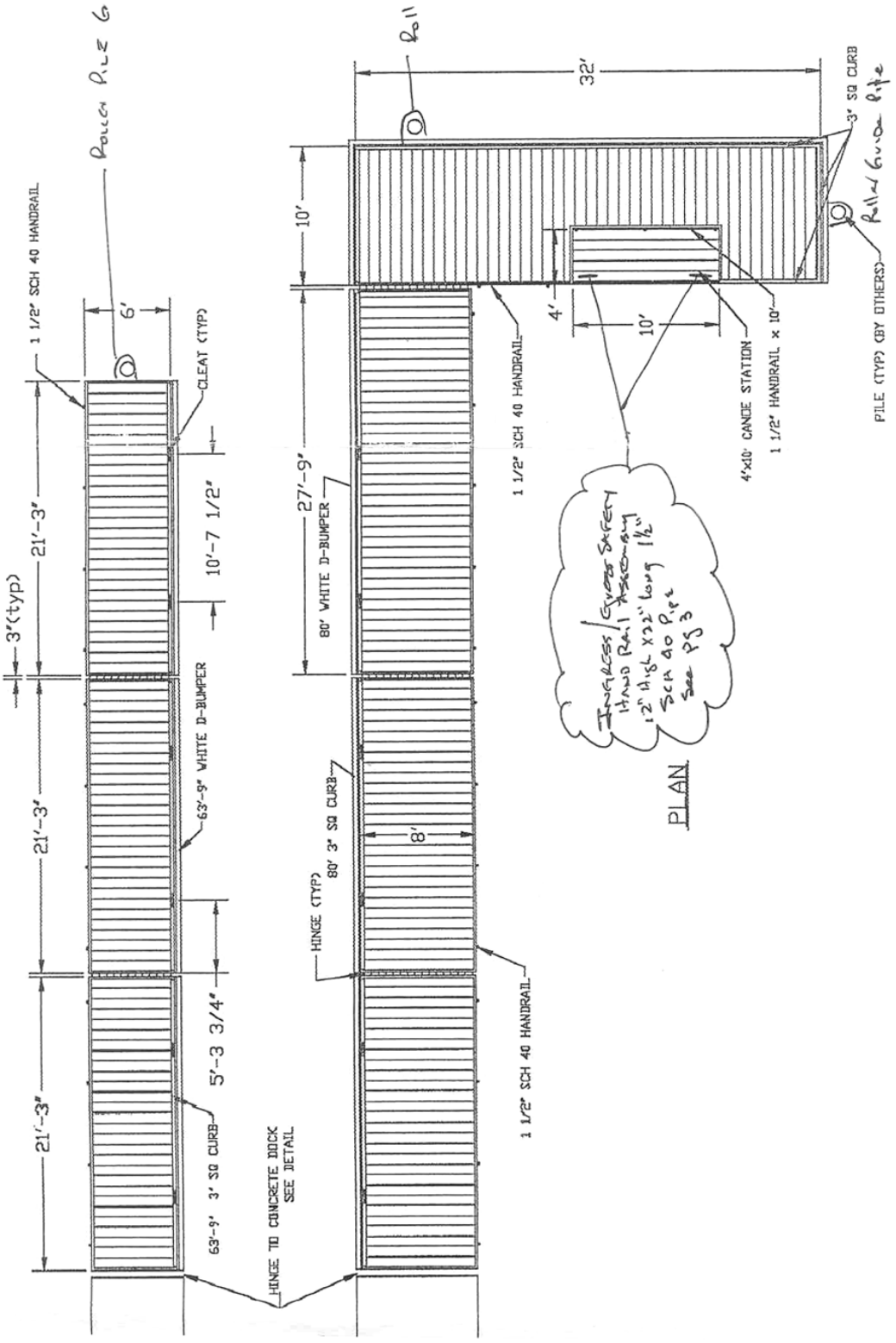


**DIAGRAM 5D: Section of floating launch and canoe station**
**Newport Boat Ramp**

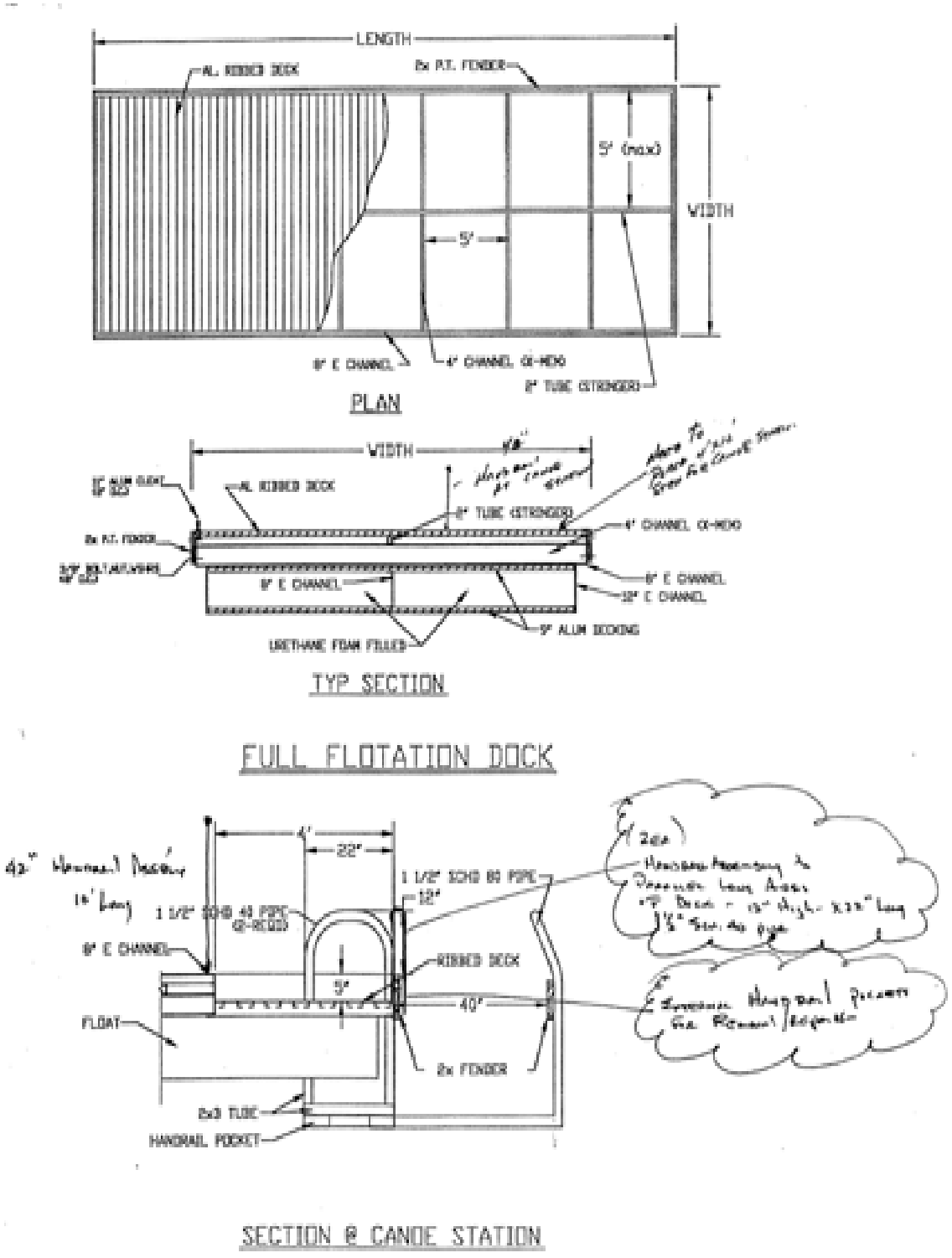
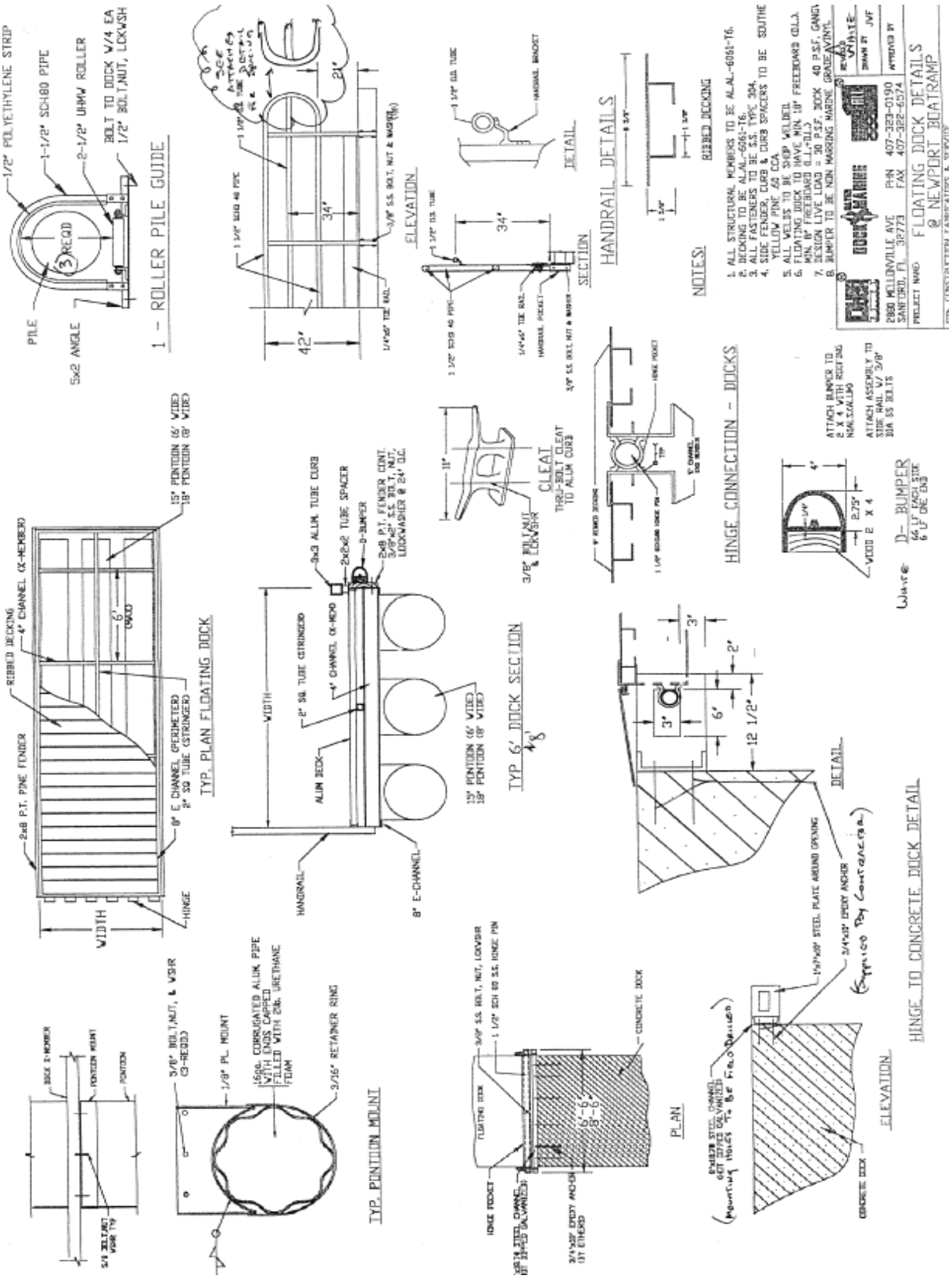


**DIAGRAM 5E:**
**Details of handrails, roller pile guides, cleats, hinges, bumper, and pontoons**
**Newport Boat Ramp**



2) South Prong River, North Carolina State Parks – Bayboro, North Carolina

*Problem:* Paddlers shared a crowded concrete boat ramp with motorized boaters. Concrete surface made launching difficult for kayakers and caused damage to the bottoms of some boats.

*Solution:* A floating dock was installed along the hardened shoreline and attached to a board-walk for easy access. This provided a separate and more suitable launch site for paddlers. The project was funded by North Carolina State Parks "Adopt-a-Trail" program.

Specifications:

*Frame:* 2" x 10" salt treated wood
*Deck:* 2" x 6" salt treated wood
*Floats:* Two 20" float drums, Follansbee Series Three
*Inset:* 4' wide x 12' long, sloping from 9¼" to 2", covered with 2" x 6" salt-treated wood deck;
*Anchors:* Pile guides

Wood floating launch is 8' x 13.5' connected to boardwalk with a 8' long slide
Slope is ADA accessible at some water levels; average distance to water is 32"

