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Impacts of using a spillway for juvenile fish passage on typical design criteria.

By

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The Dalles Lock and Dam

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The Dalles Lock and Dam

Completed 1957

Run of River w/Navigation Lock

Powerhouse has 22 units

1800 MW capacity

PH Discharge Capacity 375,000 cfs

Spillway Pertinent Data

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- 23-50’ wide Spillway bays
- SDF – 2.29 million CFS
- Crest: 121 ft msl
- Operating Range: 155-160 ft msl
- Stilling Basin Invert: El 55
- Exit Channel (shelf): El 68
- Normal TW range: 77-82 ft msl

Fish Passage History of Spillway

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- Spill for fish passage began in 1996.
- Listed species: Salmonids, Steelhead.
- Since 1999 40% of total river flow spilled for juvenile fish passage.
- Poor juvenile survival through spillway.

Pertinent Spillway Features

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- Excavated out of Basalt.
- Minimized excavation resulting in short stilling basin and shallow exit channel.
- Concrete apron added downstream of end sill to act as a warning.
- Deep, narrow canyon & shallow island area downstream of spillway.

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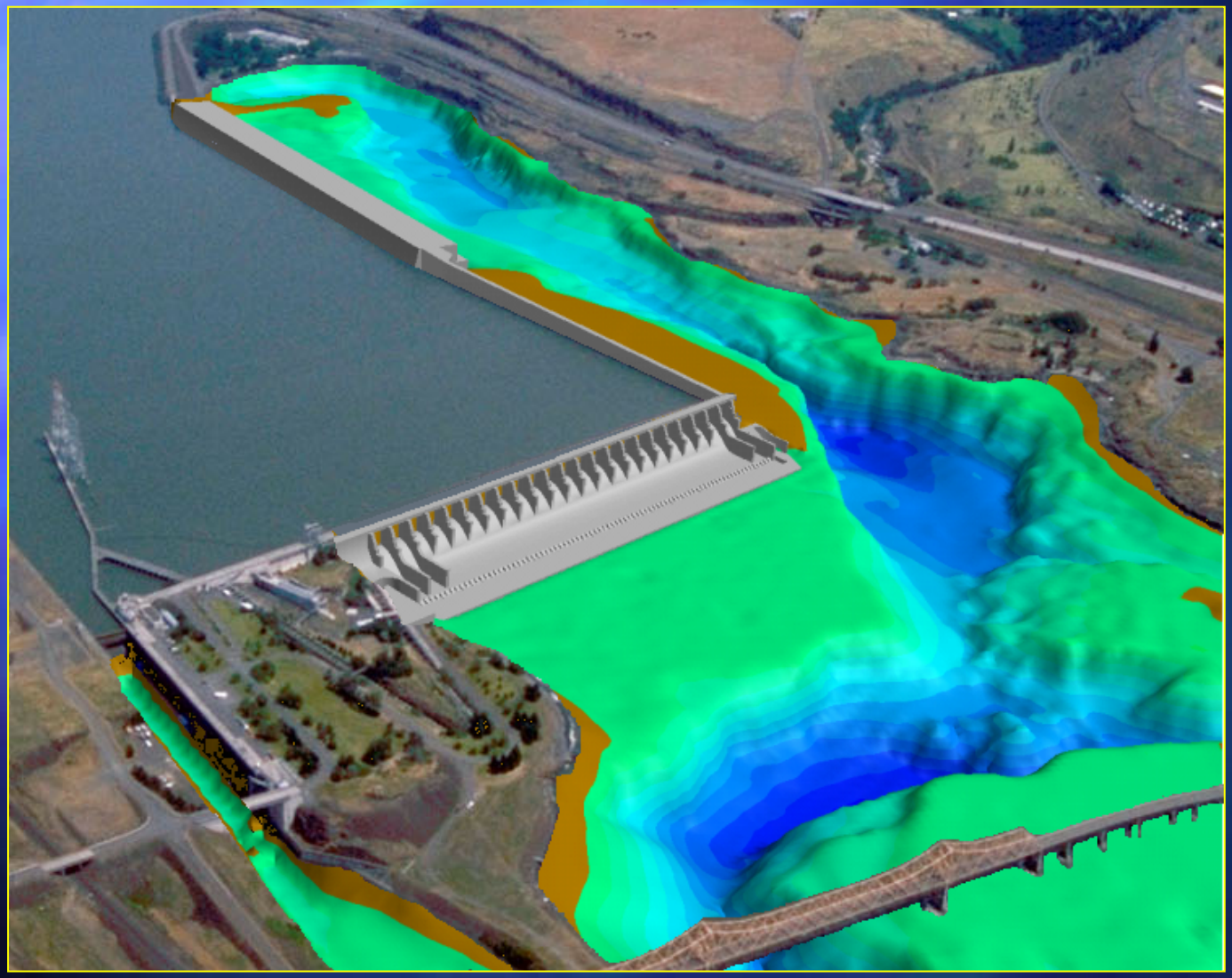

