



Western Electricity Coordinating Council

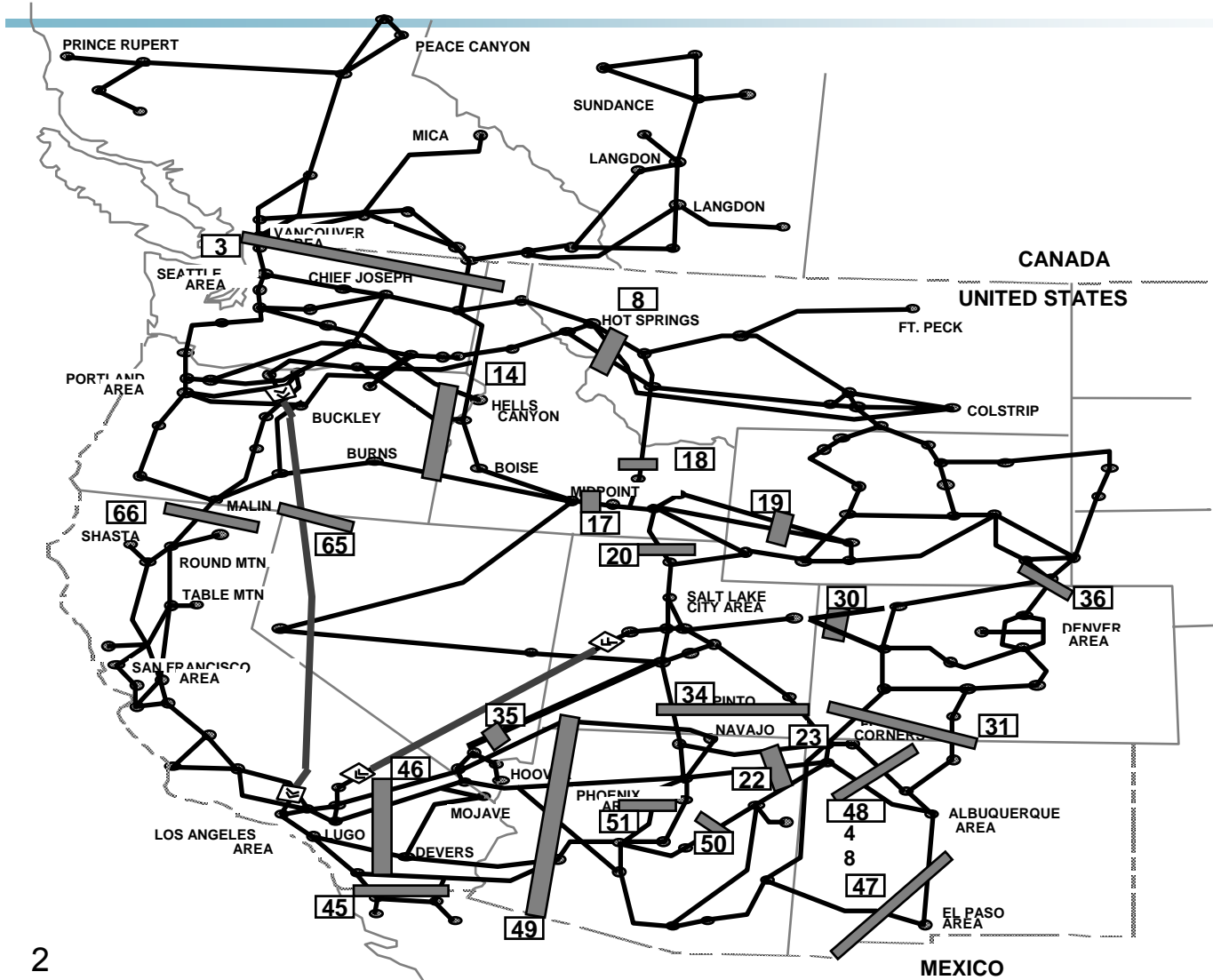
*Historical Transmission  
Congestion Study  
Western Interconnection*

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**Spring 2009 Technical Workshop  
U.S. DOE 2009 Congestion Study**

Dean Perry

# Western Interconnection Transmission Paths



# *Data Analyzed*

- Actual Power Flow – Hourly samples
- Path Transfer Limits – Hourly samples
- Path Schedules – from electronic scheduling tags – OATI
  - Hourly Firm & Non-firm
  - Net Schedule and schedules in both path directions
  - POR POD segments mapped to WECC paths
- Year – 2007
- 23 WECC Rated Paths
- Schedule data issues
  - Missing some dynamic schedules
  - Missing some POR PODs
- After adjustments, schedule data useable on 22 of 23 paths

# *Path Analysis*

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- For all paths, prepared
  - Chronological plots of actual, net schedule and schedules in each direction
  - Duration curves for actual flow and schedules for 2007
- Calculated congestion metrics for all paths
  - U75, U90, U99 for flows and schedules – seasonal hours and heavy/light load hours
  - 48 metrics calculated for each path
- Ranked paths by usage/congestion
- Examples in following slides



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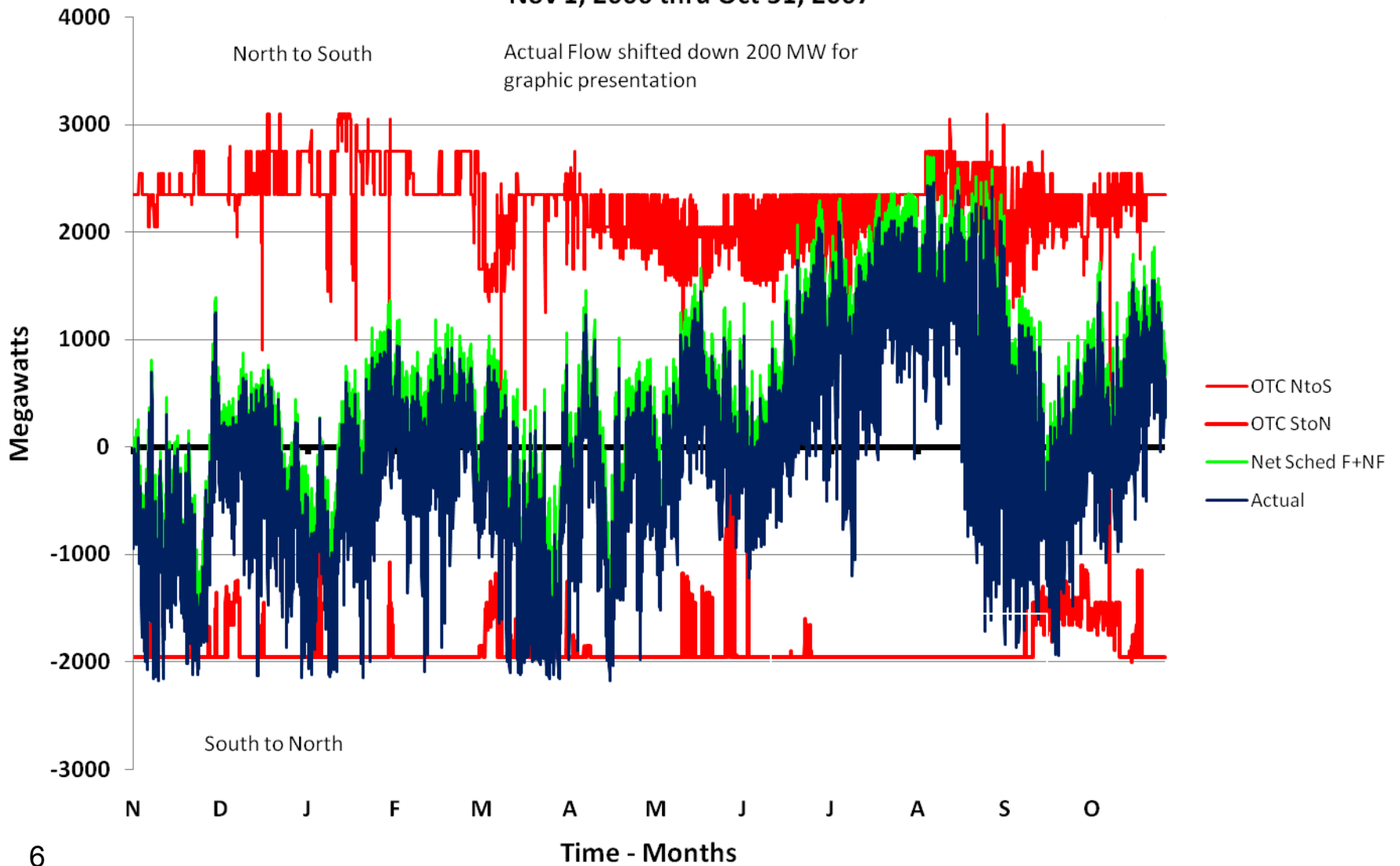
# *Individual Path Analysis*