**DIAGRAM 5F: Plan view, Bayboro launch**

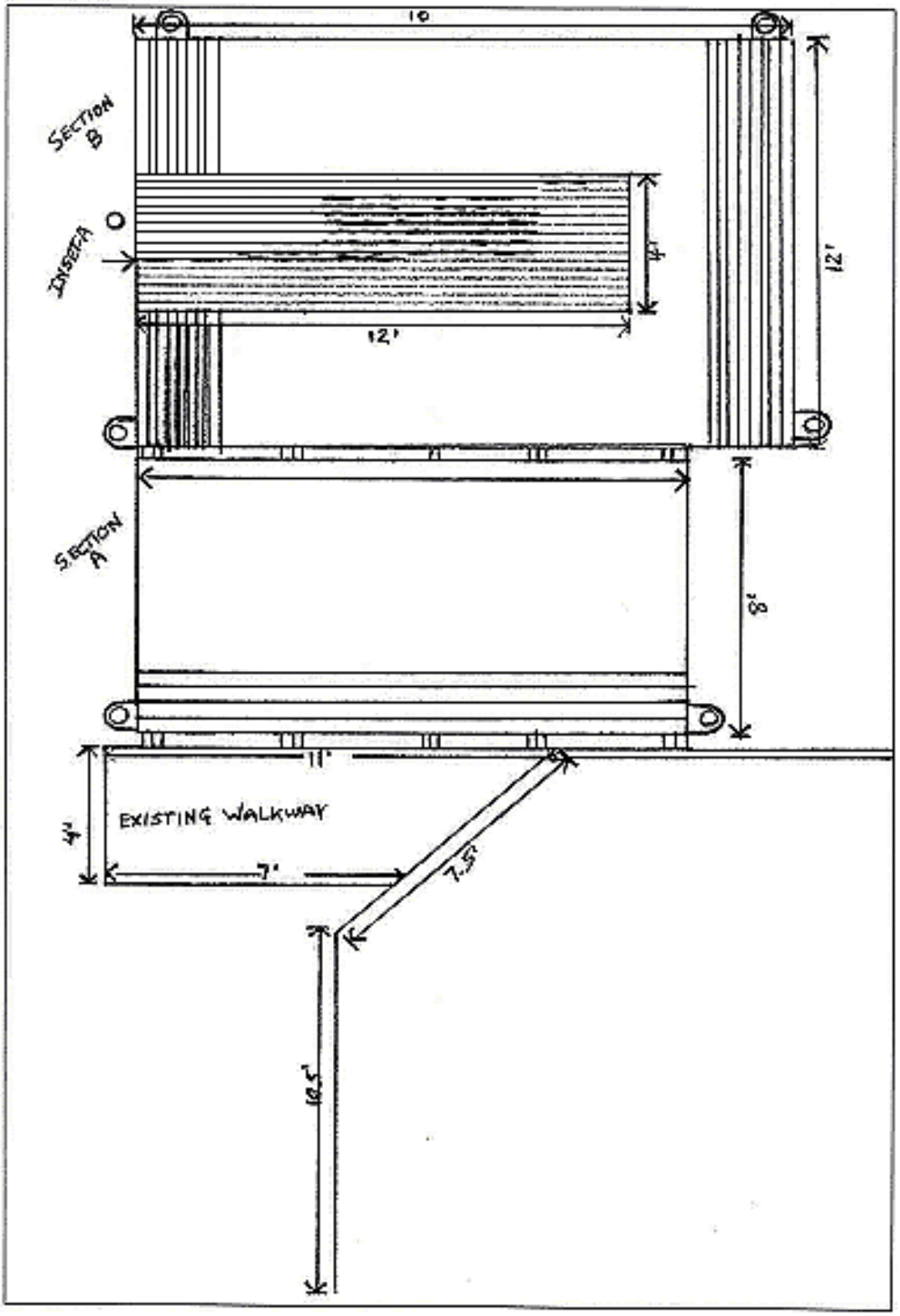


**DIAGRAM 5G: View of salt-treated deck and frame, Bayboro launch**

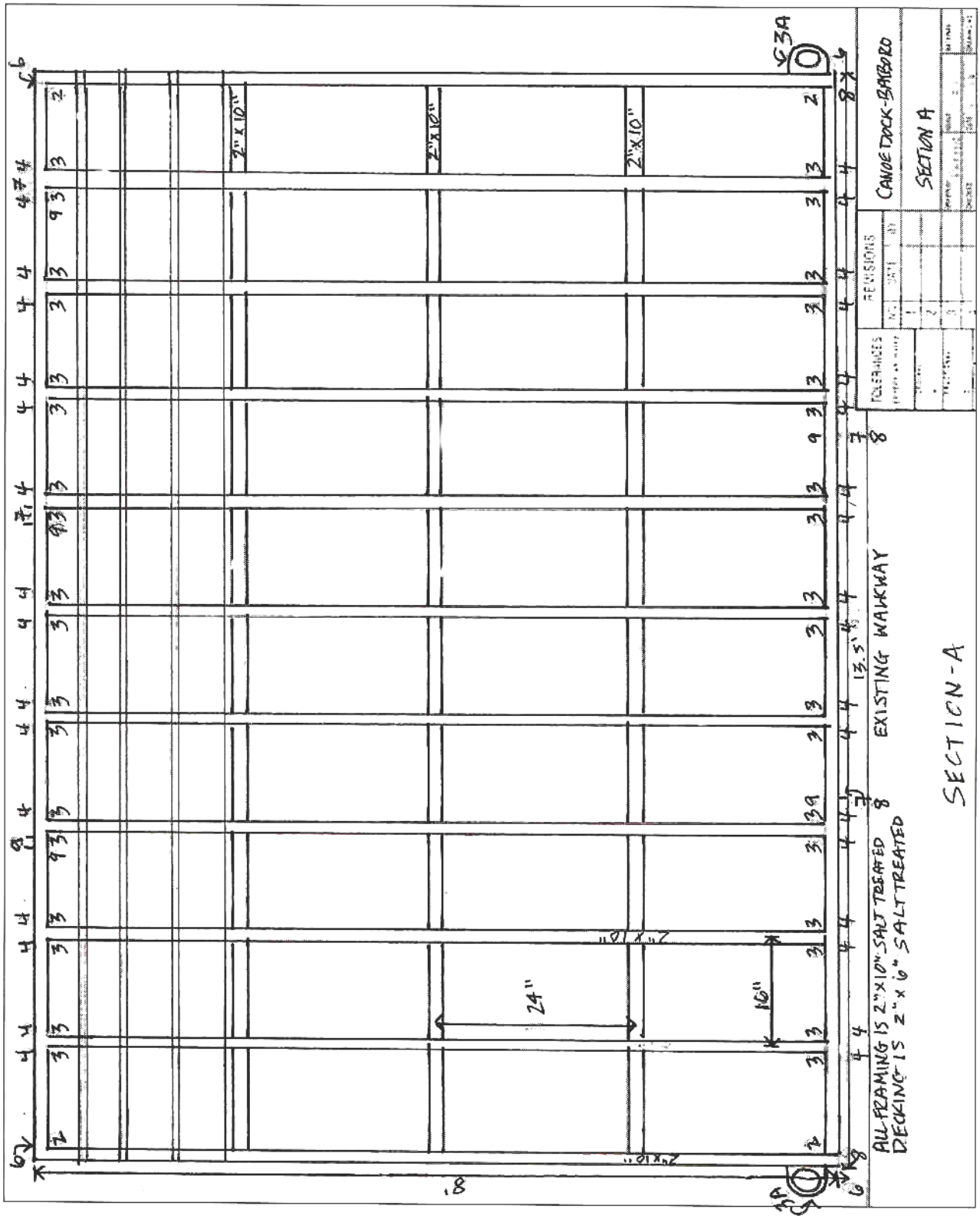


**DIAGRAM 5H: View of launch inset, Bayboro launch**

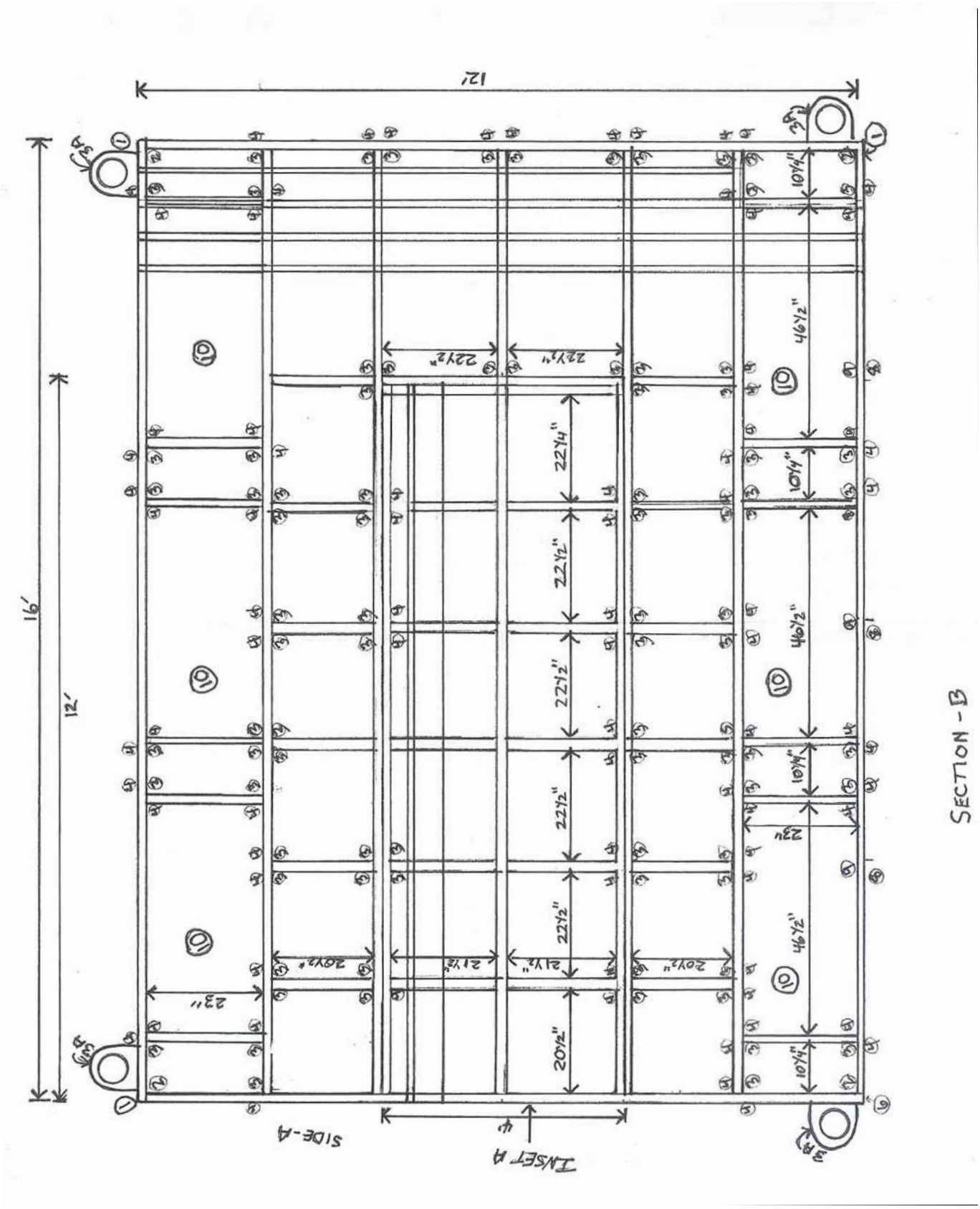


**DIAGRAM 5I: Section view of launch inset, Bayboro launch**

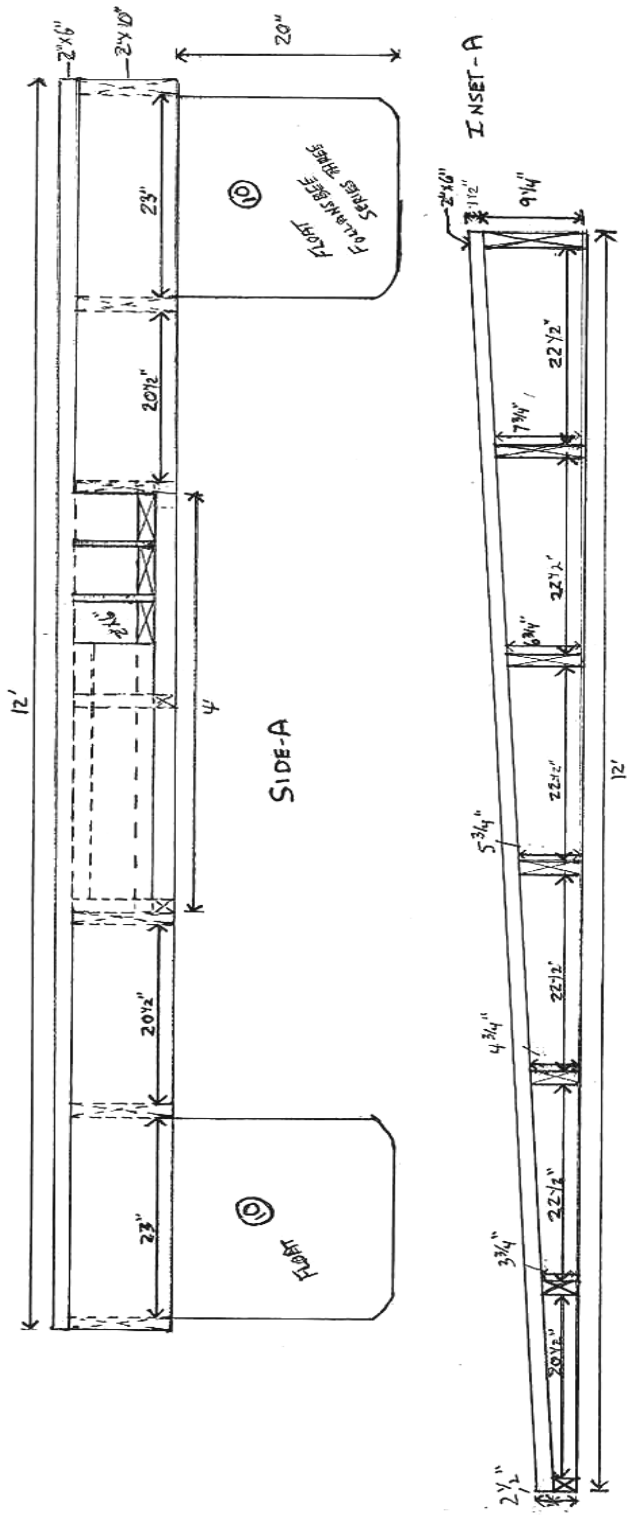
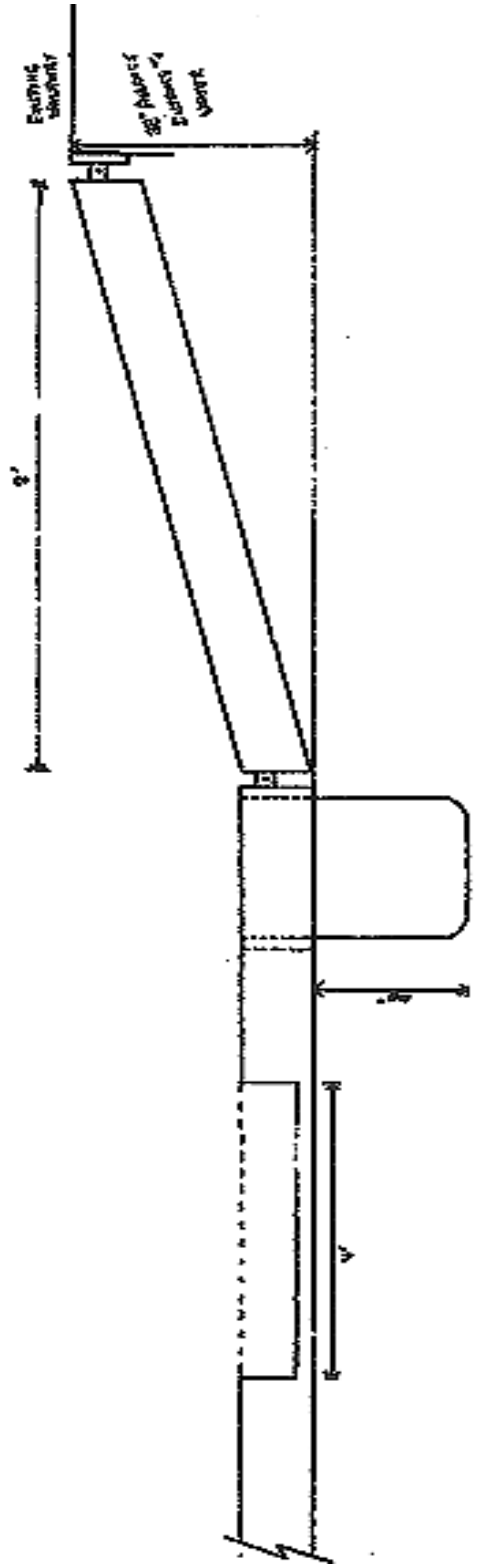


**DIAGRAM 5J: Side profile at water elevation, Bayboro launch**
**Shows launch connecting to existing walkway**



3) Annsville Creek Paddlesport Center, Hudson River Watertrail
Hudson Highland State Park, New York

Commercially manufactured floating launches may be used in combination with other structures, such as gangways or pile launches. Wholesalers sell floating launches built of pre-fabricated modular sections that can be connected together to adapt to site specifications.

The following photos and designs portray access at Annsville Creek to the Hudson River Water Trail, a tidal river with water levels that typically fluctuate at least 4 feet between tides. Several different structures are used at this site to accommodate paddlers at different water levels: a modular polyethylene floating launch connects to a wooden floating dock that is accessible from a concrete landing on the shore via two parallel aluminum gangways. The floating launch has four kayak slots or boat slides, where paddlers can easily transition into and out of the water. The entire launch configuration is ADA accessible and is used to teach paddlers with disabilities, as well as to train instructors who teach paddlers with disabilities.

Specifications:

*Floating launch:* 22' wide x 30' long; structure made of 234 polyethylene polymodules (total)
*Wooden floating dock*: 8' wide x 30' long, connects to floating launch and two transition plates
*Transition plates*: Two parallel aluminum gangways, each 4' wide x 30' long, with steel handrails
*Concrete landing:* 4' wide x 25' long at shoreline; extends into water 42" below shoreline level
*Reinforcements:* Rip-rap extends from edge of concrete landing across half of gangway length
*Total width of kayak slots* = 16.67'
Small upright and inverted modules along outer edge of launch are vented to permit adjustment

Photo by Ken Allen

**Photo 5A: Floating launch provides access to Hudson River at varying water levels**

Photo courtesy of Scott Keller

**Photo 5B: Modular polyethylene floats connect to fit site specifications**

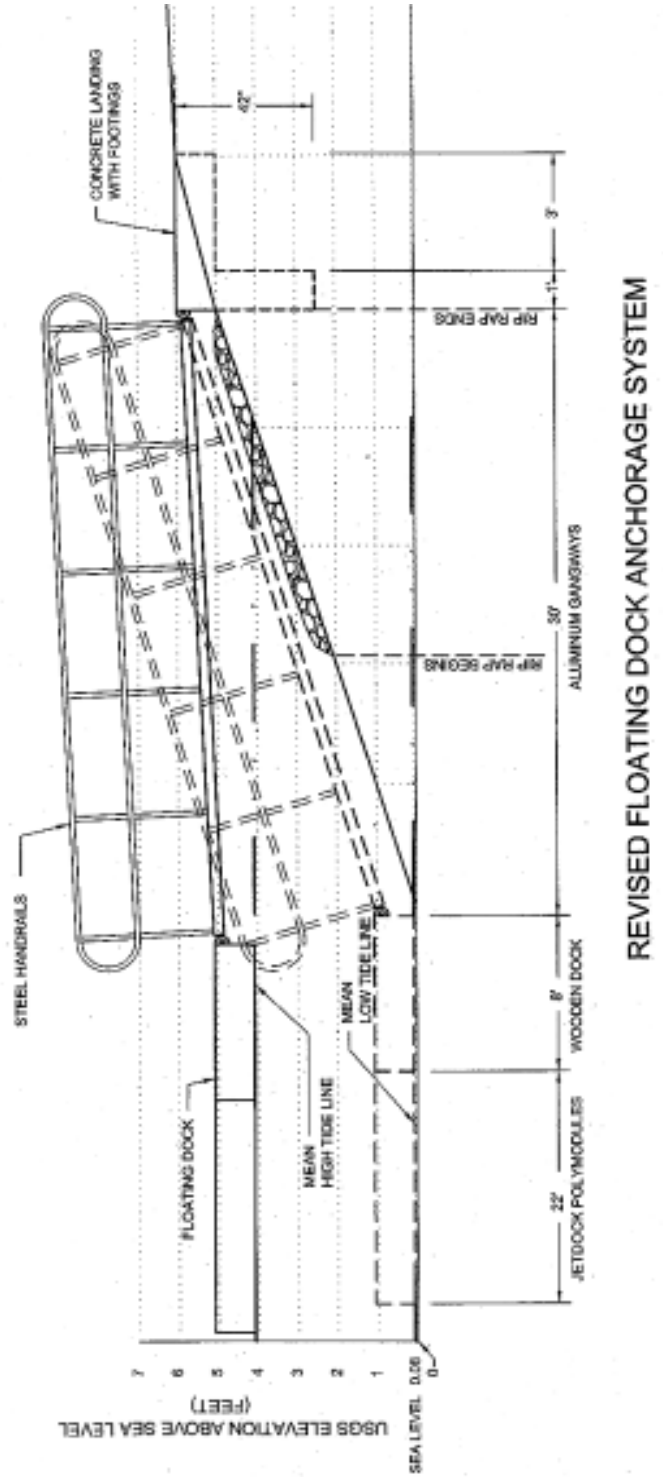
Photo courtesy of Jim Logan
Hudson Valley Watertrail Association

