385
Presentation to ANSAC:
Salt River Navigability - Rebuttal
Overview

- Historical Boating Accounts
- Modern Boating
- Hydrology
- Rating Curves
- Miscellaneous Topics
Historical Boating Accounts
Rebuttal of General Criticisms of Historical Navigability Accounts

- Newspapers are reliable sources
- “Boosterism” does not negate news accounts
- Boating accounts really did happen
- Boating occurred within ordinary flow range
- Boating accounts were on river not on canals
- Some boating was commercial
- Nearly all boat trips were successful
- Boating accounts are relevant to navigability
- All trips cited were on the Salt River in Arizona
Flat Boat (April 1873) (Segment 6)
- L. Vandermark & W. Kilgore
- “Salt is navigable for small craft”
- Five tons wheat
- Flat boat
- Hayden’s Ferry to Swilling Canal
- Canal to Helling’s Mill

Sources: Weekly AZ Miner, 5-3-1873
Map: AZPCP.org
Historical Canal Heads: Segment 6

- 1877 - Grand
- 1867 - Swilling
- 1870 - Tempe
- 1877 - Mesa
- 1878 - Highland
- 1888 - Arizona
- 1908 - Granite Reef
- 1880 - San Francisco
Why Was There No Shipping Industry on the Salt River?

- Diversion dams blocked river traffic starting in 1867
- Diversions depleted flow beginning in 1867
- Transport Alternatives existed:
  - Roads (pre-1867)
  - Railroads (1879 to Maricopa, 1886 to Phoenix/Tempe, 1898 to Globe)
    - East/West connection to USA in 1881.
  - No alternative irrigation source existed
- River travel NOT always less expensive
- Largest early markets and forts not located along the river
  - Prescott, Wickenberg, Tucson, Globe, etc.
- Population along river limited
- Segments 1-5 often not conducive to heavy loads, deep draft boats, upstream travel
- Comparison to Yuma & Colorado River
False: If the Salt River Were Navigable, There Would Be Commercial Shipping

- Ordinary & Natural Condition
- Big Boats, Big Loads
- Upstream Boating
- Population Centers
- Source vs. Market
- Cost
- Risk
- Dams & Diversions
- Roads, Rails & Rivers
- Is this true of other navigable rivers?
Is There Always Commercial Shipping Industry on Navigable Rivers?

- Mississippi River
- Missouri River
- Colorado River
- Weber River
- John Day River
- Mosquito Fork
- Umpqua River
- Rogue River
- Salmon River
False: If a River is Navigable, the Preferred Mode of Travel is by River

- Many Factors Affect Mode of Travel Used
  - See Boating PowerPoint, Slides 68-71
  - Example: The Mormon Battalion
    - Council Bluffs, IA to Kansas City, MO (Missouri River)

Charles Hayden – Log Floating Experiment

- Segment 1? Probably on White or Black River
- Initial Reconnaissance (6-14-1873)
  - “Headwaters” of Salt River Trip
  - Maine lumberman – Salt R. superior to Maine rivers
- Canoe Trip (6-21,28-1873)
  - Made canoe from a tree
  - Six men, logs for log drive
  - Abandoned boat
  - Difficulty with rapids & boulders, lost gear
  - Log jam in narrow canyons

Hayden’s Conclusion: Log floating was a failure

Sources: AZ Citizen, 6-14-1873; AZ Weekly Miner, 6-21,28-1873
New Information from *Charles Trumbell Hayden Pioneer* by Carl T. Hayden (p. 42)

- Trip suggested by Logan, a Hayden employee
  - Carpenter, employed at Ft. Apache.
  - Had boated White & Salt River, Ft. Apache to Tempe
- Hayden trip occurred after June 24, 1873
- Hayden decided to forego log-floating because:
  - Logs would lodge in canyon (Segment 1 or White River)
  - Log floats best at high water
  - During floods, couldn’t catch logs with a boom
Hayden Log Float (June 1873)

Roosevelt Dam Site
Was this Hayden’s Route Back to Tucson?

Ft. Apache-San Carlos-Tucson
Market locations
Other sources of lumber at population centers
Railroads Arrived
- Yuma 1877
- Maricopa 1879
- Tucson 1880
- Phoenix 1886
- Prescott 1886
- Globe 1898
- Flagstaff 1882
Irrigation dams
Location of Logs
- Burch: “Main Difficulty” = Logs 10 miles to river
Lessons from the Weber River
Hamilton, Jordan, & Halesworth (Jan 1879)
- Segment 6
- Skiff
  - Built for $10
- Phoenix to Yuma Trip
  - “river (is) perfectly practicable for navigation”
    - (one spot on Gila River narrowed by rocks)
  - Would easily float a loaded flat boat, drawing 2 ft. of water
  - “Successful”

Sources: Arizona Sentinel 1-25-1879
James Stewart  (October 1880)
- Segment 6
- Superintendent of Stage Company
- “Will launch his boat on Salt River tonight”

Sources: Arizona Republican 10-2-1920
Cotton & Bingham Trip (February 1881)
- Phoenix to Yuma (Salt River Segment 6)
- 18 ft skiff, flat-bottomed
- Very low draft boat, sturdy
- Article announces intended launch

AZ Gazette, 2.17.1881
N. Willcox & Dr. G.E. Andrews, February 1883

- Segment #6
- Canvas skiff
- Pleasant except for rain while camping
- Fort McDowell to Barnum’s Pier (Salt River Canal)
  - aka, Swilling’s Ditch
- “Salt River is navigable stream and should be included in the River & Harbor Appropriation Bill”

Sources: AZ Gazette, 2-14-1883
Historical Boating Accounts

N. Willcox & Dr. G.E. Andrews, February 1883

Sources: AZ Gazette, 2-14-1883
Jim Meadows, 1883
- Livingston to Tempe (Segment 3-6)
- Four men, one boat
- First descent, not reported in papers until 1909
- "Success"
  - One boater was scared
  - Boat got stuck once on rocks – floated off

Sources: AZ Republican, 10-4-1909
William Burch, June 1885

- Tonto Creek Confluence to Phoenix (Segments 3-6)
  - Began @ Judge Eddy’s Ranch, 4 mi. above Tonto Creek mouth
  - Purpose: Determine if log floating was feasible
- 18x5 flatboat – 4 or 5 men
- Hazards:
  - “Numerous projecting boulders”
  - Upset the boat once, lost some gear
- Success
  - “Undisputed conclusion” that logs can be floated
  - “Exciting & interesting trip”
  - Main difficulty is getting logs to the river (10 mi. from banks)
- Stream: “6-20 ft. deep”