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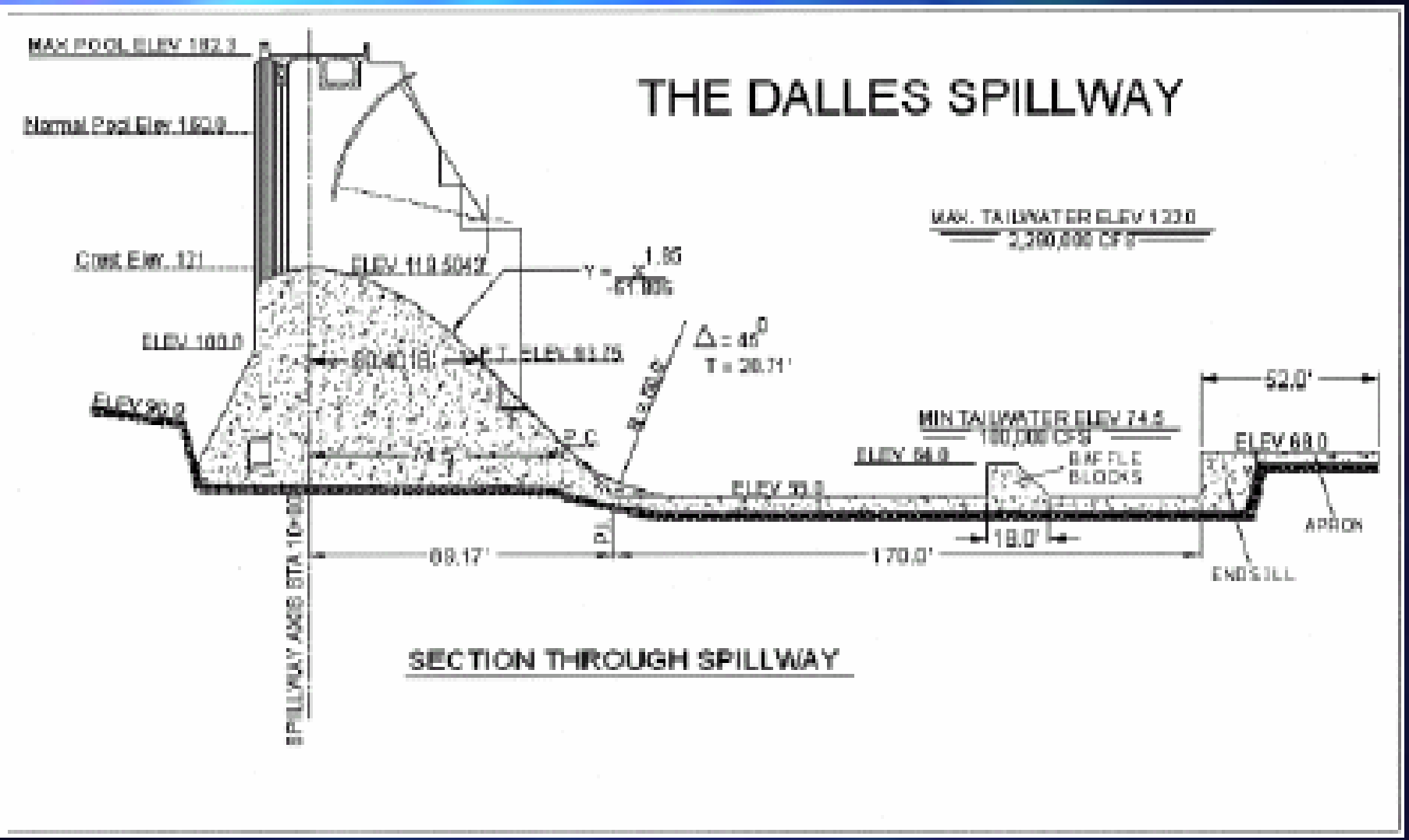

Design Solution - Spillwall

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- Aids in Egress of Juveniles
- Eliminates flow entrainment
- Increases direct survival of juveniles
- Concentrates spill in northern 6 bays.

Consequences of Spillwall

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- Higher Unit Q without an increase in tailwater.
- Impact stilling basin efficiency.
- Higher velocities exiting stilling basin.

Mitigation of Consequences

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- Extensive physical and numerical model studies and literature search.
- Evaluated exit velocity from stilling basin and established threshold criteria.
- Established monitoring program.

Dalles Spillway w/Spillwall

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Operational Limitations & Monitoring Plan

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- Depth of flow on apron at or above critical depth.
- Developed q and TW relationship.
- Monitor exposure time where above relationship exceeded (Excel file used by PH Operators)
- Perform hydro-surveys and dive surveys as appropriate.

TW-Velocity-q/bay Relationship

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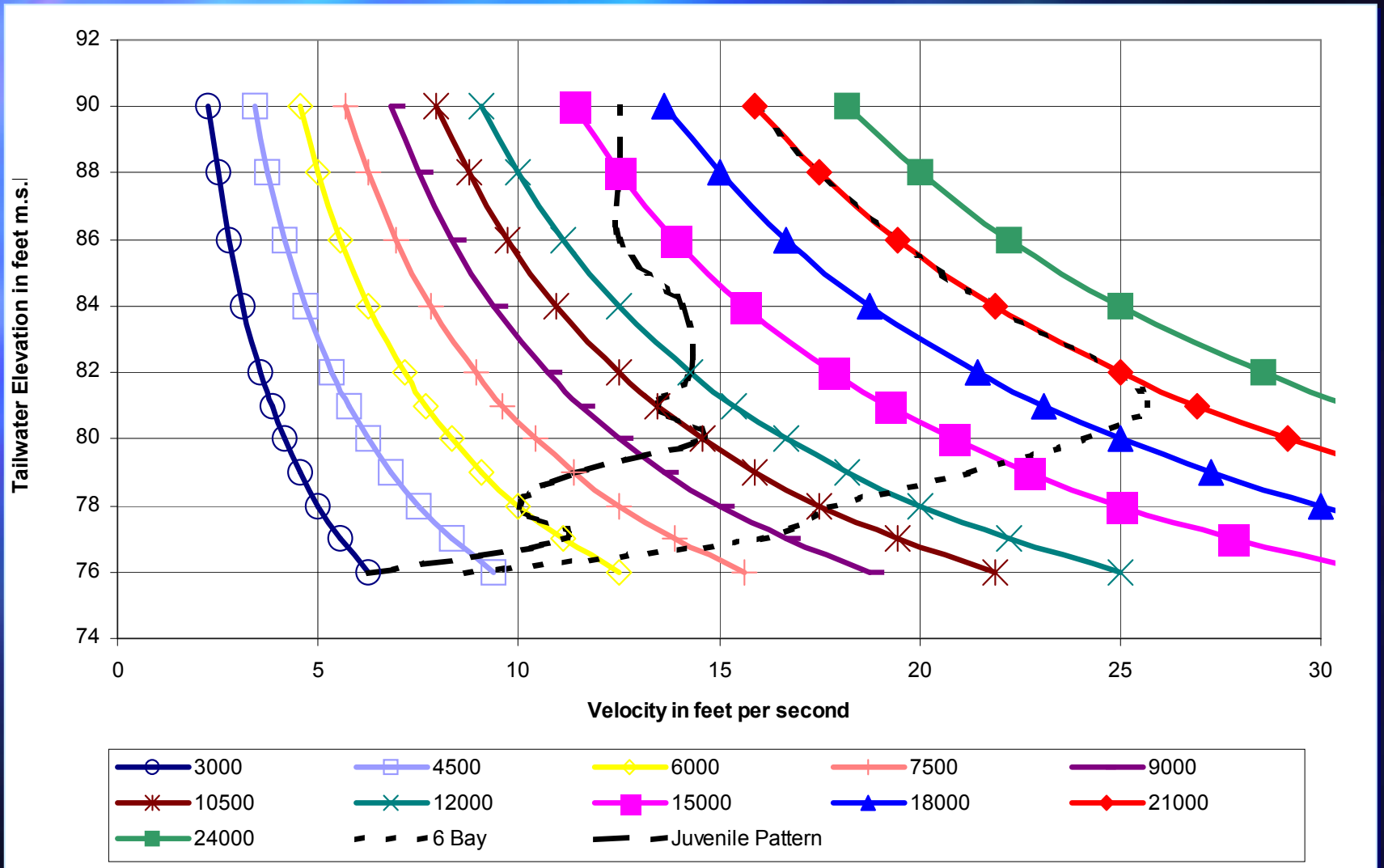