**Photo 5C: Vented polyethylene modules adjust to accommodate needs of paddlers**

## Designs for Annsville Creek Paddlesport Center, Hudson Highland State Park

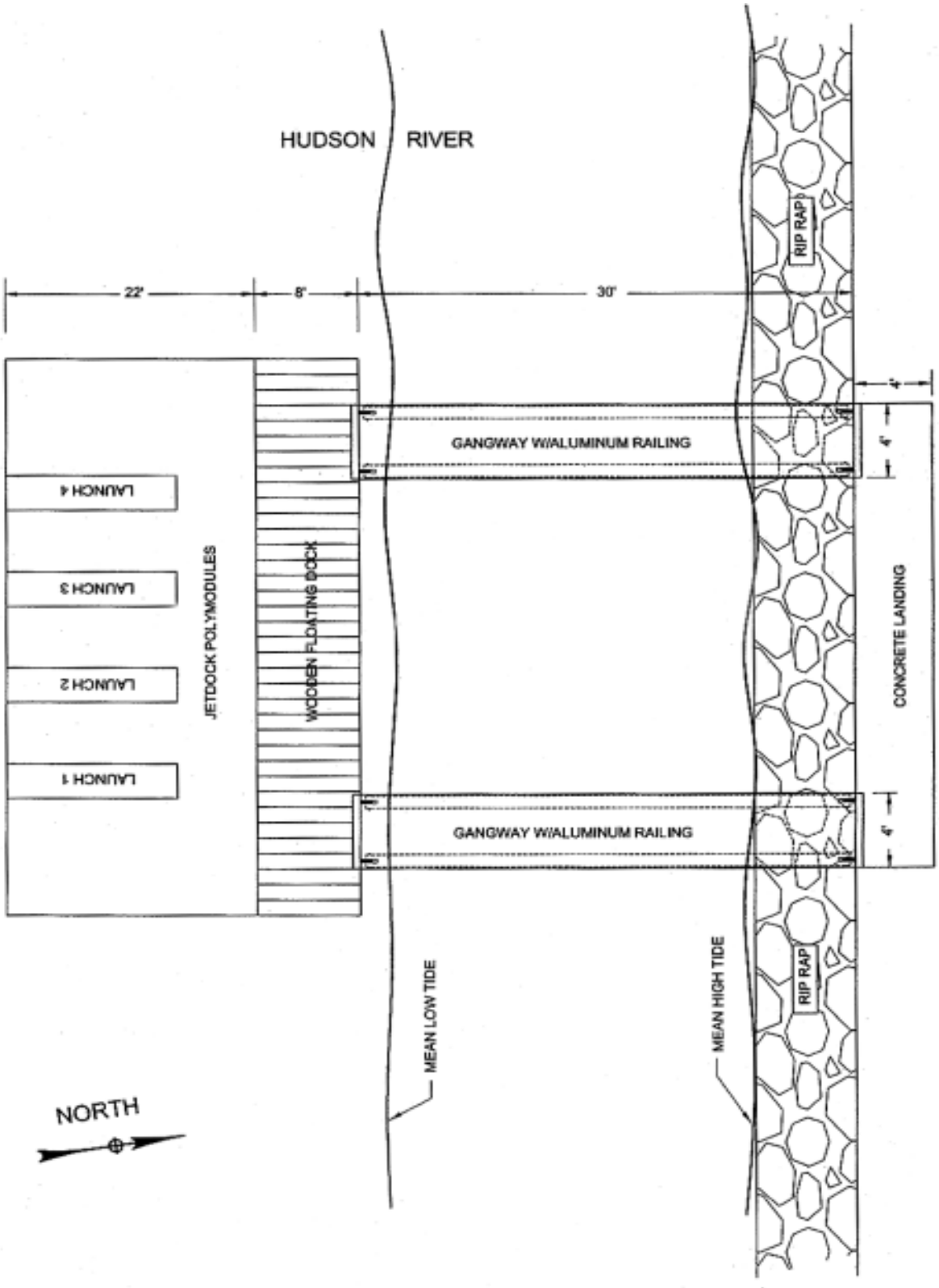
Courtesy of Ken Allen, White Mountain National Forest

### Diagram 5K: Elevation of floating dock and anchorage



## Diagram 5L: Plan view of floating dock at Annsville Creek

Courtesy of Ken Allen, White Mountain National Forest



***Commercial floating launches and floating launch supplies***

The following vendors carry floating launch products and supplies. This is not an exhaustive list and is meant only as a sampling. It is not an endorsement of these companies or their products.

- **Alumidock:** wide variety of floating docks, gangways, stairs **-** http://www.alumidock.com
- **Connect-A-Dock**: modular floating docks and platforms - http://www.connectadock.com
- **Dock Floats Ltd.:** http://www.dockfloatsltd.com
- **Flotation Systems, Inc.**: maintenance free, expandable aluminum docks - http://www.aluminumboatdocks.com/Contact.htm
- **Galva Foam Marine Industries:** http://www.shoremaster.com/news/28.html
- **Gator Dock & Marine, INC.**: aluminum floating docks - http://www.gatordock.com
- **Jetdock:** custom-made and modular floating launches - http://www.jetdock.com
- **Johnstons Docks & Supplies**: stationary and floating docks, dock kits, polyethylene floats - http://www.dockkit.com/
- **Marina Accessibility Products, Inc.**: offers a self-leveling gangway lift for physically challenged, designed specifically for floating docks - http://www.renweb.net/website/marina/
- **Mod-U-Dock**: maintenance-free, easy installation docks and floating docks with modular design and custom dock building - http://www.modudock.com/
- **Northstar Vinyl Products, LLC**: 21 polymer coated wood used in vinyl seawalls, docks, decks - http://www.northstarvinyl.com/
- **PlasTEAK Products**: uses recycled plastic - http://www.plasteak.com/
- **TIECO Floating Structures**: steel tube floating docks - http://www.tiecomarine.com/
- **Tiger Boat Docks & Lifts**: parts and plans for do-it-yourself projects - http://www.tigerboatdocks.com/
- **Traveldock**: portable lightweight docks for inland waterways - http://www.traveldock.com.au/

4) Janes Island Kayak Dock, Dougherty Creek Canal, Janes Island State Park, Maryland

*Problem*: Paddlers needed an alternative launch site at a busy marina. The existing concrete boat ramp was crowded with powerboat use and hazardous to paddlers due to its slippery surface and steep incline. Since the entire shoreline is bulkheaded, there were no "soft landing" alternatives to provide paddlers with access to the water.

*Solution*: Maryland Department of Natural Resources purchased a floating 8' x 20' dock designed specifically for canoes and kayaks that attaches to bulkhead pilings with metal rings. The new launch was placed outside the entrance to the marina basin so that paddlers do not have to cross incoming and outgoing boat traffic into the basin. Paddlers access the launch from a ladder, so it is not easily accessible to those with disabilities.

Photo courtesy of Nita Settina
Maryland Department of Natural Resources

**Photo 5D: Floating launch attached to bulkheads can be accessed from the shore by a ladder**

Specifications:

*Deck:* 2' x 6' with 3" x 6" side stringers
*Frame:* Wood, 2' x 6' with 3" x 6" cross stringers; ¼" steel brackets reinforce outside corners
*Floats*: Polyethylene shell filled with foam, 8" x 20" x 72" long

**Photo 5E: At Janes Island's busy marina, the floating launch provides access to paddlers at a safe distance from heavy motor boating traffic**

**Photo 5F: Situated lower than the boardwalk, the floating launch allows easy access to the water**

Photos courtesy of Nita Settina
Maryland Department of Natural Resources

# CHAPTER VI:
# PIPE AND PILE LAUNCHES

## A. General Description

Pipe and pile structure, which are used independently as launches or in combination with other structures, can span marshes or shallow areas to enable launching in water of sufficient depth. In some cases, "approach pads" or walkway structures are designed to enable access to the launch itself. Structures are composed of a deck and frame, which stand above water level at all times, and are supported by pipes or piles. While piles can be used in any depth of water, pipes rest on supports (e.g., concrete pads) and are not suitable for deep water.

## B. Materials

- Decking is frequently made of wood, concrete, or alternative wood materials
- Piles are usually made of treated timber, steel pipes, or concrete
- Pipes with diameters between 1½" and 3" are preferable

### *Environmental Impact from Pile Installation*

Pile design and construction can potentially have negative environmental impacts, as well as health ramifications for those involved in their construction. Piling methods should be researched and prepared for thoroughly before construction. The U.S. Forest Service's *Wetland Design and Construction* is a resource that discusses pile installations in more depth *(see Bibliography)*.

While there is limited research available on the environmental impacts of piling, some methods clearly cause less disruption to sediments and vegetation than others. The process of "driving," for example, is significantly less disruptive than "jetting," which uses high-pressure hoses. Disturbances to sediments in sandy areas can be greatly reduced when low-pressure pumps are used to create an initial hole and sharpened piles are installed with a drop hammer.

## C. Design specifications/variations

- Water level should be lower than the level of the deck at all times
- Pipe legs need cross bracing and bracketing to the frames for reinforcement

## D. Advantages

- Effective in areas of strong current
- Pipes are environmentally-friendly
- Stable surface for launching
- Good choice for providing access to paddlers with disabilities; handrails or step-downs may be easily added
- Usually requires little alteration to shoreline
- Relatively inexpensive to construct
- Structures are easily visible from rivers
- Pipe docks can be easily adjusted or removed

## E. Disadvantages

- Does not accommodate extreme variations in water level
- Construction of piles can have damaging environmental impacts, such as altering currents, if they disrupt flows or sediments
- Piles made of treated wood can contaminate water (*see notes below*)

### *Environmental impacts from wood preservatives*

According to some studies, the greatest likelihood of water contamination from launch construction occurs from preservatives that are applied to pilings or floats in locations that come into regular contact with water. Many states have banned the use of oil-based preservatives containing creosote (CRT) or pentachlorophenol (PCP) in aquatic areas due to their demonstrated toxic effects from leaching, since soluble components separate and leak into the water.

The most common material used in pressure-treating wood used for pilings and decking is chromated copper arsenate (CCA), which is usually made of 47.5% hexavalent chromic oxide, 18.5% curpic oxide, and 34% arsenic pentoxide. It has been proven that CCA will leach in salt water and can be toxic to estuarine species. However, nearly all of the leaching occurs within the first 90 days of submersion.

Studies show that the level of CCA's toxicity depends on its chemical form when it reaches an organism. Its chemical form will change over time and with different sediment types, amounts of organic material present, oxygen levels, and water movement. However, given that most leaching occurs when the launch is new and that the area surrounding the launch is relatively small, it is likely that tidal movement will prevent high levels of CCA from accumulating.

Further details may be found in report by NOAA Coastal Ocean Program Decision Analysis Series No. 22 (*see Bibliography*)

# CHAPTER VII: CANTILEVER LAUNCHES

## A. General Description

Cantilever launches extend out over the water from the shore, sometimes appearing to float on the water. Their main supports are their anchors to the shoreline, which often include anchors that are partially submerged in water.

## B. Materials

Frequently made of wood, with steel or wood supports

## C. Design specifications/variations

- Anchor and frame must be built to accommodate weights of the launch, boats, and paddlers
- An engineer should be consulted to determine if a cantilever structure is the best option given the launch's level of use
- Elevated cantilever walkways, used as launches or connected to other launch structures, can provide access in environmentally sensitive areas while protecting riparian habitat and shoreline vegetation; see Alaska Fish and Game's website for more information: http://www.sf.adfg.state.ak.us/sarr/restoration/techniques/walkways.cfm

## D. Advantages

- Have minimal environmental impact
- Suitable in a wide range of locations and shoreline configurations
- Can have removable deck sections or posts that may be removed seasonally
- Relatively inexpensive to construct

## E. Disadvantages

- Cannot support excessive weight
- Treated wood can be hazardous to the environment ; alternatively, using alternative wood materials can be expensive
- May not last as long as a fixed or floating launch due to support and weight limitations

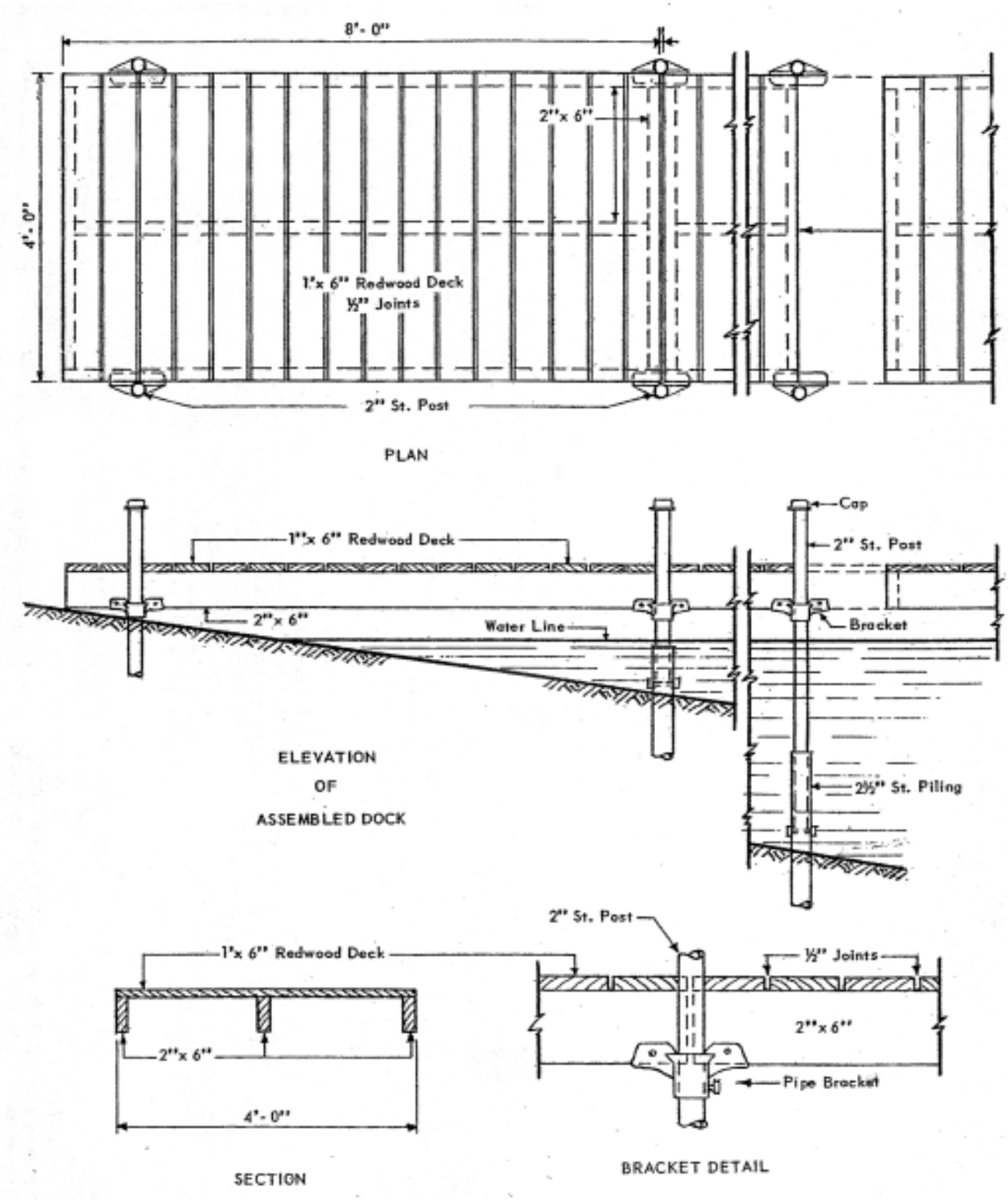
## F. Case examples, designs, photos

### 1) Design for cantilever launch, Minnesota Division of State Parks

This cantilever launch is composed of deck sections and posts that can be removed seasonally. 2 ½" footing pipes with cross bolts in place are installed into the shore bottom until they are firm (18" to 24" below the water surface). 2" pipes are installed through metal deck brackets and into pipes, capped on upper threaded ends. Deck is leveled by set screws in brackets. Dock can be unbolted when screws are loosened and 2" pipes are removed. Dock sections can be removed entirely, while the footing pipes remain.

**Diagram 7A: Plan, elevation, section, and bracket detail of cantilever launch**

Design courtesy of Minnesota DNR



# CHAPTER VIII:
# CONCRETE LAUNCHES

## Ramps, Stairs, and Mats

Concrete has a variety of applications that include ramps, stairs, mats, and strips. Some applications, such as stairs, are cast-in-place, where the concrete is poured and shaped on site. Others are composed of pre-cast mats, planks, panels, or slabs. Concrete can also be used to create strips that help to control erosion or to divert heavy flows away from a launch site.

Concrete may be purchased as a ready-mix (generally used for smaller projects) or delivered by a mixing truck. For cast-in-place ramps, approximately 0.37 cubic feet of mix are needed for every 10 cubic feet to be cast.

The basic mix for concrete consists of 1 part cement, 2 parts sand, 3 parts gravel (or aggregate), and water. Proportions can be altered to suit the needs of the site. For example, a higher proportion of cement can be used for thinner structures, while thicker launches may require more aggregate.

Portland cement (composed of ground limestone, clay or shale, sand, and iron ore) binds the materials together, hardening the mix, while sand and aggregate act as “fixers” to control the mix from shrinking. Water reacts with compounds in the cement as it hardens and allows for plasticity so that the concrete can be poured into a form and shaped.

Additives called admixtures can be added to concrete mixtures either to improve the quality of the mix or to keep the concrete workable in certain climatic conditions. Air-entraining agents, which are bubbles added to the concrete mix to improve its durability, may prevent cracking as a result of freezing and thawing cycles.

# CONCRETE RAMPS

## A. General Description

Concrete ramps may be used as launches by themselves or in combination with floating launches, piers, bridges, dock abutments, bulkheads, and rock cribs. If the ramp connects to a floating launch using a bridge, it will need a hinged metal transfer plate to allow for an easier transition.

Concrete must be installed in dry conditions, therefore the area must be totally clear of water where any portion of the ramp extends beneath the surface of the water. The underwater area may need to be cofferdammed. A cofferdam is a water-tight enclosure that is temporarily used to pump water out of an area during construction. If lime is used in this process, it must be managed carefully so as not to enter the water where it can pose a danger to riparian species.

Pre-cast concrete planks and panels should only be used on bodies of water with little to no current. Pre-cast slabs are heavy and must be placed using lifting equipment; reinforced concrete is typically needed for underwater sections of the pre-cast ramp.

## B. Materials

Surface finish, including corrugated concrete, rock salt, or exposed aggregate, may be applied to concrete to increase traction or improve its appearance. One popular finish uses 1" x 1" V-grooves formed at a 60 degree angle to the centerline. V-grooves should not be used on launches that serve as accessible routes, however, as they make wheelchair access difficult.

