Boating in Arizona
c.a. 1912
Navigability Studies
  - All Major River Systems
  - 30,000+ Small & Minor Watercourses
- Alaska, Rocky Mountain States, East Coast

Professional Experience (30 yrs in Arizona)
- Hydrologist (PH)
- Civil Engineer (PE)
- Geomorphologist (RG)

Boating Experience
- Canoe, Kayak, Raft
- AZ (Gila, Salt, Verde, Virgin, San Francisco, Colorado)
- NM, CO, UT, CA, AK, NC, GA, SC, TN, NY, MI, WI
Federal Standard for Title Navigability (Daniel Ball Test)

- Ordinary & Natural
- Used or Susceptible
- Highway for Commerce
- Trade & Travel on Water
- Customary Modes

"Navigable" or "navigable watercourse" means a watercourse that was in existence on February 14, 1912, and at that time was used or was susceptible to being used, in its ordinary and natural condition, as a highway for commerce, over which trade and travel were or could have been conducted in the customary modes of trade and travel on water.

A.R.S. § 37-1101(5)
Introduction

- Ordinary & Natural
  - Discussed in other ASLD presentation
  - Prior to human disturbance of river system

- On Water
  - Boats, watercraft
  - NOT: wagon, hoof, or feet on streambeds
Trade and Travel on Water
- Trade (exchange of commodities)
- Travel (go on as if on a trip or tour)

Susceptible to Trade and Travel
- Sufficient depth of flow
- Actual historical use not required

Customary Modes
- Boats available at statehood

"Navigable" or "navigable watercourse" means a watercourse that was in existence on February 14, 1912, and at that time was used or was susceptible to being used, in its ordinary and natural condition, as a highway for commerce, over which trade and travel were or could have been conducted in the customary modes of trade and travel on water.”

A.R.S. § 37-1101(5)
Typical Trade/Travel Uses ca. 1912

- Hauling Goods
- Hauling Passengers
- River Guiding
- Exploration
- Military
- Ferries
- Fishing
- Trapping/Hunting
- Survey
- Travel
- Carrying Mail

<table>
<thead>
<tr>
<th>General Boat Types Used</th>
<th>Large</th>
<th>Steamboat</th>
<th>Flatboat</th>
<th>Canoe</th>
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</tbody>
</table>
Boats Available in & Near Arizona ca. 1912

- Steamboats
- Flat boats, Skiffs, Scows, & Rafts
- Canoes
- Rowboats, Dories & Riverboats
- Ferries
- Many Others Available
  - Inflatable, Motor, Kayaks, Dugouts
- Boats were adapted to fit specific rivers & uses
Early Boating in Western States

“Commercial boating limited to canoes, flatboats & keelboats.”

Example:

- Lower Missouri River (MS, KS, IA, NE, SD, ND, MT) is clearly navigable.
- 27 yrs required to acquire skills and develop the type of boats needed to navigate the Missouri.
- Sand bars were a challenge... but were overcome with time.

“Before 1830, commercial boating in the West was limited to canoes, flatboats and keelboats. In that year the first steamboat left St. Louis headed up the Missouri River. Within three years, steamboats had reached the junction of the Yellowstone River in eastern Montana, though it would take another 27 years to "evolve the boats, the experience and the maneuvers required to navigate the Missouri.” The principal difficulty going upriver was in getting off or over sand bars. Often the freight would have to be unloaded, or some of it towed on a barge behind the boat.”

Source: River Boats in America, 1966
Historical Boats: Example

- Adapted Uses: Sweep Scows
  - Unique boat types for each river
    - Salmon River – rocky, fast current
  - Downstream use only
  - Hauled freight
  - Hauled tourists
  - Boat sold for lumber at river’s end

Sweep boat, or scow used on the Salmon River, a variant of the Mississippi River flatboat, 16 to 35 ft. long, 5 to 10 feet wide, with sidewalls 3 to 4 ft. deep. They had no power source other than the river current, and long sweep oars at bow and stern to steer. These craft appeared on the Salmon River in 1872 and were used through the 1920s. Like the flatboats, these were cheap but sturdy boats intended for hauling freight down a river. At the completion of the voyage, the boat would be sold for scrap. “By 1900, Harry Guleke had adopted sweep boating as his trade and, like the old flatboat men, would work his way downstream buying, selling, trading and delivering many tons of goods, always selling the boat for lumber at the end of the journey. Guleke took the trade a step farther by taking tourists through the gorge.”