Sources: AZ Gazette, 6-3,5,6,8-1885
Historical Canal Heads: Segment 6
Major E.J. Spaulding, December 1888
- Ft. McDowell to Mesa Dam (Segment #6)
- Canoe – 2 men (Capt. Hatfield)
- Major Spaulding killed by accidental gun fire during portage over dam
- No boating problems reported

Sources: Phoenix Herald, 12-12-1888
Major Spaulding: Dec, 1888

Sources: Phoenix Herald, 12-12-1888
Stanley Sykes & Charlie McLean (Winter, 1890’s)

- Segment 6 (Phoenix to Yuma)
- Canvas over wood frame, painted
- Salt River at put in: 15-20 ft wide, 1 ft deep
- Dry reaches until the Gila Confluence
  - Walked beside loaded boat in depleted flow areas
  - River 20 feet wide & 1-2 ft deep.
- Flow depleted due to irrigation diversions
- Story recounted ~50 years after the fact

Source: Coconino Sun, 9.7.1945
JK & George Day: Camp Verde to Yuma (1892)

- Segment 6
- Small boat
- September to April
- Trapping – “large quantity of furs”
- 5th trip
- Returned to Prescott by railroad
- Plan to repeat trip next September

Note: Previous trips not in newspapers

Sources: Arizona Sentinel 4-2-1892
Rebuttal of Opponent’s Economic Analyses

- Mr. Gookin Concluded:
  - Cost of Canoes too high for one-way travel
- Dr. Newell Concluded:
  - Small boats not used for commercial purposes in 1912
  - Canoes were commercially viable boat prior to 1850
- Incorrect standard of navigability:
  - Upstream travel required
  - Boat type limited to large load boats
  - Required repeated, actual historical use
  - Ignored susceptibility argument or re-framed it as actual historical use
Mr. Gookin Costs:

- Cost of Canoe: $1,282 in 2015 dollars
  - Includes cost of shipping from Sears (43% of amount shown)
- Neglects Value of Load
  - Beaver (1894): $8-20/pelt  \( \times \) cost of homemade boat
  - $192-$479/pelt (2015 dollars)
- Also Neglects:
  - Cost of homemade boat (Hamilton Account: $10 >> $239)
  - Value of selling boat at end of trip: Net Zero or Profit
  - Cost to send boat home ($250/tn): $12.50 >> $299
Reality

- Day Brothers Repeated at Least Five Times
  - Intended to continue
- Other Trappers in Arizona
  - New Account for Salt (1894), Fogel & Gireaux (1931; Verde)
- Early Trappers Did Not Live in Arizona
  - Based in Taos, NM fur market.
Historical Boating Accounts

- **Hudson Reservoir & Irrigation Co (May/June 1893)**
  - Segment 4 – “Salt River Through Canyon”
  - Canvas boats
  - Boats used in commercial survey of river bed
    - “One of the boats”
  - Boat flipped
    - Occupants thrown into river
    - Two boat ribs damaged, boat nearly unserviceable
    - Difficult to find camping spot due to steep, narrow canyon

Sources: Arizona Republican 6-2-1893
Lieutenant Robinson (1893)

- Segment 6
- Salt River by boat
  - Phoenix to Yuma
  - Three soldiers, in boat(s)
- Article recalls a previous trip
- No details re. boat type or events during trip
  - Boated safely to Yuma & beyond

Sources: Bisbee Daily Review 10-6-1909
Adams & Evans (Jan 20-Feb 17 1895)
- Segment 6
- 18 x 3.5 ft homemade wooden flat boat with cabin
- Clifton to Sacaton (Gila River)
- Tempe to Yuma (Segment 6 of Salt River)
- Hauled the boat from Sacaton to Phoenix
  - Visited for several days in Phoenix
- Boated Phoenix to Yuma
- Jan-Feb is beginning of high water season.
  - No records of unusually high flows in Feb 1895

Sources: Phoenix Herald (2.18, 25.1895), AZ Sentinel (3.9.1895), AZ Daily Herald (2.18.1895)
Hauling Freight to Roosevelt (Segment 4)

- “hauled up river in a boat”
- 4 miles up canyon
- Botticher’s Camp to Roosevelt
- When road washed out.

Sources: AZ Republican, April 30, 1905
Thorpe & Crawford, June 1910

- Roosevelt Dam to Granite Reef Dam (Segment 4-6)
- “Ordinary” Rowboat
  - Boat bottom damaged by rocks (June low water trip)
  - Dragged boat “many times”
  - Well pleased with the trip
  - Not a fast trip
  - Couldn’t compete with the stage line
- Below average flow (145 cfs @ McDowell)
  - Less than 10% flow duration

Sources: AZ Republican, 6-28-1910
Herbert Ensign & Donald Scott (May/June, 1919)

- Segments 4-6: Roosevelt Dam to Phoenix
  - Granite Reef to Phoenix on Arizona Canal
- Canoe
  - Built extra strong, but light for easy transport around rapids
- Good Trip Description
  - Flipped in rapid early on Day 1, no gear lost (strapped in)
    - Flipped again. After that, portaged some rapids
  - Few pictures because both paddlers needed to control boat
  - Flipped in Arizona Canal, lost some gear not strapped in

Sources: Arizona Republican 6-28-1919
Logan (Prior to June 1873) Seg 1-6

- Littlefield, 2015 (p. 18), citing ASLD Item 10:
  - “...find a way to float logs to Hayden’s Ferry via the White and Salt rivers; this route had been previously navigated by Logan, a Scottish carpenter, who determined this was certainly possible.”
- Hand-built boat
- White & Salt Rivers – Ft. Apache to Tempe
- Boated in Spring runoff
- Very little timber near Salt River Canyon
- Logan suggested log trip to Hayden

Charles Clark/Globe Power Co.  Segment 3

Having a new boat built to replace old boat

Old boat washed away overnight, July 5

Boats used in work conducted by engineers

Reservoirs proposed, tunnel, power plants

Cherry Creek to Redmon Flat

USGS Flow Rate (@ Roosevelt):
  - July 5: 765 cfs
  - Week prior: 385 cfs

Source: Arizona Silver Belt, July 12, 1906
Globe Power Co. (July 1906)
Two Brothers (Segment 6)
Building a boat (canoe), almost complete
Work Salt & Gila Rivers
Seen 6 miles upstream of Phoenix
Few weeks ago (January)
Beaver are plentiful (in 1894)
Skins worth $8-20 each
Jan/Feb 1894 Flows = 494-591 cfs