## C. Design variations/specifications

- The width and thickness of concrete ramps vary, but cast-in-place ramps are typically 6" to 8" thick and use rebar reinforcement
- Ramps can be cast-in-place or composed of connected pre-cast slabs, planks, or panels

## D. Advantages

- Provides the most stable, sturdy surface for launching
- Durable; not subject to rot or rust
- Easy to shape and work with, adaptable to slope needs; minimal additional construction needed
- Can be relatively inexpensive to construct, depending upon type of application
- Relatively low maintenance (depending on sedimentation levels); easy and inexpensive repairs
- Can be used to help mitigate erosion problems or assist with vegetative restoration

## E. Disadvantages

- Can cause damage to riparian ecology, preventing growth of vegetation and impacting habitats
- Surface can be slippery, especially when muddy or wet, however, using corrugated concrete, rock salt, or exposed aggregate on the surface can provide effective traction
- Can be damaged or crack easily due to freezing and thawing conditions, but can also be easily and cheaply repaired
- Can be expensive to clean if there is heavy flooding and mud build-up
- Usually not aesthetically "pleasing," although their noticeable presence can assist paddlers with locat ing take-outs from the river. They can also be surfaced for an improved appearance with materials such as river rocks, fieldstones, or salt-finishing

## F. Case examples, designs, photos

1) Wolf Creek, Missouri River, Montana

*Problem:* The original launch, installed over 25 years ago, was a pre-cast concrete ramp that angled downstream and extended out into the water approximately 10 feet. Due to its configuration, eddies formed and the fill supporting the ramp eroded, over time, due to undercutting. Undercutting is a frequent problem with ramps that are not built at a perpendicular to the shoreline. Areas of vegetation at the top of the ramp had also eroded with use by paddlers loading and unloading their boats.

*Solution:* Engineers at the Montana State Design & Construction Bureau rebuilt the ramp to make improvements for safety, longevity, and ease of use. The original intention was to reorient the alignment of the ramp to be perpendicular to the bank. However, fearing that the new ramp would encourage jet boat traffic, they decided to build it on the same location as the previous ramp.

The new concrete ramp is wider, elliptical in shape, and thickened with a 24" concrete edge along its perimeter to prevent undercutting. The previous pre-cast concrete planks were replaced by flexible, cabled concrete mats and its slope is around 1:3. Its textured surface provides traction. Rip-rap and textured bank protection were also added.

A 6" concrete slab with fiber mesh and 12" thickened edge was also added to provide a relatively flat section at the top of the ramp where paddlers load their boats. By giving paddlers a designated area to use rather than trampling vegetation, the ramp helps to decrease erosion in areas around the launch.

**Photo 8A, 8B: An elliptical concrete ramp was installed at Wolf Creek, on the Missouri River, to reinforce the bank and provide a loading area for paddlers in a way that helped mitigate erosion**

Photos courtesy of Ken Phillips
Montana State Design and Construction Bureau

2) Salida boat ramp, Arkansas River, Salida, Colorado

Salida's concrete boat ramp is an example of a launch site that has helped contribute to the revitalization of a town. Before this launch was installed a few years ago, this corridor of the Arkansas River was both inaccessible and unfriendly to paddlers and the general public. The area had been severely neglected and had become a depository of debris and waste from industrial sites upstream.

Part of the Arkansas River Trust's Whitewater Park and Greenway Project, installation of this boat ramp has helped to transform this spot into a popular one for launching, fishing, and other river-based activities. Native vegetation has replaced hundreds of tons of concrete along the banks and a whitewater course now offers a quarter mile of quality rapids on the river.

Photo by Caroline Wolf

**Photo 8C: Salida's concrete launch offers river access for a variety of recreational activitites**

3) Corrugated concrete ramp, Everglades, Florida

Photo by Tim Palmer

**Photo 8D: Corrugated concrete ramp provides effective traction for launching**

# CONCRETE STAIRS

## A. General Description

Concrete stairs are particularly effective in providing access along steep shorelines. They are durable and easily maintained and may be used in areas where water levels change dramatically, as they are likely to withstand currents and offer acess at a range of water levels.

## B. Materials

Stairs are formed from concrete that is poured on site. Once a bank is prepared to accommodate the stair dimensions (which may require some digging out with equipment, such as a backhoe), a concrete foundation is created, which is reinforced with rebar or metal. Molds are created for the stairs and concrete is poured into them. After the forms are set, the molds are removed.

## C. Design specifications/variations

- If steps are tapered in width as they descend to the water, the bottom steps should not be too narrow; paddlers need at least 5' and preferably 6' to 12' for launching
- Handrails may be needed to provide additional support for paddlers where shorelines are excessively steep; they may not be needed in areas with shorter distances to the water or less dramatic slopes
- Installing a 4' to 8' landing pad at the bottom of concrete steps can be useful to paddlers; this may serve as a “seal launch” where kayakers can put on their spray skirts before launching

## D. Advantages

- Provide effective solutions to a steep slope or eroding bank
- May be more aesthetically pleasing than concrete ramps or mats
- Can be combined with boat slides to provide easy transport of boats to water
- Require relatively little maintenance; durable

## E. Disadvantages

- May not be as easily accessible as concrete ramps or other launch types
- Can be expensive
- Rarely provide access for disabled paddlers
- May require artificial shoring (usually upstream) to protect them
- May require use of heavy equipment for preparation of bank before installation

## F. Case examples, designs, photos

### 1) Concrete stairs, West Virginia

West Virginia Department of Natural Resources provides an example of a concrete staircase with a raised, wooden boat slide. The boat slide enables paddlers to keep their boats at knee-level, so that they don't have to bend down, as they descend the staircase. The staircase is durable, projected to last at least 15 to 20 years. Little maintenance is needed, although there can be problems with mud accumulation at its base.

*Specifications:*

- Two staircases with boat slide in center; stairs lead to a ramp extending to water
- Each staircase is 2' wide x 24' long with twenty-four concrete stairs;
  each staircase measures: 24" wide x 12" long x 6¼" high
- Stairs are reinforced with #4 rebar, each 3' long, spaced 1 foot apart
- Boat slide descends center of staircase and is raised 1' above the height of the steps
- Slide is composed of two parallel boards made of pressure treated oak;
  each board measures 6" wide x 24' long x 2" thick; total width of slide spans 2½'
- Steel pipe handrails run down outer sides of each staircase
- Banks on either side of staircase are reinforced with stone rip-rap with geotextile fabric beneath

## Design details for concrete steps and boat slide

Courtesy of Dennis Kincer, West Virginia Department of Natural Resources

### DIAGRAM 8A: Details of boat slide

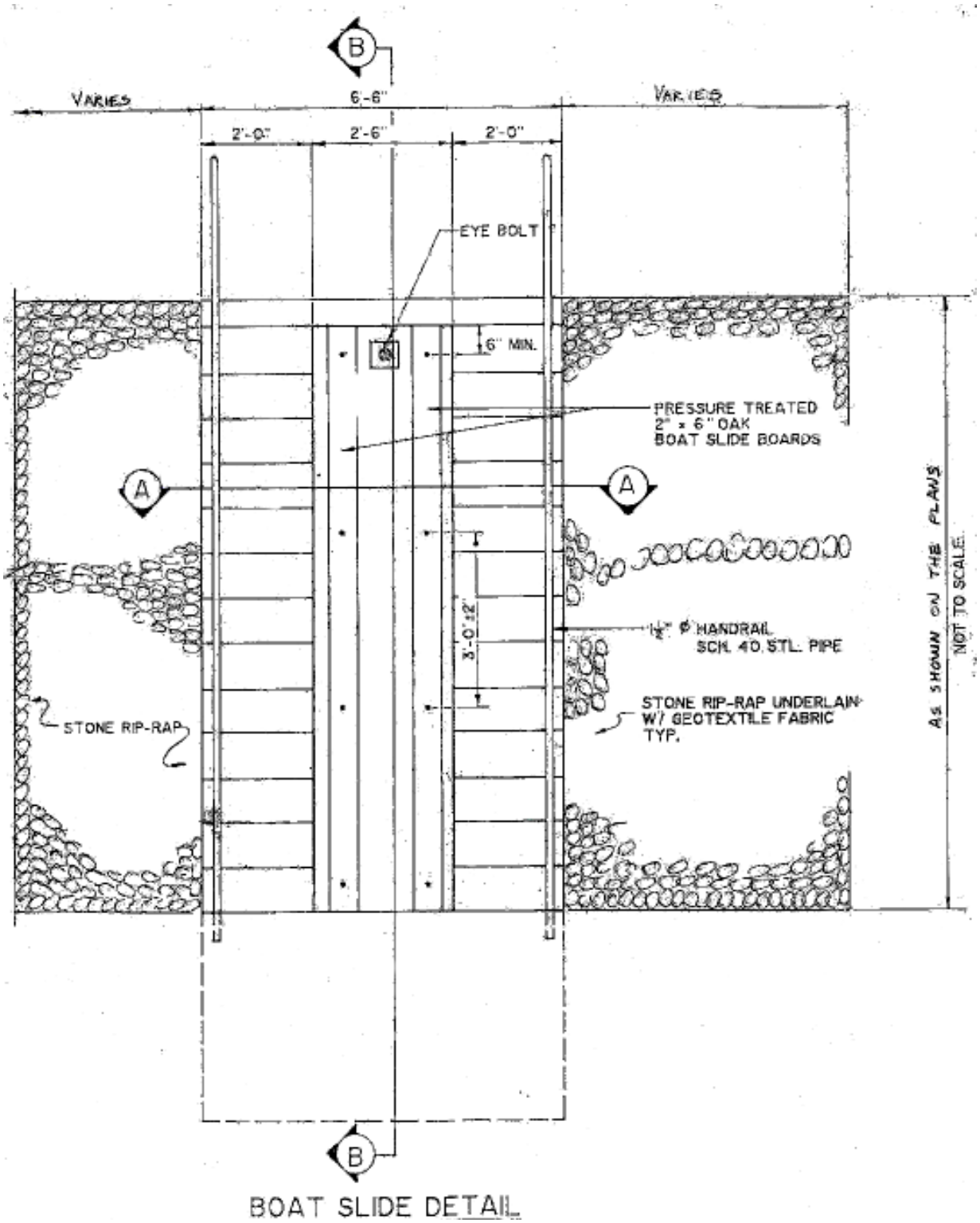
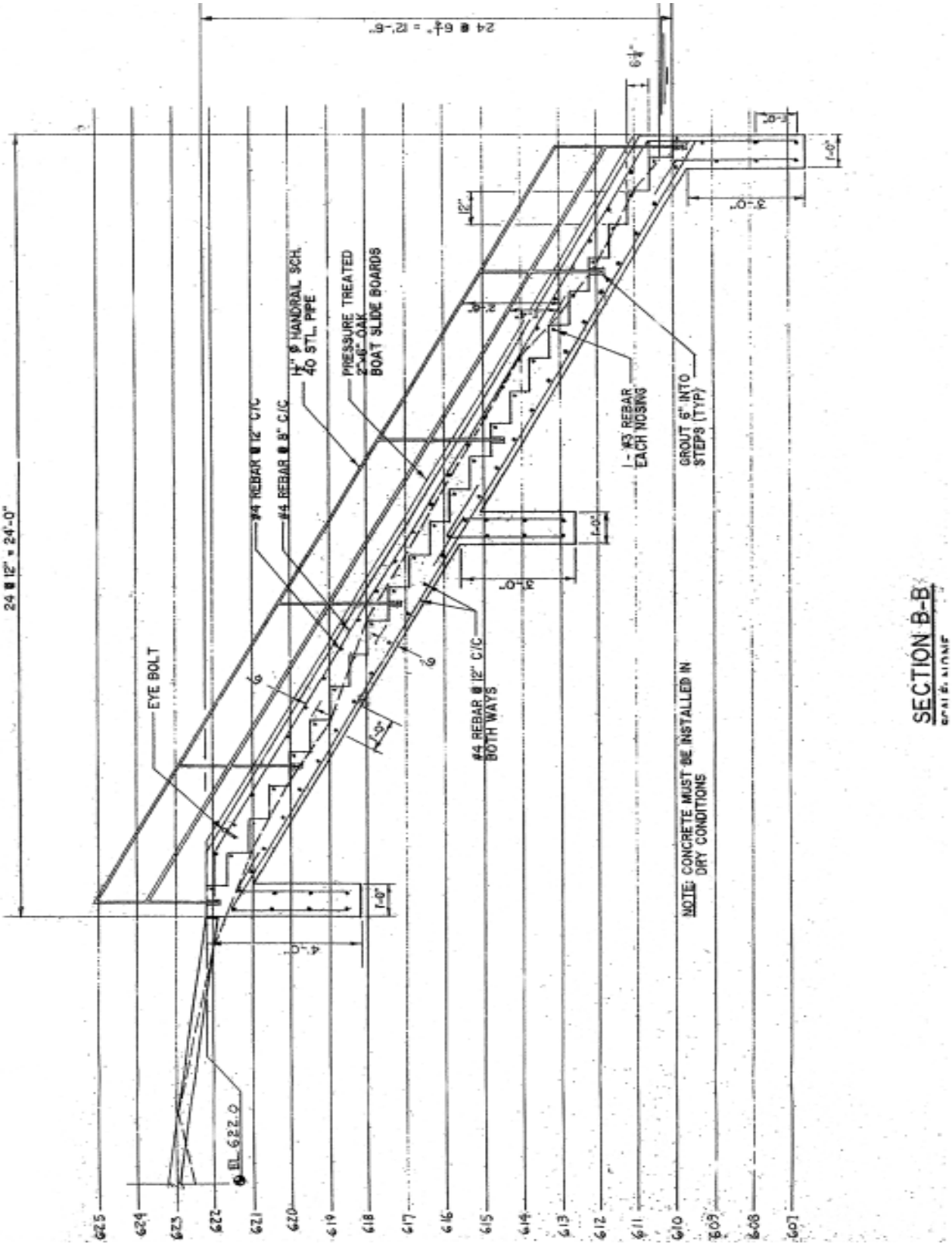
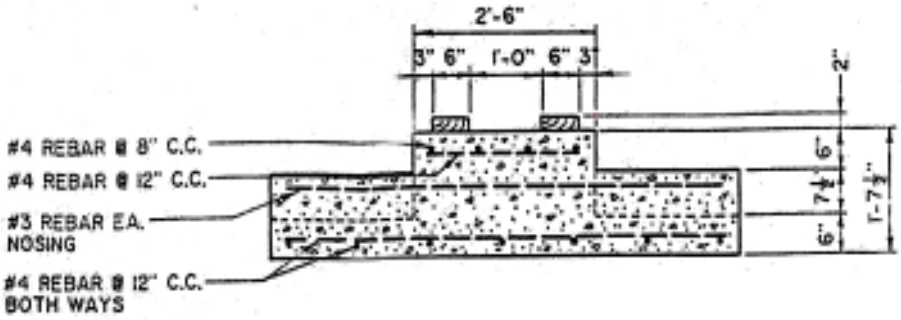


**DIAGRAM 8B: Section elevation of concere steps and slide**

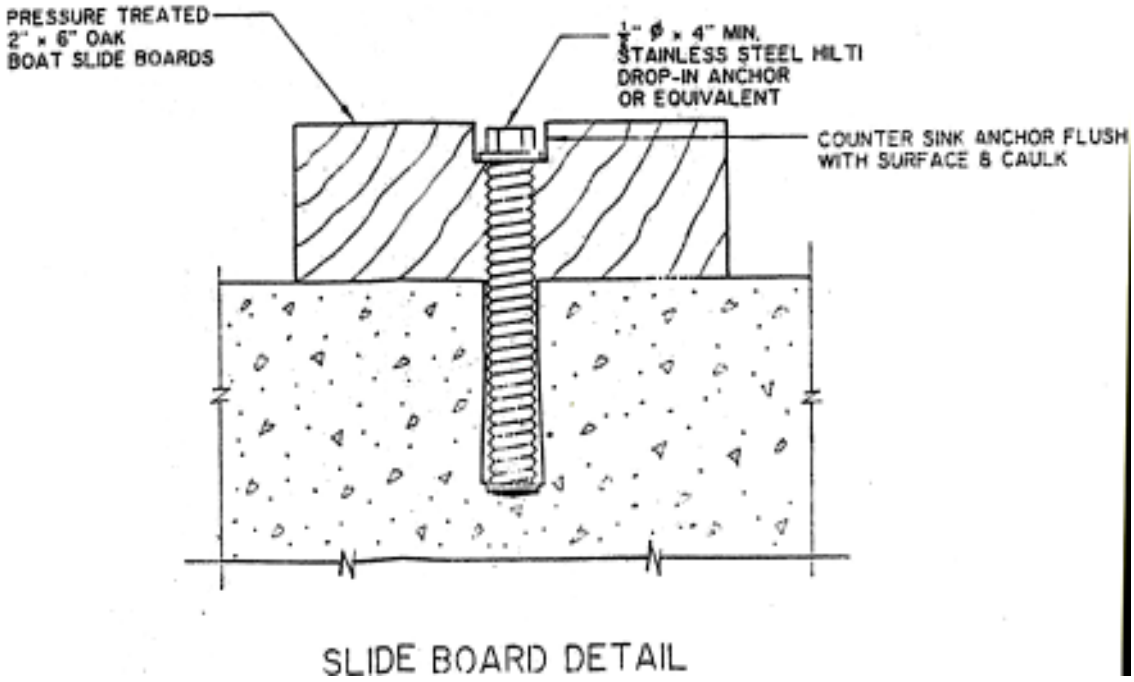


## DIAGRAM 8C: Section A-A and detail of slide board



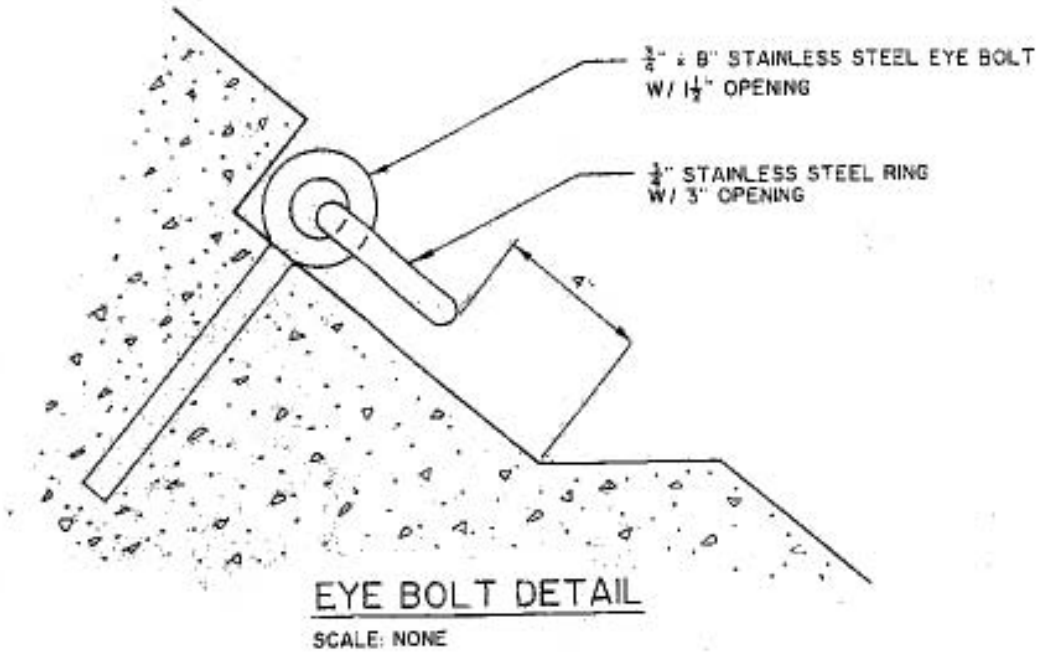

SECTION A-A

SCALE: ½" = 1'-0"



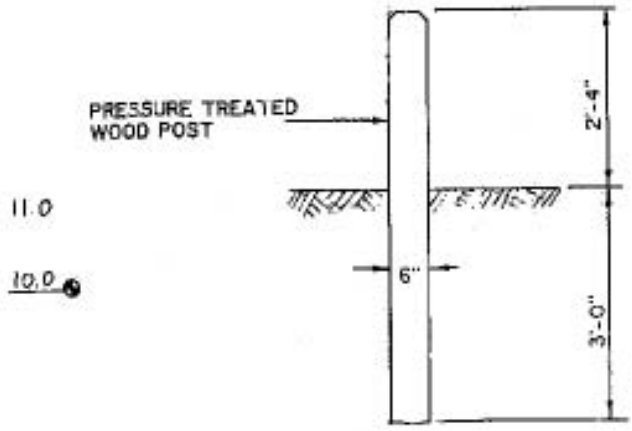

SLIDE BOARD DETAIL

**DIAGRAM 8D: Detail of eye bolt and guard post**




EYE BOLT DETAIL

SCALE: NONE




GUARD POST DETAIL

SCALE: ½" = 1'-0"

2) White Rock Park, Colorado River, La Grange, Texas

Developing an ADA accessible launch site on an excessively steep slope can prove difficult, particularly if the slope cannot be leveled, due to the type of terrain, to meet ADA standards of 8.33%. However, providing at least one accessible route to the launch area can at least make the site more accessible to paddlers with disabilities, who may be able to maneuver the transition with some assistance. This is clearly not a preferable accommodation, however, and every attempt must be made to make the launch site entirely ADA accessible.