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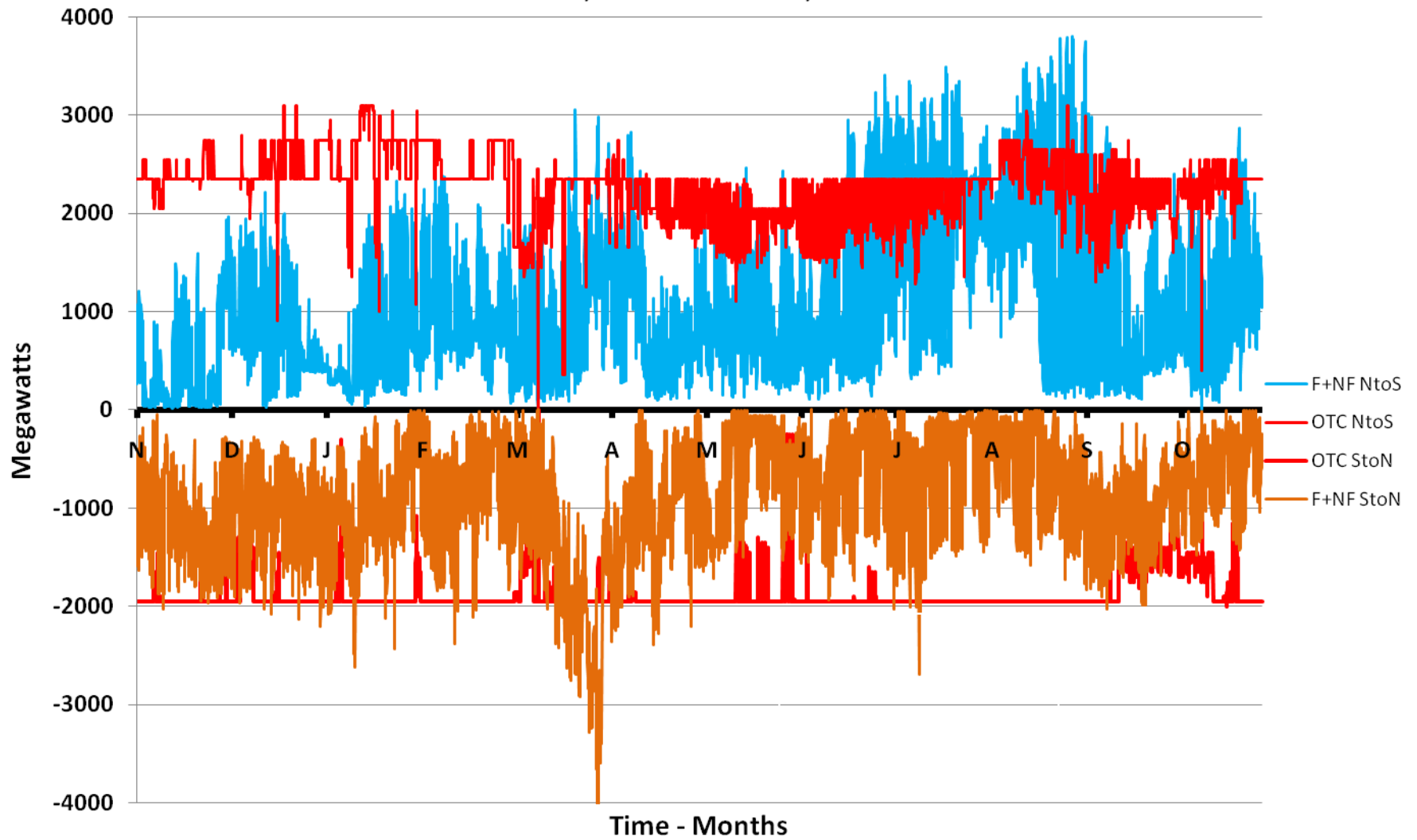
Example #1

Northwest to Canada - Path 3

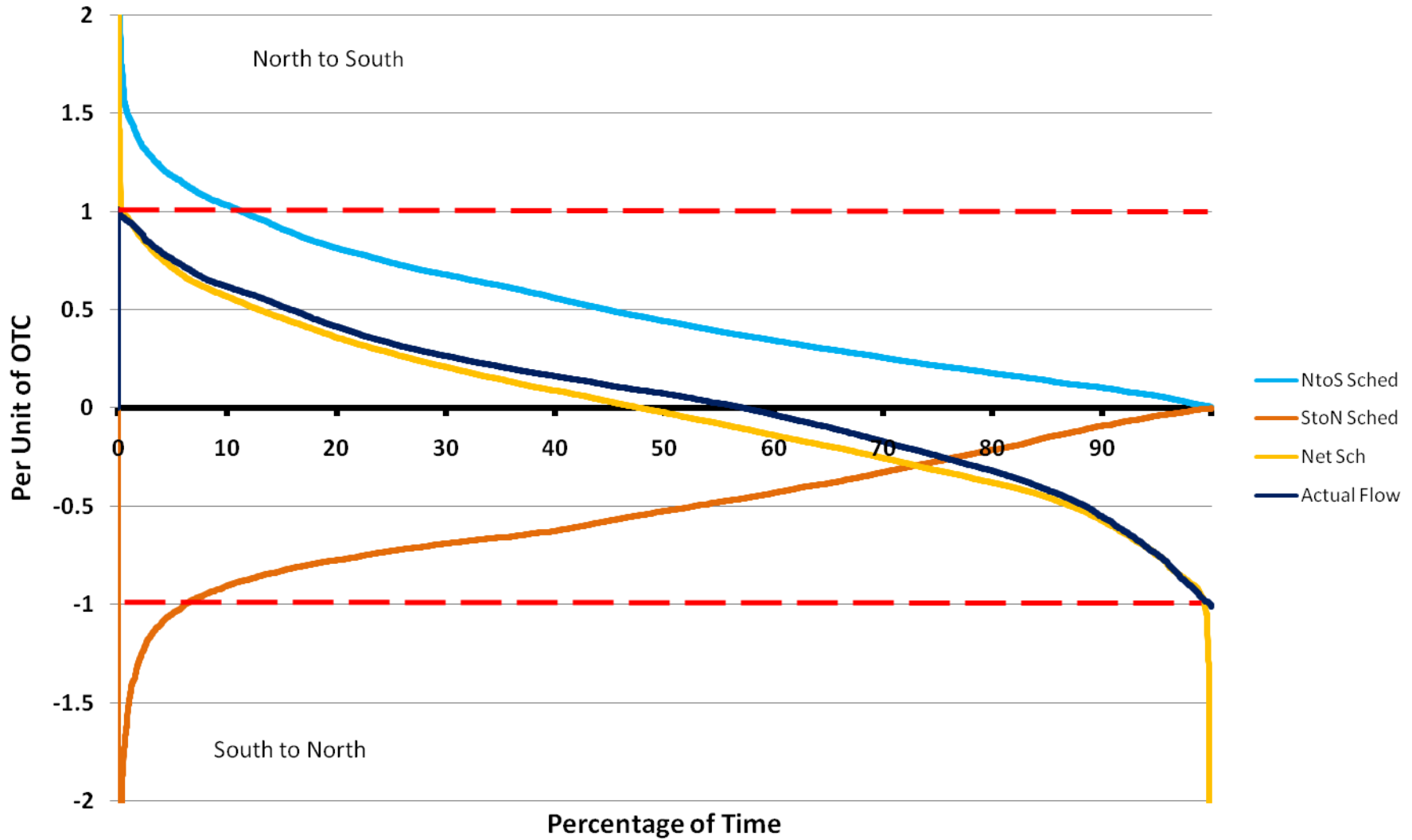
**Figure II-2**  
**Northwest to Canada - Path 3**  
Net Schedule (F+NF) - using BPA schedule data  
Nov 1, 2006 thru Oct 31, 2007



