# **SETTLEMENT AGREEMENT BETWEEN**

# **THE SUQUAMISH TRIBE AND KING COUNTY, WASHINGTON**

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SETTLEMENT AGREEMENT BETWEEN THE SUQUAMISH TRIBE AND KING COUNTY, WASHINGTON

This Settlement Agreement is entered into between the Suquamish Tribe ("Tribe"), a federally recognized Indian Tribe, and King County ("King County" or "County"), a political subdivision of the State of Washington (collectively, "Parties"), as of the Effective Date stated below.

WHEREAS, King County owns, operates, and maintains a wastewater collection and treatment system that serves a population of approximately 1.8 million residents within a 424-square-mile service area; and

WHEREAS, King County's wastewater collection and treatment system includes, among other components, the West Point Wastewater Treatment Plant ("WPTP") in the City of Seattle, four combined sewer overflow ("CSO") treatment plants in Seattle (Alki, Carkeek, Elliott West, and MLK/Henderson), and their associated separate sanitary sewer system and combined sanitary and stormwater sewer systems; and

WHEREAS, the Suquamish Tribe ("Tribe") is a federally recognized Indian Tribe with a governing body recognized by the United States Secretary of the Interior, is located on the Port Madison Indian Reservation in Suquamish, Washington in Kitsap County, and is a signatory of the 1855 Treaty of Point Elliott, in which the Tribe forever reserved its right to take fish;

WHEREAS, since time immemorial and through the present day, the Suquamish Tribe and its members engage in subsistence, cultural, and commercial harvesting of finfish and shellfish throughout the adjudicated usual and accustomed fishing area of the Suquamish Tribe ("U&A"), which encompasses Elliott Bay and other parts of Puget Sound into which King County's wastewater collection and treatment system discharges; and

WHEREAS, the Tribe sent a 60-day notice of intent to sue letter ("NOI") to King County and, in their official capacities, the King County Executive, King County Department of Natural

Resources Director, and King County Wastewater Treatment Division Director on July 20, 2020, and followed up with a supplemental NOI on February 8, 2021, a second supplemental NOI on March 19, 2021, and a third supplemental NOI on July 19, 2021 (collectively, "NOIs"); and

WHEREAS, the Tribe indicated in the NOIs that it intended to sue the County under Section 505 of the Clean Water Act ("CWA"), 33 U.S.C. § 1365, and alleged that the County has violated the CWA by discharging pollutants, including untreated or improperly treated sewage, from its wastewater collection and treatment system (including WPTP, Elliott West CSO treatment plant, and Alki CSO treatment plant) into navigable waters, which includes the Tribe's U&A, not in accordance with the terms and conditions of its National Pollutant Discharge Elimination System ("NPDES") permit and in violation of Section 301 of the CWA. 33 U.S.C. §§ 1311(a), 1342; and

WHEREAS, the Parties share the goal to protect human health and the environment and to protect the Tribe's treaty-reserved right to take fish and to engage in tribal cultural events without interference; and

WHEREAS, the County acknowledges that sewage spill events from its wastewater collection and treatment system into the Tribe's U&A has impacted the Tribe's treaty-reserved right to take fish, has impacted tribal cultural events, and has the potential to impact the Tribe's treaty rights in the future; and

WHEREAS, the County does not admit any liability to the Tribe arising out of the transactions or occurrences alleged in the Tribe's NOIs; and

WHEREAS, the Parties recognize that this Settlement Agreement ("Agreement") has been negotiated by the Parties in good faith to avoid litigation between the Parties; and

WHEREAS, this Agreement is fair, reasonable, and in the public interest.

NOW, THEREFORE, the Parties agree as follows:

## I. DEFINITIONS

1. Terms used in this Agreement that are defined in the CWA, the CWA's implementing regulations, or the County's NPDES Permit shall have the meanings assigned to them under those authorities, unless otherwise provided in this Agreement. Whenever the terms set forth below are used in this Agreement, the following definitions shall apply:

a. "Agreement" shall mean this Settlement Agreement Between the Suquamish Tribe and King County, Washington. All appendices listed in Section XV and any future modifications to the Agreement or appendices made under Section XII are incorporated in the Agreement by this reference.

b. "Authorized Representative" shall mean the definition provided in Paragraph 55.

c. "Combined Sewer Overflow" or "CSO" as used in this Agreement shall mean any discharge from the County's CSO Outfalls as a result of precipitation.

d. "Completion Date" as used in this Agreement shall mean the definition provided in Paragraph 62.

e. "Construction Completion" as used in this Agreement shall mean completion of construction, installation, or optimization of equipment or infrastructure such that equipment or infrastructure has been placed in operation and is expected to both function and perform as designed, as well as completion of operations and maintenance manuals for the equipment or infrastructure installed under this Agreement. Construction Completion specifically includes all control systems, electrical systems, and instrumentation necessary for normal WPTP operations and all residual handling systems.

f. "County" or "King County" shall mean King County, Washington.

g. "Day" shall mean a calendar day unless expressly stated to be a business day. In computing any period of time under this Agreement, where the last calendar day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the close of business of the next business day.

h. "Effective Date" shall mean the definition provided in Paragraph 61.

i. "Effluent Pump Station" or "EPS" as used in this Agreement shall mean the pump station that conveys secondarily treated and disinfected effluent from West Point Treatment Plant for discharge to Puget Sound.

j. "Elliott West CSO Treatment Plant" shall mean the combined sewer overflow treatment plant located at 545 Elliott Avenue West, Seattle, Washington, 98119, which is owned and operated by King County.

k. "Emergency Bypass Event" as used in this Agreement shall mean any discharge from the West Point Treatment Plant's emergency outfall.

l. "Force Majeure" as used in this Agreement shall mean the definition provided in Section VI.

m. "Influent Control Structure" or "ICS" as used in this Agreement shall mean the structure at West Point Treatment Plant that receives influent flows from the Wastewater Collection System and distributes influent flows to the raw sewage pump wet well.

n. "Intermediate Pump Station" or "IPS" as used in this Agreement shall mean the pump station that conveys primary treated wastewater to the secondary treatment process at WPTP.

o. "Material Alteration" as used in this Agreement shall mean the definition provided in Paragraph 13.

p. "NPDES Permit" as used in this Agreement shall mean the King County Wastewater Treatment Division – West Point Wastewater Treatment Plant & Combined Sewer Overflow System National Pollutant Discharge Elimination System Permit, No. WA0029181, issued by the State of Washington Department of Ecology on December 19, 2014, for the County's West Point Wastewater Treatment Plant & Combined Sewer Overflow System, or such permits that succeed this permit covering the County's West Point Wastewater Treatment Plant & Combined Sewer Overflow System issued and in effect at a relevant time under this Agreement.

q. "Paragraph" shall mean a portion of this Agreement identified by an Arabic numeral.

r. "Parties" shall mean the Suquamish Tribe and King County.

s. "Party" shall mean the Suquamish Tribe or King County.

t. "Section" shall mean a portion of this Agreement identified by a Roman numeral.

u. "Uninterruptible Power Supply" or "UPS" as used in this Agreement shall mean an electrical supply system that provides power in emergency situations when the primary Seattle City Light utility power source fails due to voltage sags or brief power interruptions.

v. "Variable Frequency Drive" or "VFD" as used in this Agreement shall mean the controls connected to pump motors that control pump motor speeds.

w. "Variable Frequency Drive Optimization" or "VFD Optimization" as used in this Agreement shall mean revision of VFD protective threshold set points to maximize the ability of a pump to continue normal operation during a voltage sag and not begin a protective pump shutdown process.

x. "Wastewater Collection System" shall mean the collection and conveyance system owned or operated by the County, including all pipes, force mains, gravity sewer segments, pump stations, lift stations, interceptors, diversion structures, maintenance holes, and appurtenances thereto, designed to collect and convey municipal sewage (including residential, commercial, and industrial wastewaters, and storm water) to West Point Treatment Plant, CSO treatment plants, or to a permitted CSO Outfall.

y. "West Point Treatment Plant" or "WPTP" shall mean the wastewater treatment plant located at 1400 Discovery Park Blvd., Seattle, WA 98199, which is owned and operated by King County.