Source: Anderson, 2013
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Source: Anderson, 2013
Special Master Report, Utah Riverbed Case, 1931

“The watercraft most commonly used in commercial navigation have been row boats of 16-18’ in length, drawing 6-12”, row boats 18-22’ long, drawing 14-18”, steel rowboats 18’ long, drawing 7-19”, motor boats of 20-27’ length drawing 10”-2’, rowboats 16-18’ length, propelled by outboard motors drawing 15-18”; scows 32’x8’ and 24’x6, drawing 8”, and rafts.”

Canoes – exploration, cargo, trapping, hunting
### Historical Boat Materials, ca. 1912

<table>
<thead>
<tr>
<th>Material</th>
<th>When 1st Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>B.C.</td>
</tr>
<tr>
<td>Metal (copper, steel, aluminum)</td>
<td>1800’s</td>
</tr>
<tr>
<td>Canvas</td>
<td>1800’s</td>
</tr>
<tr>
<td>Skin</td>
<td>B.C.</td>
</tr>
<tr>
<td>Rubber</td>
<td>1800’s</td>
</tr>
<tr>
<td>Composite</td>
<td>1800’s</td>
</tr>
<tr>
<td>Other (frame, wicker, reed, inflatable, pottery) materials were used by indigenous people centuries before western expansion of USA.</td>
<td></td>
</tr>
</tbody>
</table>

- Experienced boatman (Steamboat Exploration)
- Little Colorado River (Flax River)
- Lacked materials to build boats
- Standard military issue canvas boats (Buchanan’s)
- Some other common boat types didn’t fare well when packed/stowed in the heat.

Description:
- Canvas over pine frame
- 150 lbs
- Packed on mule
- Assembled in 10 minutes
- Light, durable, staunch
- Used in Indian wars
Types of Boats Used in Arizona

- Steamboats (Colorado River, Lower Gila River)
- Flatboats (Salt, Gila, Verde)
- Ferries (Salt, Gila)
- Rowboats (Salt, Gila, Verde)
- Canoes (Salt, Gila, Verde)
- Floating Logs (Gila, Salt, Verde)
Historical Boating Accounts in AZ

- **Seasons Boated**
  - Throughout the Year: Spring-Summer-Fall-Winter

- **Flow Rates Boated**
  - Normal low water: Yes
  - Normal high water: Yes
  - Floods: Not ordinarily

- **Boats Were Available When Needed**
  - If rivers weren’t boatable, why did people have boats?
Steamboats

- Large Vessels
  - Adapted for river conditions
  - Used on major rivers
- Colorado River, 1865-1908
  - Ended with Imperial Dam
  - Competition from Railroad
- Gila River
  - Segment 8
  - Occasional use

Yuma Landing, 1885
Steamboats

- Specifications: ~60-150 ft
- Draw: ~19” (fully loaded)

- Typical Uses
  - Shipping, Passengers, Exploration, Military, Travel, Mail

- Availability – in Arizona prior to 1912

- Use on Arizona Rivers
  - Colorado, Gila

See Lingenfelter, 1978
The “Cochan” on the Colorado River near Yuma, 1900
Steamboats in Arizona

- Traffic dried up after railroad in 1877, p. 49
- Imperial Dam was obstruction to thru-boating
- Draw: 30” fully loaded, p. 37. Later 19”
- Technique for sandbars, p. 49
  - “Crawfish” – stern 1st, use paddle wheel to claw through

Source: Swanson & Altschul, 1989, Cultural Resources Investigations of the Yuma Quartermaster Depot.
Steamboats Used on the Navigable Colorado

- Navigable in high stage
- Boulders, snags & sandbars
- Navigation difficult & dangerous
- Remote
- Powerful floods
- Steamboat use mostly ended when Imperial Dam built above Yuma
  - Use not compatible with irrigation diversions & dams

Sources: Arizona Territorial Legislature (1866); Steamboats on the Colorado (1978)
Historical Boat Types

1875
Ferries

Hayden’s Ferry – Salt River @ Tempe
Historical Boat Types

- Ferries
Historical Boat Types

- Ferries
Ferries
Historical Boat Types

- Ferries
Ferries

Specifications: Vary widely (6-35 ft)
Minimum Depth of Flow: 2 ft*
Typical Uses
- Commercial, Passengers, Travel, Military, Mail
Availability: In Arizona
Use on Arizona Rivers
- Actual Historical (Salt, Gila, Verde, Colorado, LCR)

*Ferries only needed if rivers couldn’t be easily forded
Ferry Use in Arizona
- Used to Cross Rivers
  - Not downstream/upstream
- Ferry types, size, & shape vary
  - Barge-like
- Materials
  - Reeds, clay, hide, wood, steel
- Some used seasonally
  - Seasons of high water
  - Others used year round
- Eventually replaced by bridges
  - Demonstrate susceptibility to boating
    - Sufficient depth for large boats