Source: AZ Republican, Feb 11, 1894
## Historical Boating Accounts

### Summary of Historical Boating Accounts

<table>
<thead>
<tr>
<th>#</th>
<th>Account</th>
<th>Boat Type</th>
<th>Date</th>
<th>Success?</th>
<th>Segment</th>
<th>Purpose</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Logan</td>
<td>Wood</td>
<td>&lt; 1873</td>
<td>Yes</td>
<td>1-6</td>
<td>Travel</td>
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<tr>
<td>2</td>
<td>5 Tons of Wheat</td>
<td>Flat boat</td>
<td>April 1873</td>
<td>Yes</td>
<td>6</td>
<td>Commercial</td>
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<tr>
<td>3</td>
<td>Hayden</td>
<td>Canoe, Logs</td>
<td>June 1873</td>
<td>No</td>
<td>1</td>
<td>Commercial</td>
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<tr>
<td>4</td>
<td>Hamilton</td>
<td>Skiff</td>
<td>Jan 1879</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>5</td>
<td>Stewart</td>
<td>Boat</td>
<td>Oct 1880</td>
<td>Unknown</td>
<td>6</td>
<td>Boat builder</td>
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<tr>
<td>6</td>
<td>Cotton &amp; Bingham</td>
<td>Skiff</td>
<td>Feb 1881</td>
<td>Unknown</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>7</td>
<td>Yuma or Bust</td>
<td>Flat boat</td>
<td>Nov 1881</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>8</td>
<td>Willcox &amp; Andrews</td>
<td>Canvas Skiff</td>
<td>Feb 1883</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>9</td>
<td>Meadows</td>
<td>Boat</td>
<td>1883</td>
<td>Yes</td>
<td>3-6</td>
<td>Commercial</td>
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<td>10</td>
<td>Burch</td>
<td>Flat boat</td>
<td>June 1885</td>
<td>Yes</td>
<td>3-6</td>
<td>Commercial</td>
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<tr>
<td>11</td>
<td>Spaulding</td>
<td>Canoe</td>
<td>Dec 1888</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>12</td>
<td>Sykes</td>
<td>Canvas boat</td>
<td>1890’s</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>13</td>
<td>JK Day</td>
<td>Boat</td>
<td>Spring ‘92</td>
<td>Yes</td>
<td>6</td>
<td>Commercial</td>
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<td>17</td>
<td>JK Day</td>
<td>Boat</td>
<td>Spring Pre-1892</td>
<td>Yes</td>
<td>6</td>
<td>Commercial 4 trips</td>
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<tr>
<td>18</td>
<td>Hudson Res.Co.</td>
<td>Canvas boat</td>
<td>June 1893</td>
<td>Yes</td>
<td>4</td>
<td>Commercial</td>
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<td>#</td>
<td>Account</td>
<td>Boat Type</td>
<td>Date</td>
<td>Success?</td>
<td>Segment</td>
<td>Purpose</td>
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<tr>
<td>19</td>
<td>Robinson</td>
<td>Boat</td>
<td>1893</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>20</td>
<td>Trappers</td>
<td>Wood</td>
<td>Jan 1894</td>
<td>Yes</td>
<td>6</td>
<td>Commercial, Trapping</td>
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<tr>
<td>21</td>
<td>Adams &amp; Evans</td>
<td>Flat boat</td>
<td>Jan 1895</td>
<td>Yes</td>
<td>6</td>
<td>Travel – Recreation</td>
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<tr>
<td>22</td>
<td>Gentry &amp; Cox</td>
<td>Large Ferry</td>
<td>Jan 1889</td>
<td>Yes (on Salt)</td>
<td>6</td>
<td>Commercial</td>
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<td>23</td>
<td>Roosevelt Freight</td>
<td>Boats</td>
<td>April 1905</td>
<td>Yes</td>
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<td>24</td>
<td>Advertisement</td>
<td>Boat</td>
<td>May 1905</td>
<td>Unknown</td>
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<td>Hunting</td>
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<td>25</td>
<td>USRS</td>
<td>Boat</td>
<td>Dec 1905</td>
<td>No</td>
<td>6</td>
<td>Travel</td>
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<td>26</td>
<td>Shively</td>
<td>Boat</td>
<td>Mar 1905</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tbody>
<tr>
<td>27</td>
<td>Globe Power Co</td>
<td>Wood</td>
<td>July 1906</td>
<td>Yes</td>
<td>3</td>
<td>Commercial, Survey</td>
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<tr>
<td>28</td>
<td>Rains</td>
<td>Boat</td>
<td>April 1909</td>
<td>Yes</td>
<td>6</td>
<td>Travel</td>
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<tr>
<td>29</td>
<td>Selly</td>
<td>Boat</td>
<td>1909</td>
<td>Unknown</td>
<td>3 or 6?</td>
<td>Boat builder</td>
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<tr>
<td>30</td>
<td>Thorpe &amp; Crawford</td>
<td>Rowboat</td>
<td>June 1910</td>
<td>Yes</td>
<td>3-6</td>
<td>Travel – Recreation</td>
</tr>
<tr>
<td>31</td>
<td>Ensign &amp; Scott</td>
<td>Canoe</td>
<td>June 1919</td>
<td>Yes</td>
<td>3-6</td>
<td>Travel - Recreation</td>
</tr>
</tbody>
</table>

Not Counted in Summary:
1. Boats used in construction of dams (Roosevelt, irrigation dams)
2. Boats used during floods
3. Boats used on canals
4. Ferry trips across river (~ commercial ferries, multiple locations, 1,000’s(?) of trips)
Are These Every Historical Trip?

- 1993 Report: 13 Accounts
- 2015 Testimony: 28 Accounts
- 2016 Rebuttal: 31 Accounts

9 of 31 were not reported immediately in newspapers.
Historical Accounts: Definition of Success

- Boating Success =
  - Boat, Boater & Cargo arrive at destination
  - No deaths or serious injury due to boating
  - The boaters themselves called it a success

- This is the Standard Generally Used by Boaters
Historical Accounts: “Other Guys” Definition of Failure

- Any Single Account is a Failure (MN)
  - Trip must be repeated regularly (> 5 times; > 1/year)
- Not Carrying a “Commercial” Sized Load
  - 15 Tons (MN)
- Canoes not Commercial After 1850 (MN)
- Boat Flipped (Gkn, DL)
  - Even if boat is righted and trip continues
Historical Accounts: “Other Guys” Definition of Failure

- Boat Damaged (Gkn)
  - Scratched, worn, & repairable are failures
- Boat is Temporarily Stuck (Gkn, DL)
  - Getting stuck in Colorado River apparently is different
- Trip Not Long Enough (Gkn)

- No Adjustment for Depleted River Flow Conditions
31 Trips
- 2 Unsuccessful (only 1 failure in Segment 2-6)
- 4 Insufficient information (e.g., launch only)