**Figure II-3**  
**Northwest to Canada - Path 3**  
Total Schedule (F+NF), NtoS and StoN - using BPA schedule data  
Nov 1, 2006 thru Oct 31, 2007



**Figure II-4**  
**Canada to Northwest - Path 3**  
 Schedule (F+NF) and Actual Flow Duration Chart  
 Nov 1, 2006 thru Oct 31, 2007







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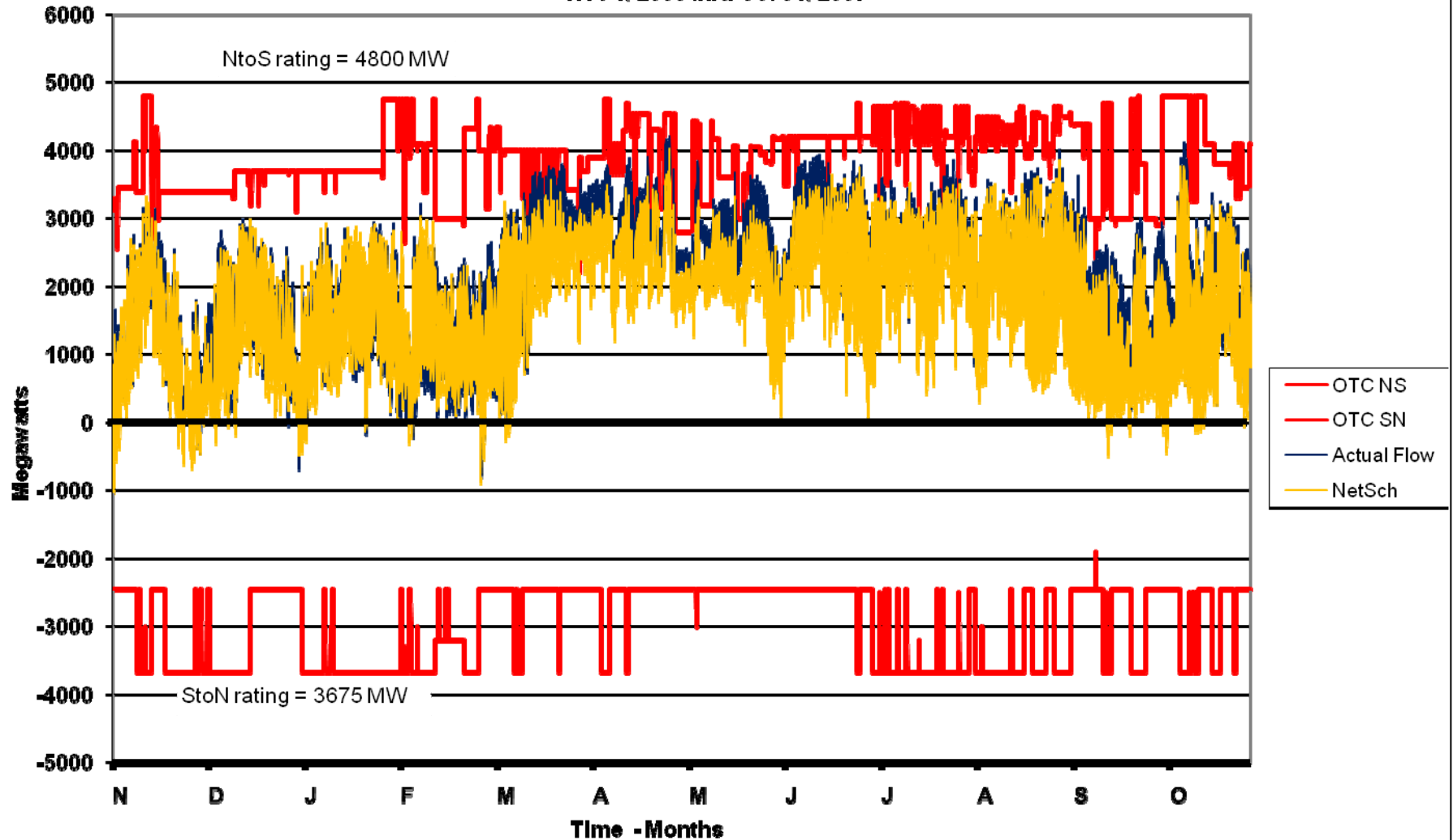
# *Individual Path Analysis*