## II. TRIBAL MITIGATION

2. The Tribe shall establish a Tribal Mitigation Fund for the purpose of receiving mitigation payments from the County under this Agreement. Any funds received by the Tribe from the County shall be unrestricted and managed solely at the Tribe's discretion.

3. The County shall transmit a payment of $2.5 million to the Tribe to provide compensation for Tribal impacts for the past five years and any Tribal impacts for an additional three years, through December 31, 2024, within thirty (30) days from the Effective Date of this Agreement.

4. Beginning on January 1, 2025 and continuing through December 31, 2026, the County shall pay $50,000 to the Tribe's Tribal Mitigation Fund for any Emergency Bypass Event, regardless of the volume of the Emergency Bypass Event. The County shall transmit each payment to the Tribe no later than sixty (60) days after the day on which the Emergency Bypass Event began.

5. Beginning on the Effective Date of the Agreement and until the Completion Date of the Agreement, the County shall report all Emergency Bypass Events to the Tribe within three (3) days from the day on which the Emergency Bypass Event began. The report shall include: the date on and time at which the Emergency Bypass Event began and ended; the total number of gallons discharged (including how many gallons were discharged on each day if the Emergency Bypass Event spans more than one calendar day); and the cause of the Emergency Bypass Event. The County shall also promptly provide the Tribe any investigation reports that may be completed regarding any Emergency Bypass Event.

## III. SUPPLEMENTAL ENVIRONMENTAL PROJECT

6. The County shall fund one or more Supplemental Environmental Projects ("SEPs") in the amount of $2.4 million.

7. Within ninety (90) days of the Effective Date of the Agreement, the Parties shall cooperatively determine which SEP(s) will be funded from the list in Paragraph 8, describe in writing the goal(s) for each SEP to be funded under this Section III, identify the entity or entities that will be awarded the funds to complete the SEP(s) (i.e., "implementing entity"), determine the amount of SEP funds that each such entity will be awarded to complete the SEP(s), and establish the reporting requirements that each such entity shall have to the Parties.

8. The Parties shall mutually agree to choose one or more SEPs from the following list:

   a. **Nearshore Habitat Restoration Project 1:** Restoration of Boeing Creek mouth and delta

   b. **Nearshore Habitat Restoration Project 2:** Perkins Lane protection and restoration (e.g., acquire properties; remove bulkheads; restore feeder bluff that supports nearshore habitat, including eelgrass and kelp)

c. **Kelp and Eelgrass Research and Monitoring in Central Puget Sound Support:**

i. Build capacity for monitoring expanded network of kelp index sites (e.g., train divers in survey protocols; develop data management systems and coordination; document and report on findings and trends);

ii. Expand lab capacity for banking and production of kelp seeds at NOAA's Manchester Lab; and/or

iii. Fund long-term monitoring of eelgrass conditions in Central Puget Sound.

d. **Other Related Project**: By mutual agreement of the Parties, a project not listed in this paragraph may be identified and/or selected for implementation as a SEP.

9. The Parties shall jointly identify and jointly select the appropriate implementing entity or entities, which shall have specific expertise to implement the SEP(s) selected from Paragraph 8.

10. All funds paid to the entity or entities selected under Paragraph 9 to implement the SEP project(s) shall be restricted to efforts to achieve completion of the SEP project(s) identified under Paragraph 8.

11. The County shall arrange for each implementing entity selected under Paragraph 9 to submit to the County and the Tribe a proposed plan and timeline for completion of the SEP project(s) for which that entity was selected. Within sixty (60) days from receipt of such plan and timeline, the County and the Tribe may provide comments on the proposed plan and timeline to the submitting entity. Within sixty (60) days of receipt of the comments from the Parties, the final plan and timeline for completion of the SEP project(s), as determined by the entity in coordination with the County and the Tribe, shall be provided to the County and the Tribe.

12. The County shall be responsible for oversight of the entity or entities selected under Paragraph 9 to implement the selected SEP(s).

13. A Material Alteration is any change to the final plan or timeline for a SEP that was provided to the County and the Tribe under Paragraph 11 that decreases the effectiveness of the SEP in achieving the goals identified for that SEP under Paragraph 7 or that delays implementation beyond the deadlines set forth in the final timeline. If a Material Alteration occurs or if the entity implementing the SEP becomes aware that a Material Alteration is likely to occur, the entity implementing the SEP shall notify the County and the Tribe within five (5) days of becoming aware of the Material Alteration or of becoming aware that a Material Alteration is likely to occur. The Parties shall consult and negotiate in good faith with the entity implementing the SEP regarding any Material Alterations or likely Material Alterations and seek to reach agreement as to whether and how to amend the SEP plan or mitigate the effects of the Material Alteration so that the goals identified for that SEP under Paragraph 7 will still be achieved.

14. All SEP projects selected under Paragraph 8 shall be completed no later than five (5) years from the Effective Date of the Agreement unless an extension of time is warranted by a Force Majeure Event or is agreed to by the Parties.

15. The Parties shall include the terms and conditions described in this Section III in any agreement(s) entered into with the entity or entities selected to implement the SEP(s).

16. Nothing in this Section III shall affect the County's payment obligations under Paragraph 6 above.

## IV. INFRASTRUCTURE

### West Point Treatment Plant

17. **Uninterruptible Power Supply ("UPS") Replacement**

a. The County shall replace the UPS (Asset Number 703-UPS01) in the Influent Control Structure ("ICS") at the WPTP, with Construction Completion by September 30, 2022.

b. WPTP has thirty-eight (38) UPSs that currently range in age from two (2) to eighteen (18) years. The useful service life of each UPS is ten (10) years. Within two (2) years of the Effective Date of this Agreement, the County shall achieve Construction Completion for replacement of eleven (11) UPSs at WPTP that have exceeded their useful service life. The UPSs that are either not currently connected to the WPTP alarm and control system (also known as the "Ovation Control System") shall be generally prioritized for replacement first among the eleven (11) UPS that shall be replaced within two (2) years of the Effective Date of this Agreement. Appendix A lists each of the thirty-eight (38) WPTP UPSs, as well as each UPS's useful service life, current age, and whether it is currently tied into the WPTP alarm and control system. Appendix B lists the eleven (11) UPSs that shall be replaced within two (2) years of the Effective Date of this Agreement under this Paragraph 17.b, the general order in which the County anticipates replacing those eleven (11) UPSs, whether each of those eleven (11) UPSs will be connected to the WPTP alarm and control system upon replacement, and how any of those eleven (11) UPSs that will not be connected to the WPTP alarm and control system upon replacement will be otherwise monitored in the future.

c. The County shall develop a written UPS replacement and rehabilitation program for WPTP and provide a copy of the proposed program to the Tribe no later than eighteen (18) months from the Effective Date of this Agreement. The UPS replacement and rehabilitation program shall establish operating condition assessment guidelines; schedules for ongoing UPS condition assessment based on the results of previous UPS condition assessment results, the most recent date of rehabilitation, or the most recent date of replacement; a standard for UPS replacement based on condition assessment results; timeframes for UPS rehabilitation or replacement based on condition assessment results; and a plan to connect any UPS to the WPTP alarm and control system that is not currently connected. The Tribe shall have an opportunity to comment on the UPS replacement and rehabilitation program within forty-five (45) days of receipt of the proposed program. The UPS replacement and rehabilitation program shall go into effect within two (2) years of the Effective Date of this Agreement.

18. **Voltage Sag Mitigation**

a. The County has determined that Variable Frequency Drive Optimization at WPTP within the protective threshold set points of the VFDs and hydraulic capacity of WPTP is feasible and beneficial to maximize the ability of pumps to continue normal operation during a voltage sag and not begin a protective pump shutdown process. The County achieved Construction Completion for the Variable Frequency Drive Optimization for all the IPS and EPS pumps at WPTP on April 14, 2022. All IPS and EPS pumps at WPTP are listed in Appendix C, and the two Technical Memoranda, entitled Replica Simulation Summary and Hydraulic Transient Analysis are available at Appendix D.

b. The County shall install battery-powered UPS for the EPS and IPS capable of maintaining power in the event of a voltage sag or Seattle City Light power interruption requiring automatic transfer of the WPTP power supply to the Broad Street Substation, with Construction Completion by December 31, 2024.