No Flood Accounts Included

Canoes, Flatboats, Canvas Boats, Skiffs

Downstream & Upstream Direction
- Most trips went downstream only

No Problems with Beaver Dams Noted

Rapids Noted (Seg 4 only), Did Not Stop Trips

Includes Trade & Travel

Throughout Year (June most frequent)
Modern Boating
What are the Areas of Consensus?
- Modern Boating Occurs
- When Modern Boating Occurs
- Types of Modern Boats Used

What are the Areas of Disagreement?
- Are Modern Boats Meaningfully Similar to Historical Boats?
- Do Modern Boats Allow Boating in Reaches that Could Not be Boated by Historical Boats?
Modern Boating - Rebuttal

- Does Modern Boating Occur?
  - No Disagreement That it Occurs
  - Segment 1: Prevented by Indian Law. Has occurred.
  - Segment 2: Year-round, but most in spring runoff
    - Spring boating limited by USFS permit caps
    - WMAT currently limits boat type (no open canoes)
  - Segment 3: Year-round, but most in spring runoff
    - Spring boating limited by USFS permit caps
  - Segment 4: On reservoirs (not natural condition)
  - Segment 5: Most during reservoir release
  - Segment 6: On effluent & during floods
What Types of Modern Boats Are Commonly Used?

- No Disagreement on Common Boat Types
  - “Rubber” Rafts (Seg 2-3,5,6)
  - Hard Shell & Inflatable Kayaks (Seg 1-3, 5,6)
  - Hard Shell & Inflatable Canoes (Seg 2-3, 5,6)
  - Segment 5 only: Jet & Air Boats, Row Boats, Tubes, Canoes, Kayaks, Dories, Rafts, Small Motor Boats
  - Segment 4: Under Reservoirs - many boat types on lakes.
Are Modern Boats Meaningfully Similar to Historical Boats?

- Little consensus on this point
  - Apples to apples comparisons
  - Clean up some errors
  - Qualified experts

- Review of “Meaningfully Similar”
  - Does not mean exactly the same or without difference
  - Does mean: Can you boat now where you could not then?
  - “Similar” does not mean “Same”
Meaningfully Similar – Comparison of Historical and Modern Boats of Similar Type

- **Purpose:** carry people & load   | No change
- **Design:** performance improvements   | No change
- **Weight:** depends on material   | No change
- **Durability:** depends on materials   | Some change
- **Draw:** function of load   | No change
- **Load:** gravitational pull the same   | No change
Design: performance improvements, but similar design.
Modern Boating Rebuttal: Comparison Error by Gookin (Slide 111)

- Gookin Slide 111

- Compares wood & canvas rigid canoe to folding canvas rowboat with metal frame. These are two different boat types, with different uses and purposes.
## Modern Boating Rebuttal: Historical Canoes NOT Heavier

<table>
<thead>
<tr>
<th>Boat</th>
<th>Historical</th>
<th>Modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birch Bark</td>
<td>50lbs (<a href="http://www.barkcanoe.com">www.barkcanoe.com</a>)</td>
<td>50lbs (<a href="http://www.barkcanoe.com">www.barkcanoe.com</a>)</td>
</tr>
<tr>
<td>14 ft</td>
<td>50lbs (<a href="http://www.barkcanoe.com">www.barkcanoe.com</a>)</td>
<td>50lbs (<a href="http://www.barkcanoe.com">www.barkcanoe.com</a>)</td>
</tr>
<tr>
<td>15 ft</td>
<td>50lbs (<a href="http://www.barkcanoe.com">www.barkcanoe.com</a>)</td>
<td></td>
</tr>
<tr>
<td>Wooden Canoe</td>
<td>55lbs (wooden-canoes.com)</td>
<td></td>
</tr>
<tr>
<td>14 ft (EM White)</td>
<td>55lbs (wooden-canoes.com)</td>
<td></td>
</tr>
<tr>
<td>15 ft (BN Morris)</td>
<td>60lbs (wooden-canoes.com)</td>
<td></td>
</tr>
<tr>
<td>16 ft (Old Town Guide)</td>
<td>76lbs (<a href="http://www.oldtowncanoe.com">www.oldtowncanoe.com</a>)</td>
<td></td>
</tr>
<tr>
<td>Wood &amp; Canvas (Rigid)</td>
<td>75lbs (wooden-canoes.com)</td>
<td></td>
</tr>
<tr>
<td>17 ft (BN Morris)</td>
<td>76lbs (<a href="http://www.oldtowncanoe.com">www.oldtowncanoe.com</a>)</td>
<td></td>
</tr>
<tr>
<td>16 ft (Old Town Guide)</td>
<td>76lbs (<a href="http://www.oldtowncanoe.com">www.oldtowncanoe.com</a>)</td>
<td></td>
</tr>
<tr>
<td>Canvas (Folding)</td>
<td>55lbs (ASLD 32)</td>
<td>45lbs (pakboats.com)</td>
</tr>
<tr>
<td>12 ft (Canvas Boat Co., 1908)</td>
<td>55lbs (ASLD 32)</td>
<td></td>
</tr>
<tr>
<td>15 ft (Pakboats 150)</td>
<td>45lbs (pakboats.com)</td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td>69lbs (<a href="http://www.canoekayak.com">www.canoekayak.com</a>)</td>
<td></td>
</tr>
<tr>
<td>16 ft (Wenonah Rogue)</td>
<td>69lbs (<a href="http://www.canoekayak.com">www.canoekayak.com</a>)</td>
<td></td>
</tr>
<tr>
<td>Kevlar Ultra-light</td>
<td>39lbs (<a href="http://www.wenonah.com">www.wenonah.com</a>)</td>
<td></td>
</tr>
<tr>
<td>16 ft (Wenonah Aurora)</td>
<td>39lbs (<a href="http://www.wenonah.com">www.wenonah.com</a>)</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>69lbs (<a href="http://www.marathonboat.com">www.marathonboat.com</a>)</td>
<td>72lbs (<a href="http://www.directboats.com">www.directboats.com</a>)</td>
</tr>
<tr>
<td>15 ft (Grumman/Marathon)</td>
<td>69lbs (<a href="http://www.marathonboat.com">www.marathonboat.com</a>)</td>
<td></td>
</tr>
<tr>
<td>17 ft (Pro Strike)</td>
<td>72lbs (<a href="http://www.directboats.com">www.directboats.com</a>)</td>
<td></td>
</tr>
</tbody>
</table>

Note: SRP Expert Newell suggests boat weight might make 0.5-1 inch difference in draft.
Correction: **Some** modern canoes are more durable than **some** historical canoes

- Plastics generally more durable than wood & canvas.
- Modern wood and canvas have about the same on-the-water durability to historical wood and canvas.
- Most Kevlar boats are lightweight but not durable.
- Fiberglass boats are not known for durability. Rarely used today except on flat water.
- Aluminum boats are vulnerable to denting. Rarely used today except on flat water.
- Durability is a non-issue in Segments 5 & 6
- Historical boats were sufficiently durable for the Salt River
Going downstream is called snubbing, in birch bark canoe.