TW vs q/bay Relationship

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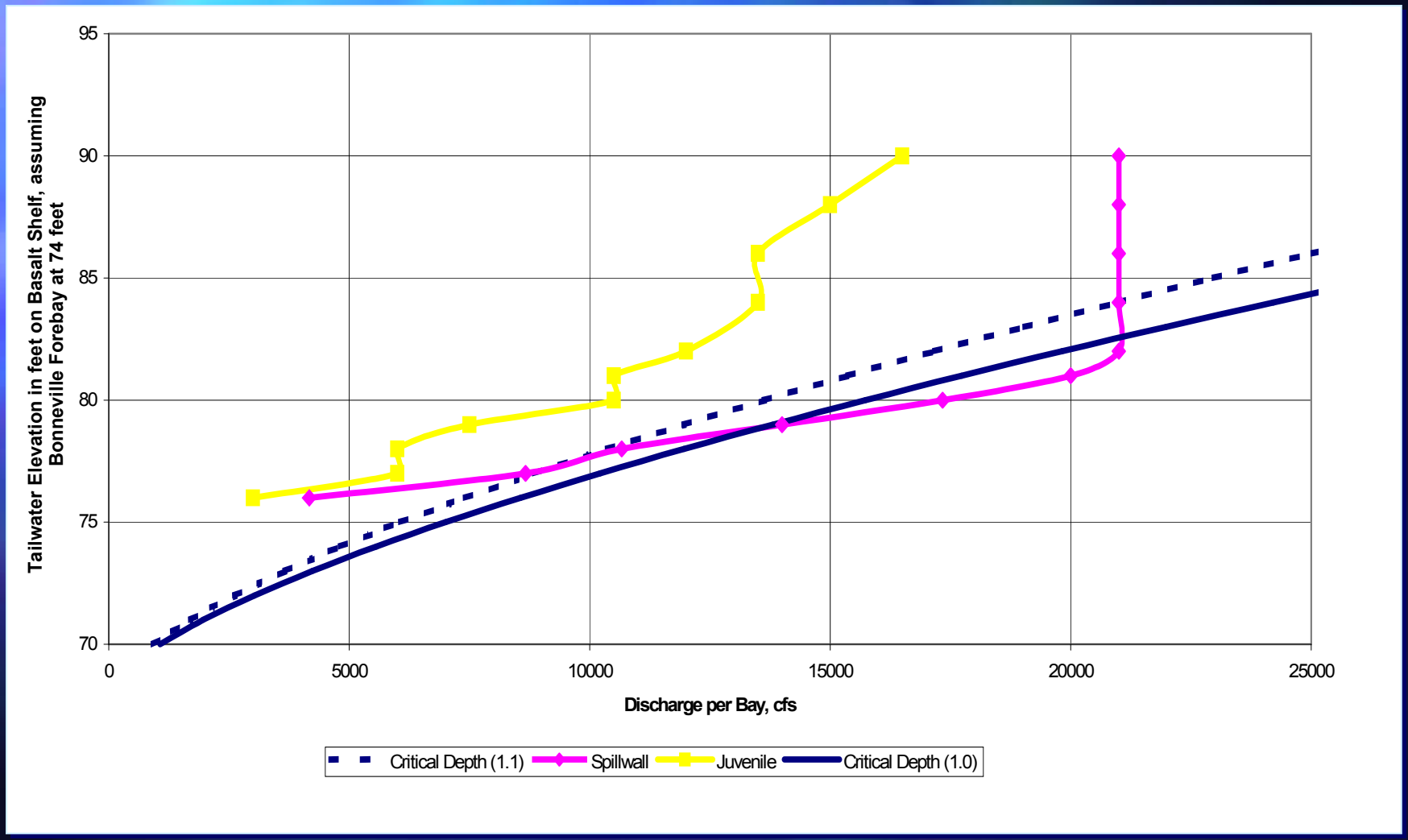