19. **Peak Flow Redundancy**

a. The County shall replace the four existing raw sewage pumps at WPTP with larger capacity, electric motor driven pumps, as recommended in the Jacobs West Point

Treatment Plant, Raw Sewage Pump Replacement Project, Alternatives Analysis Report dated March 2, 2021, with Construction Completion within ten (10) years of the Effective Date of this Agreement.

**Elliott West CSO Treatment Plant**

20. On December 21, 2021, the County completed an alternatives analysis of long-term projects to address unauthorized discharges at the Elliott West CSO Treatment Plant. The alternatives analysis was transmitted to the Tribe on March 4, 2022. The Tribe shall have an opportunity to comment on the Elliott West CSO Treatment Plant alternatives analysis within sixty (60) days of the Effective Date of the Agreement.

## V. STIPULATED PENALTIES FOR FAILURE TO MEET DEADLINES IN SECTION IV (INFRASTRUCTURE)

21. Except as may be altered by Section VI (Force Majeure and Recalculation of Deadlines), the County shall pay the following stipulated penalties to the Tribe's Tribal Mitigation Fund for missing any deadlines established in Section IV within thirty (30) days of each penalty having been incurred. The County shall pay a first-time stipulated penalty of $40,000 for the initial failure to meet each deadline established in Section IV of this Agreement. For continuing delays in meeting the deadlines established in this Agreement, the County shall pay an additional $10,000 to the Tribe's Tribal Mitigation Fund for every month of delay after the initial missed deadline for each project, with the first monthly time period ending thirty-one (31) days after the initial missed deadline, the next monthly time period ending thirty-one (31) days thereafter, and so on, until Construction Completion of the project. For example, if the County does not achieve Construction Completion of a project with a deadline established in this Agreement until sixty-five (65) days after the deadline, the County would pay the Tribal Mitigation Fund $60,000, which would include $40,000 for the initial missed deadline, $10,000 for not achieving

Construction Completion within thirty-one (31) days after that, and $10,000 for not achieving Construction Completion within thirty-one (31) days after that. In this example, the County would not owe any money for the three (3) additional days beyond the first two monthly periods of delay because the County would only owe another $10,000 if the delay extended a full additional thirty-one (31) days beyond the end date of the last monthly period.

## VI. FORCE MAJEURE AND RECALCULATION OF DEADLINES

22. "Force Majeure," for purposes of this Agreement, is defined as any event arising from causes beyond the control of the County, of any entity controlled by the County, or of the County's contractors, that delays or prevents the performance of any obligation under this Agreement, despite the County's making all reasonable efforts to fulfill the obligation. The requirement that the County make "all reasonable efforts to fulfill the obligation" includes using all reasonable efforts to anticipate any reasonably foreseeable Force Majeure events and all reasonable efforts to address the effects of any such event 1) as it is occurring and 2) after it has occurred to prevent or minimize any resulting delay to the greatest extent possible. Force Majeure does not include the County's financial inability to perform any obligation under this Agreement, or the County's failure to approve contracts necessary to meet the requirements of this Agreement.

23. The County's duty to comply with the terms of this Agreement is not contingent upon the receipt of any federal, state, or local funds. The County's failure to comply is not excused by the lack of federal or state grant funds, by the processing of any applications for the same, or by the County's financial capabilities. Application for construction grants, state revolving loan funds, or any other grants or loans, or delays in processing or receipt of federal, state, or local funds caused by inadequate facility planning or plans and specifications on the part of the County shall

not be the cause for extension of any deadline established in this Agreement. In no circumstances shall the County's failure to obtain federal, state, or local funds constitute a Force Majeure event.

24. To the extent that any U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (DOE), or other permits or approvals are necessary to meet specific requirements of this Agreement, the failure to timely submit a complete application for a required permit or approval, or the failure to timely respond to the relevant permitting agency's requests for additional information, shall not constitute a Force Majeure event. Failure to obtain, or a delay in obtaining, a permit or approval required to fulfill such obligation is a Force Majeure event if the County has submitted a timely and complete application for such permit or approval and has taken all other reasonable actions within the County's control to obtain such permit or approval.

25. If any event occurs or has occurred that may delay the performance of any obligations under this Agreement, whether or not caused by a Force Majeure event, the County shall provide notice orally or by electronic transmission to the Tribe, within ten (10) days of when the County first knew, or, in the exercise of reasonable diligence under the circumstances, should have known, of such event. Within ten (10) days thereafter, the County shall provide in writing to the Tribe an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or effect of the delay; and the County's rationale for attributing such delay to a Force Majeure event if it intends to assert such a claim. The County shall include with any notice all available documentation supporting the claim that the delay was attributable to a Force Majeure event. Failure to comply with the above requirements shall preclude the County from asserting any claim of Force

Majeure for that event for the period of time for such failure to comply, and for any additional delay caused by such failure.

26. If the Tribe agrees that a Force Majeure event has occurred, the Tribe shall agree in writing by letter or email within ten (10) days after receiving the explanation and description of the reasons for the delay under Paragraph 25 from the County to extend the time for the County to perform the obligations under this Agreement that are affected by the Force Majeure event for such time as is necessary to complete those obligations. After further discussion with the County, the Tribe shall notify the County in writing of the length of the extension, if any, for performance of any obligations affected by the Force Majeure event. An extension of time to perform the obligations affected by the Force Majeure event shall not, by itself, extend the time to perform any other obligation under this Agreement.

27. If the Tribe does not agree that the delay or anticipated delay has been or will be caused by a Force Majeure event, or does not agree to the extension of time sought by the County, the Tribe shall notify the County in writing of its decision.

28. The Tribe's written decision shall be binding unless the County invokes the dispute resolution procedures set forth in Section XI (Dispute Resolution) of this Agreement within fifteen (15) days after receipt of the Tribe's written decision. In any such dispute, the County bears the burden of proving by a preponderance of the evidence that 1) each claimed Force Majeure event is a Force Majeure event; 2) the Force Majeure event caused the delay or anticipated delay that the County claims is or was attributable to that Force Majeure event; 3) the County exercised reasonable efforts to prevent or minimize any delay caused by the event and the effects of such delay; 4) the duration of the delay or the extension sought was or will be warranted under the circumstances; and 5) the County complied with the requirements of

Paragraphs 23-28 above. If the County carries this burden, then the delay at issue shall not be deemed a violation of this Agreement and no stipulated penalties shall be due for the delay caused by the Force Majeure event.

## VII. REPORTING

29. The County shall provide the Tribe a written annual report each year starting in 2023 and ending in the year immediately after the Completion Date of this Agreement. The annual report shall describe the progress made between January 1st and December 31st of each calendar year on each of the items required by Section IV of the Agreement. The annual report shall include at a minimum: 1) the status of all projects described in Section IV; 2) any problems anticipated or encountered, along with the proposed or implemented solutions; 3) a description of any non-compliance with the requirements of this Agreement and an explanation of the likely cause and duration of the violation and any remedial steps taken, or to be taken, to prevent or minimize such violation; and a summary of whether the County believes it will be able to achieve Construction Completion for each of the items required by Section IV of the Agreement by the deadline established in this Agreement. Appendix E includes a complete list of the deadlines established in this Agreement. The report shall be transmitted to the Tribe no later than January 31st of the following year, beginning on January 31, 2023.

30. Within seven (7) days of each deadline established in Section IV of the Agreement, and as may be modified under Section VI and Paragraph 46, the County shall report to the Tribe whether the project associated with that deadline has achieved Construction Completion. If the project has not been completed by that deadline, the County shall include in the report an explanation of the cause of the violation, an estimated date for Construction Completion, and a description of the steps being taken to ensure the estimated date for Construction Completion

will be met. The County shall continue to make such reports to the Tribe on a monthly basis following the missed deadline until the project has been completed.

## VIII. ATTORNEY AND EXPERT FEES AND COSTS

31. The County shall pay $240,000 to the Tribe's Tribal Mitigation Fund for the Tribe's attorney and expert fees and costs within thirty (30) days of the Effective Date of this Agreement.