Keewaydin Photo Archives
Durability of Historical Boats on Shallow Rocky Rivers

In cedar canvas canoe, going upstream
From Paddlemaking blogspot
Segment 5: 2015 Edith Voyage
Wood & canvas replica boats

Edith on Grand Canyon above
Salt River Segment 5 at left

Historical wood and canvas
boats can be used on a wide
variety of rivers, shallow &
rocky – or large & fast.
Many modern boat materials more durable
Does not mean all historical boats had NO durability or were fragile
Dimock: Old growth wood more durable.
Historical boats used on shallow, rocky rivers
Historical boats used on Salt River, Verde River, Gila River; other rivers throughout the western USA
Boat designs were adapted for specific river characteristics
Modern Boating Rebuttal: Boat Crashes ≠ Non-Navigable

- EG: Gookin, Slide 108-9
  - Citing USFS Report
  - Note: USFS advocates against navigability
If so, the Mississippi River is NOT navigable.

No. The occurrence of boat accidents is not part of the federal navigability test.
Modern Boating Rebuttal: Gookin – Slide 99

- Stantech ≠ Fuller
- Report for ANSAC, not ASLD
- Not Directly Applicable to Salt River
- Repeated this Error More than 30 times
- Not directly applicable to Salt River – already considered boatable

- Fuller in 1998 Confirmed

Commercial recreational rafting started in the 1930s, but developed in the 1970s, on the Colorado River (especially upstream in Utah) and later on the Salt, Gila, and Verde Rivers. The development of durable small boats - plastic, fiberglass and other modern types of canoes and kayaks, inflatable boats for single paddlers and for groups - all contributed to the rising popularity of river running in Arizona especially on rivers not previously considered boatable, or boatable only very rarely because of low water.

Source: Stantech, pg 32.
Load & Draw

- Most of boat’s weight is in load, not boat materials
- Load capacity is function of boat design
- Basic design not changed significantly

Draw is a function of

- Load carried
- Displacement
- Design of boat (length, width, section, depth)
- Placement of load within boat
**Draw vs. Operating Depth**

- HYRA standard considers operating condition
- Boatman’s viewpoint
- Factors:
  - Boat length – plunging significant for long boats
  - Boat design – rocker, rigidity, flare, decking
  - Boat maneuverability
  - Boat load – how and how much
  - Slope of rapid
  - Flow velocity
- Operating Draw ≠ Boat Design Factors
- Geomorphology of Pool & Riffle Streams
- Plunging Not a Factor on Salt River for Small Boats
Do Modern Boats Allow Boating in Segments that Could Not be Boated by Historical Boats?

- No.
  - What segments of the Salt did people boat then? 1-6
  - What kinds of boats did they use? Small, low draft
  - What times of year did they boat? All year

Summary:
- Historical boats were used then & now
- Modern boat materials make it easier to boat rocky rivers.
- Less boating & repair skills needed today.
- But the same reaches are boated today as then in similar boats
Modern Boating - Rebuttal

What Can We Learn From Modern Boating?

- What the river looks like
- River depths & widths
- Low & high water boating conditions
- The nature of “obstacles” like:
  - Rapids and riffles
  - Sand bars
  - “Braiding”
  - Beaver Dams
Modern Boating vs. Historical Boats
What are the Right Flow Rates for the Salt River?

- Average?
- Median?
- Seasonal?
- Monthly?
- Daily?
- USGS Published Values?
- USGS Raw Data?
- Reconstructed Values?
Salt River Hydrology

“Lies, Damned Lies & Statistics”

Figures often beguile me, particularly when I have the arranging of them myself; in which case the remark attributed to Disraeli would often apply with justice and force: "There are three kinds of lies: lies, damned lies and statistics."

- Mark Twain's Own Autobiography: The Chapters from the North American Review

Illustration by Peter Newell from COSMOPOLITAN, August 1898
The upper watershed does not produce all the runoff.
The Salt River is not erratic and unpredictable.
There is no evidence that the Salt River ordinarily dried up.
“Base Flow” does not mean only the water that rises out of the subsurface at one point.
Seasonal high flow ≠ flood.
Mr. Burtell’s flow reconstructions may not be conservative upper limit estimates.
No evidence that Salt River loses 200 cfs between Tempe Butte and Gila River confluence.
Gookin: Slide 22 – 200 cfs lost to ancient channel

There is no evidence for Mr. Gookin’s theory.
Salt River Hydrology: Miscellaneous Rebuttal Items
Salt River Hydrology: Miscellaneous Rebuttal Items

- Annual Flow Rate
- Salt Near Roosevelt, 1913-1939
- Salt @ Chrysotile, 1924-1940
- Long-Term Daily Flow
- Salt @ Roosevelt, 1889-1908

Data Source: Meko and Hirsc
The Salt River is Perennial
There are Ordinary Seasonal Fluctuations
Flow Rates Increase with Drainage Area
- Some loss in Segment 6
The Salt River has a Larger Flow Volume than the Gila River at their Confluence
USGS Flow Data are the Best Available
Human Impacts Have Depleted Flow
- Natural condition had higher flow rates
Salt River Hydrology: Recommended Flow Rates

Segments 1-5

- Use USGS Stream Gauge Data – full period of record
  - Segment 2: Salt River near Chrysotile (#9497500;1925-2015)
  - Segment 3: Salt River near Roosevelt (#9498500;1914-2015)
  - Segment 4: Sum of Salt River near Roosevelt and Tonto Creek above Gun Creek (#9499000;1942-2015)
  - Segment 5: Add Salt River near Roosevelt and Tonto Creek above Gun Creek (same as Segment 4)

- Addition of ~20 years of record, primarily below average flows lower discharge estimates.
Salt River Hydrology:
Recommended Flow Rates

- Segments 1-5
  - Use Rich Burtell’s Flow Depletion Estimates
    - Segment 1: 0 cfs
    - Segment 2: 31 cfs (Chrysotile)
    - Segment 3-5: 68 cfs (Roosevelt)
    - Adjustment not applied to mean & median annual estimates
  - 2-Year Discharge Estimate Published by USGS
    - Segment 1 estimate from Black River gage (not White River)
    - Segment 6 estimate from ASLD report
Segments 1-5

Range of Ordinary Flow
- Low End: 10% flow duration based on daily data
- High End: 2-Year Discharge Estimate Published by USGS
  - Segment 1 estimate from Black River gage (not White River)
  - Bankfull Discharge
  - Ordinary High Water Mark