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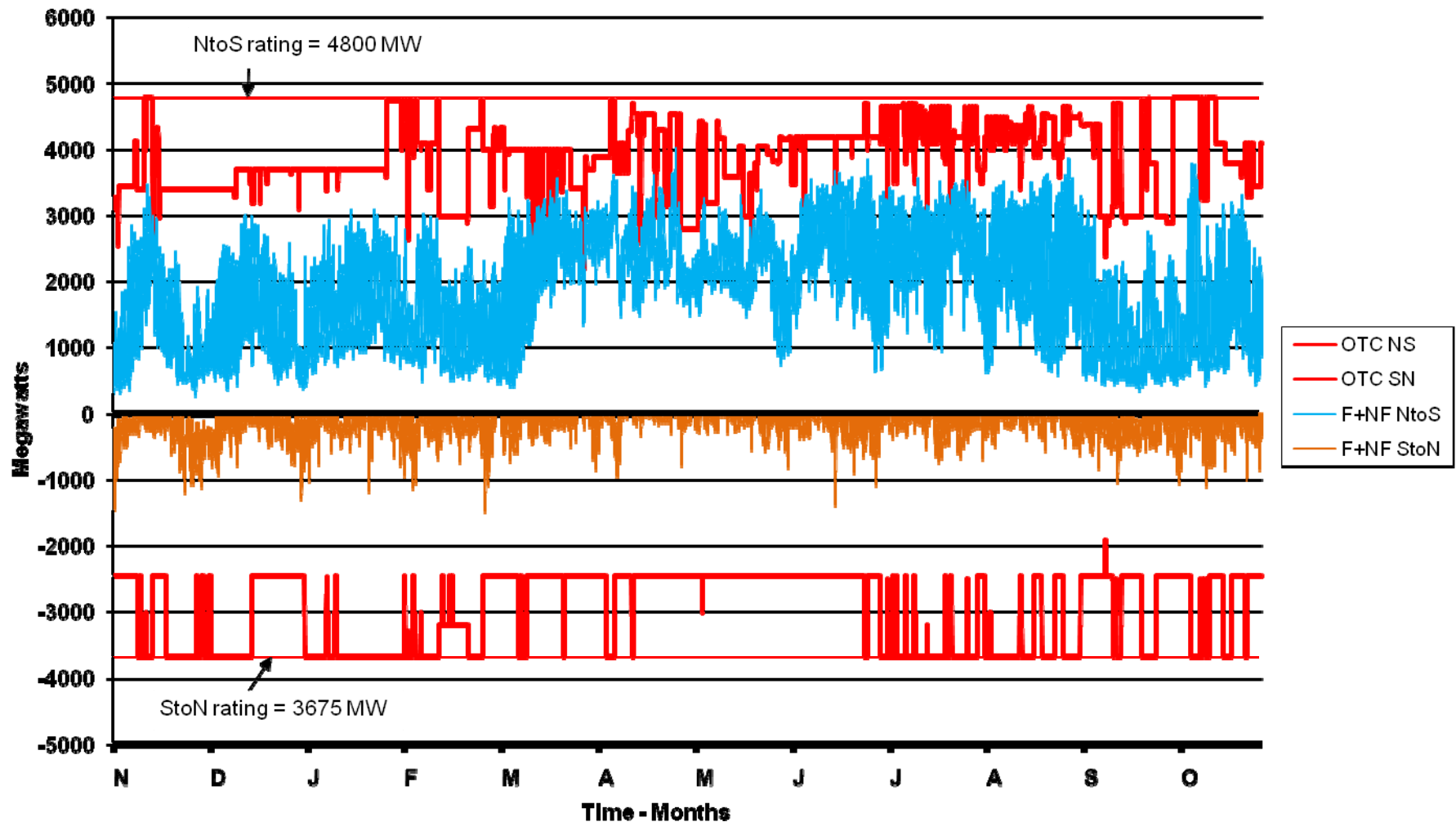
## Example #2

California Oregon Intertie – Path 66

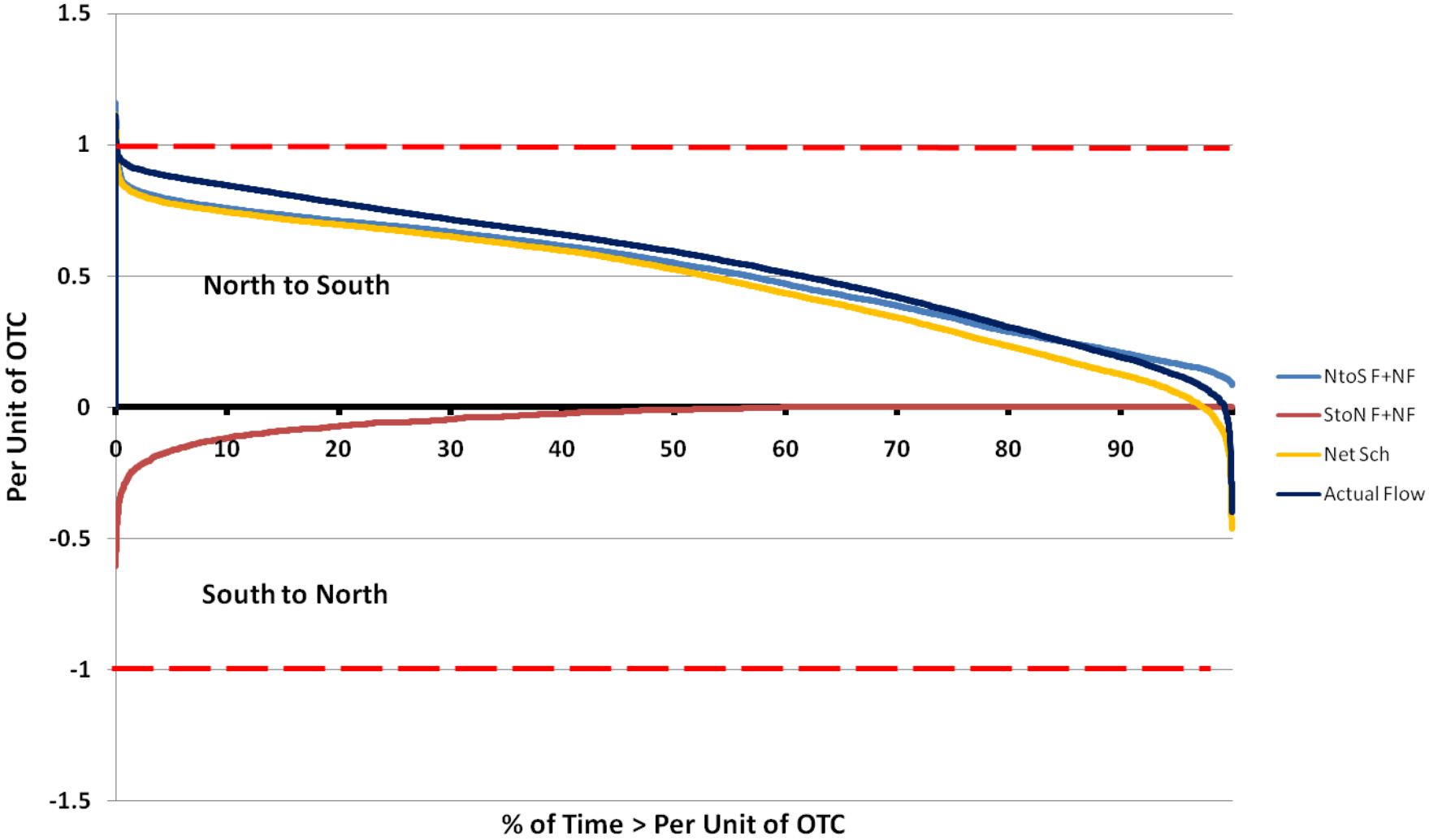
**Figure 4**  
**COI - Path 66**  
**Actual Flow and Net Sch (F+NF) - using BPA Flow data and etag schedule data**  
**Nov 1, 2006 thru Oct 31, 2007**



**Figure 5**  
**COI - Path 66**  
**Total Schedule (NtoS and StoN) and OTC Limits - using etag sched data**  
**Nov 1, 2006 thru Oct 31, 2007**



**Figure 6**  
**COI (Pacific AC Intertie) - Path 66**  
**Schedule (F+NF) and Actual Flow Duration Chart**  
 Nov 1, 2006 thru Oct 31, 2007





