

# **Hydro Optimization MODEL Validation Report**

**By CddHoward Consulting Ltd  
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# Two Phase Validation Process

Two independent factors to check.

- Phase 1. Check calculations in simulation.
- Phase 2. Check the effect of the linear stage-storage curve.

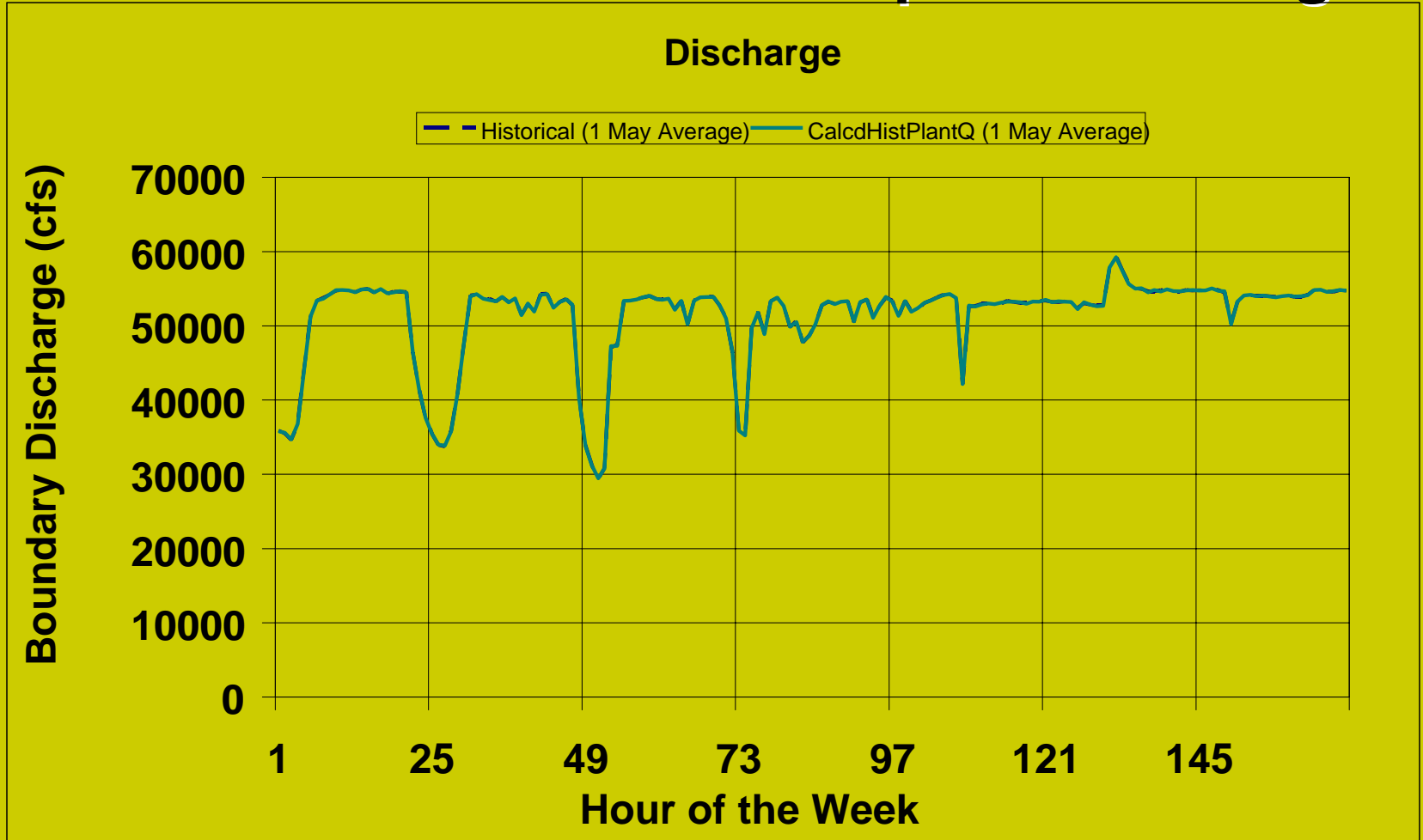
# Validation Process

Compare actual and calculated pool levels, tailwater, Mwh.

- Phase 1
  - Drive MODEL with historical plant discharge.
- Phase 2
  - Drive MODEL with storage calculated by historical pool levels applied to the linear stage-storage curve.