## IX. NOTICE AND PAYMENT INFORMATION

32. Notices, reports, demands, or other communications required under this Agreement shall be in writing. The sending Party may use any of the following methods for delivery: (1) email; (2) registered or certified mail, with return receipt requested and postage prepaid; (3) personal delivery; or (4) a nationally recognized overnight courier service, with proof of delivery and all fees prepaid. To be valid, the notice, report, demand, or other communication, must be delivered to the receiving Party at the addresses listed below.

**If to the Suquamish Tribe:**

The Suquamish Tribe
c/o Director, Office of Tribal Attorney
P.O. Box 498
Suquamish, WA 98392

Email: mallen@suquamish.nsn.us

**And to:**

Jane Steadman
Kanji & Katzen, P.L.L.C.
811 1st Ave., Suite 630
Seattle, WA 98104

Email: jsteadman@kanjikatzen.com

**If to King County:**

King County
Director, Wastewater Treatment Division
201 South Jackson Street, Suite 505
Seattle, WA 98104-3855

Email: kgurol@kingcounty.gov

**And to:**

Verna P. Bromley, Sr. Deputy Prosecuting Attorney
King County Prosecuting Attorney's Office, Civil Division
1191 2nd Avenue, Suite 1700
Seattle, WA 98101

Email: Verna.Bromley@kingcounty.gov

A notice, report, demand, or other communication sent in accordance with this Paragraph 32 will be effective when received if the notice, report, demand, or other communication is received by 5:00 p.m. on a business day. If the notice, report, demand, or other communication is received at 5:01 p.m. or after on a business day, or if the communication is received on a non-business day, then the notice, report, demand, or other communication shall be deemed to have been received at 9:00 a.m. on the next business day.

33. A Party may change its address for purposes of Paragraph 32 through written notice given to the other Party in the manner provided in this Section IX.

34. All payments to the Tribe, including the payments described at Paragraphs 3 and 4 (Tribal Mitigation), 21 (Stipulated Penalties for Failure to Meet Deadlines), and 31 (Attorney and Expert Fees and Costs), shall be made by wire or by check payable to "The Suquamish Tribe" with reference to "King County Settlement – Tribal Mitigation Fund." Checks shall be mailed to:

The Suquamish Tribe
c/o Finance Director

P.O. Box 498
Suquamish, WA 98392

## X. APPLICABILITY

35. The provisions of this Agreement shall apply to and be binding upon the Suquamish Tribe, the County, and their respective officers, directors, agents, administrators, employees, successors, and assigns.

36. For any public works construction and architect, engineering or professional services (AEP) contracts entered into, after the Effective Date, in order to meet the requirements described in Sections III and IV, the County shall make the contractors, major equipment vendors, and consultants of those contracts aware of the relevant provisions of the Agreement, including the Agreement's provisions regarding Force Majeure (Paragraph 22) and Stipulated Penalty (Paragraph 21).

37. Any action taken by any entity retained by the County to implement the County's obligations under this Agreement shall be considered an action of the County for purposes of determining compliance with this Agreement. In any action to enforce this Agreement, the County shall not raise as a defense the act or failure to act by any of its officers, directors, agents, administrators, employees, successors, assigns, major equipment vendors, consultants, or contractors.

## XI. DISPUTE RESOLUTION AND ENFORCEMENT

38. Any dispute arising between the Parties under this Agreement shall be initiated by a Party sending a complaint letter to the other Party. The complaint letter must include the basis for the Party's complaint and the Party's suggested solution to resolve the dispute. The responding Party shall have five (5) business days from the date of receipt of such letter to respond in writing and

shall provide at least one alternate solution to the dispute if the suggested solution is unacceptable. The Parties shall seek to settle the dispute through direct discussions within a period of not less than five (5) business days following the complaining Party's receipt of the responding Party's response. The Parties' principals (e.g., County Executive and Tribal Chairman or their designees) shall have at least one face-to-face meeting within the time set aside above for direct discussion.

39. If direct discussions fail to resolve the dispute, either Party may request that the Parties enter mediation. Any such mediation is voluntary and non-binding. Within five (5) business days after a Party requests mediation in writing, the other Party must state whether it consents to mediation. If the Parties agree to mediation, the Parties shall select a mediator that is mutually agreed upon by the Parties, and if no agreement can be reached, then by a single mediator selected by Judicial and Mediation Services, Inc, Seattle, Washington office (J.A.M.S.) or a similar service in Seattle, Washington. Any mediator selected shall have at least ten (10) years of legal experience in contract, construction, and environmental law. Either Party may end the mediation at any time upon written notice to the other Party and the mediator.

40. If the Parties are unable to resolve the dispute through direct discussions or through mediation, a Party may invoke and demand binding arbitration to be conducted virtually or at a location agreeable to both Parties. Within five (5) business days after the Party invoking arbitration provides written notice to the other Party of the arbitration demand, the Parties shall select a single arbitrator mutually agreed upon by the Parties, and if no agreement can be reached, then by a single arbitrator selected by Judicial and Mediation Services, Inc, Seattle, Washington office (J.A.M.S.) or a similar service in Seattle, Washington. Any arbitrator selected shall have at least ten (10) years of legal experience in contract, construction, and environmental

law. The arbitration shall proceed using mutually agreed upon procedures, or if agreement cannot be reached, then the Commercial Dispute Resolution Procedures of the American Arbitration Association, excepting AAA Rule R-50(c).

41. An arbitration award against the County shall be enforceable in federal court or if federal court jurisdiction is not available, the Tribe agrees to submit to King County Superior Court in Washington for enforcement of an arbitration award against the County. An arbitration award against the Tribe may only be enforced in the Suquamish Tribal Court. Provided, however, that any court enforcing an arbitration award shall not modify, correct, alter, or vacate the arbitrator's decision in any way unless the court finds after notice and hearing upon the application of a Party, one or more of the following: 1) the arbitration decision was procured by corruption, fraud or undue means, 2) there was evident corruption in the arbitrator, or 3) the arbitrator was guilty of the specific misconduct of refusing to hear evidence pertinent and material to the controversy which prejudiced the rights of a Party. If the court vacates the arbitration decision, the parties shall re-arbitrate the dispute before a new arbitrator to be chosen in the manner provided in Paragraph 40. The terms contained in this Section XI are based on the particular circumstances of this matter and will not establish any precedent as to the form or substance of any other agreement or be used as a basis to seek or justify similar terms in any subsequent matter.

42. Nothing in this dispute resolution provision or this Agreement shall constitute nor shall be construed as a waiver of the Tribe's sovereign immunity except to the extent that the Tribe consents to binding arbitration and enforcement of the arbitration award only as provided in Suquamish Tribal Court.

43. The arbitrator shall award the substantially prevailing Party its reasonable attorney fees and costs.

44. Federal law, Suquamish Tribal law, and Washington contract law shall govern the interpretation of this Agreement in that order of preference.

45. Nothing in this Section XI relieves either Party of fulfilling its obligations under the Agreement, including but not limited to adherence to deadlines established under Section IV (Infrastructure), during the pendency of any dispute.

## XII. MODIFICATION

46. This Agreement, including any attached Appendices, may be modified only in writing and must be signed by both Parties.

47. The Parties have carefully developed the type and scope of infrastructure projects included in Section IV of this Agreement to address specific water quality concerns. If events outside of the Parties' control could materially decrease the effectiveness of the infrastructure improvements agreed to between the Parties in achieving those goals, the Parties agree to consult regarding whether any modification of the Agreement may be warranted.

## XIII. EFFECT OF SETTLEMENT AGREEMENT

48. This Agreement is intended to be and will constitute the exclusive remedy and final resolution of any and all civil claims, including without limitation, claims of violations of the Clean Water Act, whether known or unknown, asserted or unasserted of the Tribe against the County which occurred before the Effective Date of this Agreement, including the alleged violations set forth in or arising out of the transactions or occurrences alleged in the Tribe's NOIs.

49. For a period of five years, ending on December 31, 2026, the Tribe releases and agrees not to sue the County or its officers, directors, administrators, or employees for any claim, demand, or cause of action arising under the CWA or any other federal, state or common law that arise from an Emergency Bypass Event at WPTP, another unauthorized bypass at WPTP, a violation of the NPDES Permit, or a numeric effluent violation at Elliott West CSO Treatment Plant or Alki CSO Treatment Plant. This release and agreement not to sue includes but is not limited to claims for civil penalties, attorneys' fees and costs, and declaratory or injunctive relief.