At White Rock Park, an accessible route was developed as far as the top of a concrete stairway launch area by leveling a 40' cutback to 10' through several switchbacks along a concrete trail. Every 30 feet or so along the trail, level resting points have been installed to accommodate wheelchairs. The actual launch, a concrete staircase, is clearly not ADA accessible, however it was needed to accommodate the short 10' drop to the water and to withstand mud accumulation after flooding. An ADA accessible transfer plate, or level platform, adjoins the staircase, providing an area where one can dismount a wheelchair and either lower themselves down the staircase or be assisted to the with their boat.

Photo courtesy of Roger Lewis
Lower Colorado River Authority

**Photo 8E: Steep shoreline grade prevents site from being entirely ADA accessible; Concrete staircase provides access at base of ADA accessible trail**

## Designs for White Rock canoe launch

## DIAGRAM 8E: Section view of launch area

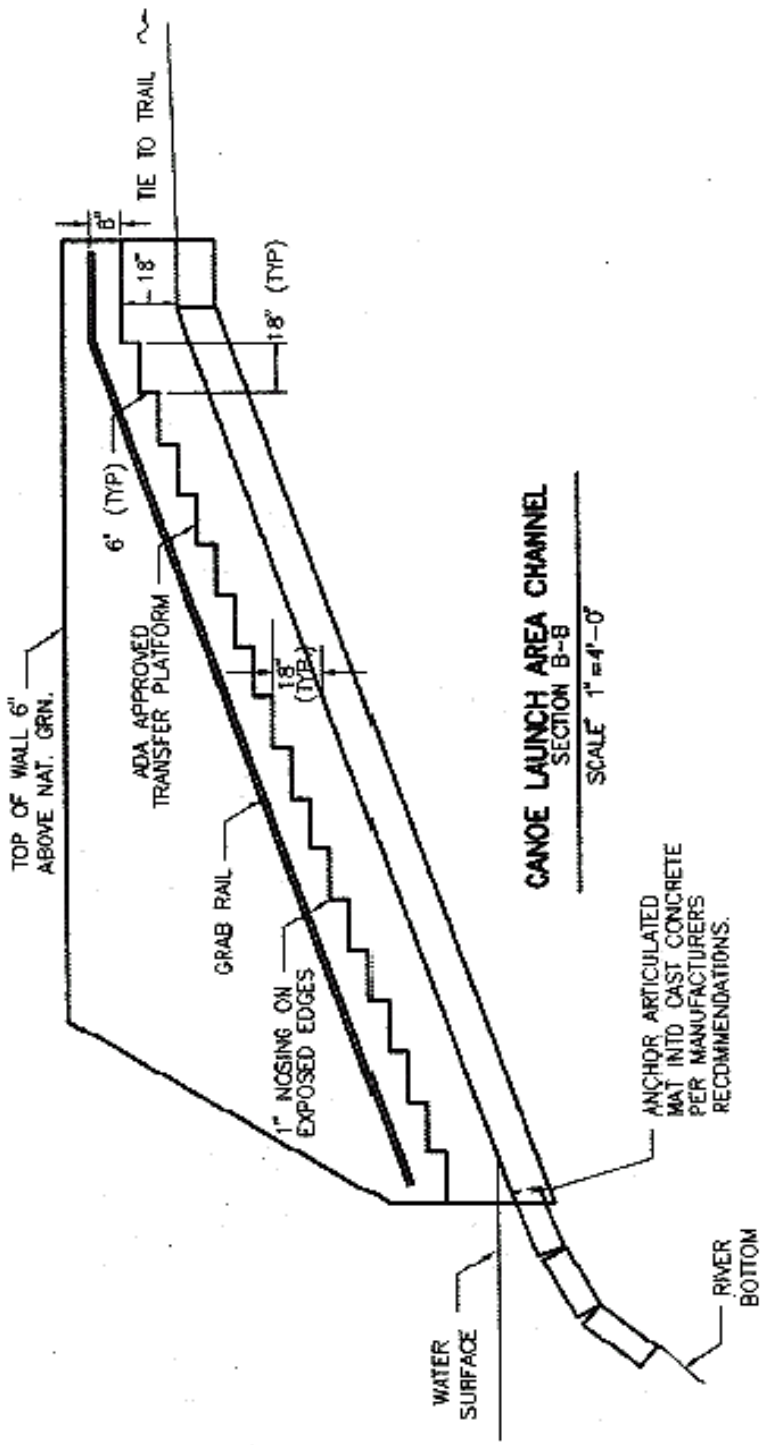


**DIAGRAM 8F: Plan view of ADA transfer platform**
**White Rock canoe launch**

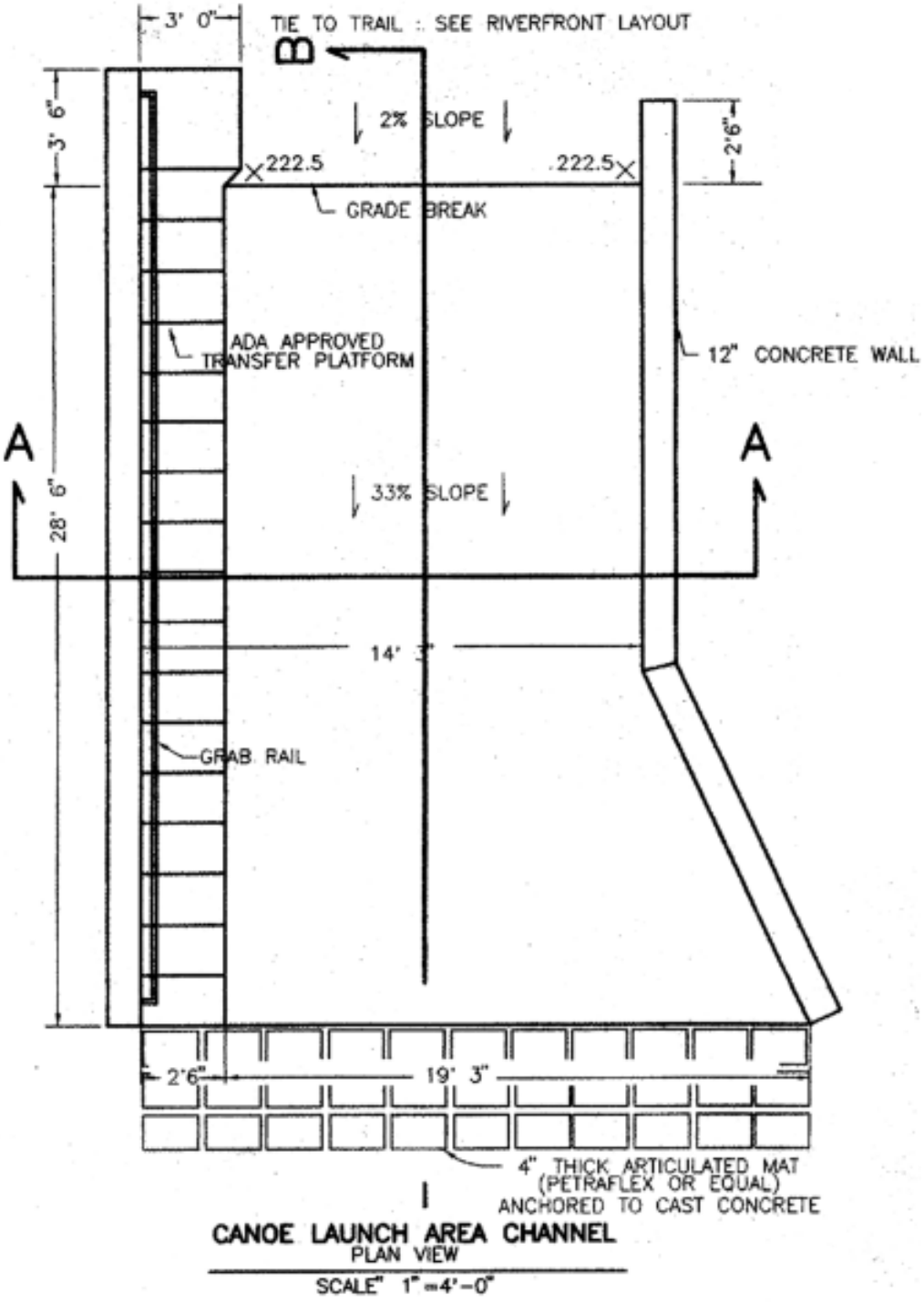


**DIAGRAM 8G: Section view of ADA platform**
**White Rock canoe launch**

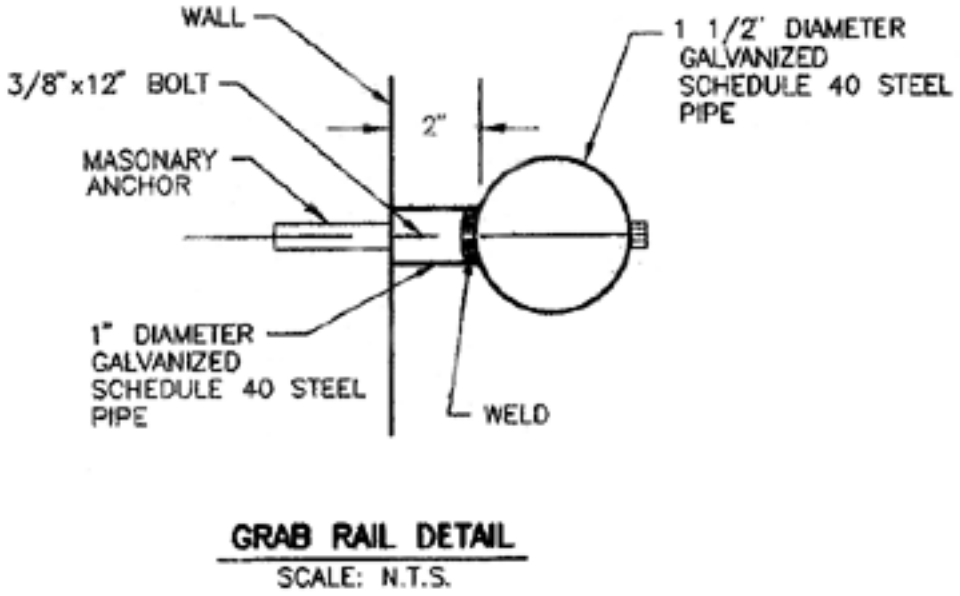
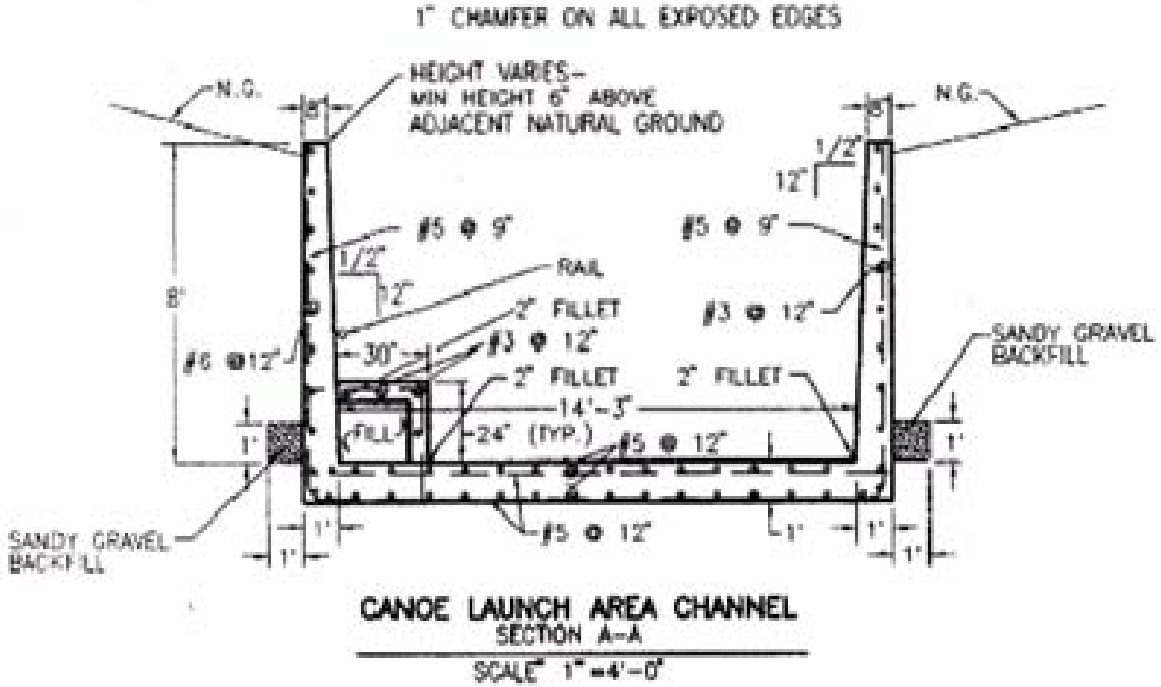



**DIAGRAM 8H: Detail of grab rail**



3) Concrete steps at Confluence Park, South Platte River, Denver, Colorado

At the confluence of two rivers in downtown Denver, sets of concrete stairs offer access to whitewater chutes at varying water levels. The whitewater course is part of a revitalization project along the South Platte River that began in the mid-1970s.

Photos by Caroline Wolf

**Photos 8F, 8G: Concrete steps provide access to different levels of rapids along the South Platte River**

Photos by Caroline Wolf

**NOTES**

# CONCRETE MATS

## A. General Description

A concrete mat is a oncrete mats may not be the most practical choice for launch sites that mainly serve paddlers; they are more suitable for sites where access is shared with motorized boats.

## B. Materials and C. Design specifications/variations

Concrete mats may be applied to a shoreline without significant alteration to its slope. Articulated mats follow the changing slope of a bank and do not require cutting or filling. They are supplied as mats, up to 8' wide, that interlock as they are being placed. Their installation usually requires heavy equipment, such an excavator with a spreader bar, or a crane. They are typically delivered to a site on flatbed trailers.

Placing concrete mats may require some underwater preparation, as the ends of the mats are often submerged in the water, depending on the slope. Submerged areas may need to be sub-excavated and filled with a leveling course, such as washed gravel. If the bank soil is soft, it may require extra protection; an engineering fabric can be added or sub-excavation can be increased, along with the gravel leveling.

Bank surfaces may need smoothing, so rod readings may be used, with the water serving as a leveling device. The first mat (usually the center one) should be placed carefully, as it is needed to align the others. Once the remaining mats are set, they interlock with each other. When all mats are in place, the loops on the upper end of the mats are pulled, using an excavator, to tighten the mats together. Loops are clamped off, clamped loops are buried, and pea gravel may be spread over the mats to fill in-between the blocks, stabilizing them. Additionally, the sloped outside edges of cable concrete may be backfilled.

## E. Advantages

- Since they are pre-cast, concrete mats will not need to be poured in areas that are submerged; cofferdamming is not required
- Cutting or filling the bank is not necessary, as it might be with a concrete ramp that needs to be poured at a steady grade
- Since there is less risk of deposition from the cut or erosion of the fill, there is less need for regular maintenance
- Concrete mats typically have soil or gravel between the blocks and are therefore less “developed” or intrusive to a natural shoreline than poured concrete
- If erosion becomes a problem, concrete mats can adapt to changing bank structures; if supporting soil is washed away, blocks may slide downwards and provide protection to eroded areas

## F. Disadvantages

- Typically are more expensive than concrete slabs
- Are heavy (an 8' x 26' mat weighs approximately 5 tons) and require heavy duty equipment to install
- Installation can damage to shoreline vegetation, when heavy equipment is used
- Can disrupt “natural” look to shoreline; may not be considered aesthetically pleasing

Geotextile mats may be a less costly or disruptive alternative to concrete mats (*see Chapter XI*).