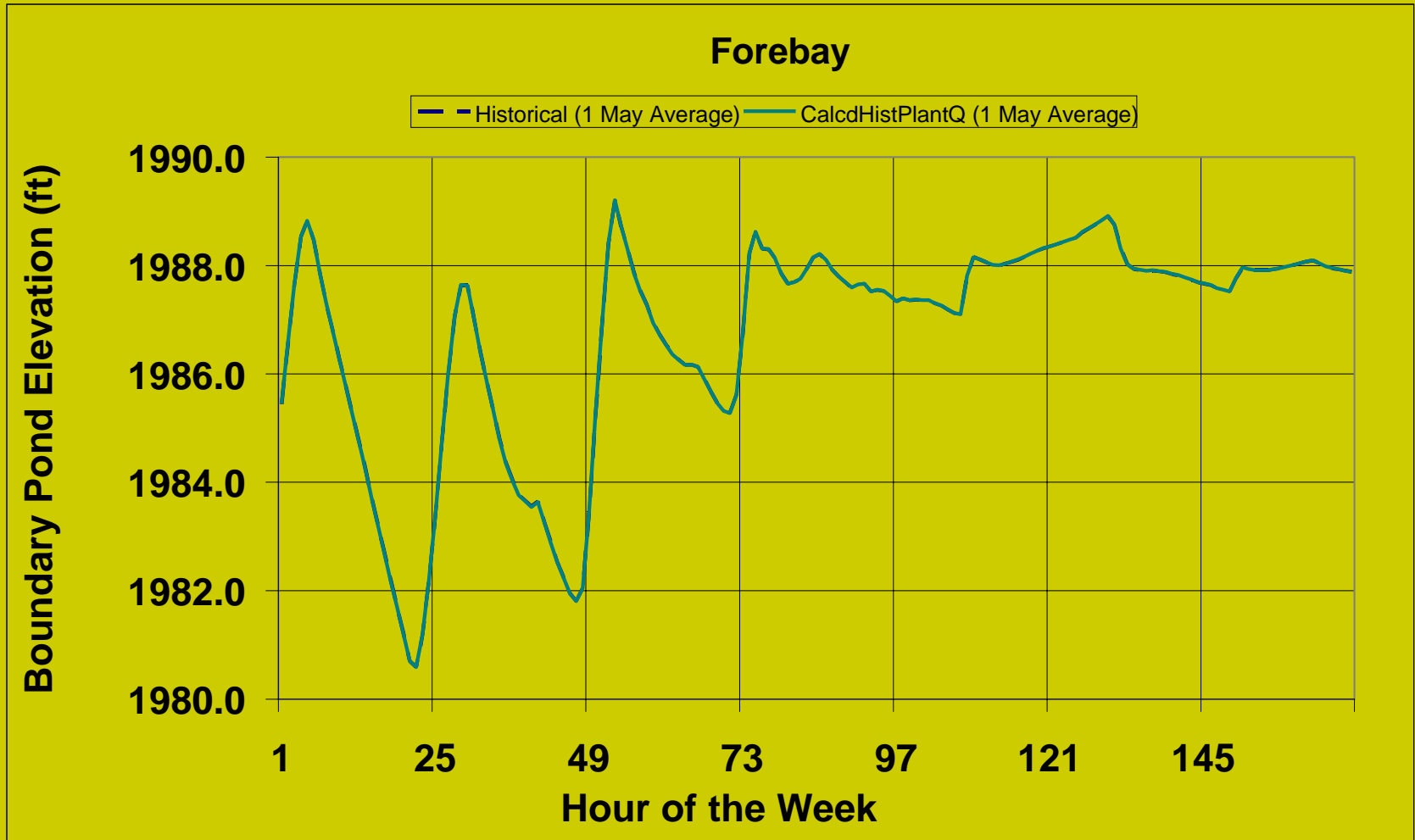
# Phase 1 Plant Discharge

## Drive MODEL with historical plant discharge.



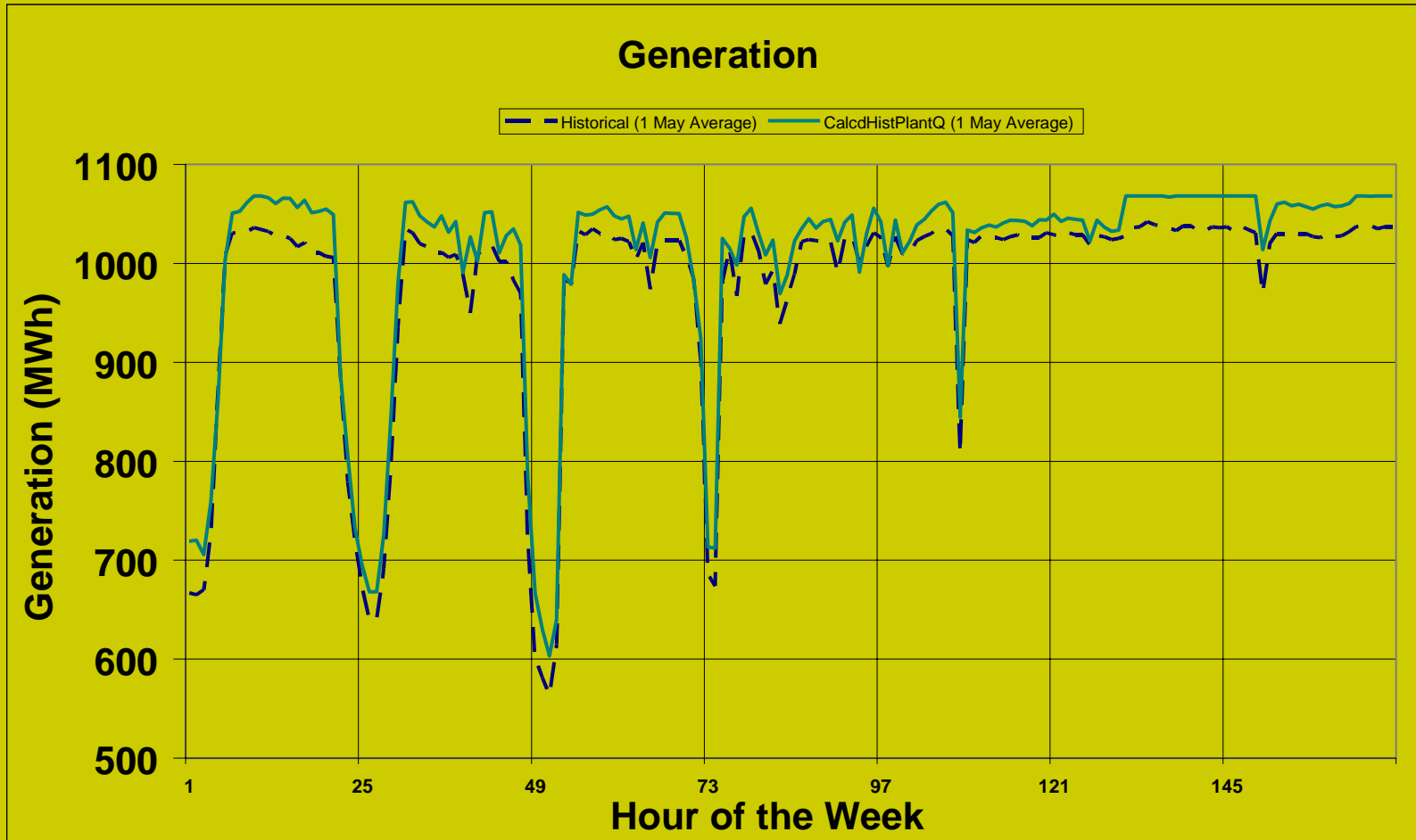
# Phase 1. Pond Elevations

## Drive MODEL with historical plant discharge.



# Phase 1 Generation Mwh

## Drive MODEL with historical plant discharge.



# Phase 1: Generation Validation

## Drive MODEL with historical plant discharge.

Hydrology	Historical Mwh	Model Mwh	Ratio
Wet	4,843,933	5,392,857	1.113
Average	3,791,910	3,970,008	1.047
Dry	2,339,590	2,463,372	1.053