50. Neither this Agreement, nor the terms thereof, nor performance of the terms thereunder by the County shall constitute or be construed as an admission or acknowledgement by the County of the factual or legal assertions contained in this Agreement or in the Tribe's NOIs. The County retains the right to controvert in any subsequent proceedings, other than proceedings for the purpose of implementing or enforcing this Agreement, the validity of the facts or determinations contained in this Agreement or in the NOIs. Neither this Agreement, nor the terms herein, nor the performance of the terms herein, shall constitute or be construed as an admission or acknowledgement by the County of any liability, or an admission of violation of any law, by the County or by its officers, directors, administrators, or employees.

51. The Agreement is conditioned upon the approval of the King County Council and the Suquamish Tribal Council. The Authorized Representative's signature executing this Agreement on behalf of each Party constitutes a warranty that the respective council of that Party has duly approved the Agreement.

52. The Tribe does not, by its consent to this Agreement, warrant or aver in any manner that the County's compliance with any aspect of this Agreement will constitute or result in compliance with the provisions of the Clean Water Act, 33 U.S.C. §§ 1251-1387, or with any

federal, state, tribal, or local laws, regulations, permits, or treaties. The County shall remain responsible for compliance with the terms of the CWA and its implementing regulations, applicable state law and regulations, its NPDES Permit, all relevant orders, and this Agreement. The pendency or outcome of any proceeding concerning issuance, reissuance, or modification of any NPDES Permit shall neither affect nor postpone the County's duties and obligations as set forth in this Agreement.

53. This Agreement does not limit or affect the rights of the Parties against any third parties not party to this Agreement. This Agreement shall not be construed to create rights in, or grant any cause of action to, any third party not party to this Agreement.

## XIV. MISCELLANEOUS PROVISIONS

54. **Entire Agreement.** This Agreement and its Appendices constitute the final, complete, and exclusive agreement and understanding among the Parties with respect to the settlement embodied in the Agreement and supersedes all prior agreements and understandings, whether oral or written, pertaining to the settlement embodied herein. Other than the deliverables subsequently submitted and approved pursuant to this Agreement and incorporated herein, no other document, nor any representation, inducement, agreement, understanding, or promise constitutes any part of this Agreement or the settlement it represents.

55. **Authorized Representative.** Each undersigned representative of the County and the Tribe certifies that he or she is fully authorized to enter into the terms and conditions of this Agreement and to execute and legally bind the Party he or she represents to this Agreement.

56. **Interpretation.** The provisions contained herein shall not be construed in favor of or against any Party because that Party or its counsel drafted this Agreement, but shall be construed as if all Parties prepared this Agreement, and any rules of construction to the contrary are hereby

specifically waived. The terms of this Agreement were negotiated in good faith and at arm's length by the Parties hereto.

57. **Headings.** The Section and Paragraph headings contained in this Agreement are for reference purposes only and shall not affect in any way the meaning or interpretation of this Agreement.

58. **Counterparts.** This Agreement may be signed in counterparts.

59. **Severability.** In the event that any of the provisions of this Agreement are held by an arbitrator or a court of competent jurisdiction to be unenforceable, the validity of the enforceable provisions shall not be adversely affected.

## XV. APPENDICES

60. The following documents are attached to and incorporated into this Agreement:

a. APPENDIX A: List of All WPTP UPSs

b. APPENDIX B: List of WPTP UPSs To Be Replaced Within Two Years of Effective Date of Agreement

c. APPENDIX C: List of WPTP IPS & EPS For Which Variable Frequency Drives Optimized

d. APPENDIX D: Technical Memoranda entitled Replica Simulation Summary and Hydraulic Transient Analysis

e. APPENDIX E: Deadlines in the Agreement

## XVI. EFFECTIVE DATE AND COMPLETION DATE

61. The Effective Date of this Agreement shall be the date upon which this Agreement has been executed by an Authorized Representative of each Party.

62. The Completion Date of this Agreement shall be the date upon which all SEP(s) selected under Paragraph 8 have been completed and all projects described in Section IV have achieved

Construction Completion, or the date upon which any disputes regarding whether such projects have achieved Construction Completion are finally resolved, whichever is later.

IN WITNESS WHEREOF, the undersigned party has caused this Agreement to be executed as of the date set forth below.

FOR THE SUQUAMISH TRIBE

_____________________________ DATE: ______________________

Leonard Forsman, Chairman
The Suquamish Tribe
18490 Suquamish Way
Suquamish, WA 98392

IN WITNESS WHEREOF, the undersigned party has caused this Agreement to be executed as of the date set forth below.

FOR KING COUNTY, WASHINGTON

____________________________ DATE: ______________________

Dow Constantine, Executive
King County
401 5th Ave. Suite 800
Seattle, WA 98104

## APPENDIX A: List of All WPTP UPSs

| Asset Number | Description | Install Date | Projected End of Life | Ovation Monitored (Y/N) |
|---|---|---|---|---|
| 701-UPS01 | UPS ADM BLDG SCS | 1/1/2003 | 1/1/2013 | Y |
| 703-UPS01 | UPS ICS STRUCTURE | 1/1/2003 | 1/1/2013 | Y |
| 708-UPS1510C | UPS 708-LCP1510 | 12/1/2003 | 12/1/2013 | N |
| 702-UPS02 | UPS PACTEAM SHOP PWR MON COMPUTER | 12/1/2003 | 12/1/2013 | N |
| 707-UPS02 | UPS EPS SCS RCON | 6/29/2007 | 6/29/2017 | N |
| 715-UPS1410 | UPS FOR 715-LCP1410, GBT SOLIDS HANDLING | 6/29/2007 | 6/29/2017 | N |
| 710-UPS01 | UPS 710-WCNW00001 | 9/15/2008 | 9/15/2018 | N |
| 702-UPS03 | UPS PACTEAM SHOP WCNW00001 | 2/22/2010 | 2/22/2020 | N |
| 708-UPS03 | UPS NORTH DIG POD RCON08 | 6/21/2010 | 6/21/2020 | N |
| 704-UPS01 | UPS RSP FOR VAPORPHASE | 6/20/2011 | 6/20/2021 | Y |
| 707-UPS01 | UPS EPS PLC, ANALYZERS | 6/20/2011 | 6/20/2021 | Y |
| 724-UPS01 | UPS IPS | 6/27/2011 | 6/27/2021 | Y |
| 717-UPS01 | UPS W2E 717-LCP3001 | 1/1/2014 | 1/1/2024 | N |
| 711-UPS02 | UPS 711-WCNW00001 | 5/19/2014 | 5/19/2024 | N |
| 708-UPS02 | UPS SOUTH DIGESTER POD OVATION CONTROL | 7/14/2014 | 7/14/2024 | Y |
| 715-UPS1704C | UPS 715-FP1704 | 11/4/2014 | 11/4/2024 | N |
| 715-UPS1708C | UPS 715-FP1708 | 11/4/2014 | 11/4/2024 | N |
| 715-UPS1711 | UPS 715-LCP1711 | 11/4/2014 | 11/4/2024 | N |
| 715-UPS1712 | UPS 715-LCP1712 | 11/4/2014 | 11/4/2024 | N |
| 715-UPS1716C | UPS 715-FP1716 | 11/4/2014 | 11/4/2024 | N |
| 716-UPSP01 | UPS PANELBOARD | 12/10/2014 | 12/10/2024 | Y |
| 714-UPS1302 | UPS HYPO OVATION | 11/2/2015 | 11/2/2025 | N |
| 715-UPS1702 | UPS SOLIDS BLDG DRIVE RM | 11/3/2015 | 11/3/2025 | Y |
| 715-UPS01 | UPS SOLIDS RCON18 | 1/1/2016 | 1/1/2026 | N |
| 715-UPS1408 | UPS FOR 715-LCP1408, SOLIDS DIG FEED AREA | 9/23/2016 | 9/23/2026 | N |
| 711-UPS01 | UPS OGADS FACP | 2/20/2017 | 2/20/2027 | N |
| 715-UPS1704 | UPS 715-LCP1704 | 2/20/2017 | 2/20/2027 | N |
| 711-UPS1101B | UPS 711-LCP1101 | 3/8/2017 | 3/8/2027 | N |
| 713-UPS01 | UPS CL2 BLDG, ELEC RM | 6/8/2017 | 6/8/2027 | Y |
| 715-UPS1712C | UPS 715-FP1712 | 12/18/2017 | 12/18/2027 | N |
| 718-UPS01 | UPS ACC 3 RCON 16 & 17 | 1/1/2018 | 1/1/2028 | N |
| 711-UPS1101C | UPS 711-LCP1101 | 3/30/2018 | 3/30/2028 | N |
| 711-UPS1101A | UPS 711-LCP1101 | 3/30/2018 | 3/30/2028 | N |
| 715-UPS1713 | UPS 715-LCP1713 | 3/30/2018 | 3/30/2028 | N |
| 715-UPS1714 | UPS 715-LCP1714 | 3/30/2018 | 3/30/2028 | N |
| 710-UPS0601 | AERATION UPS 0601 | 9/5/2018 | 9/5/2028 | Y |
| 710-UPS1601 | AER-UPS OVATION CONTROL BACKUP | 9/23/2018 | 9/23/2028 | Y |
| 704-UPS02 | UPS ACC 1 TELEPHONE ROOM | 7/25/2019 | 7/25/2029 | N |