## G. Case examples, designs, photos

1) York Bridge, Missouri River, Montana

*Problem:* York Bridge was initially a motor boat launch site that was also popular for canoeists, mainly due to its location above a backwater. Due mainly to heavy boater usage, there were a number of erosion problems along the shoreline.

*Solution:* Slopes on the downstream side of the detention basin were smoothed and reinforced with an articulated concrete mat, and an existing ditch was filled in order to widen the launching area. Articulated concrete was chosen as an alternative to rip-rap in order to mitigate erosion while providing an alternative access to canoeists. This enables canoeists to launch without competing with motorized boaters for space. Additionally, an access road (approximately 150' long and 12' wide) was installed to serve a dual purpose: while providing access to canoeists and small boaters, it also makes the detention basin easily accessible for maintenance purposes.

**Photo 8H: Gravel road provides access to both the launching area and a detention basin used for maintenance purposes**

Photos courtesy of Ken Phillips, Montana State Design and Construction Bureau

**Photo 8I: Articulated concrete launch helps to mitigate erosion while providing paddlers with a separate access site from heavy boat traffic**

2) Concrete mat installation, Stickney Creek, Montana

**Photo 8J: Concrete mats are installed individually**

**Photo 8K: Crane is used to place and interlock mats**

Photos courtesy of Ken Phillips
Montana State Design & Construction Bureau

## NOTES

# CONCRETE STRIPS

Poured on site to fit the desired specifications, a concrete buffer or strip may be installed divert heavy flow or sediment loads away from a launch area.

1) Hecla Junction, Arkansas River, Salida, Colorado

*Problem:* Due to its proximity to an extensive drainage area, the popular launch area at Hecla Junction was continually flooded when combined irrigation waters and spring runoff brought heavy flows and sediment loads. The area was heavily scoured, and a deep ditch formed.

*Solution:* A concrete strip, approximately 2' wide and 90' long, was installed at the base of the drainage area before it drops off into the beach launching area. Water is forced to flow over the strip, preventing a deep channel from forming. The strip interrupts the strength and velocity of the flow water to flow over it, preventing formation of a deep channel.

**Photo 8L: Drainage area adjacent to launch site carries heavy flows during spring runoff and causes scouring**

**Photo 8M: Concrete strip helps to divert flows away from launch site**

Photos by Caroline Wolf

## NOTES

# CHAPTER IX:

# STAIRWAY VARIATIONS

## TIMBER STAIRCASES

### A. General Description

Staircases composed of timber steps may be cost effective alternatives to concrete when working with a launch site along a steep shoreline. Timber can be easily cut and shaped to meet site specifications and may be built into a steep shoreline in a variety of manners, depending on a site's needs. For example, timbers cut into rectangular or cylindrical piece could be installed from the bottom of a slope upwards, stacked one upon another, in order to reinforce an eroding slope.

### B. Materials

- Timber, typically pressure treated; *see Chapter V for information on using treated wood*
- Reinforcement bars, rebar
- Soil, gravel, or "roadbase" (mixture of rough soil and class 6 gravel), used as fill
- Retaining walls, rip-rap (as needed)

### C. Design specifications/variations

- Stairs may be constructed as boxes built on top of one another, ascending a slope, to help reinforce an eroding bank
- The launch area at the base of the stairs needs protection from excessive currents in order to prevent undercutting; large rocks or a vegetative buffer may be used
- Launch area at base of stairs should provide consistent access to the water, during changing water levels; surface should be sturdy and able to withstand varying flows
- Handrails are most effective when they are 24" to 32" above the height of the steps; it is important that they not be too high or low for paddlers to be able to use

### D. Advantages

- Allows paddlers easier access from a steep or eroding shoreline
- Aesthetically pleasing; less disruptive to "natural" shoreline than concrete
- May be easily and inexpensively repaired, if damaged

### E. Disadvantages

- Installation may be costly and may require alteration to shoreline
- May be susceptible to undercutting
- May require maintenance as stairs age and weather

## F. Case examples, designs, photos

### 1) Fisherman's Bridge, Arkansas River, Salida, Colorado

*Problem:* The slope at this popular raft and kayak launch site is very steep and vulnerable to erosion. In order to access the river, paddlers had to slide down the bank, which contributed to erosion problems.

*Solution:* A 15 foot-wide timber staircase, with a metal slide for rafts and boats, was installed into the slope. Parallel metal bars running down the center of the staircase provide allow paddlers and rafters to slide boats and rafts to the water below.

Construction of the staircase was designed to maximize bank stabilization. Each stair level consists of a timber box filled with "roadbase," a mixture of rough soil and class 6 gravel. Boulders placed around the launch area, at the base of the staircase, provide protection from undercutting.

Photo by Caroline Wolf

**Photo 9A: Timber stairs and metal boat slide facilitate access from a steep bank**

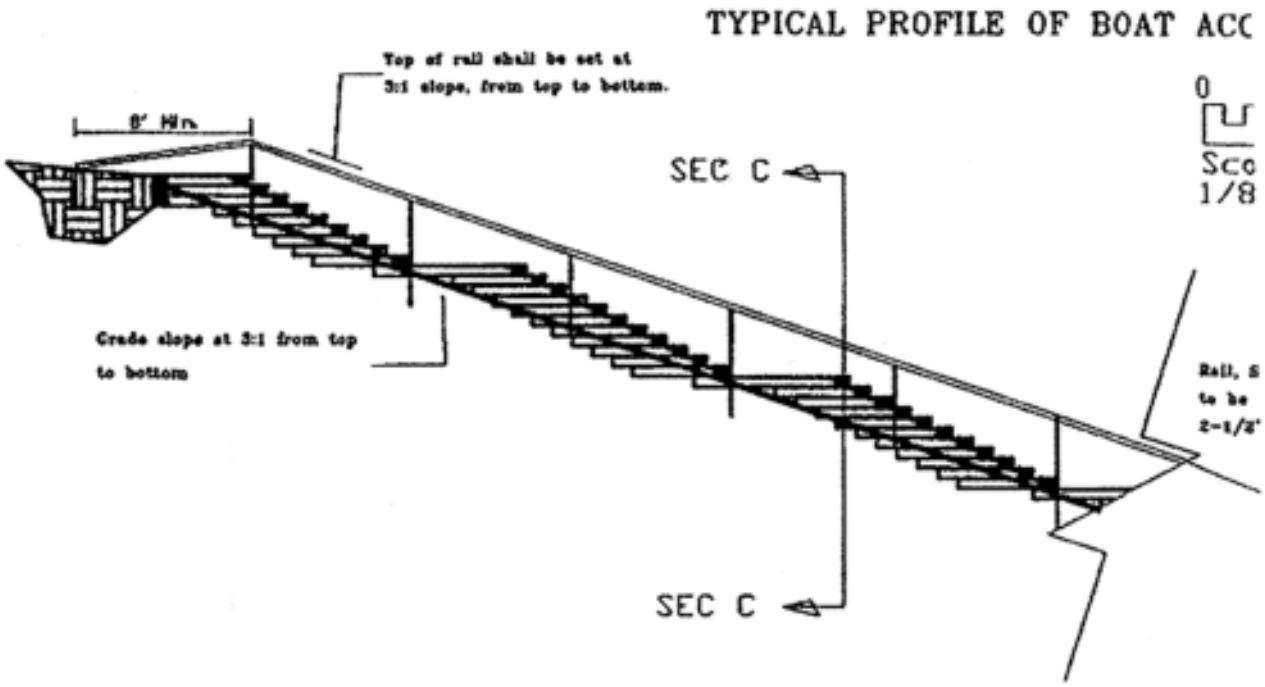
Photo by Caroline Wolf

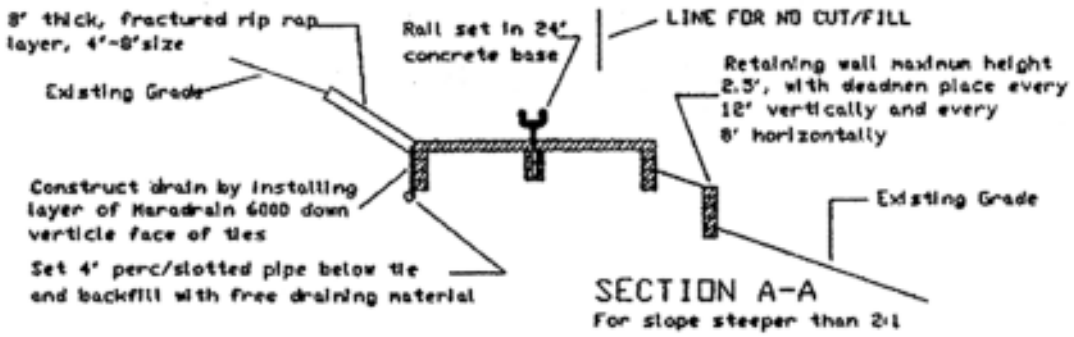
**Photos 9B, 9C:  Two views of staircase at Fisherman's Bridge from the river**

Photo courtesy of Arkansas Headwaters Recreation Area

## Diagram 9A: Design for Fisherman's Bridge (Page 1 of 2)

Courtesy of Arkansas Headwaters Recreation Area



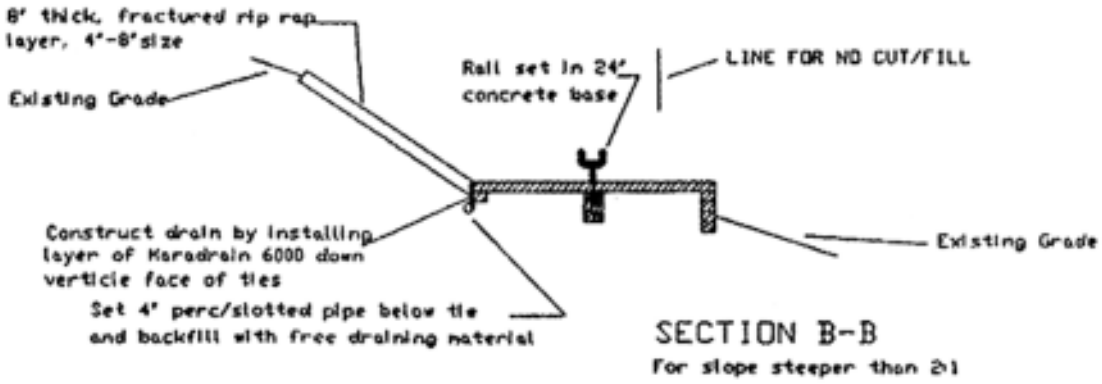
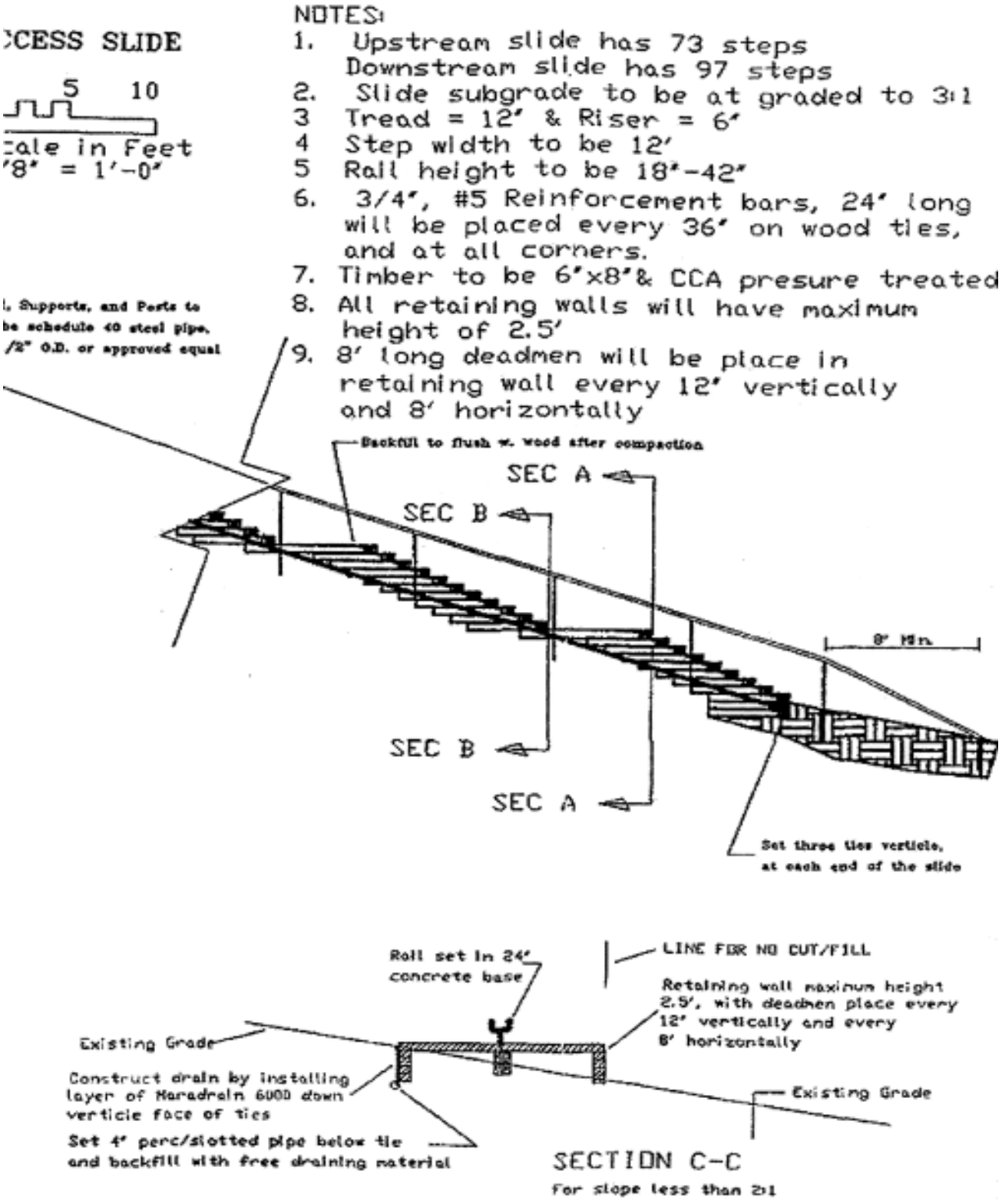



**Diagram 9B: Design for Fisherman's Bridge, continued (Page 2 of 2)**

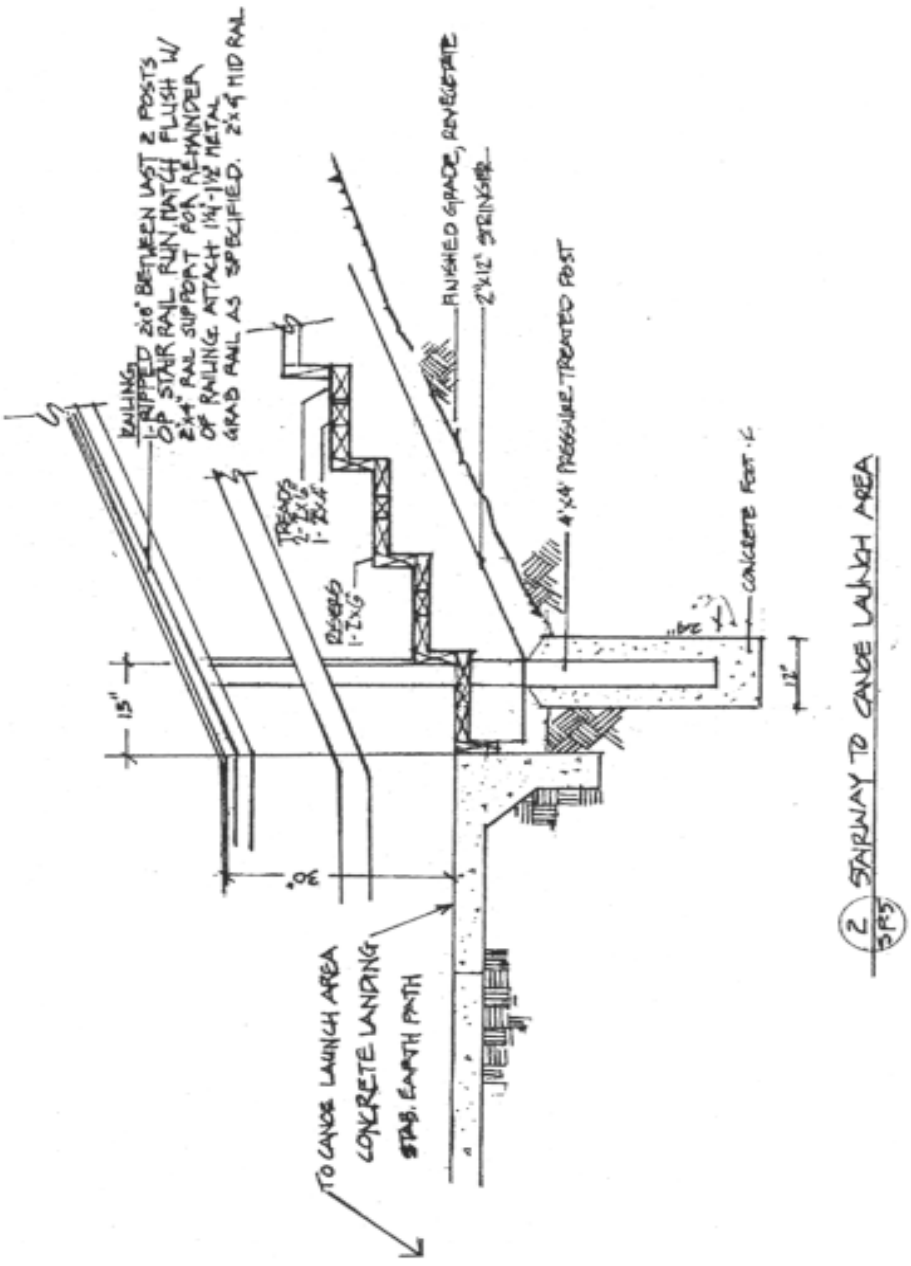
Courtesy of Arkansas Headwaters Recreation Area