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# *Metric Calculations*

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U75, U90, U99

# Congestion Metrics

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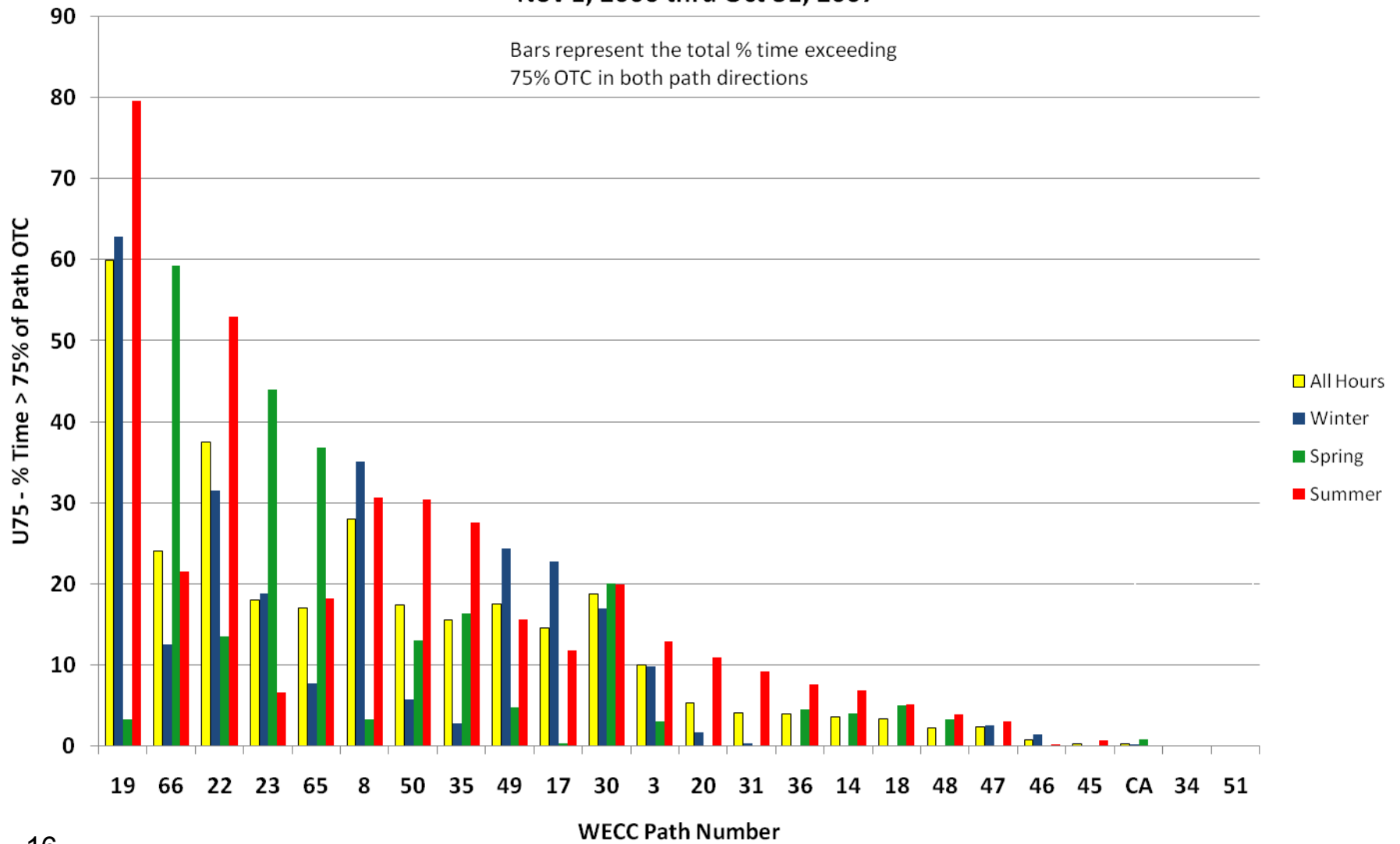
- U75 = % of Time flow/schedule exceeds 75% of path transfer capability\*
- U90 and U99 – same definition
- Calculated metrics for actual MW flow and for Path Schedules
- Calculated metrics for different time intervals
  - All hours of the year
  - Seasonal hours – Winter, Spring and Summer
  - Heavy and Light Load Hours

\*Path transfer capability can vary over the time period with changing operating conditions.

# *Metrics Calculated for each Path*

- Actual Flow – U75 – All Hr, W, Spr, Su, HLH, LLH
- Actual Flow – U90 – same
- Net Schedule – U75 – All Hr, W, Spr, Su, HLH, LLH
- Net Schedule – U90 – same
- Net Schedule – U99 – same
- Max. Direction Schedule – U75 – All Hr, W, Spr, Su, HLH, LLH
- Max. Direction Schedule – U90 – same
- Max. Direction Schedule – U99 – same
  
- 48 Metric Combinations Calculated for each Path

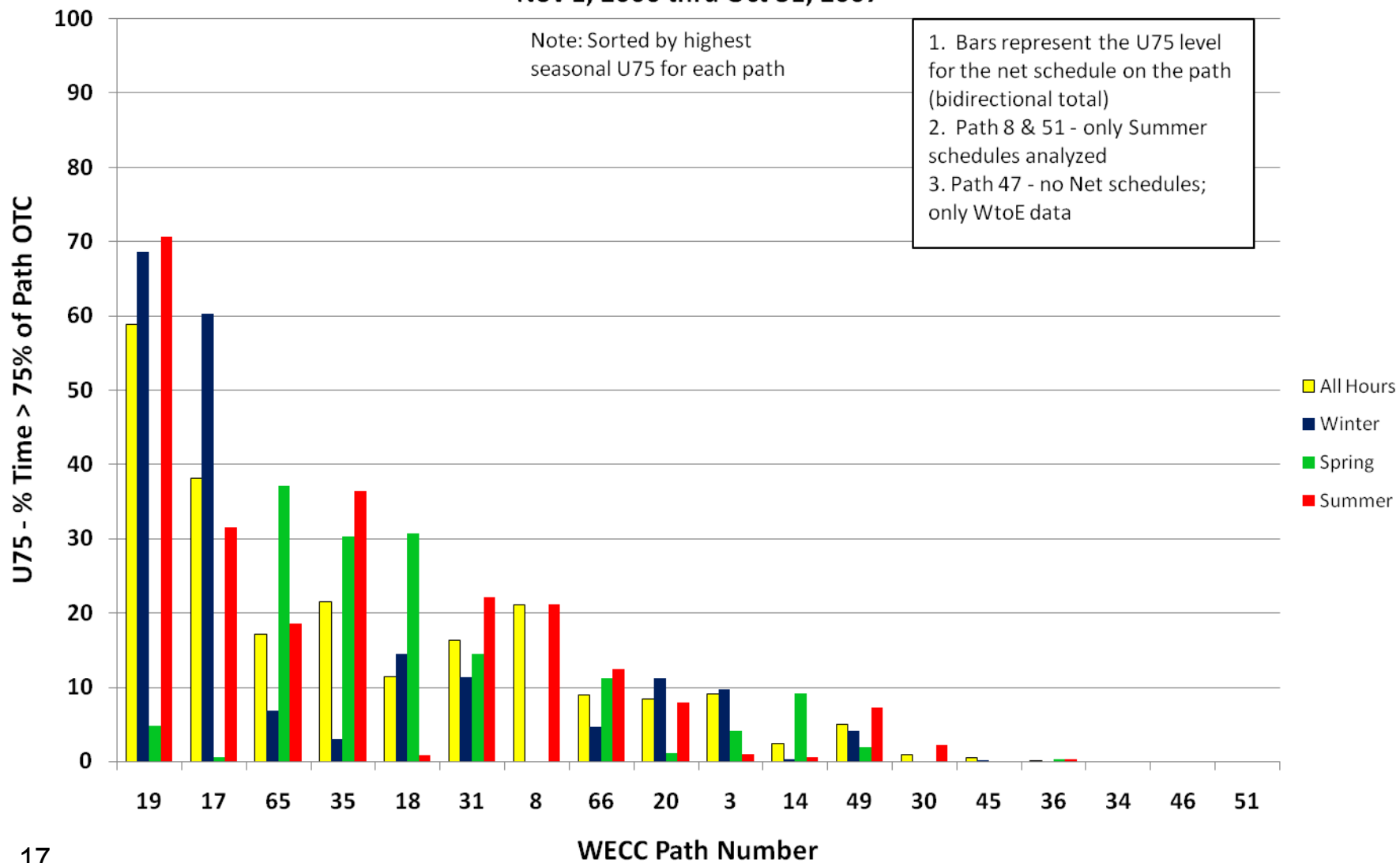
**Figure 8**  
**Path Actual Flow - U75**  
 Seasonal Variation sorted by Max Seasonal Flow  
 Nov 1, 2006 thru Oct 31, 2007