Includes normal seasonal fluctuations
- Use of full record of USGS daily discharge estimates to determine median flow by calendar day.
Salt River Hydrology:
Recommended Flow Rates

- Segment 6
  - Use USGS Stream Gauge Data – full period of record
    - Add Salt River near Roosevelt, Tonto Ck above Gun Creek, and Verde below Tangle Ck (#9508500; 1946-2015)
    - Flow Duration & Median Daily Estimates
  - Use Burtell’s Depletion Estimates for Salt & Verde
    - Segment 6: 251 cfs (Salt-Roosevelt (68 cfs)+ Verde (183 cfs))
  - Use USGS (Thomsen & Porcello) for mean and median annual flow rates
    - No addition for depletion for annual data
  - 2-Year Discharge from ASLD Report
<table>
<thead>
<tr>
<th>Seg</th>
<th>Flow Descriptor (cfs)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean Annual</td>
<td>Median Annual</td>
</tr>
<tr>
<td>1</td>
<td>556</td>
<td>410</td>
</tr>
<tr>
<td>2</td>
<td>632</td>
<td>482</td>
</tr>
<tr>
<td>3</td>
<td>859</td>
<td>641</td>
</tr>
<tr>
<td>4</td>
<td>1,005</td>
<td>727</td>
</tr>
<tr>
<td>5</td>
<td>1,005</td>
<td>&gt; 727</td>
</tr>
<tr>
<td>6</td>
<td>1,690</td>
<td>1,230</td>
</tr>
</tbody>
</table>

Notes:  
(1) Flow data obtained from USGS website through 2015  
(2) Depletion estimate not added to mean & median annual estimates.  
(3) Segment 5 estimates noted by “>” symbol are low due to ungaged drainage areas.  
(4) Segment 6 mean & median annual estimates from Thomson & Porcello USGS Report.  
Segment 1 - White River + Black River

- 90% Flow Duration: 1452 cfs
- Mean Annual Flow: 556 cfs
- Median Annual Flow: 410 cfs
- Median Daily Flow: 167 cfs
- 10% Flow Duration: 67 cfs
- 2-Year Flood: >7500 cfs
Segment 5: Salt River - Roosevelt + Tonto

2-Year Flood: >14,400 cfs

90% Flow Duration: 2229 cfs

Mean Annual Flow: 1005 cfs

Median Annual Flow: 727 cfs

Median Daily Flow: 405 cfs

10% Flow Duration: 224 cfs
Segment 6: Salt River - Roosevelt + Tonto + Verde

2-Year Flood: ~20,000 cfs

90% Flow Duration: 3251 cfs

Mean Annual Flow: 1690 cfs

Median Annual Flow: 1230 cfs

Median Daily Flow: 819 cfs

10% Flow Duration: 522 cfs

1-Jan 1-Feb 1-Mar 1-Apr 1-May 1-Jun 1-Jul 1-Aug 1-Sep 1-Oct 1-Nov 1-Dec
Salt River Rating Curves

- Perspectives on Rating Curves & Navigability
  - ASLD Rating Curves
    - Error Checking
  - How Different is Different?
  - How Important are the Rating Curves?
  - Impact of Flow Rate Differences?
  - What Flow Rates Should be Used?
Rating Curves: Differences

Segment 2: Comparison of Depth Estimates
Rating Curves: Differences

Segment 3: Comparison of Depth Estimates

- Fuller-Low
- Fuller-High
- Burtell-Low
- Burtell-High
Rating Curves: Differences

Segment 6: Comparison of Depth Estimates

Graph showing depth estimates for different segments.

- Fuller-Low
- Fuller-High
- Gookin
- Mussetter-Low
- Mussetter-High
Salt River Rating Curves

Perspectives of Rating Curves

What Does River Depth Mean?

- “I mean, putting a depth on any river is sort of an amorphous sort of definition. I mean, rivers are defined by obstacles, rocks, and deep channels, shallow channels, deep channels. You know, they're dynamic animals. So to put a depth on a river, it's just really not a logical way to look at it.” (376:3-8, Salt River Testimony)

Tyler Williams, Boating Expert, Professional Boater & Author

Areas of Agreement:

- Segment 1, 4, 5
- Velocity & Width
- Depths vs. Basic Boat Types

Rating Curves & Beyond...
Beyond Rating Curves

- The Biggest Difference Between Experts
  - On-the-River Experience
  - Ranges of Disciplines Considered
  - Reliance on Computer Models

- Significance of Differing Flow Depth Estimates on:
  - Boat Type
  - Seasonality
Beyond Rating Curves: Verification & Integration

- Historical Descriptions
- Ferry Boats
- Field Work & Observations
- Boat Trips
- USGS Rating Curves
- Historical Photographs
- Historical Maps
- Historical Boating Accounts
- Beaver & Fish
- Hohokam & Early Anglo Irrigation
January 15, 1901 – ASU Special Collections; Littlefield: Fig 59

USGS Gage Data:
- Salt McDowell: 254 cfs
- Verde McDowell: 250 cfs
- Maximum @ Tempe: 504 cfs

Deep enough to float (and need) the ferry.

Gookin:* 1.2 ft
Mussetter: 1.2-2.6 ft
Fuller: 1.4-2.1 ft

All are low
Specific Rebuttal Issues

- ASLD’s N Values
- Average Depth vs. Maximum Depth
- Topographic Map Accuracy
- Rating Curve Cross Section Location Selection
- How Accurate Can a Rating Curve Be?
- ASLD Source Data
Recommended Rating Curves

- Use the Recommended Discharges
  - 10% to 2-Year Peak
- Maximum, not Average Depth
- Segment 6: Use Mussetter’s 10 Sections
- Segment 5: Use Segment 6, Section #6
- Segment 4: Use Burtell’s (High) Curve @ Roosevelt
- Segment 3: Use Burtell’s (High) Curve @ Roosevelt
- Segment 2: Use Burtell’s Mean Depth Curve nr Chrysotile, Adjust for Maximum Depth
## Beyond Rating Curves

<table>
<thead>
<tr>
<th>Seg</th>
<th>Flow Rate Type</th>
<th>Representative of Riffle Sections along the Main Channel Thalweg (not Pools)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Annual</td>
<td>Median Annual (Entire Year)</td>
</tr>
<tr>
<td>2</td>
<td>2.2 ft</td>
<td>2.0 ft</td>
</tr>
<tr>
<td>3</td>
<td>2.7 ft</td>
<td>2.5 ft</td>
</tr>
<tr>
<td>4</td>
<td>2.8 ft</td>
<td>2.7 ft</td>
</tr>
<tr>
<td>5</td>
<td>2.6 ft</td>
<td>2.2 ft</td>
</tr>
<tr>
<td>6</td>
<td>2.2-4.9 ft</td>
<td>1.9-4.2 ft</td>
</tr>
</tbody>
</table>