Spillway Monitoring Spreadsheet

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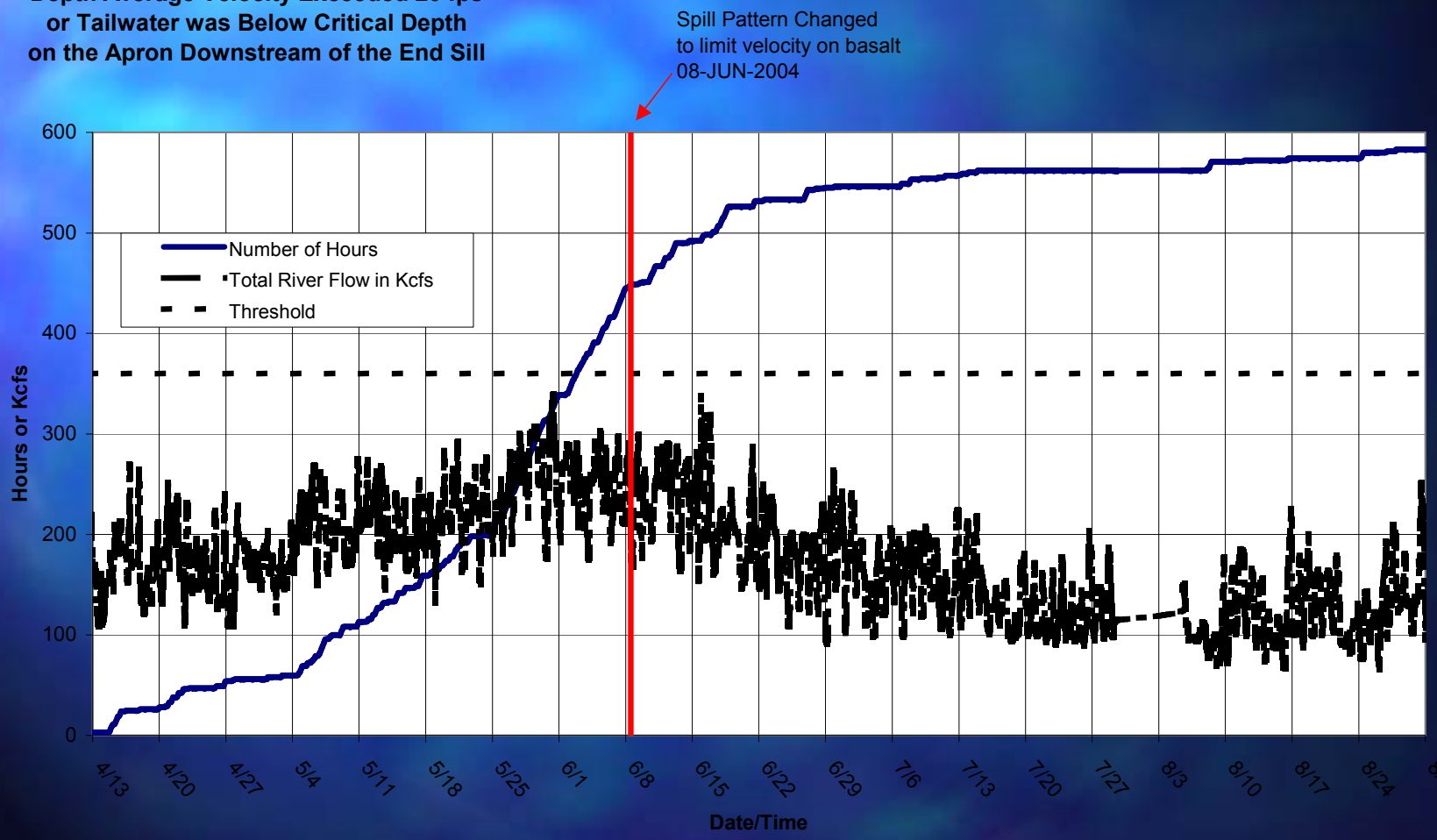
The Dalles Spillway
Cumulative Hours Where
Depth Average Velocity Exceeded 20 fps
or Tailwater was Below Critical Depth
on the Apron Downstream of the End Sill