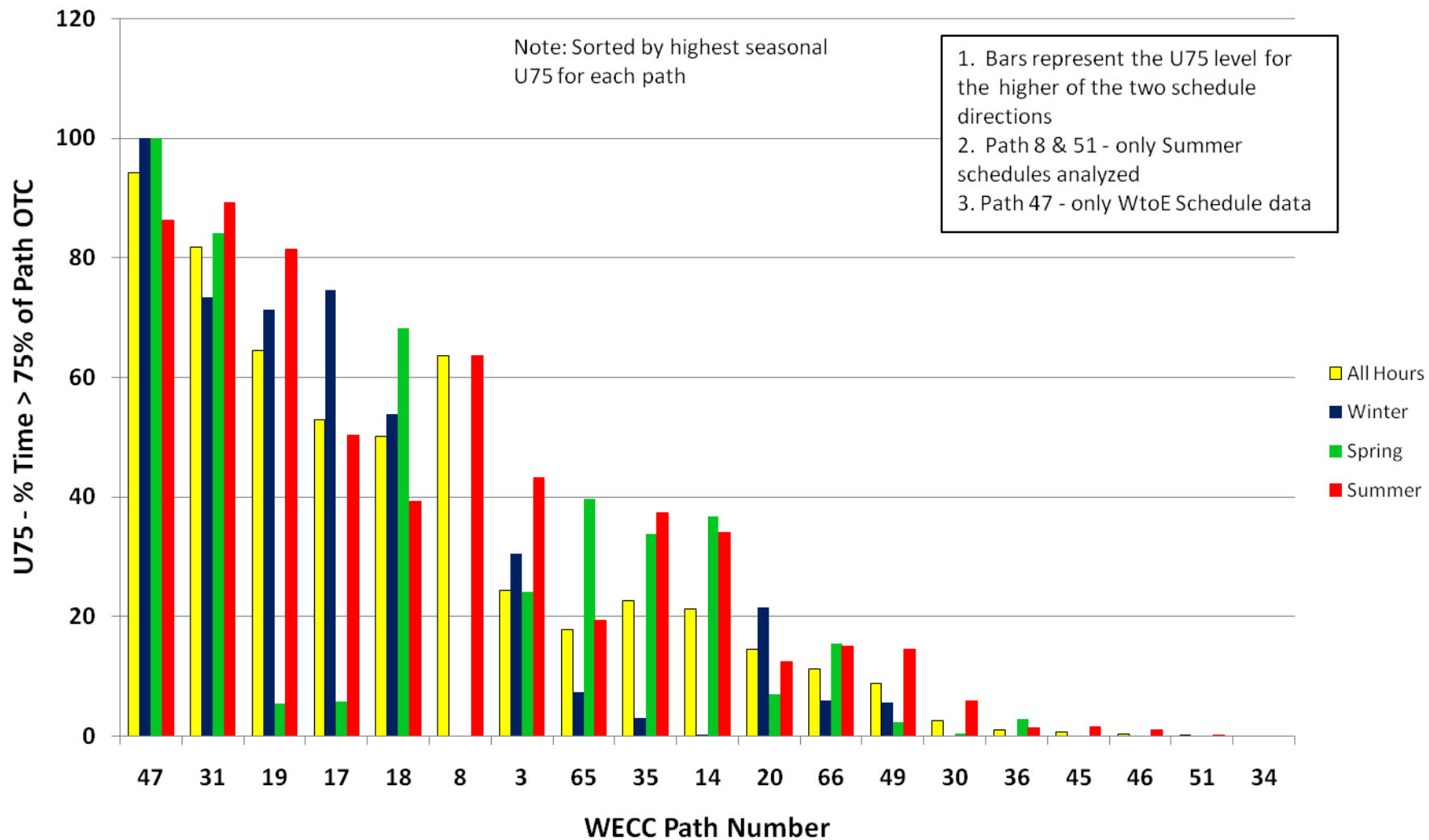
## Figure 10 Path Schedules

**U75 Net Schedule (F+NF) - Seasonal**  
**Nov 1, 2006 thru Oct 31, 2007**

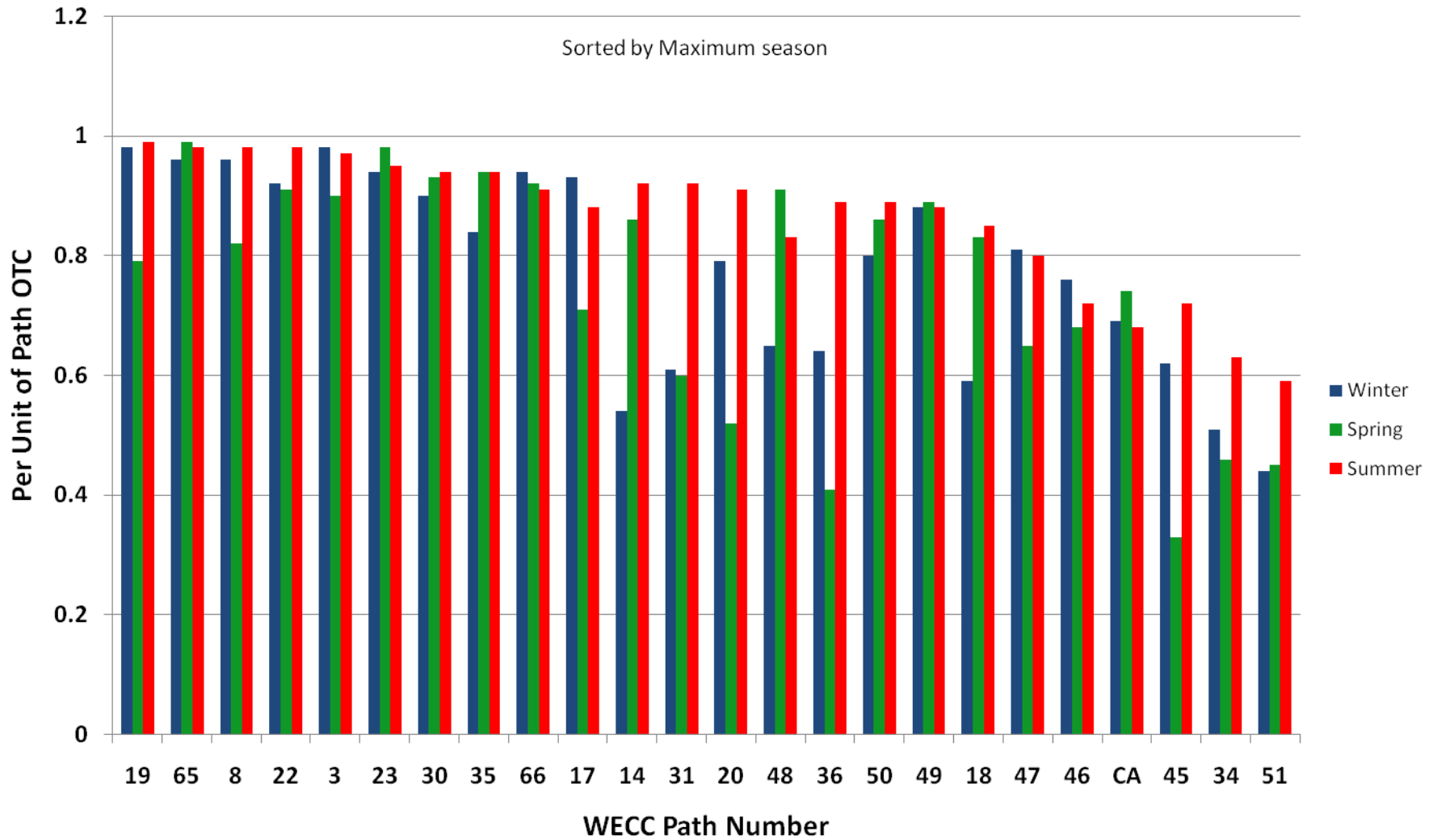


## Figure 9 Path Schedules

**U75 - Max. Directional Schedules (F+NF) - Seasonal**  
**Nov 1, 2006 thru Oct 31, 2007**



**Figure 