See notes in written summary
Susceptibility to Navigation

- Flow Depth
  - Rating Curves & Beyond
- Flow Duration
  - Percent of Time Boatable Conditions Exist
- Flow Seasonality
  - Regular Season of High Flow
- Boat Types
  - Low Draft Boats, Wood & Canvas
- Obstacles to Navigation
Year-Round
- Canoes (Seg 2-6)
- Low-Draft, Maneuverable Flat Boats (Seg 2-6)

Seasonal High Flow
- Canoes & Maneuverable Flat Boats (Seg 2-6)
- Loaded Small Boats, Low Draft (Seg 2-6)
- Loaded Flat Boats, Mod Draft (Seg 6)
Expert Opinions on Susceptibility

- Boated the Salt River
- Field Trips to the River
- Flew Over the River
- Expertise in Modern Boating
- Expertise in Historical Boats

- Use this experience to interpret river conditions with respect to rating curve depths and boat types
None of These Prevent Navigation on the Salt River:

- Rapids & Riffles
- Beaver Dams
- Braiding
- Marshes
- Flash Floods
- Erratic Flow

According to:
- The Qualified Experts Who Testified on the Salt
- The Historical Accounts of Boating
Rapids & Riffles

- Many Navigability Decisions on Rivers with Rapids
- Rapids Not an Issue for Segment 6 and 5
- Downstream vs. Upstream Travel
- Meaning of Rapids Ratings I-V: Boatable
  - Difference is Difficulty
  - Class VI is Unboatable
  - Many Boating Guides Available for Salt
- Rapids & Riffles Impact Boat Type
  - Small, low draft boats designed for rapids
  - Heavily loaded, deep draft boats not used in rapids
What Did the Qualified Boating Experts Say About Rapids on the Salt River?

- Not an issue in Segments 3-6
- Easily portaged or lined if needed in Segment 2
- Boatable at a wide range of ordinary discharges (below 10% rate to above 90% rate)
Braiding

- Salt River Boating Channel is Not Braided
- No Expert Who Has Boated the Salt Reported Any Problems Relating to Braiding
  - Every “braid” identified by Mr. Burtell & Dr. Mussetter has been boated. Routinely. Without difficulty.
- No Historical Account Mentions Any Problem Due to Braiding
- Split Channels Are Not Necessarily Shallower
There is no map or photograph in evidence that shows a marsh located on ANY segment of the Salt River over the area of the low flow or boating channel.

No modern boating expert or historical account of the Salt River reports ANY problem with boating because of marshy conditions.
Flash Floods & Erratic Flow

- **Segments 1-5**
  - Portions of Segment 1-4 may be at risk of flash floods.
  - Such events are extremely rare, i.e., NOT ordinary
  - Even more rare are flash floods that are so flashy that boaters would be unable to avoid the hazard.

- **Segment 6 was NOT subject to flash floods**

- **Salt River Flow Was Not Erratic From the Perspective of Boating**
  - Range of Ordinary Flow Conditions Are Boatable
Beaver Dams on the Salt River

- Expert Opinion
- Boater’s Opinion
- Historical Accounts
- Physically Possible?
- Enough Trees?
- What About Floods?
- Did Beavers Need Dams?
Beaver Dams on the Salt River

Expert Opinions:
- Beaver Were Found on Salt River Prior to Statehood
- Beavers Do Live in Segments 1-3, 5-6 Today
  - Beaver Sign Seen, No Dams Seen in Segments 1-3, 5
- Beaver Dams Not Found on Segments 1-3 Today
- Beavers Do Not Require Dams to Live
  - Not on Pool & Riffle Streams With Adequate Pool Depths
  - May Not Build Dams on Rivers with Large Floods & Channels
- Beaver Dams are Not an Obstruction for Small, Low Draft Boats
- No Historical Account Mentions Problems With (or Existence of) Beaver Dams on Salt River Channel
  - Several accounts of beaver trapping in Segment 6
Mr. Gookin Says:

- Numerous Beaver Dams Existed on Segment 6
  - One every few hundred yards
  - Hundreds of beaver dams on Segment 6
- Beaver Dams Are Similar to Diversion Dams
- Beavers Dams Created the Marshes Along the Salt
- Beaver Dams Still Exist on the Salt River
- Beaver Dams Needed to Create 3 ft. Depth
Beaver Dams on Segment 6?

- 1800 ft long dams?

~170 trees needed per dam

~41,000 trees needed for 1 dam every 300 yds

~ Would deforest the entire river bank in less than 1 year

Conclusion: Impossible
## Summary of Non-Navigability Expert Opinions on Segment 5

<table>
<thead>
<tr>
<th>Claim</th>
<th>By</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel bed was sandier in past</td>
<td>Mus</td>
<td>Possible Near Dam, No Evidence</td>
</tr>
<tr>
<td>Channel was less stable in the past</td>
<td>Mus</td>
<td>Possible, Irrelevant to Navigability</td>
</tr>
<tr>
<td>Channel has degraded (scour)</td>
<td>Mus, Gkn</td>
<td>Possible Near Dam, No Evidence</td>
</tr>
<tr>
<td>Channel is deeper &amp; narrower</td>
<td>Mus, Gkn</td>
<td>No Evidence, Field Evidence Contradicts</td>
</tr>
<tr>
<td>Channel is more single thread now</td>
<td>Mus, Gkn</td>
<td>Minor, Irrelevant Change</td>
</tr>
<tr>
<td>Channel has moved</td>
<td>Gkn</td>
<td>Minor, Irrelevant to Navigability</td>
</tr>
<tr>
<td>Channel slope has changed</td>
<td>Gkn</td>
<td>No Evidence</td>
</tr>
<tr>
<td>Bank vegetation is denser</td>
<td>Gkn</td>
<td>No Evidence</td>
</tr>
<tr>
<td>Hydrology has changed</td>
<td>Mus, Gkn</td>
<td>True</td>
</tr>
</tbody>
</table>
Hydrology: Flow Regulation

- Change in Seasonality of Runoff
  - High flow season shifts from winter to summer
  - Median daily rates are similar
  - Annual daily median rate increases
  - High flow season duration is longer
  - Low flow season goes to near-zero (~10 cfs)
    - SRP shuts off river for several months per years.

- Impact on Floods
  - Flood peak & volume generally reduced
  - Floods not eliminated
Segment 5: Salt River

Reconstructed pre-dam hydrograph (median daily discharge)

Post-Dam hydrograph (median daily discharge)
USGS 09502000 SALT RIVER BLW STEWART MOUNTAIN DAM, AZ.