**APPENDIX B: List of WPTP UPSs To Be Replaced Within Two Years of Effective Date of Agreement**

| Asset Number | Description | Ovation Control System Monitored (Y/N) | Beneficial to Connect to Ovation Control System (Y/N)* | UPS Replacement Priority | Comments |
|---|---|---|---|---|---|
| 701-UPS01 | UPS ADM BLDG SCS | Y | Y | High | New unit received - replacement pending fair weather opportunity |
| 708-UPS1510C | UPS 708-LCP1510 | N | Y | High | |
| 702-UPS02 | UPS PACTEAM SHOP PWR MON COMPUTER | N | Y | High | |
| 707-UPS02 | UPS EPS SCS RCON | N | Y | Medium | |
| 715-UPS1410 | UPS FOR 715-LCP1410, GBT SOLIDS HANDLING | N | Y | Medium | |
| 710-UPS01 | UPS 710-WCNW00001 | N | Y | Medium | |
| 702-UPS03 | UPS PACTEAM SHOP WCNW00001 | N | N | Low | Non-critical; will be independently monitored through routine preventative maintenance checks |
| 708-UPS03 | UPS NORTH DIG POD RCON08 | N | N | Low | Non-critical; will be independently monitored through routine preventative maintenance checks |
| 704-UPS01 | UPS RSP FOR VAPORPHASE | Y | Y | Low | |
| 707-UPS01 | UPS EPS PLC, ANALYZERS | Y | Y | Low | |
| 724-UPS01 | UPS IPS | Y | Y | Low | |

* All UPS marked "Y" in this column shall be connected to the Ovation Control System upon replacement.

Appendix C: List of WPTP IPS & EPS Pumps For Which Variable Frequency Drives Optimized

| Pump Number | Status |
|---|---|
| IPS #1 – 724 – VSD31AC011 | OPTIMIZED |
| IPS #2 – 724 – VSD31AC021 | OPTIMIZED |
| IPS #3 – 724 – VSD31AC031 | OPTIMIZED |
| | |
| EPS #1 – 707 - VSD09AC011 | OPTIMIZED |
| EPS #2 – 707 - VSD09AC021 | OPTIMIZED |
| EPS #3 – 707 - VSD09AC031 | OPTIMIZED |
| EPS #4 – 707 - VSD09AC041 | OPTIMIZED |

# Appendix D:
# Technical Memoranda entitled
# Replica Simulation Summary and
# Hydraulic Transient Analysis

# Replica Simulation Summary

701 Pike Street, Suite 1200
Seattle, Washington 98101
T: 206.624.0100

| | |
|---|---|
| Prepared for: | King County |
| Project Title: | WPTP Power Quality Assessment |
| Contract: | Work Order 03 |
| Project No.: | 156452 |

**Technical Memorandum**

| | |
|---|---|
| Subject: | Replica Simulation Summary and IPS & EPS Pump Engineering Analysis Final |
| Date: | February 15, 2022 |
| To: | Kolby Hoagland/WTD King County; Felix Brandli/WTD King County |
| Reviewed by: | David Kelly, Jacobs; Marc Maisonville, BC |
| From: | Samantha Brittain, BC |
| Copy to: | Petra Liskova, Jacobs |
| | Kevin Stively, BC |

| | |
|---|---|
| Prepared by: | Matt Deavenport, Jacobs |
| | Cameron Isaman, Jacobs |

# Section 1: Introduction

This Technical Memorandum summarizes the Replica modelling efforts to evaluate how the Intermediate Pump Station (IPS) and Effluent Pump Station (EPS) respond during a voltage sag, as well as the results of the engineering EPS and IPS pump analysis relative to proposed changes to Nidec drives that entail a 4.5 percent reduction in power factor. During the SCADA upgrade where the PLCs were replaced with the Ovation distributed control system, a Replica dynamic simulation model of the West Point Treatment Plant was developed, calibrated, and utilized to support control logic modifications at both IPS and EPS. The Replica model includes both hydraulic as well as instrumentation and control aspects of the plant which enabled control logic modifications to be developed, debugged, and tested in a risk-free environment prior to startup of Ovation at IPS and EPS.

## 1.1 Replica Modeling Summary

### 1.1.1 Data Review and Assumptions

Variable Frequency Drive (VFD) ramp rates and Ovation control slew rates were requested to confirm settings in the calibrated Replica model.

#### 1.1.1.1 VFD Ramp Limits Comparison

Comparing existing ramp rates implemented in the calibrated Replica model (Table 1-1) to those provided by Nidec (Table 1-2 and Table 1-3) indicates that the assumed ramp rate limits currently used in the model are more restrictive to speed change. Tables 1-2 and 1-3 also seem inconsistent across the pumps. Most settings are set to a value of 5 RPM/sec (units are assumed) while a few are edited and show rates that are less stringent than currently implemented in the model.

Table 1-1. Ramp Rates in calibrated Replica model

| IPS | | | EPS | | |
|---|---|---|---|---|---|
| Speed (rpm) | Ramp Rate (%/s) | rpm/second | Speed (rpm) | Ramp Rate (%/s) | rpm/second |
| 0 to 80 | 7.3300 | 22.0 | 0 | 27.000 | 81.0 |
| 80 to 300 | 0.5666 | 1.7 | 80 | 0.820 | 2.5 |
| > 300 | 0.5666 | 1.7 | 300 | 0.820 | 2.5 |

| Table 1-2. Ramp Rates at IPS provided by Nidec | | | | | | |
|---|---|---|---|---|---|---|
| | IPS1 | | IPS2 | | IPS3 | |
| | RPM | Limit (rpm/second) | RPM | Limit (rpm/sec-ond) | RPM | Limit (rpm/second) |
| Acceleration | <10 | 5 | <20 | 10 | <20 | 100 |
| | <50 | 5 | <50 | 5 | <50 | 20 |
| | <70 | 5 | <70 | 5 | <70 | 15 |
| | <150 | 5 | <150 | 5 | <150 | 5 |
| | <300 | 5 | <300 | 5 | <300 | 5 |
| | 300+ | 5 | <310 | 5 | <310 | 5 |
| Deceleration | 30 | 5 | 30 | 5 | 30 | 5 |
| | 45 | 5 | 45 | 5 | 45 | 5 |
| | 70 | 5 | 70 | 5 | 70 | 5 |
| | 130 | 5 | 130 | 5 | 130 | 5 |
| | 200 | 5 | 200 | 5 | 200 | 5 |
| | 250 | 5 | 250 | 5 | 250 | 5 |

| Table 1-3. Ramp Rates at EPS provided by Nidec | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | EPS1 | | EPS2 | | EPS3 | | EPS4 | |
| | RPM | Limit (rpm/second) | RPM | Limit (rpm/sec-ond) | RPM | Limit (rpm/second) | RPM | Limit (rpm/sec-ond) |
| Acceleration | <10 | 5 | <10 | 5 | <20 | 100 | <20 | 100 |
| | <50 | 5 | <50 | 5 | <35 | 20 | <35 | 20 |
| | <70 | 5 | <70 | 5 | <70 | 15 | <70 | 15 |
| | <150 | 5 | <150 | 5 | <150 | 5 | <150 | 5 |
| | <300 | 5 | <300 | 5 | <300 | 5 | <300 | 5 |
| | 300+ | 5 | 300+ | 5 | <310 | 5 | <310 | 5 |
| Deceleration | 30 | 5 | 30 | 5 | 30 | 5 | 30 | 5 |
| | 45 | 5 | 45 | 5 | 45 | 5 | 45 | 5 |
| | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 |
| | 130 | 5 | 130 | 5 | 130 | 5 | 130 | 5 |
| | 200 | 5 | 200 | 5 | 200 | 5 | 200 | 5 |
| | 250 | 5 | 250 | 5 | 250 | 5 | 250 | 5 |