2) Concept drawings for White Rock Park, Colorado River, La Grange, Texas

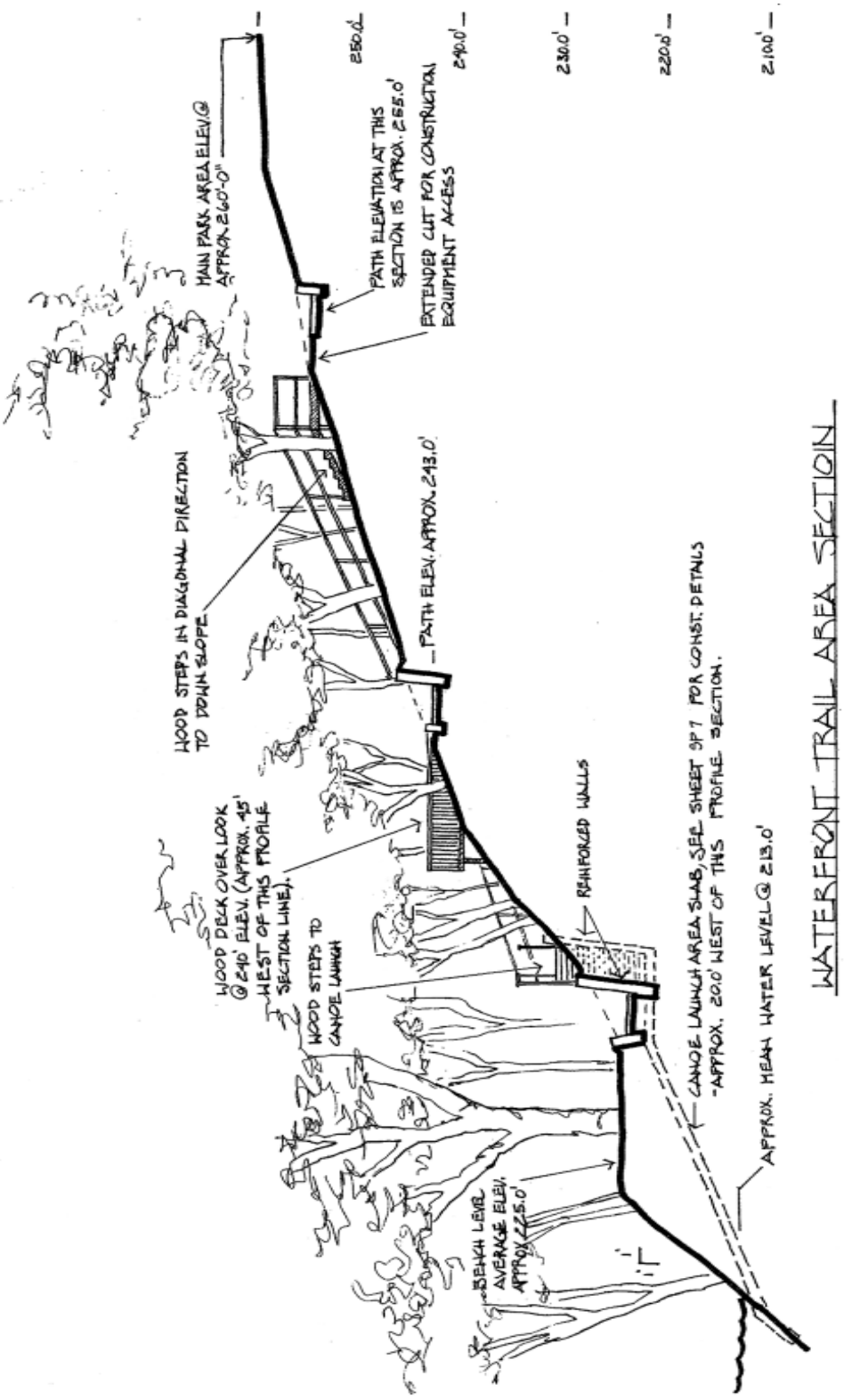
This staircase leading to a canoe launch below a 40' cutback along the Colorado River was never constructed. However, the following designs for the staircase offer an effective solution to providing access along an extremely steep bank.

**Diagram 9C: Section view of proposed staircase to canoe launch area**
**Concept drawing for White Rock Park**




Design courtesy of Diana Steinbrook, Winterowd Associates

**Diagram 9D: Section elevation of staircase leading to canoe launch**
**Concept drawing for White Rock Park**




Design courtesy of Diana Steinbrook, Winterowd Associates

3) Jump Rock launch site, Arkansas River, Salida, Colorado

Jump Rock, another site along the Arkansas River, has a stairway constructed of 8" x 8" x 8' treated timbers. On the steeper part of the hill the timbers are placed close together with the tread and rise at 8" in some areas. As the hill becomes less steep, the tread increases but the rise remains at 8" in order to reduce erosion and need for maintenance. At the top of the hill, where it is least steep, the tread and rise decrease to the point where the top few stairs are relatively shallow.

Photo courtesy of Arkansas Headwaters Recreation Area

**Photo 9D: Rectangular timber stairs with varying treads provide access to steep shoreline while helping to mitigate erosion**

4) Thompson River, British Columbia

Photo courtesy of Thomas O'Keefe

**Photo 9E: Rounded timbers serve as staircase for paddlers**

# ROCK STAIRCASES

1) Rock steps at Whitechuck launch, Sauk River, Washington

**Photos 9F, 9G: Rock staircase provides river access with a "natural" appearance**

Photos courtesy of Thomas O'Keefe

2) Rock steps at Parkdale launch, Arkansas River, Salida, Colorado

Photo courtesy of Arkansas Headwaters Recreation Area

**Photo 9H: Rock staircase reinforced with rip-rap form a simple staircase to launch area**

# CHAPTER X:

# PORTAGES AROUND DAMS

## A. General Description

Portages are land routes used by paddlers to transport their boats to and from a launch area or between access sites. Often located along water bodies where dams or other obstructions interrupt a paddling route, portages can provide direct access to areas of water beyond these obstacles. Portages can also serve as detours around difficult sections of water that paddlers choose not to run, and they may serve as navigable connections between lakes or other bodies of water, helping to create a continuous paddling route. While this chapter discusses designs for portages around dams, the information provided may be applicable to portages in each of these settings.

## B. Materials

Portages can be simple routes, such as trails made of soil, gravel, or asphalt, or they may be built structures, such as staircases with chutes or slides. The materials used and amount of construction necessary will depend on circumstances at an individual site. These may include shoreline configurations, frequency of usage, dam ownership, and available funds.

Signage is crucial to making a portage visible to paddlers and to informing paddlers about potential hazardd on the water. Regardless of their visibility from the water, portages should be clearly marked in order to provide paddlers with sufficient time to reach the shore and take out. Having clear and appropriate signage can also help discourage paddlers from attempting to clear a low head dam or spillway. For guidance on developing appropriate signage along water trails, including details on sign specifications, a helpful resource is *Publishing Trail Guidance: Maps and Guides, Guidebooks and Signs* (North American Water Trails, 2002).

Some dam owners have installed signage to educate paddlers about potential dangers; however this is not always the case. Dams for hydropower use may be required to have signage. The Federal Energy Regulatory Commission (FERC) provides regulatory oversight to help develop and maintain safe hydropower projects and considers designated and well-marked portages to be crucial measures enabling paddlers to travel safely from the top to the bottom of a dam.

Licensing requirements issued by FERC require hydropower applicants to review recreational needs in the areas around their facilities. Licensees may be required to supply public recreational facilities during the term of the license. For further information on the relationship between hydropower relicensing and recreational liability, see “Hydropower Relicensing and Recreational Liability” in *American Whitewater Journal* (May/June 2001).

Essential safety information that includes a discussion of signage may be found in *FERC Guidelines for Public Safety at Hydropower Projects*, available online at: http://www.ferc.gov/industries/hydropower/safety/signage/Appendix_B/FERC%20Safety%20Guidelines%201992%20(web%20version).pdf

The FERC website http://www.ferc.gov/industries/hydropower/safety/signage/portages/web/portages.htm also provides examples of effective signage.

## C. Design specifications/variations

According to *FERC Guidelines for Public Safety at Hydropower Projects*, a portage should not be located within 300 feet of a dam, spillway, or powerhouse.

The following general recommendations for portage areas are gathered from several sources, including an April 2003 assessment of the Trinity River in Texas (see their website at http://www.trinityrivervision.org/Final%20Report/3_Recreation.PDF for more information).

*An effective portage should include:*

- Clear, well-marked signage allowing paddlers sufficient time to reach shore before take out
- A path at least 2' wide around the dam, with a slope no steeper than a 1:3
- *An ADA accessible portage cannot have a slope that exceeds 8.33% or 1:12*
- At least 8' overhead clearance on the path and 4' to 8' clearance on either side
- A vertical distance of 12" or less between the height of boat and shore
- A route that minimizes the distance that paddlers must carry their boats
- Access points located on inside bends or areas of calm water
- An escape path downstream from portage, when possible, giving paddlers an additional area to egress the water if they miss a take out or portage

## D. Advantages

- Provides defined and safe routes around dams and other structures that can be obstacles for paddlers, as long as they are well located and clearly marked
- Enables paddlers to navigate a somewhat continuous route along a water trail
- Gives paddlers designated routes to transport their boats between parking areas and launch sites
- May prevent damage to riparian or other sensitive areas by directing paddlers to a designated route
- Offers paddlers an opportunity for additional exercise!

## E. Disadvantages

- May not be easy for paddlers to manage while transporting their boats, if portages have a steep slope, uneven surface, or limited space
- May not provide paddlers with sufficient time or space to take out – especially if currents or winds are strong – if portage is located immediately upstream of a dam or other obstruction
- May be difficult to locate or access when not clearly marked

## F. Case Examples, designs, photos

### 1) Little Quinnessec Falls Hydroelectric Dam, Menomonee River, Wisconsin

The Menomonee River serves here as the border between Wisconsin and Michigan. This site is a busy spot for local paddlers and whitewater guide services that offer trips down the river. Before the Menomonee River was dammed at this spot, Little Quinnessec Falls was a small waterfall. The existing dam now has a net head of approximately 67 feet.

The kayak and whitewater raft put-in is located about 1/8 mile downstream of the dam on the Wisconsin side. While there is no built launch structure, the area is designed to accommodate portaging. Restrooms, an asphalt path, and a parking area (with an overlook about 20' feet above the river) have also been installed. The portage trail, which is 10' to 12' wide, is composed of natural ground cover with wood chips added to reinforce problem areas. Its slope is steep, so the path curves to gradually reduce the grade. The asphalt path leading from the parking area to the river is 6' wide and has a slope of about 12%, which is the lowest grade that could be constructed at this site in attempt to meet ADA accessibility standards.

The access site has a medium size layer of fractured rock rip-rap from a local quarry and edges are protected with rip-rap and filter fabric, an impermeable mesh material that prevents both runoff and sediment from passing through. Smaller “pea gravel” rocks abut the asphalt path so that barefoot paddlers do not cut their feet

The shoreline adjacent to the put-in, which extends further into the river, protects the access area from direct flows coming from the hydroelectric plant. However, since the put-in sits immediately downstream of the dam, it can be inundated during periods of heavy rains or with dam releases, when water exceeds the normal range of river flows. Water below the dam can rise to about six feet in the area of the put-in, which can submerge the lower third of the asphalt path for short periods of time each year.

Photo courtesy of Mark Anderson
Consolidated Water Power Company

**Photo 10A: Little Quinnessec Falls portage trail, made of natural ground cover with wood chips**

**Diagram 10A: Blueprint for Little Quinnessec Falls**
**View of canoe launch area and portage trail**

Blueprint courtesy of Mark Anderson, Consolidated Water Power Company

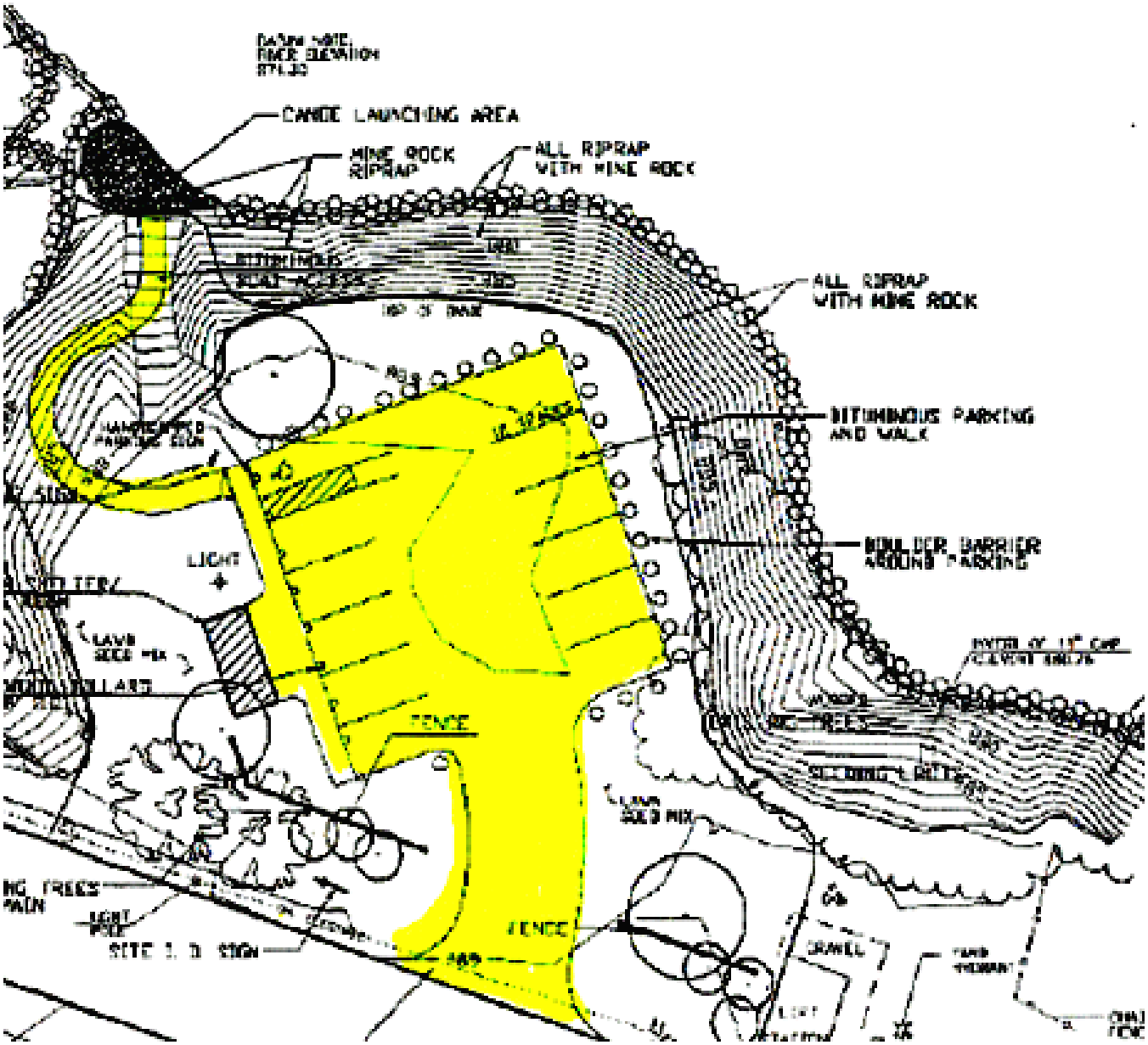


**Photo 10B, 10C: Asphalt path leading to launch area below Little Quinnessec Falls Dam**

**Photo 10D: Little Quinnessec Falls launch area, reinforced with fractured rock riprap**

All photos courtesy of Mark Anderson
Consolidated Water Power Company

## 2) Pejepscot River Access, Androscoggin River, Lisbon Falls-Brunswick, Maine

One of the largest rivers in Maine, the Androscoggin hosts 28 dams along its 170 river miles. Not all of the dams have navigable routes around them; some require excessively long portages or do not provide access at all. Other dams have portage trails that provide access both upstream and downstream. Most portage trails are marked with signs, however dam warnings are not easily visible on all sections of the river.

The Pejepscot River Access, downstream of Lisbon Falls, offers a solution to launching from a steep, rocky, and unstable shoreline where boulders, rock fragments, and fallen tree limbs make river access a challenge. Take-out occurs just above the dam, and a short portage through the woods connects paddlers with access just below the dam. A metal staircase, with a handrail on one side and a carpet-covered wooden slide on the other, enables paddlers to easily maneuver their boats down to the water. The carpet provides traction and helps to protect boat bottoms from damage. The staircase leads to a rocky, but sturdy and level launch area at the water's edge.

Photo courtesy of Julie Isbill

**Photo 10E: Metal staircase with boat slide facilitates river access from a steep, rocky shoreline**

**Photo 10F: Detail of metal staircase, wooden boat slide, and handrail**

**Photo 10G: View of launch area from top of staircase**

Photos courtesy of Julie Isbill


Photo courtesy of Julie Isbill

**Photo 10H: Signage identifies portage trail on the Androscoggin River**

3) Boat slide, portage to White Salmon River, Washington

Photo courtesy of Thomas O'Keefe

**Photo 10I: Parallel metal bars serve as a boatslide while designating the portage trail**

4) Low-head dam, Arkansas River, Salida, Colorado

*Problem:* A six-foot, low-head dam posed danger to paddlers and prevented upstream passage.