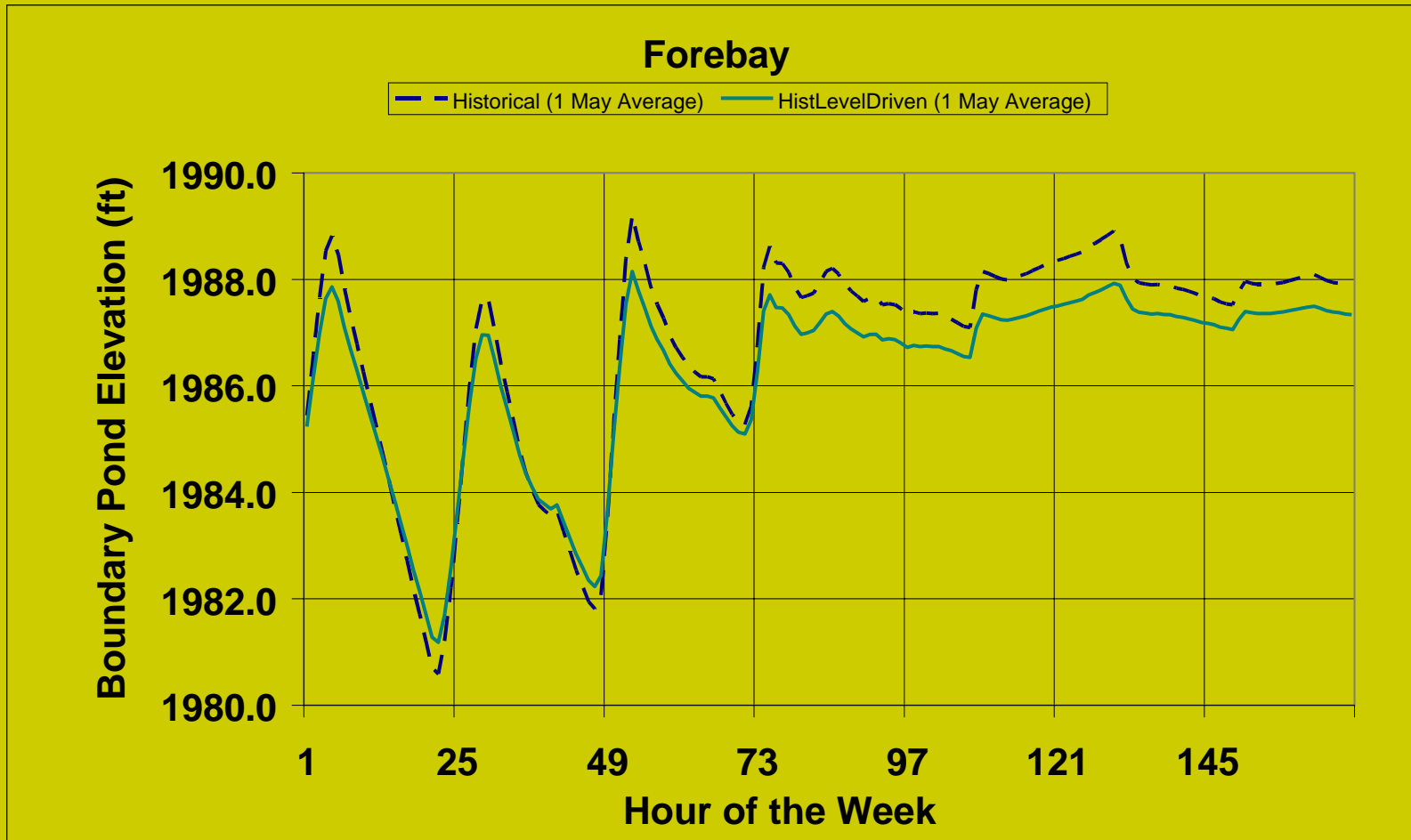
# Phase 1 Conclusions

## Drive MODEL with historical plant discharge.

- 1. Mass balance is modeled correctly. When MODEL is driven by historical discharges the resulting pond levels are on the accepted stage-storage curve.
- 2. Tailwater does not match exactly. This reflects known uncertainty in the tailwater curve. Tailwater is relatively unimportant to Mwh because of high total head.
- 3. Compared to actual Mwh MODEL produces more Mwh. Probably because MODEL optimizes unit scheduling and assumes no outages.