Cumulative Number of Hours = 585
as of date / time: 8/31/04 23:00



Dalles Spillway Bathymetry 4/03

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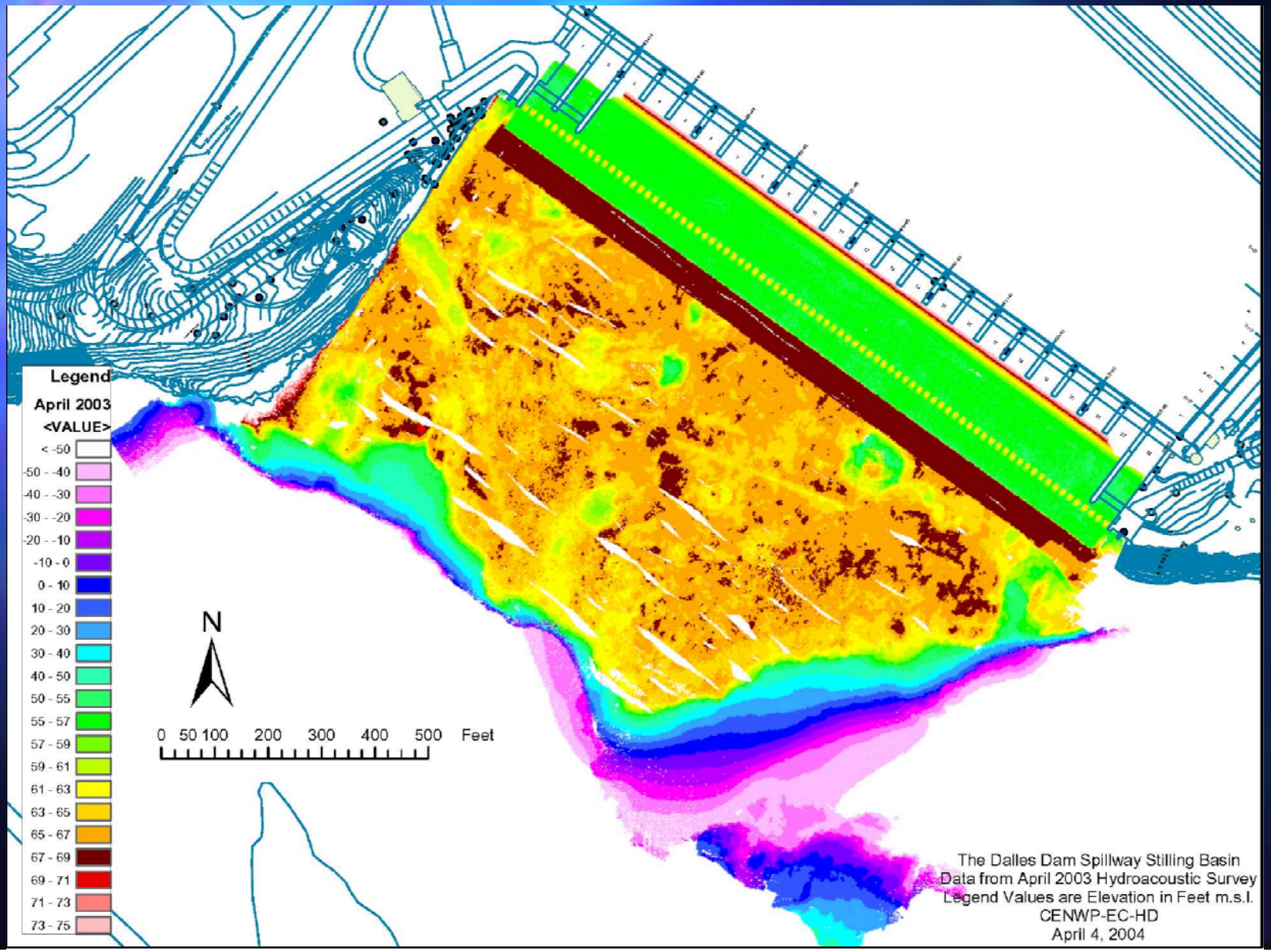
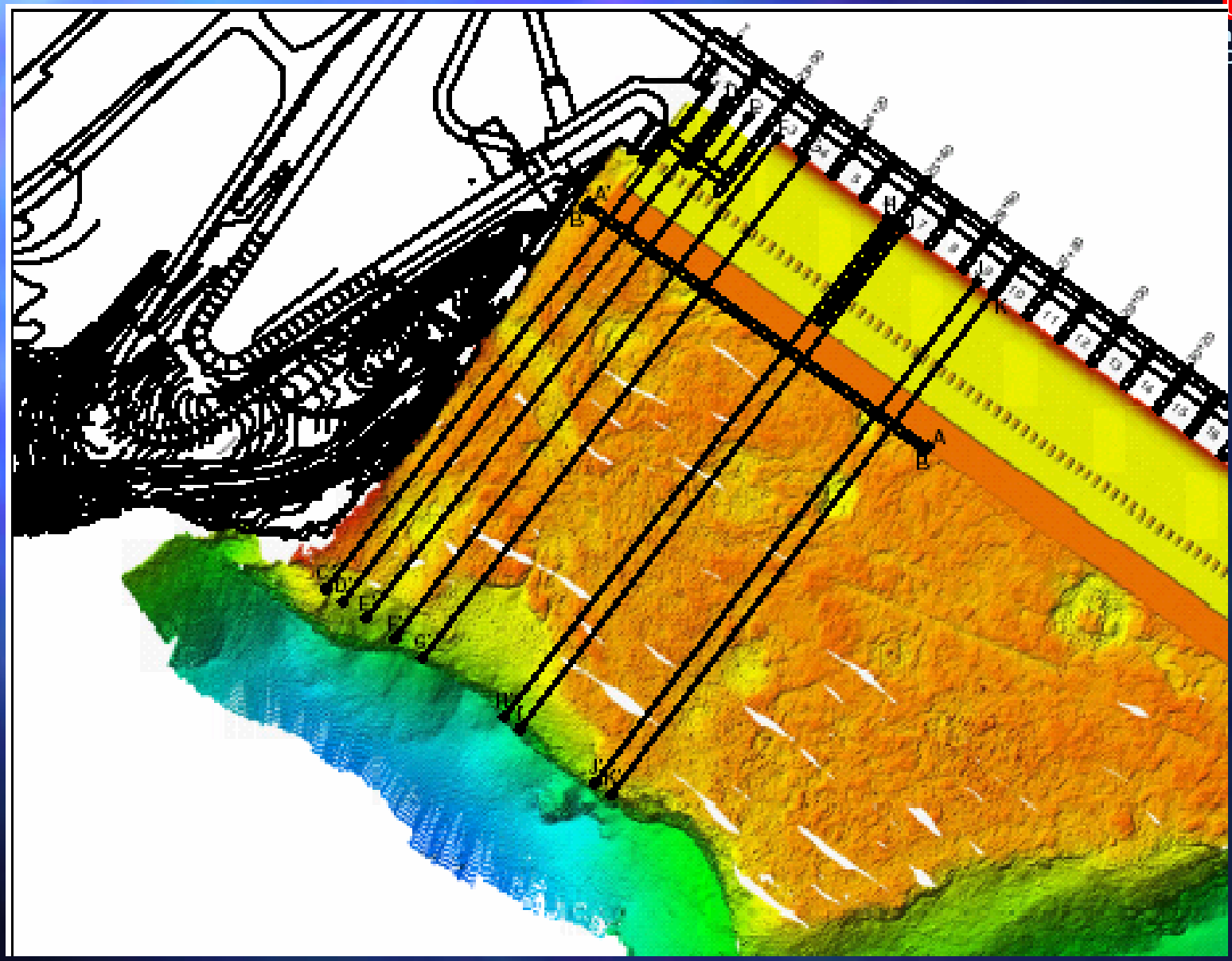


Monitoring Ranges



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Range A-A’