Source: Stantec, 2005 – Figure 3.1; McCroskey, 1989
Historical Boat Types

- Ferries

Gila River Ferry, 1913
Flat Boats, Skiffs, Rafts

- Specifications: Sizes vary widely (8-30 ft)
  - Often homemade
- Minimum Depth of Flow: ~1 ft.
  - Shallow draft boats
- Typical Uses
  - Hauling goods, travel, passengers, exploration, ferries
- Availability: In Arizona
- Use on Arizona Rivers
  - Actual Historical (Salt, Gila, Verde)
Historical Boat Types

- Flat Boats, Skiffs & Rafts
  - Strip Skiff (15’ long, 3’ wide)
  - Board Skiff (2 board bottom & sides, common)
  - Canvas Skiff (over wood frame)

- Propelled by Poles, Oars, Current
  - Without oars & experience, these boats are difficult to control
  - Uncontrolled boats experience more difficulties
Historical Boat Types
Historical Boat Types
Historical Boat Types

- Rowboats & Dories

Powell Expedition

Powell Replica Boat
Rowboats & Dories

Specifications
- Sizes vary widely (6-22 ft)
- Minimum Depth of Flow: 3 inch to 2.5 ft

Typical Uses
- Hauling Goods, Passengers, Recreational, Exploration, Travel, Trapping/Hunting, Survey, Mail

Availability:
- In Arizona

Use on Arizona Rivers
- Actual Historical (Salt, Gila, Verde, Colorado)
Historical Boat Types

Rowboats available from 1912 Sears Catalog

1895 Montgomery Wards Catalog:
- Wood & Canvas Rowboats
- Mail order availability

The “Edith” in GCNP collection, Kolb brothers 1911
Wood Boat Specifications: Edith (ca. 1911)

Used by Kolb Brothers
Draw: < 1 ft
Load: 2,000 lbs
Relict Homemade Rowboat on Green River
Historical Boat Types

Boating on Salt River, Arizona.
Historical Boat Types
Historical Boat Types
Historical Boat Types

- Canoes
Historical Boat Types

- Canoes

Kolb Brothers
Historical Boat Types

- Canoes
Historical Boat Types

- Canoes
  - Specifications
    - Sizes vary widely (8-25 ft)
  - Minimum Depth of Flow: 6 inches
  - Typical Uses
    - Hauling Goods, Passengers, River Guiding, Exploration, Military, Fishing, Trapping, Travel, Mail
  - Availability: In Arizona
  - Use on Arizona Rivers
    - Actual Historical (Gila, Salt, Verde)
Canoes

- Dugouts – single log
- Strip – fitted wood pieces
- Canvas – metal or wood ribs
- Upstream travel (poling)
- Many other types of canoes available, modified for the type of water & intended use.

Country Life Magazine, 1908
Canvas Folding boats

- Specifications: 5-12 ft
- Minimum Depth of Flow: 3 inches
- Typical Uses
  - Hunting, Fishing, Trapping, Travel, Military, Exploration
- Availability: In Arizona
- Use on Arizona Rivers
  - Actual Historical (Gila, Verde, Salt)
Historical Boat Types: Folding Canoes & Rowboats

King Folding Boat Co, ca. 1880’s
Canvas over wire frame

Kolb brothers & others in canvas canoe

LIFE SAVING FOLDING CANVAS BOAT.
Made by Life Saving Folding Canvas Boat Co., Kalamazoo, Michigan.

These boats are splendid for hunters, trappers, fishermen or pleasure, safe and steady, the 12 foot regular 37 inch beam, 12 inches deep, 20 inches at ends, with jointed oars or double paddles, carrying case, thwart seats and spreaders, air chambers and camp chair, capacity 700 pounds. Weight 35 pounds, package is 4 feet by 9 inches by 11 inches.

Price $35. This boat will carry three persons nicely. Given for EIGHTY-FIVE New Subscribers.

The 9 foot boat, suitable for a trapper or hunter, 32 inch beam, 10 inches deep, 16 inches at ends, with jointed oars or double paddles, carrying case, thwart seat and spreaders, air chambers, capacity 350 pounds, package is 3 feet by 8 inches, weight 30 pounds, price $25. Given for SIXTY New Subscribers.

Always mention the HUNTER-TRADER-TRAPPER when writing to advertisers.