#### 1.1.1.2 Ovation Slew Rates Comparison

Comparing the Ovation's controller slew rates provided by WTD (Table 1-5) versus the values in the calibrated Replica model (Table 1-4), the Replica model's settings which were provided by the Emerson programming team and set during startup of Ovation at EPS, are more stringent and restrictive to speed change compared to the updated ramp rates provided by WTD in August of 2021. No slew rates were implemented in the Replica model previously for IPS.

| Table 1-4. EPS Slew Rates set in Replica model during Ovation start-up at EPS | | |
|---|---|---|
| EPS | %/s | Rpm/s |
| Operating ramp rate | 0.75 | 2.25 |
| Startup ramp rate | 0.34 | 1.02 |
| Shutdown ramp rate* | 0.17 | 0.495 |

**Once effluent valve is at 20% and minimum speed achieved (80 rpm), no ramp rate invoked.*

| Table 1-5. Slew rates provided by WTD in August of 2021 | | | |
|---|---|---|---|
| | IPS | EPS | Units |
| Ramp rate limit | 7.5 | 4.5 | rpm/sec |
| Ramp rate when feedback is false | 45 | 3 | rpm/sec |

### 1.1.2 Worst-Case Voltage Sag

WTD reviewed historical events and identified 52 voltage sag events that occurred between April of 2018 and July of 2021. From these 52 events, 5 second data was retrieved and reviewed for 9 events that were identified as significant. WTD and Jacobs reviewed 1-second data of these nine (9) events to determine a worst-case voltage sag. Where data was sufficient to do so, impacts to the VFD speed after a voltage sag were quantified to determine the magnitude and length of time the VFD speed drops during and after a voltage sag occurs.

During the weekly project team meeting on August 26, 2021, it was reported that the output converter section of the VFD would shut down (motor would coast) if the voltage sag caused the line voltage to drop below 66 percent of nominal and that the VFD would fault if the voltage remained below 66 percent of nominal for 3.02 seconds. This statement aligns with what has been observed in the historical data as illustrated in where the pump speed drops over 2 to 3 seconds. Based off the historical data reviewed and discussions, a worst-case voltage sag impact on VFD speed is assumed to be a 62 rpm drop of speed in 4 seconds.

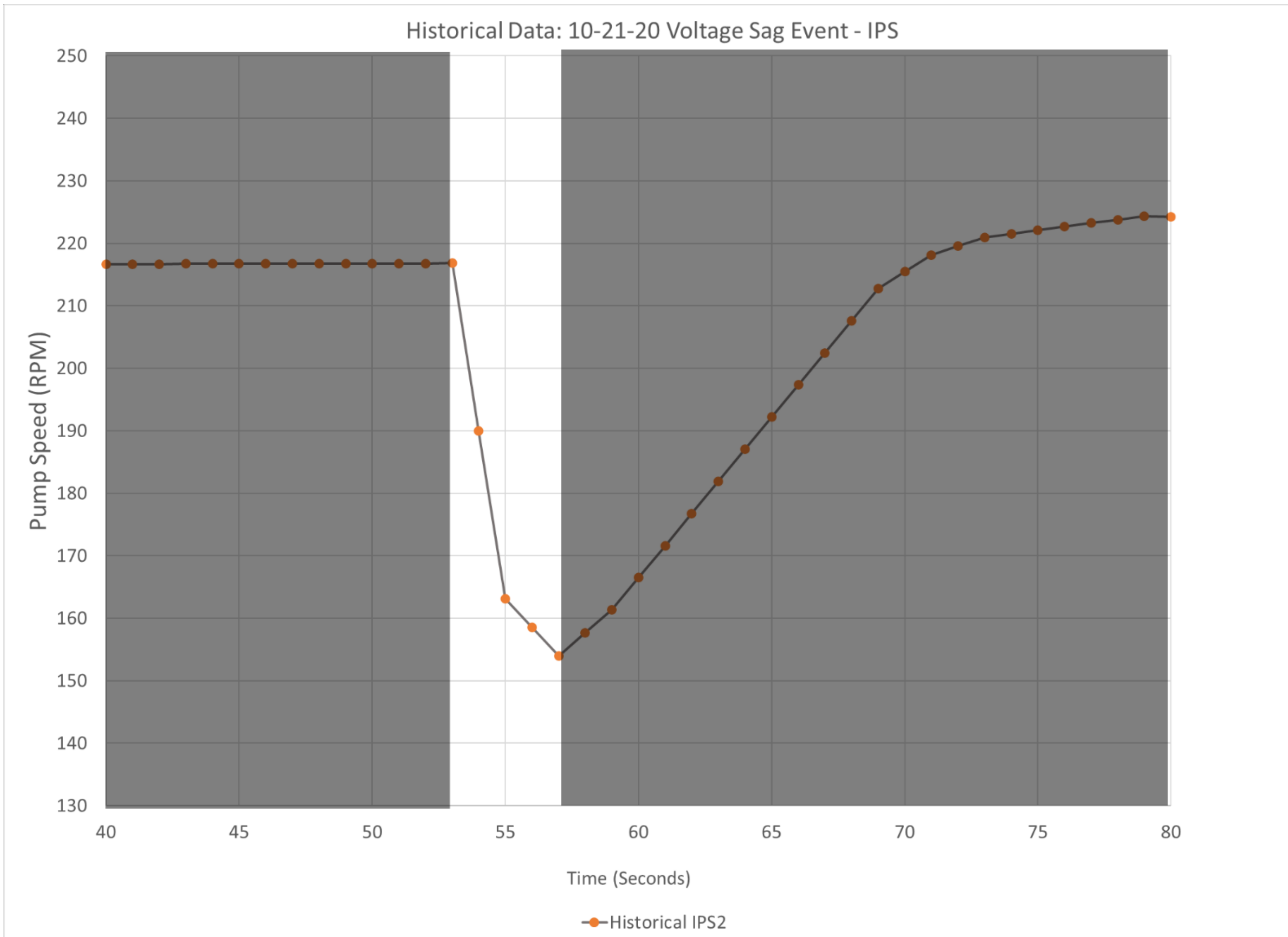



**Figure 1. October 21, 2020, Voltage Sag Event. The pump speed drops rapidly over 2 to 3 seconds and then decreases at a slower rate, followed by recovery.**

### 1.1.3 Model Validation

Two (2) voltage sag events where the VFDs and pumps were able to recover without issue were identified and used for validating the model. These two events which occurred on October 21, 2020, and July 21, 2021, both demonstrate a drop in pump speed and rapid recovery. The October event Figure 2 illustrates how the IPS pump speed (grey line) dropped 62 rpm over 4 seconds and then recovered while the wet-well (yellow line) increased from 111.5 feet to 112.2 feet due to the pump speed drop. As illustrated by the grey line in Figure 3, during the July event the voltage sag induced a slightly smaller VFD speed drop of 50 rpm over 4 seconds.