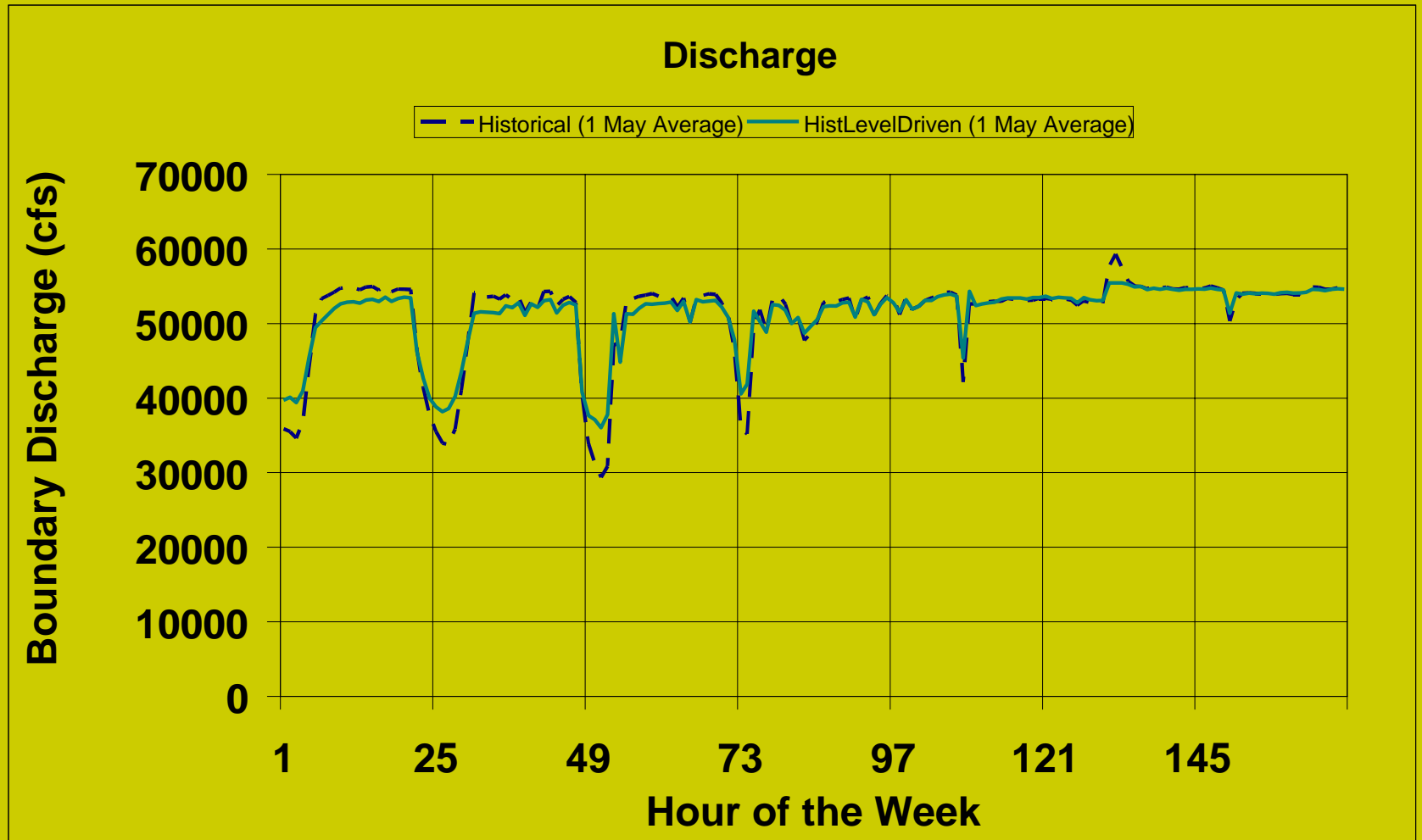
# Phase 2: Pond Levels

## Linear stage-storage curve



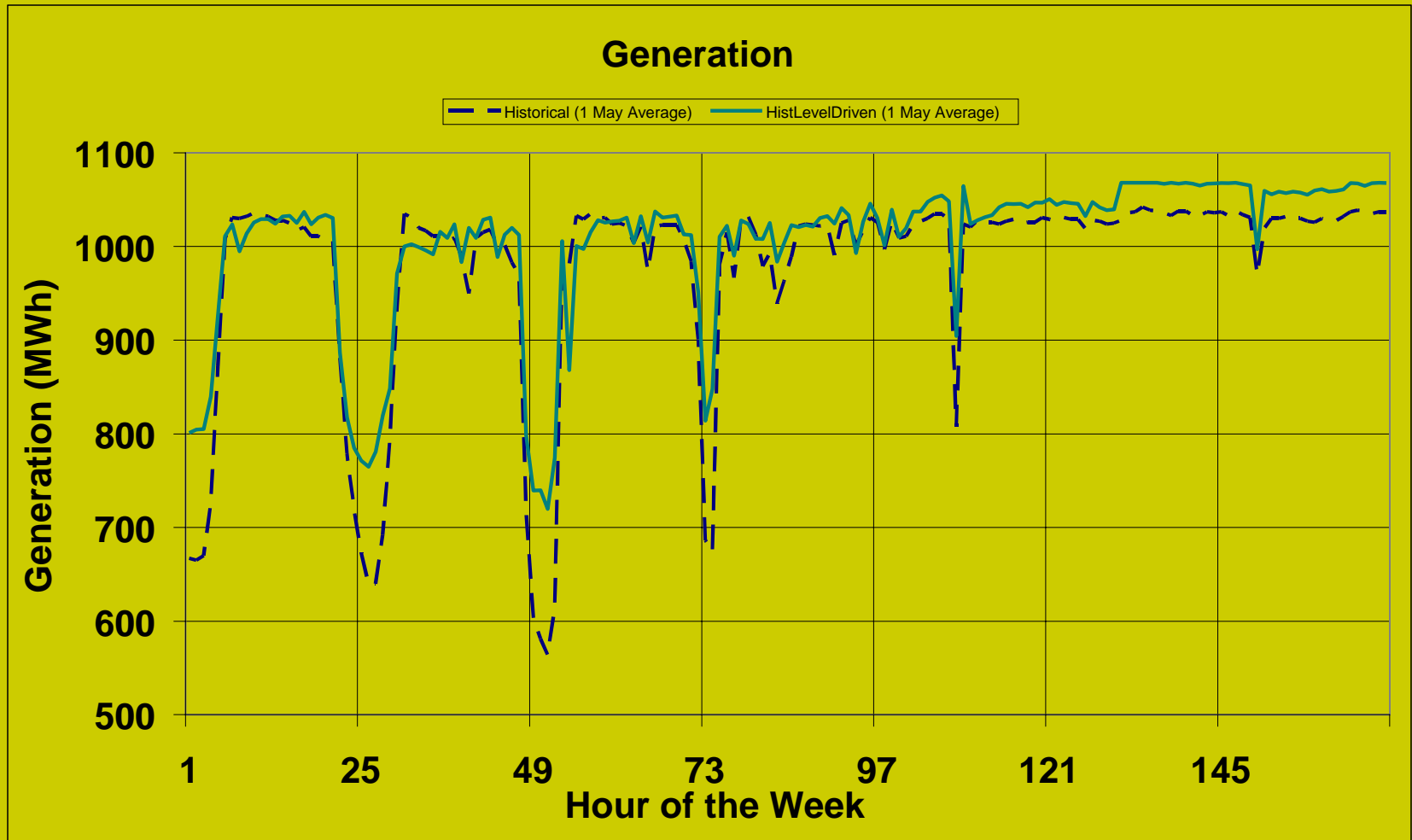
# Phase 2: Discharge

## Linear stage-storage curve



# Phase 2: Generation

## Linear stage-storage curve



# Phase 2: Generation

## Linear stage-storage curve

Hydrology	Historical MWh	Model MWh	Ratio
Wet	4,843,933	5,520,257	1.140
Average	3,791,910	3,960,960	1.045
Dry	2,339,590	2,446,796	1.046

# Overall Comparisons

Summary Annual MWh				
Hydrology	Phase 1 Verification	Phase 2 Verification	Ratio	
Wet	5,392,857	5,520,257	1.024	<b>2.4 %</b>
Average	3,970,008	3,960,960	0.998	<b>0.02%</b>
Dry	2,463,372	2,446,796	0.993	<b>0.07%</b>

**Phase 1. Simulation equations mass balance 0.001%**

**Phase 2. Linear stage-storage week mass balance 0.122%**

# Overall Conclusions

- **MODEL correctly models mass balances.**
- **MODEL calculations provide 13% more Mwh in the wet year and 5 % more in the other years, compared to actual.**
- **The linear stage-storage curve increases MODEL's wet year generation by 2.4 % - in the other years there is no effect on generation.**
- **Most of the increased generation in MODEL comes from the optimized unit dispatch in the simulation and/or historical outages.**

**Reservoir water management was not optimized in this study.**

**Thank-You!**

**Questions?**