Hunter-Trader-Trapper Magazine, 1908
Historical Boat Types
Historical Boat Types

- Canvas Canoes, 1911 Publication
  - “In years past, 1000’s of streams could not be reached [until] the folding canvas boat..”
  - 9 ft boat: carries 350 lbs, costs $25
  - 20 ft boat: carries 3,000 lbs, costs $65.
  - Described as more reliable than inflatable boats.

Source: Outing with Portable Equipment, 1911

If “Its” a Life Saving Folding Canvas Boat, or Canoe,---You Know the Rest.

Its the Best. Unbreakable, Galvanized Steel Frames. Guaranteed for five years. Best possible Canvas body. Easiest and quickest to set up, or take down. Will outlast and outcarry wood or steel boats of same size. Safe, rigid, durable and satisfactory. Your dealer has it or send for Folder S.

LIFE SAVING FOLDING CANVAS BOAT CO., Kalamazoo, Mich.

Hunter-Trader-Trapper, 1912
Guaranteed, Outlast Wood or Steel boats, Safe
Canvas Canoes

- Numerous manufactures, shipped anywhere
- Elastic rigidity (deflects snags & rocks)
- Very low draft (clears 1” depths)
- Military usage (more durable than wooden boats)
  - Ives’ Account
  - Fort Verde

Outing with Portable Equipment, 1911
Historical Boat Types

- **Inflatables**
  - Specifications: Varies (8-30 ft)
  - Minimum Depth of Flow: 1 ft.
  - Typical Uses
    - Passengers, Exploration, Ferries, River Guiding, Military, Fishing, Travel
  - Availability: In Southwest
  - Use on Arizona Rivers
    - Actual Historical (Colorado)
Historical Boat Types

- Inflatables
  - 1837: First rubber boat invented
  - 1842: Fremont uses Day raft for Platte River survey
  - 1846: Horace Day patents rubber raft
  - 1851: Goodyear rubber pontoon
  - 1853: Whipple crosses Colorado in inflatable raft
  - 1866: Atlantic Ocean crossing in inflatable raft
  - 1900: Durability of rubber improved
  - 1937: First Grand Canyon inflatable trip
Historical Boat Types

An inflatable rubber boat, circa 1855.

Used in Mexican-American War (1848)

A two-man Halkett boat, with and without its canvas cover.

Used by Royal Navy, 1845
Native American Boating

- Yuman Tribes, Gila & Colorado Rivers
  - Fishing, Ferrying
  - Rafts made from Tule bundles
  - Unshaped logs (Maricopas)
  - Catamarans (for high water)
  - Hand paddled or poled
- Halchidhoma, Mohave
  - Clay Pots

Source: Yuman Tribes of the Gila River, 1970
Native American Boating

- Interior Tribes
  - Limited record of boating
  - Apaches – wicker baskets
  - Canoe in Hohokam canal (F. Cushing)
- Tohono Mythology
  - Montezuma & the Flood – Canoe story
Native American Boating

- Disposable Canoes & Boats
  - Bark or Skin over wood frames
  - Used short term & abandoned
  - Willow basket boats waterproofed with sap
  - Rafts made from reeds or agave stalks
  - Poorly preserved

Sources:
- The Bark Canoes & Skin Boats of North America, 1938
- Crossing the River: Ferries & Other Small Boats in Arizona, 1999
Native American Boating

- Reasons for Limited Record of Boating
  - Boat materials not well preserved
  - Alternative modes more suitable
  - Cultural beliefs about rivers

“The present day Indians, the Navajos and the Utes, probably owing to old superstitions and legends, have not navigated these rivers in boats and do not now navigate them except to cross at fords” p. 25-26 Report of Utah Special Master

“W.E. Medenhall: “We could never get Navajo Indians to go down with us into the canyon. They hear the rocks rolling down there and they say it is the Great Spirit...The Indians seem to believe the canyons are inhabited by spirits...Their tradition is that they fought the Cliff-dwellers and defeated them repeatedly...and rather than be captured the Cliff-dwellers jumped into the River and were turned into what is called the hump-backed fish and that reason has kept them from ever eating or catching a fish” p. 26, Report of Utah Special Master
Why Weren’t There More Boating Accounts on AZ Streams?

- **The Basic Paradox:**
  - When the rivers had the water, Arizona didn’t have the population.