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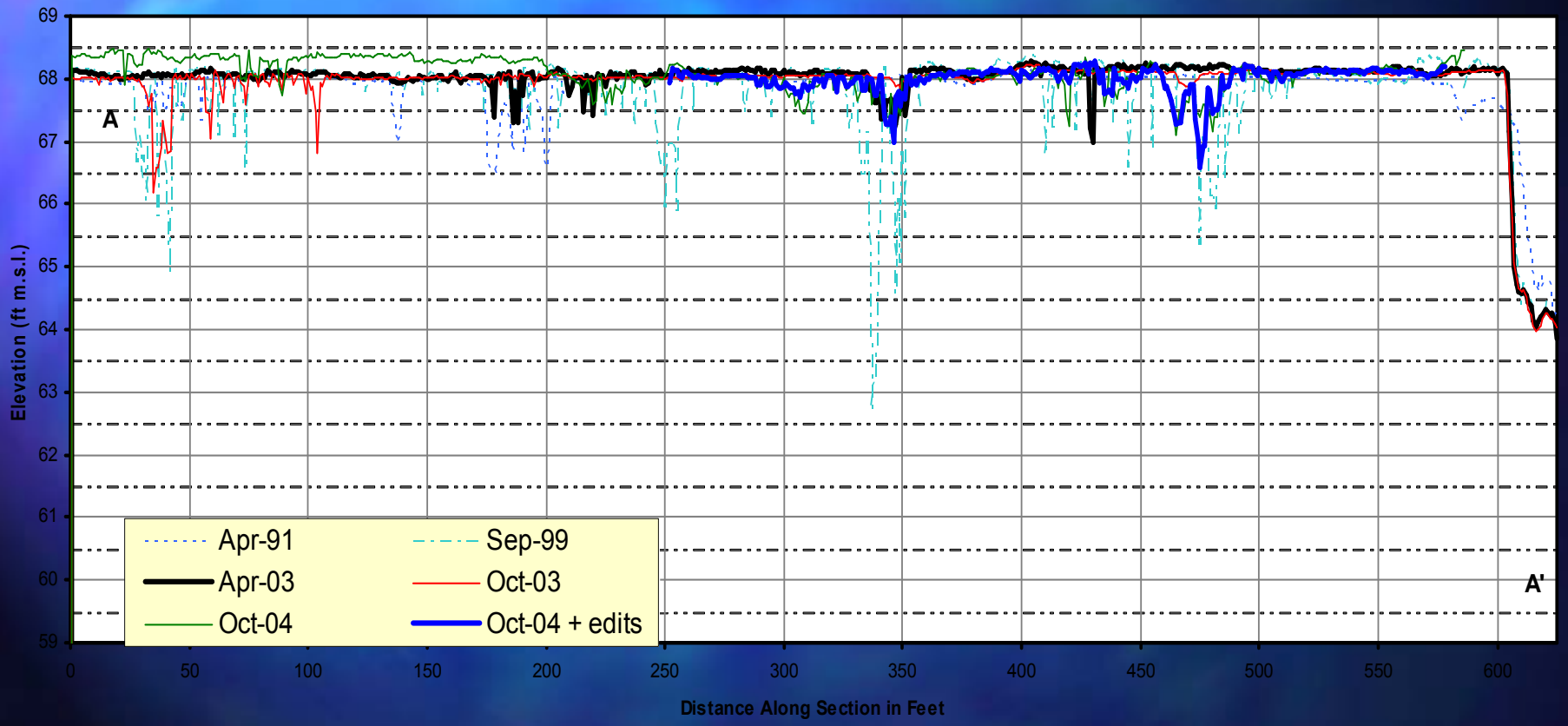
The Dalles Dam North Stilling Basin
Comparison of Bathymetry from October 1991, September 1999, April 2003, October 2003 and October 2004
Section A-A'
CENWP-EC-HD January 3, 2005



Range B-B’

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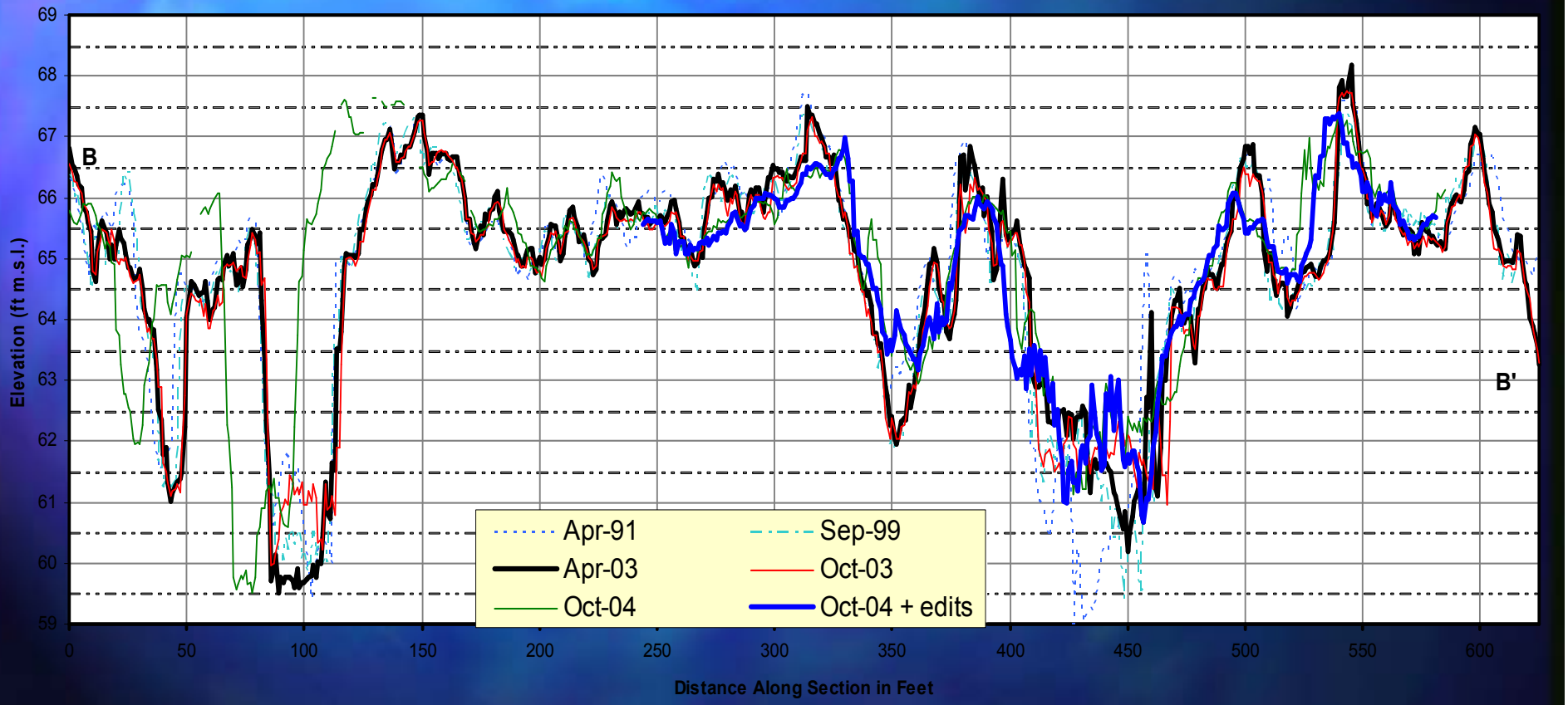
The Dalles Dam North Stilling Basin
Comparison of Bathymetry from October 1991, September 1999, April 2003, October 2003 and October 2004
Section B-B'
CENWP-EC-HD January 3, 2005



Range D-D’