11**  
**Path Actual Flow**  
 Maximum Seasonal Flow (99% Probability Level)  
 Nov 1, 2006 thru Oct 31, 2007





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# *Path Ranking Results*

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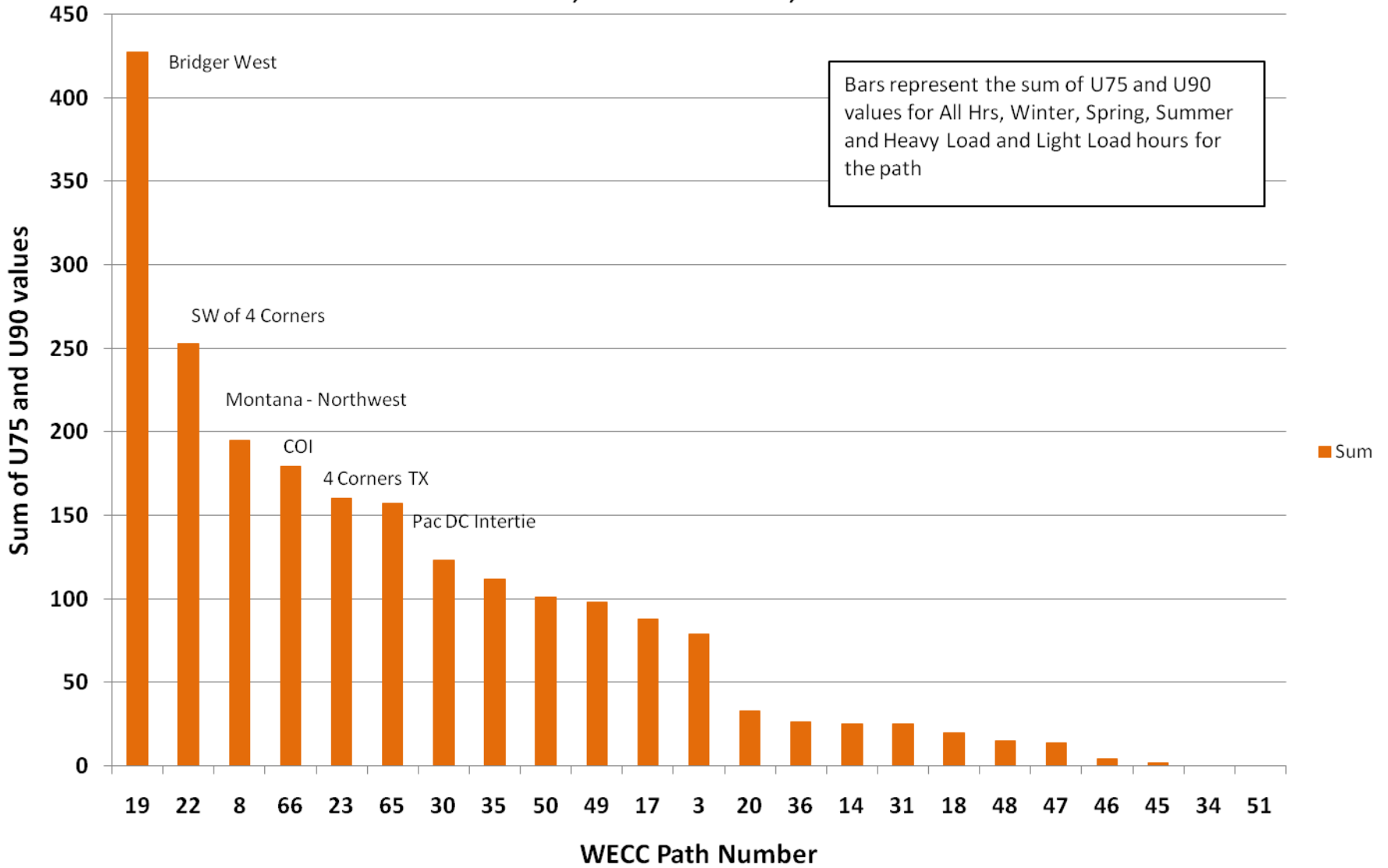
Actual Flow and Schedule Rankings