<table>
<thead>
<tr>
<th>Arizona Population by Decade (US Census Bureau)</th>
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<tbody>
<tr>
<td>Year</td>
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</tr>
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<td>1880</td>
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<td>1900</td>
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<td>1910</td>
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<tr>
<td>2011</td>
</tr>
</tbody>
</table>

* Arizona is currently the 33rd least densely populated state. (#1 – NJ – 1,210/mi²)
The Basic Paradox:

- When the rivers had the water, Arizona didn’t have the population.
- When Arizona had the population, the rivers no longer had the water.
Boating may not have been newsworthy
- Only unusual or extraordinary trips were “news”
- In 1871, when the railroad arrived, there were < 10,000 English readers in the entire state.

There may be more published boating accounts

River Boating Requires
- Specialized equipment
- Specialized skills
Why Weren’t There More Boating Accounts on AZ Streams?

- Other Reasons:
  - Many early AZ population centers weren’t on the “wet” rivers
    - Prescott, Tucson, Tombstone, Wickenberg, Flagstaff, Forts
  - Modern Transportation Routes not on Rivers
    - Except parts of Gila
      - Which was in Mexico until 1853
      - Apache threat until 1886
    - Verde aligned North-South, Travel routes primarily East-West
Why Weren’t There More Boating Accounts on AZ Streams?

Other Reasons:

- Alternatives Available
  - Railroads (1870’s)
  - Roads: Wagon & Horseback (1500’s)
  - Roads: Automobiles (1900’s)
  - Alternative modes required to get into & out of Arizona
Arizona City Populations, 1910
Bisbee (9,019)
Clifton/Morenci (9,884)
Douglas (6,437)
Flagstaff (1,633)
Globe/Miami (8,473)
Jerome (2,393)
Mesa (3,330) ..................................Salt R.
Nogales (3,514)
Phoenix (11,134) ..................Salt R.
Prescott (5,093)
Maricopa (1,473)
Safford/Thatcher (3,490) ..................Gila R.
Tempe (3,073) ..................Salt R.
Tombstone (1,582)
Tucson (13,193)
Winslow (2,381)
Yuma (2,914) ..............Colorado R.

Source: Sharlot Hall Museum
Why Weren’t There More Boating Accounts on AZ Streams?

- Some Segments of Arizona Rivers
  - Not conducive to carrying major tonnage (e.g., ore)
  - Not easy to travel upstream (possible, but hard work)

- Rivers were diverted & dammed before Statehood
Faulty Logic: If the river was navigable, people would have regularly boated it.

Many Factors Involved:
- Flow depth
- Need
- Cost
- Speed of Travel
- Skills
- Location

“All the men interviewed state that ...it was possible to drive a wagon nearly anywhere one desired.” Ciolek-Torrello & Welch, 1994
Reasons Why Not to Boat a Navigable River

- You don’t own a boat
- You don’t know how to build a boat
- There are no materials to build a boat
- It takes too long to build a boat
- You don’t know how to pilot a boat
- You already own a wagon, car, horse, etc.
- Wagon, horse, car, railroad etc. are faster
- It’s too cold. Or hot. Or rainy. Or windy....
- You are afraid of boating
- You can’t swim
Reasons Why Not to Boat a Navigable River

- The river doesn’t go where you want to go
- The boat won’t carry what you want to carry
- You need a car, horse, etc. when you get there
- Going upstream is too much work or expense
- You can’t risk capsizing
- The river was remote – no access in 1912
- You don’t live/work near the river
- The river is unexplored, unknown
- You don’t need to go anywhere.
  - Self-sustained communities

- Someone built a dam or removed all the water
Advantages of Trains over Boats, 1912

- Trains are faster
  - Steamboat: 240 miles/12 days
  - Steam Engine: 20-50 miles/hour

- Trains carry more cargo
  - Canoe: 500 lbs
  - Steamboat: 50 tons
  - Train: 50 tons/ore car

- Trains can move 24 hrs/day
- Trains go uphill, onto & through mountains
- Trains not affected by weather, drought, flood

Why are railroads located along rivers?
- Flat terrain
Floating Logs as Navigability

- Floating Logs Requires:
  - River located in forest (source of logs)
  - Population (market for logs)
  - River located in market (delivery point)
  - Sufficient river flow to float logs
  - Wide & straight enough river to prevent log jams

- Some accounts of log-floating in AZ
Instances of Historical Boating
- Gila, Salt & Verde River
- Throughout the year, during ordinary conditions

Primarily
- Low Draft Boats
- Downstream Travel

**NOTE:** Actual *historical boating is not required* to demonstrate title navigability. Only *susceptibility* to boating is required.
What Type of Boat is Required?