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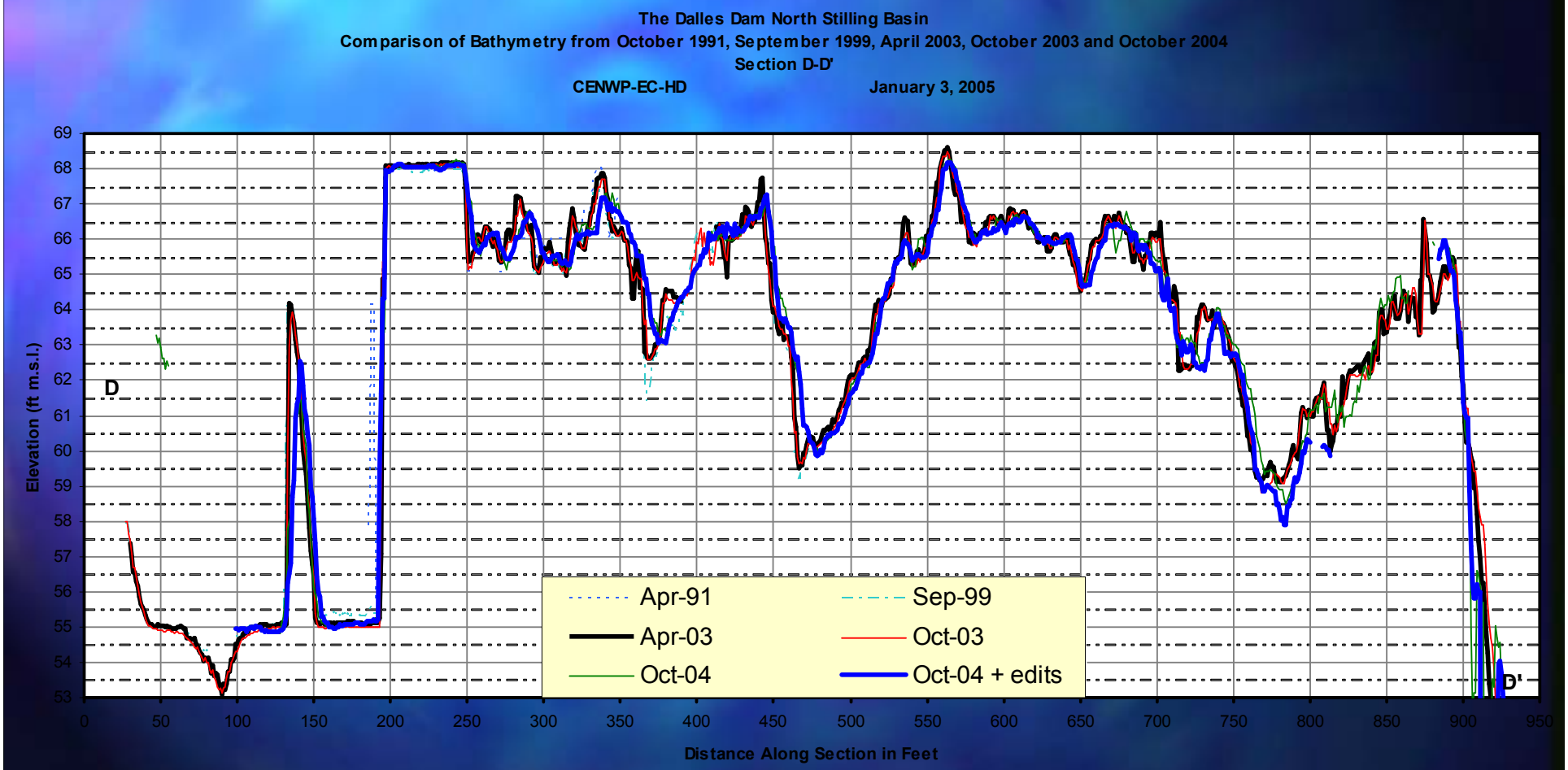

Range G-G'

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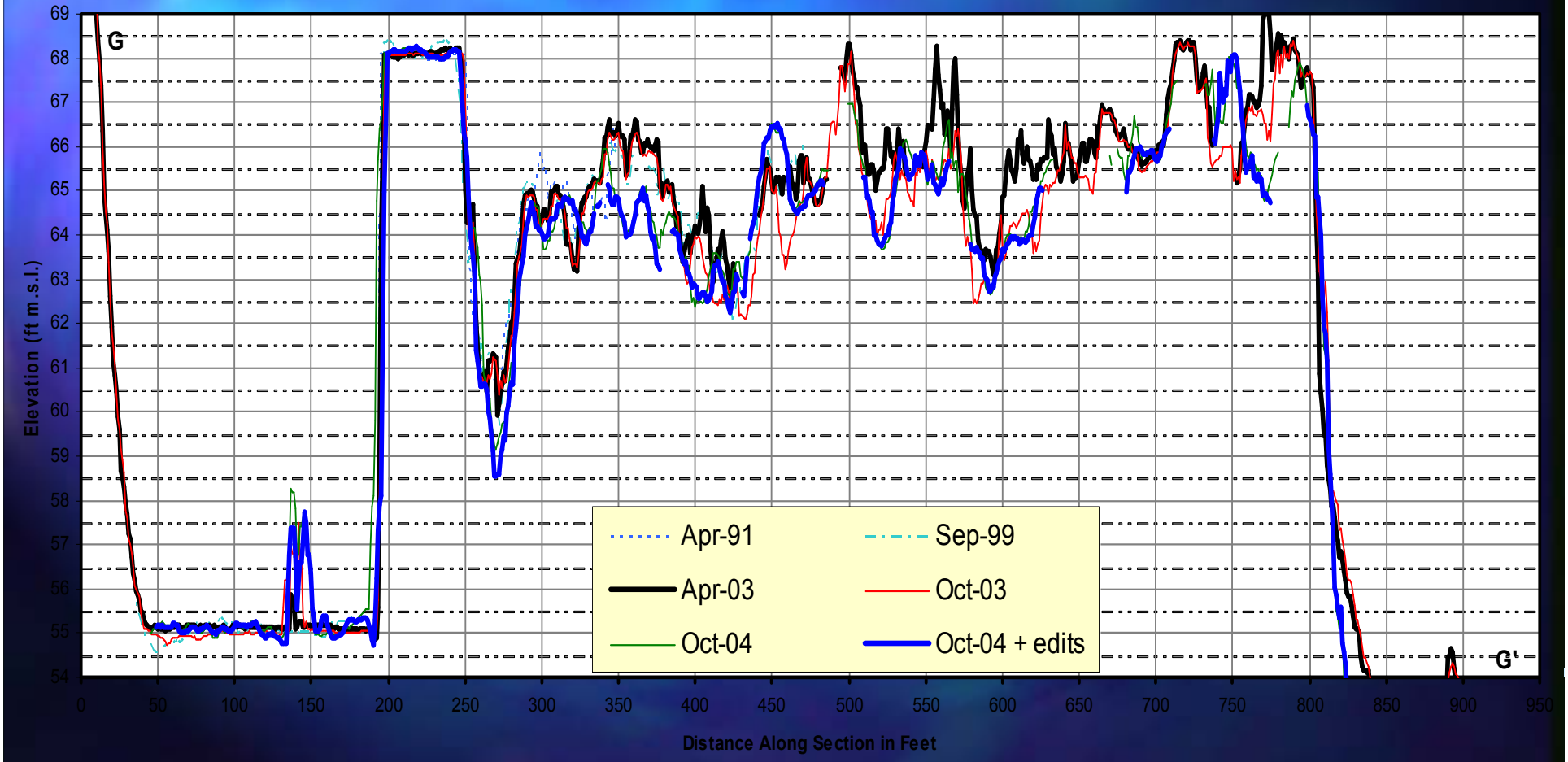
The Dalles Dam North Stilling Basin
Comparison of Bathymetry from October 1991, September 1999, April 2003, October 2003 and October 2004
Section G-G'
CENWP-EC-HD January 3, 2005