# Usage Ranking Methodology

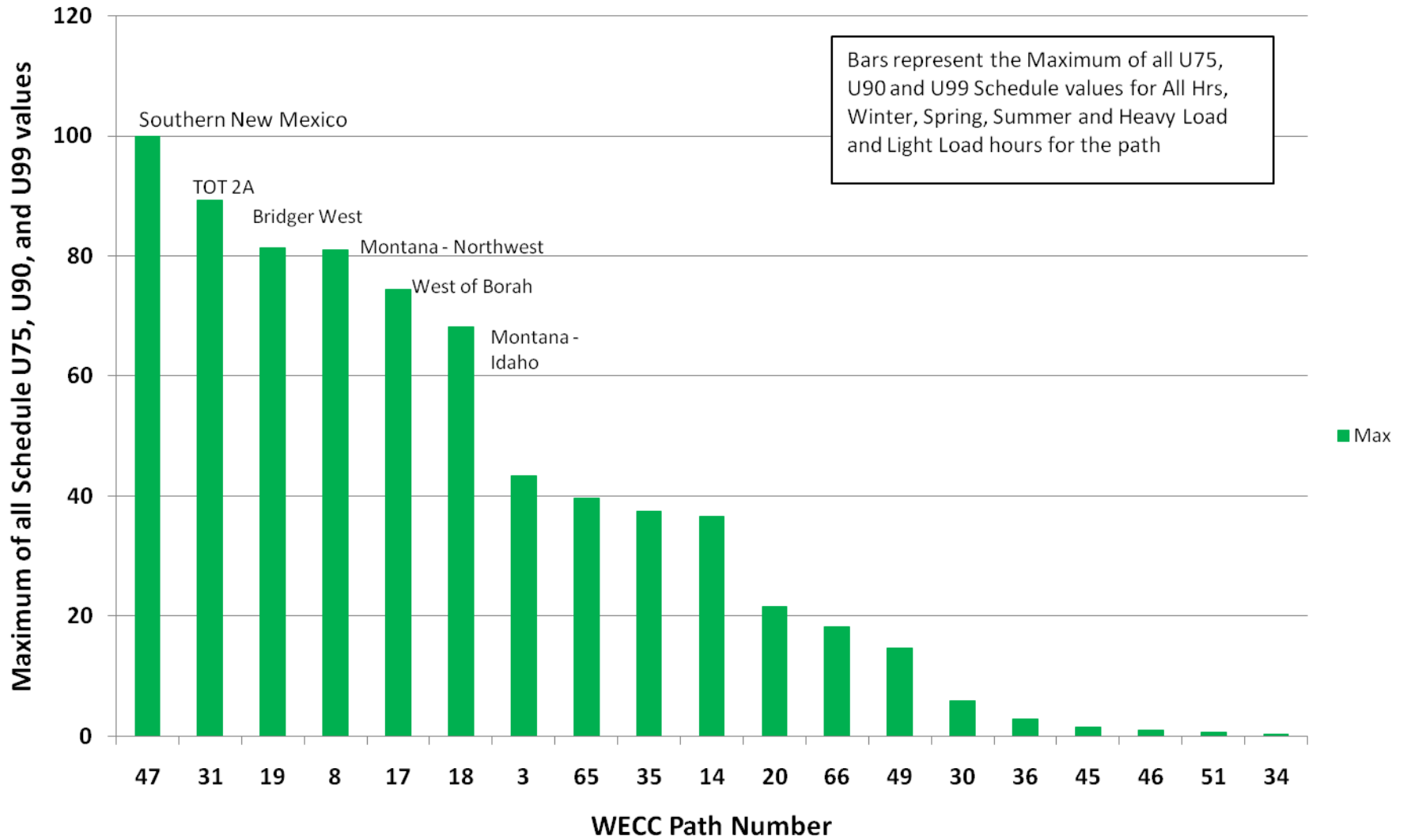
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- Four Methods - using individual path metrics
  - ACTUAL FLOW
    - Method #1 – Sum of 12 Metrics
    - Method #2 – Maximum of 12 Metrics
  - NET SCHEDULE
    - Method #3 – Sum of 18 Metrics
  - DIRECTIONAL SCHEDULE
    - Method #4 – Maximum of 18 metrics
- Final “Highest Use” Grouping combines the results of the 4 Methods

**Figure 12**  
**Path Congestion Ranking - ACTUAL FLOW - Ranking Method #1**  
 Nov 1, 2006 thru Oct 31, 2007



**Figure 14**  
**Path Congestion Ranking - SCHEDULES - Ranking Method #4**  
 Ranking based upon the Path Maximum of all Path Schedule Metrics  
 Nov 1, 2006 thru Oct 31, 2007





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# *CONCLUSIONS*

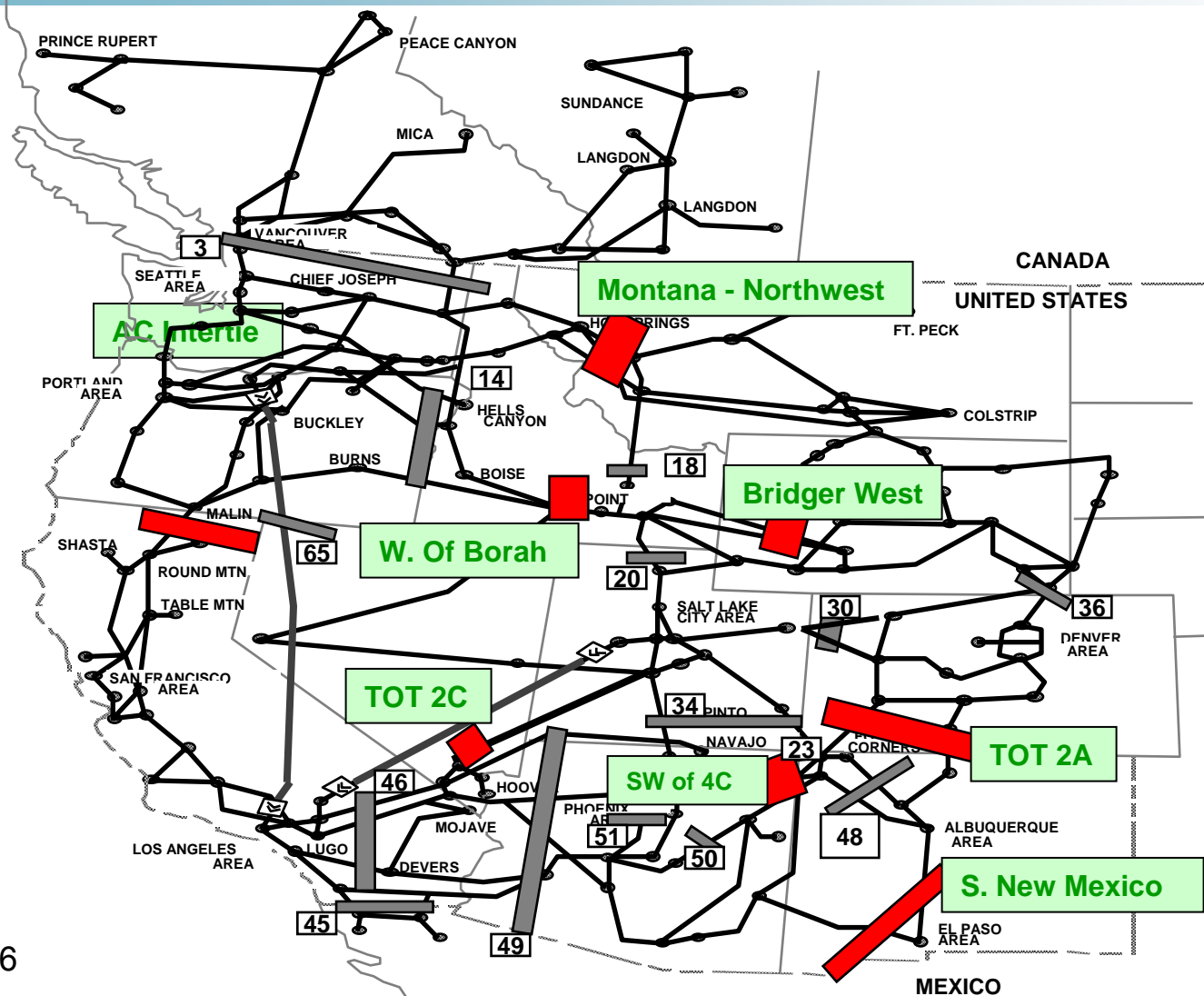
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# Key Findings

- Most Heavily Utilized Paths in 2007 - (NOT FINAL - - MAY BE REVISED AFTER ANALYSIS OF UPDATED SCHEDULE DATA)
  - Bridger West – Path 19
  - Montana to Northwest – Path 8
  - Southwest of Four Corners – Path 22
  - COI – Path 66
  - TOT 2C – Path 35
  - West of Borah – Path 17
  - Southern New Mexico – Path 47
  - TOT 2A – Path 31
- Report recommends several areas for database improvements

# Most Heavily Used Transmission Paths - 2007



# Questions

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**Dean Perry**

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