Annual Peak Streamflow, in cubic feet per second

0 10000 20000 30000 40000 50000 60000

Channel Pattern
- Nearly Identical 1903-2015
  - 1903: 17% split channel
  - 2015: 12% split channel

Channel Position Nearly Identical
- A few local changes

Channel Width (1904-2007)
- USGS Quad Maps & USRS Maps
- Channel symbology did not change: blue corridor of variable width (~150-300 ft). Conclusion: no significant change in width.
Is Segment 5 in its Ordinary & Natural Condition Today: Bank Vegetation

From Mussetter, Slides 98-99
- Floodplain & Upland Vegetative Cover Increases (Grazing Affect)
- Channel Bank Vegetation About the Same
Is Segment 5 in its Ordinary & Natural Condition Today: Bank Vegetation

Sept. 9, 1938
2390 cfs

March 7, 1979
13 cfs
Taken after 1978 & 79 Floods

Source: Webb pg. 324

Gookin Slide 215
Is Segment 5 in its Ordinary & Natural Condition Today: Bank Vegetation

Historical Photographs

Date: pre-1908
Location: Salt/Verde Confluence
Source: Beasley, 1908
Classic Indicators of Post-Dam Degradation (deepening) Not Found in Segment:

- Perched channels
- Hanging tributaries
- Extensive cut banks
- Hanging, exposed roots
- Headcuts – main stem Salt or tributaries
Mussetter Slide 66: Shows INCREASE in bed elevation 1903-2001
Is Segment 5 in its Ordinary & Natural Condition Today? Channel Depth

- Sheep Bridge – piers still in place

**Historical Photographs**

Date: ca. 1920  
Location: Sheep Bridge on Salt River  
ASU Special Collections CP MCL 34967.A3
Flow Depths: Is the Channel Deeper Today?

Ground Truthing Estimates:

- Historical Boating Accounts - No Problems in Segment 5
- Historical Descriptions – Chest deep in winter at fords
- Sheep Bridge Crossing
- Boating @ 8 cfs
- Field Observations of River Morphology
How did Verde Respond to Dams?

- Channel is more “braided”
- No obvious degradation
- “Few reservoir related morphological changes to the river below the dam” Mussetter, 2004, p. 6.2, 6.3

How did Gila respond?

- No obvious signs of degradation
Why Would Segment 5 Not Have the Classic Post-Dam Response?

- Coarse bed material
- Pool & riffle channel pattern
- Bedrock – shallow, and locally in banks
- Caliche & clay banks
- Well-vegetated banks
- Sediment from tributaries
- Infrequency of bankfull discharges
Is Segment 5 in its Ordinary & Natural Condition Today: Conclusion

- The Salt River in Segment 5 is substantively in the same condition today as in its ordinary & natural condition.
- Boat trips on the river today are in meaningfully similar conditions to the pre-development, ordinary and natural conditions of the Salt River.
## Segments 1-4 vs. Segments 5-6

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Segments 1-4</th>
<th>Segment 5</th>
<th>Segment 6</th>
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</thead>
<tbody>
<tr>
<td>Rapids (Class II-VI)</td>
<td>II-IV</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Riffles (Class I)</td>
<td>Yes</td>
<td>Yes</td>
<td>Possible</td>
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<tr>
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<td>Yes</td>
<td>No</td>
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<tr>
<td>Slope</td>
<td>Steeper</td>
<td>Flatter</td>
<td>Flattest</td>
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<tr>
<td>Channel Bed Materials</td>
<td>Cobbles, Gravel, Bedrock</td>
<td>Cobbles, Gravel, Minor Bedrock</td>
<td>Sand &amp; Gravel</td>
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<tr>
<td>Flow Rates</td>
<td>Lowest</td>
<td></td>
<td>Highest</td>
</tr>
<tr>
<td>Human Impacts</td>
<td>Lowest</td>
<td></td>
<td>Highest</td>
</tr>
</tbody>
</table>
Surveyors Meanders & Patents

- GLO Survey Designations Not Definitive for Navigability Decisions.
  - Basis of GLO Surveyor Designation is Unknown.
  - Past Court Decisions

- US Patent Offices Did Not Make New Particularized Assessments of Navigability
Salt River Corridor was NOT densely populated in 1868.

Dams began to block the Salt River immediately after the first settlers arrived in 1868.

Diversion dams were an obstacle to some types of commercial boating.

The railroad arrived early (1879 @ Maricopa) relative to population growth. Alternative transportation methods available.

No alternative water supply for irrigation.
Apache threat existed along Salt River until 1880’s
The Globe mining district was NOT located on the Salt River. Ore was sent east for processing, not in direction of Salt River.
Hohokam civilization had the largest irrigation system in the Americas, which required reliable, significant flow in the Salt River. Diversions required flows depths and channel stability.
## History: Key Findings

### Canals

<table>
<thead>
<tr>
<th>Canal</th>
<th>Year</th>
<th>Mileage from JD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swilling’s (Salt R Canal)</td>
<td>1867</td>
<td>Jointhead Dam</td>
</tr>
<tr>
<td>Maricopa Canal</td>
<td>~1870</td>
<td>Jointhead Dam</td>
</tr>
<tr>
<td>Tempe Canal</td>
<td>1870</td>
<td>9 mi. upstream JD</td>
</tr>
<tr>
<td>Broadway Canal</td>
<td>1870</td>
<td>4 mi. upstream JD</td>
</tr>
<tr>
<td>Utah Canal</td>
<td>1877</td>
<td>14 mi. upstream JD</td>
</tr>
<tr>
<td>Mesa Canal</td>
<td>1878</td>
<td>16 mi. upstream JD</td>
</tr>
<tr>
<td>Grand Canal</td>
<td>1878*</td>
<td>3 mi. upstream JD</td>
</tr>
<tr>
<td>San Francisco Canal</td>
<td>1880</td>
<td>Tempe Canal</td>
</tr>
<tr>
<td>Arizona Canal</td>
<td>1883</td>
<td>Arizona Dam</td>
</tr>
<tr>
<td>Highland Canal</td>
<td>1888</td>
<td>8 mi. upstream JD</td>
</tr>
<tr>
<td>Consolidated Canal</td>
<td>1891</td>
<td>Arizona Dam</td>
</tr>
</tbody>
</table>

ASLD, Table 7-8 (Lower Salt)
Salt River* is a Navigable Watercourse

- Existed in February 1912
- Was used as highway of commerce
- Was susceptible to use as highway of commerce
  - For trade and travel on water
  - By customary modes of travel on water

"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)