- Federal Standard for Boat Type for Navigability
  - US v. Holt (1926) “…navigability does not depend on the particular mode in which such use is or may be had - whether by steamboats, sailing vessels or flatboats…but in the fact…that the stream in its natural and ordinary condition affords a channel for useful commerce”
  
  - No required type of boat.
Susceptibility to Trade & Travel

- It’s All About Flow Depth & Obstructions
  - Requirements vary with the type of boat
  - Width generally not a limiting factor

- Navigability Requirements
  - Not susceptible to every type of boat
  - Long enough stream segment
  - Minor obstacles not important
  - Some difficulty not important
## Federal Minimum Standards for Boating

### Table 8-1
Minimum Required Stream Width and Depth for Recreation Craft

<table>
<thead>
<tr>
<th>Type of Craft</th>
<th>Depth (ft.)</th>
<th>Width (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canoe, Kayak</td>
<td>0.5</td>
<td>4</td>
</tr>
<tr>
<td>Raft, Drift Boat, Row Boat</td>
<td>1.0</td>
<td>6</td>
</tr>
<tr>
<td>Power Boat</td>
<td>3.0</td>
<td>6</td>
</tr>
</tbody>
</table>

State Standards for Boating

- Arizona:
  - Presumptions of Non-Navigability Struck Down by Arizona Courts; Particularized Assessment Required

- Alaska:
  - Criterion Craft – Powered boat + 1000 lbs (Gulkana)

- Washington:
  - Depth Classification (Probably Not, Maybe, Probably)

- Oregon:
  - Floating logs – Clear Channel
  - Dugout canoes
Obstructions & Obstacles

- Obstructions to Navigability
  - Depends on the Type of Boat
    - River Barges vs. Trapper Canoes
  - Depends on Boater’s Experience
  - Depends on Flow Rate
  - Obstruction ≠ Obstacle, Challenge
  - Some commercial enterprises require “obstacles”
## Obstructions & Obstacles

<table>
<thead>
<tr>
<th>Obstruction?</th>
<th>Barges</th>
<th>Canoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapids</td>
<td>Yes</td>
<td>No (I-V)</td>
</tr>
<tr>
<td>Beaver Dams</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Waterfalls</td>
<td>Yes</td>
<td>Some</td>
</tr>
<tr>
<td>Sand Bars</td>
<td>Only if river wide</td>
<td>No</td>
</tr>
<tr>
<td>Strainers / Sweepers</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Marshes</td>
<td>Yes, if no clear channel</td>
<td>If shallow</td>
</tr>
<tr>
<td>Braiding</td>
<td>No, unless shallow</td>
<td>No</td>
</tr>
<tr>
<td>Shallow Flow</td>
<td>&lt; 10 ft.</td>
<td>&lt; 0.5 ft.</td>
</tr>
</tbody>
</table>

On Gila, Salt & Verde Rivers, continuous, regular shallow flow is the only real obstruction to boating.
Rapids

- Defined as: A section of a river where there is an increase in water velocity & turbulence.
- Some rapids (not all):
  - Slope increase
  - Shallow or exposed rocks
  - Whitewater
- Most rapids are obstacles, not obstructions
  - Depends on boat type, suitability for rapids
  - Long, continuous, major rapids could be obstruction
- International Rating Scale for Rapids (I-VI)
Elements of Rating Rapids
- Ease of passage & route finding
- Size of waves
- Need to maneuver
- Complexity of maneuvers, skills required
- Danger to swimmers
- Need for group assistance, difficulty of self-rescue
- Need for scouting
- Power of current
- Length & complexity of rapid

Can be subjective, seasonal, annual
Rapids & Navigability in Arizona

- Class I-V are Navigable (by definition)
  - There are very few Class III-VI rapids on the Salt, Gila, and Verde Rivers (mostly I-II)
  - The *navigable* Colorado River has some of the largest rapids in North America

- Rapids are minor parts of the rivers’ lengths
  - Vast majority (>95%) = Class I or Pools
### Obstructions & Obstacles

<table>
<thead>
<tr>
<th>River</th>
<th>Percent of River’s Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class II</td>
</tr>
<tr>
<td>Gila</td>
<td>0.2%</td>
</tr>
<tr>
<td>Salt</td>
<td>1.8%</td>
</tr>
<tr>
<td>Lower Salt</td>
<td>0</td>
</tr>
<tr>
<td>Verde</td>
<td>2.4%</td>
</tr>
</tbody>
</table>
Obstructions & Obstacles

- International Scale - Rapids Classification
  - Class I: Fast Moving Water
    - Riffles, easily navigated with little training
  - Class II: Straightforward Rapids
    - Wide, clear channels, easy with training
  - Class III: Rapids
    - Boat maneuvering required
    - Moderate waves, tight channels, powerful currents
Verde River, Unnamed Class I Rapid @ 122 cfs
Video:

- Clay Bank Rapid, Verde River
Class II Rapids in Arizona

Gila River, Above Needle’s Eye Rapid, Class II @ 220 cfs
Video:

- Needle’s Eye, Gila River
Class III Rapids in Arizona

- Video
  - Grumman Rapid, Salt River
Class III Rapids in Arizona

Eye of the Needle Rapid, Salt River

Ledges Rapid, Salt River
Obstructions & Obstacles

International Scale of River Difficulty

- **Class IV: Rapids**
  - Powerful, intense, predictable rapids
  - Moderate to high risk if capsized

- **Class V: Rapids**
  - Complex, violent, demanding
  - High risk, difficult rescue

- **Class VI: Obstacles**
  - Unrunnable for most boaters
Class IV Rapids in Arizona

Black Rock Rapid, Class IV Upper Salt River, 1600 cfs
Class IV Rapids in Arizona

Quartzite Falls, Upper Salt River

Corkscrew Rapid, Upper Salt River
Video

- Black Rock Rapid, Salt River
No Class V or VI Rapids on:
- Salt River
- Gila River
- Verde River

Only Class V Rapids in Arizona:
- Colorado River:* Navigable
- Small Rivers: East Verde, Burro Creek, etc.

*Grand Canyon rapids are rated on a 1-10 scale
Beaver Dams

- Not on major river main channels
  - Small river feature
  - Removed by seasonal high flow
- Not necessarily dams
  - Bank dens or lodges
- Not obstructions to small boats
  - Obstacle at dam itself (sluice or carry)
  - Raises water depths upstream of dams
Mid-channel beaver lodge on the Gila River, Segment 7, February 2003
Waterfalls:
- Definition: River flow over a vertical drop.
- Not drowned out at high flow
- Permanent feature
- Rapids are less steep, may be drowned out
- None on Gila, Salt, or Verde River in AZ
  - Some Rapids are named “falls”

Apache “Falls”, Salt River Canyon

Verde “Falls”

Havasu Falls
**Obstructions & Obstacles**

- **Waterfalls**
  - There are none on the Gila, Salt, Verde
  - Verde “Falls” is a rapid (Class III-IV) & is often run by canoes, kayaks & rafts
Sand Bars

- Raised area of sand at or near the water surface
- Occupies part of the stream bed channel

Gila River near Apache Grove

Colorado River near Bullhead City

Cimarron River Oklahoma
Sand Bars

- Occur on all major rivers.
  - Colorado & Mississippi.
  - Do not preclude navigability
- Obstacle at low flow
- Boats go around sand bars

Gila River, Segment 1, 39 cfs
October 1871—Upstream travel on the Colorado River in Black Canyon. Trip extended to Diamond Creek through many large rapids. (Wheeler Expedition – flat boats)

Photos shows large sand bars in river.

Source: Webb et. al., 2007
Obstructions & Obstacles

- Strainers & Sweepers
  - Fallen trees in channel
  - Overhanging bank vegetation
  - Removed by Floods, Time
    - Worse after dams built
  - Hazardous to Unprepared
  - = Obstacle, Not Obstruction
    - Easily removed
    - Easily avoided
Boating around Obstacles

- Avoid the obstacle – just go around it
- Lining, Scooting, Dragging
- Depends on
  - Skill of boater
  - Knowledge of river
Portaging

- Carrying the boat over land
- Short Hauls
- Long Hauls
- Around non-navigable segment
  - Then back to navigating the river

Trapper Routes

Deciding to portage, line or run an obstacle

- Weather, Consequence, Fatigue, Skill, durability of craft
First Descent Obstruction = 2\textsuperscript{nd} Trip Obstacle

- John Wesley Powell
  - Lined and portaged 62 of 476 rapids
  - Damaged & sunk several boats

- 2013 Replica Trip
  - Same boats, more skill & knowledge
  - Portaged one rapid (to replicate)
  - Ran the rest
  - No significant damage reported
Obstructions & Obstacles

- Not Obstructions
  - Remoteness
    - In 1912, the entire State of Arizona was “remote.”
  - Deep Canyons
    - Canyon depth is not a river feature
  - Narrow Rivers
    - Wide enough for a boat
  - Manmade features
    - Dam, road, mine, channelization, fences

- Obstacles are Not Obstructions to Navigability
  - US v. Holt (1926) “…nor on an absence of occasional difficulties…”
Modern Recreational Boating

- Montana PPL v. Montana Criteria
  - Modern watercraft are meaningfully similar to those in customary use at time of statehood.
    - Can modern boats go where historical boats couldn’t?
  - River’s post-statehood condition is not materially different from statehood physical condition.
    - Has the river changed to substantially improve boating?
    - Less torrential in high flow periods?
    - Less shallow in low flow periods?
Meaningfully Similar to Historical Boats?