*Solution:* A chute was created on the river, just east of the dam. The six-foot drop was leveled into three separate two-foot drops, creating a navigable whitewater hole and enabling fish to travel upstream. Pad-

**Photo 10J: Low-head dam poses an obstacle to paddlers**

Photos by Caroline Wolf

**Photo 10K: Whitewater chute, installed just east of dam, offers paddlers rapids on three 2' drops**

5) Niobrara River, Nebraska

Photo by Tim Palmer

**Photo 10L: Take-out is situated in dangerous proximity to the dam**

# CHAPTER XI:

# LOW-IMPACT DESIGNS FOR ENVIRONMENTALLY SENSITIVE AREAS

The following designs do not fit exactly in the previous chapters, however they are important models to consider when working with access sites located in environmentally sensitive areas. Although developing a launch site in these areas is strongly discouraged, there may be situations where no alternative access points are available.

## ELEVATED WALKWAYS

### A. General Description

Elevated walkways are raised structures that allow paddlers to access launching areas without having direct contact with the ground. They are effective in minimizing potential impacts from recreational use on riparian habitats, fragile shorelines, or other sensitive environmental areas. While providing a stable surface, elevated walkways can prevent erosion, protect existing vegetation, and be used to promote revegetation of damaged areas. Many of these structures are light-penetrating walkways, which allow vegetation beneath them to receive the sunlight necessary for growth.

### B. Materials

Typically constructed from expanded metal, aluminum, fiberglass, or wood, elevated walkways allow plants to grow through their grated surfaces. They are most effective when used with tripodsor other above-ground supports. These can include posts that are driven into the bank, however posts should not be installed too close to the edge of the bank as this may contribute to erosion. If a ladder is used, it should have minimal contact with the bank or shoreline vegetation at all water levels. Shorter walkways are preferable so that wildlife may access water easily.

### C. Design specifications/variations

Elevated walkways can be used in a variety of ways. They may be combined with other walkways or connecting structures to provide access to floating or other types of launches; they may be attached to stairs or ladders that lead to launch structures or rest on the bottom of a river or lake; or they can be cantilevered over a river while supported by a tripod. Manufacturers offer materials that meet ADA accessibility standards.

More information on elevated walkways is available online on Alaska Fish and Game's website at: http://www.sf.adfg.state.ak.us/sarr/restoration/techniques/walkways.cfm

# GEOTEXTILE MATS AND BLOCKS

## A. General Description

Geotextile mats or blocks are light-weight, plastic mats composed of open cells that allow water to pass through to vegetation below. Since they enable access in environmentally sensitive areas without significantly disrupting riparian habitats or vegetation, they are often used near lakes or reservoirs or to access the water from marshy areas.

## B. Materials

Commercial products such as the Geoblock porous pavement system offer a flexible support system that can support heavy weight while protecting vegetation. Composed of recycled polyethylene, individual Geoblock mats typically measure 20" x 40" x 2" and fasten together with ¾" screws. Interlocking mats are stabilized by topsoil or vegetative material spread into the cells. Grass can be also used at sites that see low to moderate use. Rip-rap or fist-sized gravel can provide a smooth surface for walking and also serve as reliable anchors.

## C. Design specifications/variations

- Proper anchoring of mats and blocks is essential, as erosion can cause them to separate and scatter in the water, potentially becoming dangerous strainers in the water downstream.
- In areas that become submerged, gravel can be added into cells in order to add weight and anchor them in place. See website at http://www.prestogeo.com for more detailed specifications.

## D. Advantages

- Are light-weight
- Are made of recycled polyethylene
- Allow light to penetrate (40% open area per panel)
- Will not leach chemicals into water or surrounding riparian area
- Will not rot
- Have tread width of 20"

## E. Disadvantages

- Can be more expensive than other materials
- Require the use of special tools
- May take longer to install than other materials
- Can create potentially dangerous strainers, down river or elsewhere on a water body, if erosion causes blocks to separate and scatter in the water

## F. Case Examples, designs, photos

1) Deal Island Wildlife Management Area, St. Peters Creek, Somerset County, Maryland

Constructed as part of a traditional boat launch for motorized boats, this "soft" launch was built using Geoweb cellular confinement material filled with pea gravel. The launch serves a dual purpose of providing separate access to paddlers and stabilizing the shoreline from erosion.

Specifications

- *Dimensions:* Geocell is 8' wide x 16' long x 6" thick
- *Anchor:* Geocell is filled with #67 pea gravel, naturally rounded with no sharp edges; placed on a 4" thick compacted layer of CR-6
- *Slope:* 1:8, from an elevation of +1.5' down to an elevation of -.5'

**Photo 11A: Geocell material provides paddlers with a "soft" launching alternative to a traditional boat launch**

**Photos 11B: Geocell material anchored with pea gravel offers low-impact access while helping to stabilize an eroding bank**

Photos courtesy of Maryland Department of Natural Resources

2) Historic canoe launch, Fort Clatsop National Memorial
Lewis and Clark River, near Astoria, Oregon

The historic canoe launch at Fort Clatsop National Memorial, along the Lewis and Clark River, is an example of a site located in an environmentally sensitive area that cannot be moved, given its role in the historic and cultural landscape. Fort Clatsop was the site from which Lewis and Clark launched on their return journey east in 1804. Moving the launch would alter the site's historic accuracy, as well as the vistas important to the character and experience of the site.

Although the launch is used primarily for display purposes and is not open for public use, the environmental challenges posed at this site resemble those at many public launch areas.

*Problem:* Situated on an exposed area of a tidal river, the main challenges to the longevity of the launch are impacts of erosion, wind, and heavy flows. Additionally, due to its location on a bend of the river, the landing is vulnerable to lateral flows caused by the dramatic changes in direction and curvature on this part of the meander.

*Solution:* Through detailed site analyses, assessments were made of the site that accounted for current and future trends in channel morphology and behavior, as well as the effects of sedimentation and erosion patterns. Due to the vulnerability of the canoe landing's location and exposure to strong winds and currents, it was determined that this site needed "erosive resistant features," such as a vegetation buffer, to offer protection and stabilization to the landing.

A beach area on the south side of the landing has been designated as a public launch site that will be open as of June 2004. The site may be not used at all times, however, due to the tides. Paddlers may launch at high tide only, as the area becomes too muddy for launching at low tide. Paddlers will need to carry their boats to the beach site while walking on a concrete path from a parking area located just north of the site.

**DIAGRAM 11A: Site evaluation of Fort Clatsop, showing both development opportunities and constraints, Fort Clatsop National Memorial**

Design provided by NPS, Denver Service Center

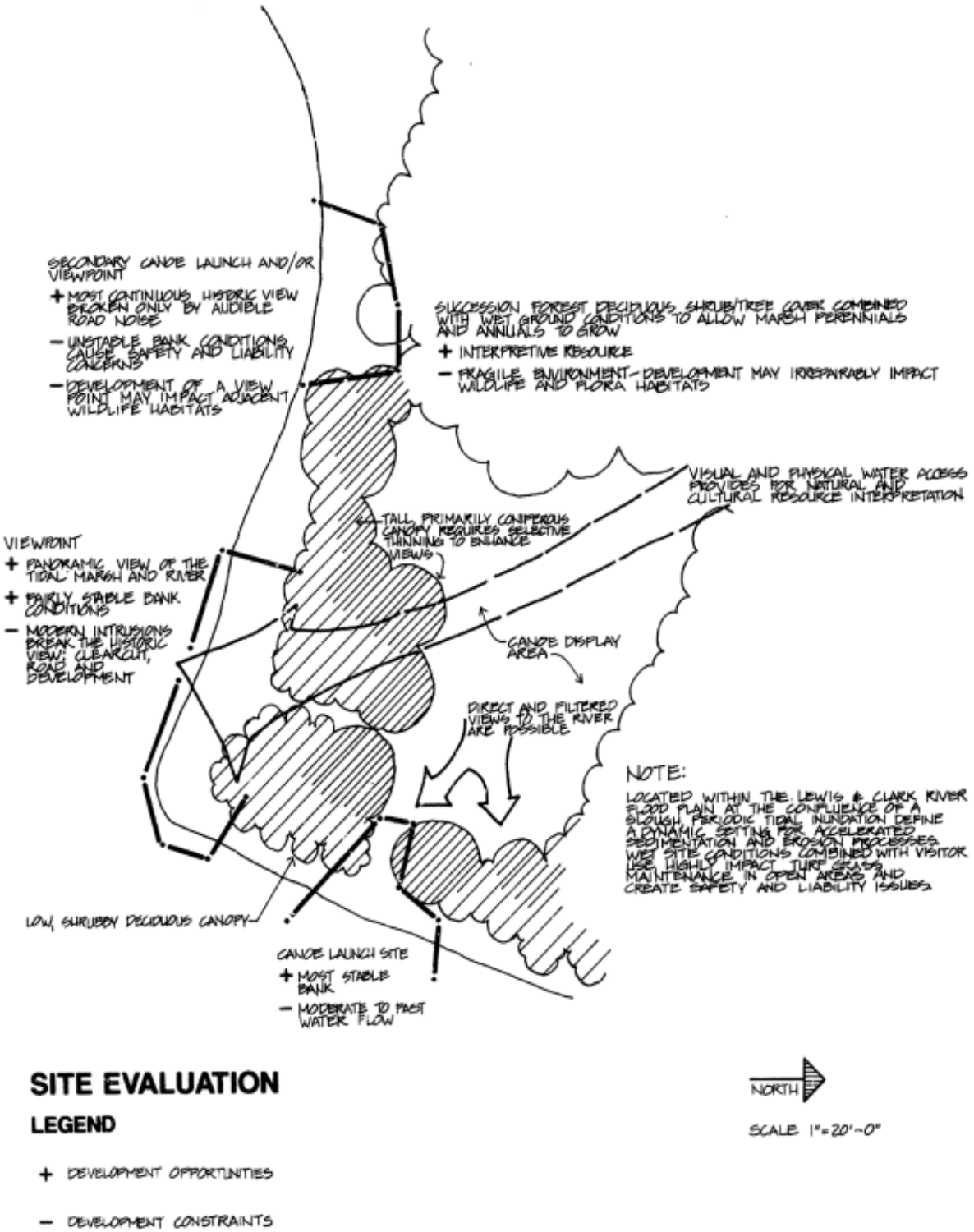
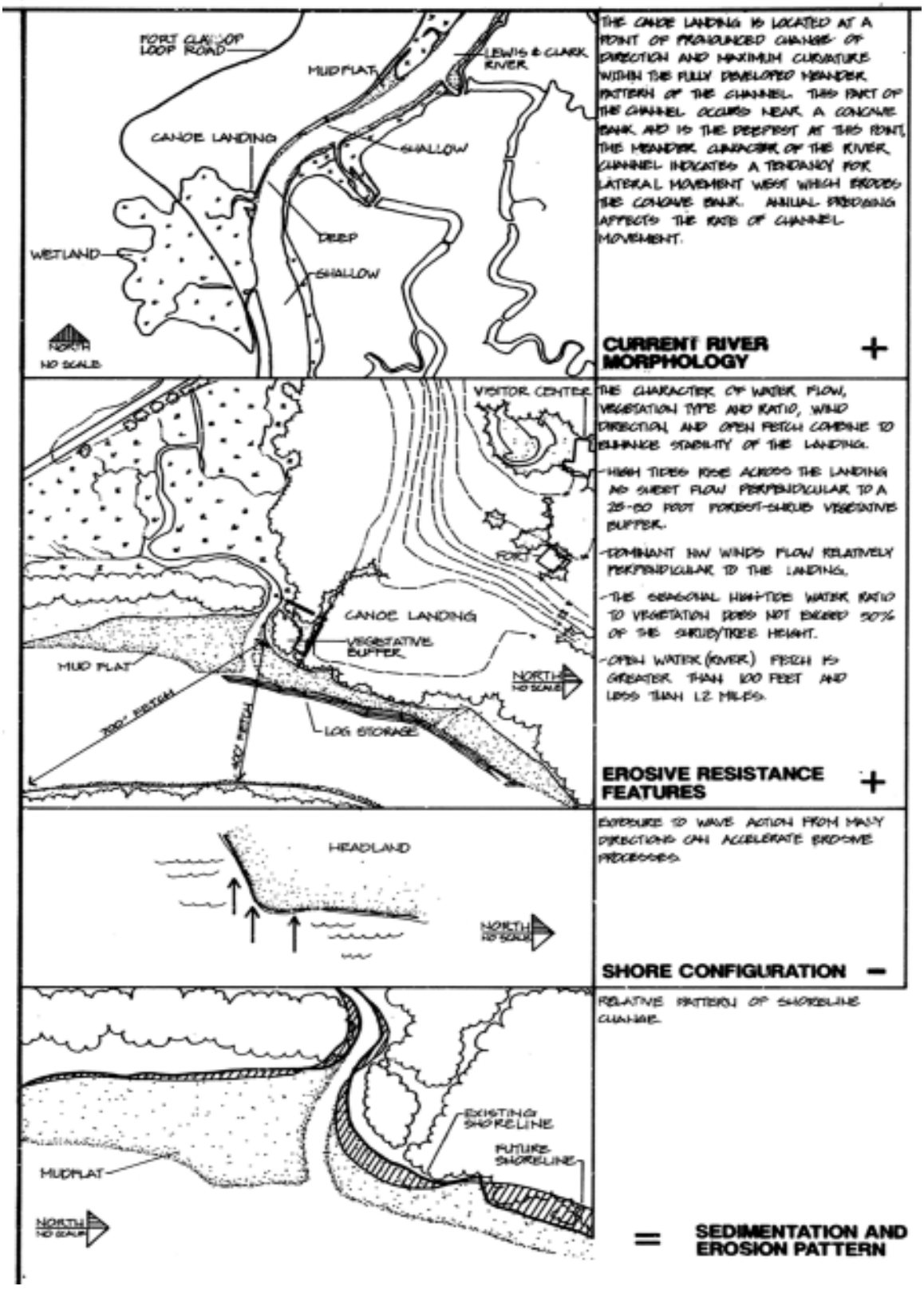


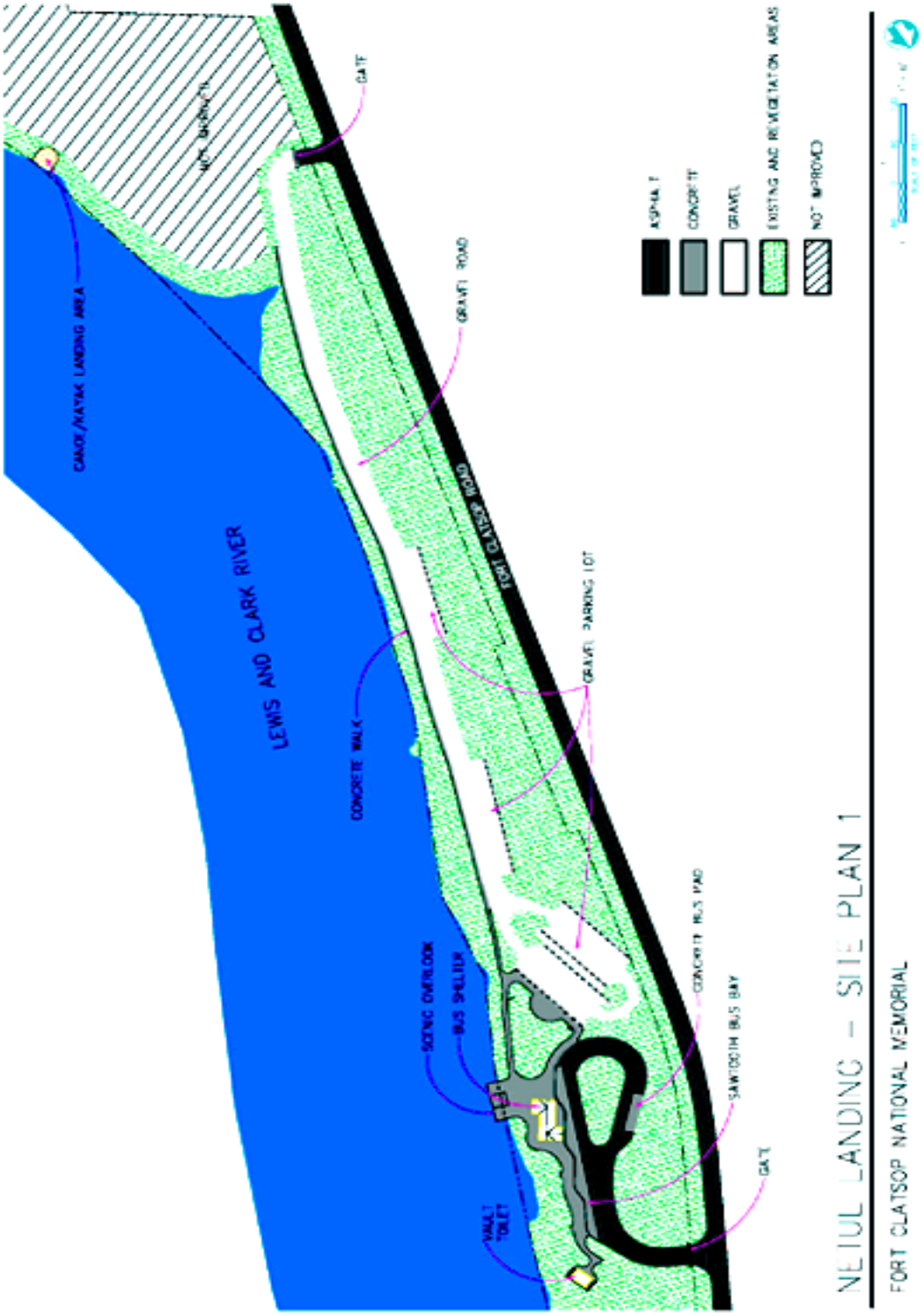
**DIAGRAM 11B: Site analysis of river morphology, shore configuration and sedimentation/erosion patterns, Fort Clatsop National Memorial**

Design provided by NPS, Denver Service Center



## DIAGRAM 11C: Site plan for Netul Landing, new public launch at Fort Clatsop

Design provided by Jill Harding, Fort Clatsop National Monument



## NOTES

# INDEX OF CASE EXAMPLES, DESIGNS, PHOTOS

## Case examples

**(Index continued)**



## Designs

**(Index continued)**

## Photos

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**(Bibliography continues on page 117)**

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