2004 Experience

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- Operation limits reached in early June
  - Modified spill pattern to above 1.1 Dc.
  - Conducted limited hydro-survey.
  - Conducted mid-season dive survey.
  - No damage noted – continued operation.
- End of Season Survey
  - Limited results due to survey error.
  - Detailed diver mapping of apron undercutting.
  - Results went into 2005 monitoring plan.

Results of 2004 dive survey.

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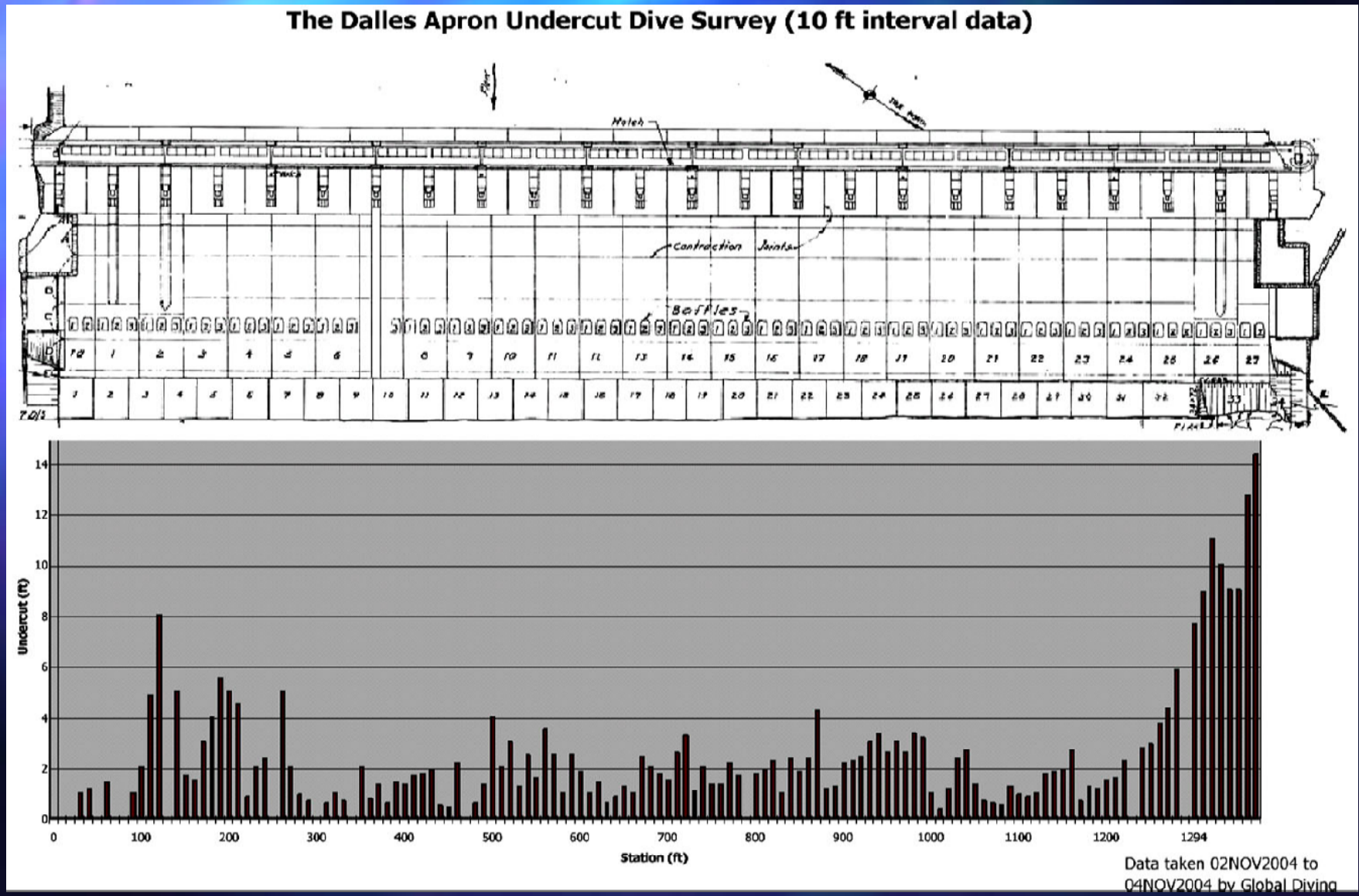

Conclusions

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Spillwall increased juvenile survival.

A detailed monitoring plan can mitigate for operations outside of design criteria.

Monitoring is annual event so we know what is going on in spillway better than through dam safety program.

Met needs of biologists to spill for listed species but ensured project not compromised.