- Draw is the same (canoes, flatboats, rowboats)
  - Same depth needed for historical & modern boats
  - Weight of canoes about the same
- Design is essentially the same
  - Performance improvements in specialty boats
Modern Recreational Boating

Meaningfully Similar to Historical Boats?

A B. N. Morris wood-and-canvas canoe built approximately 1912

Guide 16

2014 Old Town Wood Canoes
Meaningfully Similar to Historical Boats?

Kolbs in “Edith” in 1911
Replica boating in the Edith in 2013
Modern Recreational Boating

An inflatable rubber boat, circa 1855.

Avon Inflatable Raft, 2014
A two-man Halkett boat, with and without its canvas cover
Meaningfully Similar to Historical Boats?

- Durability is improved (plastic, hypalon, etc.)
  - Less skill needed
- Low durability was an expectation
  - Repair – canvas, wood
  - Extra care & time in selecting route
Modern Recreational Boating

Emery Kolb repairing the Edith, Christmas 1911, in Grand Canyon

Durability & expectations differ.
### Historical & Modern Boat Flow Depth Requirements

<table>
<thead>
<tr>
<th>Boat Type</th>
<th>Required Depth</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Canoe</td>
<td>0.3-0.5 ft</td>
<td>USFWS, Slingluff, Cortell</td>
</tr>
<tr>
<td>Canvas Canoe</td>
<td>0.2 ft</td>
<td>1910 Sears Catalog, Hunter/Trapper</td>
</tr>
<tr>
<td>Drift Boat</td>
<td>1.0 ft</td>
<td>Cortell</td>
</tr>
<tr>
<td>Duck Boat</td>
<td>0.2 ft</td>
<td>1910 Sears Catalog</td>
</tr>
<tr>
<td>Kayak</td>
<td>0.15-0.5 ft</td>
<td>Brosius, USFWS</td>
</tr>
<tr>
<td>Rowboat</td>
<td>1.0 ft</td>
<td>USFWS</td>
</tr>
</tbody>
</table>

As reported in Stantec (Tellman), 2005
Similar Depths Needed for Historical Boats & Modern Recreational Boats

Source: Shelby, Whittaker & Donahue, 2011
Has River Condition Improved?

- Since Ordinary & Natural Condition Existed
- Discussed in Specific River Presentations
- Generally: No!
  - Flow rates significantly depleted
  - Flow depths lower
  - Invasive species due to altered flow regime
  - Fences, diversion dams, channelization, mining
Modern Recreational Boating

- Demonstrates Susceptibility
  - Can be boated given opportunity, time & motive
- Is Travel (“travel on water”...Daniel Ball test)
- Recreation is Commercial
  - Commercial river touring existed in 1912
  - Tourism-based economies
  - Boat rental, supplies, guiding, outfitting

“The Government’s assertion as to lack of commercial possibilities fails to recognize one source of commerce which in the future will undoubtedly develop to a considerable extent—the use of these Rivers for the transportation of tourists for hire, to view the natural scenic wonders and explore the archaeological features of these regions”

Utah Special Masters Report, p. 117)
Modern Recreational Boating

- In Arizona
  - Federal monitoring & regulation
  - Commercial outfitters
  - Published river guidebooks
  - Boat rentals
  - Websites
  - Paddling clubs
  - Boat races & events
  - Shuttle services
Commonly Boated for Recreation In Arizona

- Gila Box (Segment 2)
- Gila Coolidge Dam to Ashurst Hayden (Segments 4-5)
- Gila River Downstream Phoenix (Segment 7)
- Salt River Canyon (Segment 2-4)
- Salt River Segment 5
- Verde River (all)
- Colorado, San Francisco, Virgin, Little Colorado, Black, Bill Williams
Modern Recreational Boating

Summary – Modern Boating Occurs:

- Wherever river flow has not been altered
- Wherever public access is not prevented
- Most often in scenic or exciting river reaches
- Year-round & seasonally, depending on flow rates
Boating Summary

- Boats Were Available in Arizona at Statehood
  - Wide Variety – Primarily Low Draft
- Boats Were Used on Arizona Rivers
  - Many Accounts Despite Flow Depletion
- Boats Are Still Used on Arizona Rivers
  - Modern Recreational Boating
- Modern Recreational Boats are Meaningfully Similar to Historical Boats