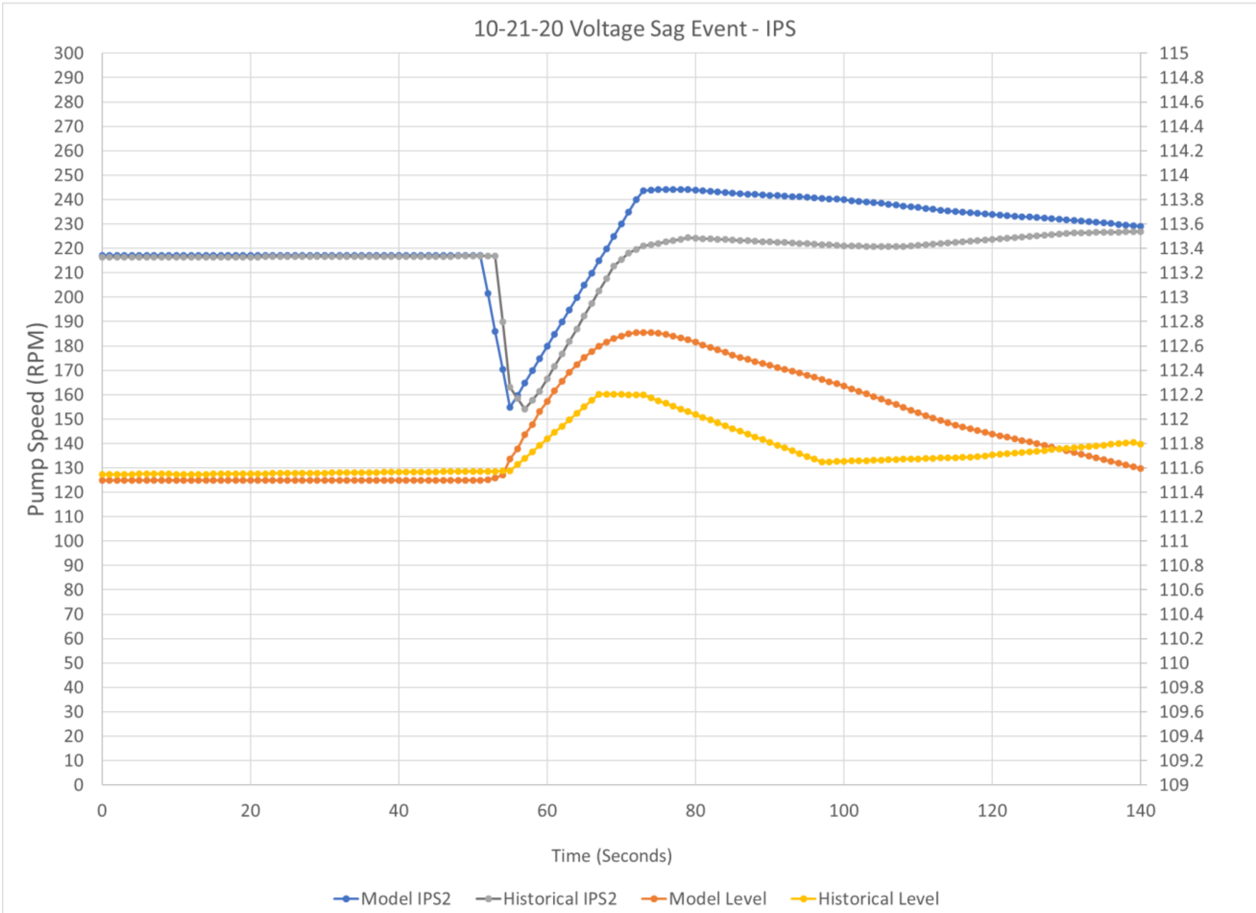



**Figure 2. Model versus historical data for Voltage Sag on October 21, 2020. One IPS pump was online and pumping approximately 100 mgd prior to the voltage sag.**

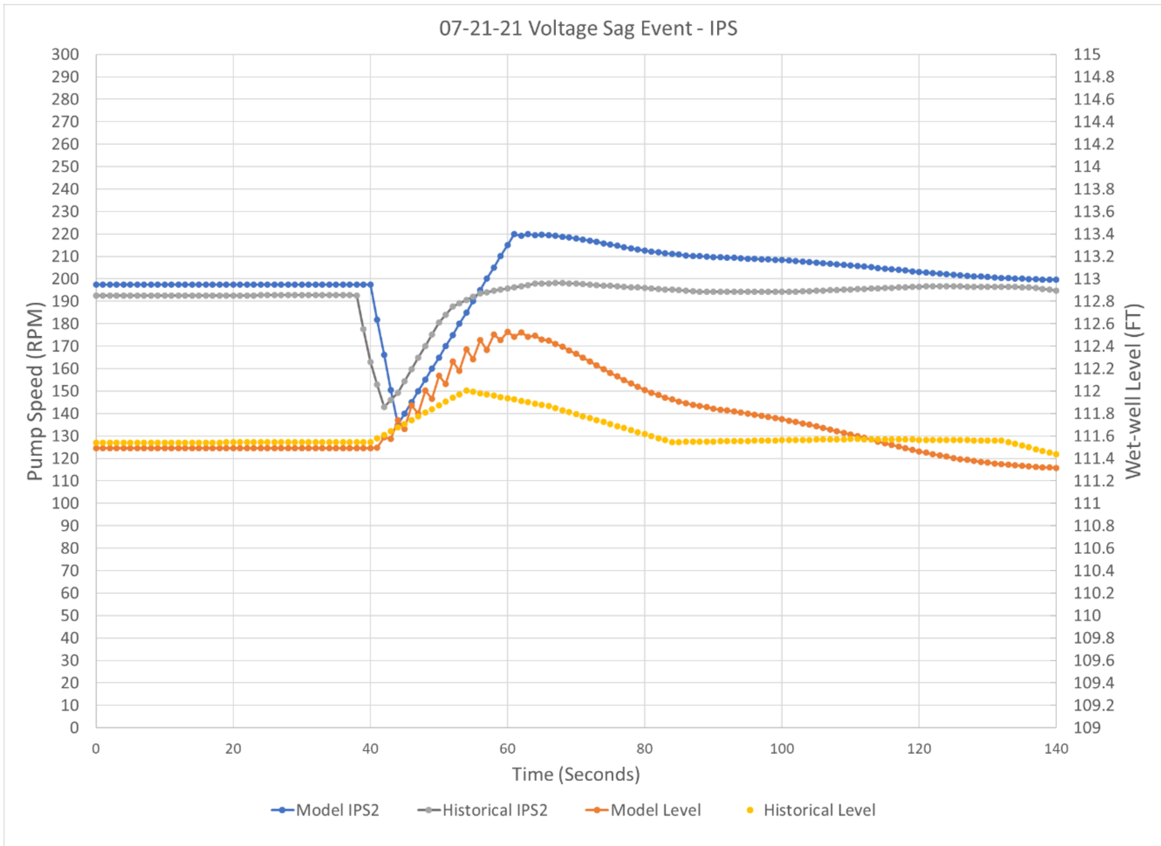



**Figure 3. Model versus historical data for Voltage Sag on July 21, 2021. One IPS pump was online and pumping approximately 65 mgd prior to the voltage sag.**

Both events were simulated at IPS to ensure the Replica model predicts the pump speed drop and recovery similar to what is observed in the data. As illustrated in both Figure 2and **Error! Reference source not found.**, the Replica model closely trends the historical pump speed during the voltage sag. During validation, the recovery speeds were assessed to confirm the VFD ramp limits implemented. Both Figure 2 and Figure 3 show that the historical pump speed (grey line) changed by 5 rpm/second as the pumps recovered. This aligns with the VFD ramp limits provided by Nidec and listed in Table 1-2.

While the pump speeds matched closely to historical data throughout the two events, the model consistently overpredicts the wet-well level increase by approximately 6 inches for both validation scenarios. Given the limited data available to analyze voltage sags during higher flow rates (300 mgd and 440 mgd total effluent flow), this overprediction is considered to be conservative and thus appropriate to predict performance during the worst-case flow scenarios

Data available for EPS did not demonstrate the same voltage sag impacts to pump speeds or wet-well levels. Figure 4 illustrates that the single EPS pump online had a speed drop of 23 rpm with no rise in wet-well level until well after the sag. Indeed, the observed EPS level increase has been found to be due to an anomaly involving EPS discharge control valves, commonly known as Pratt valves, programming which is now being corrected.

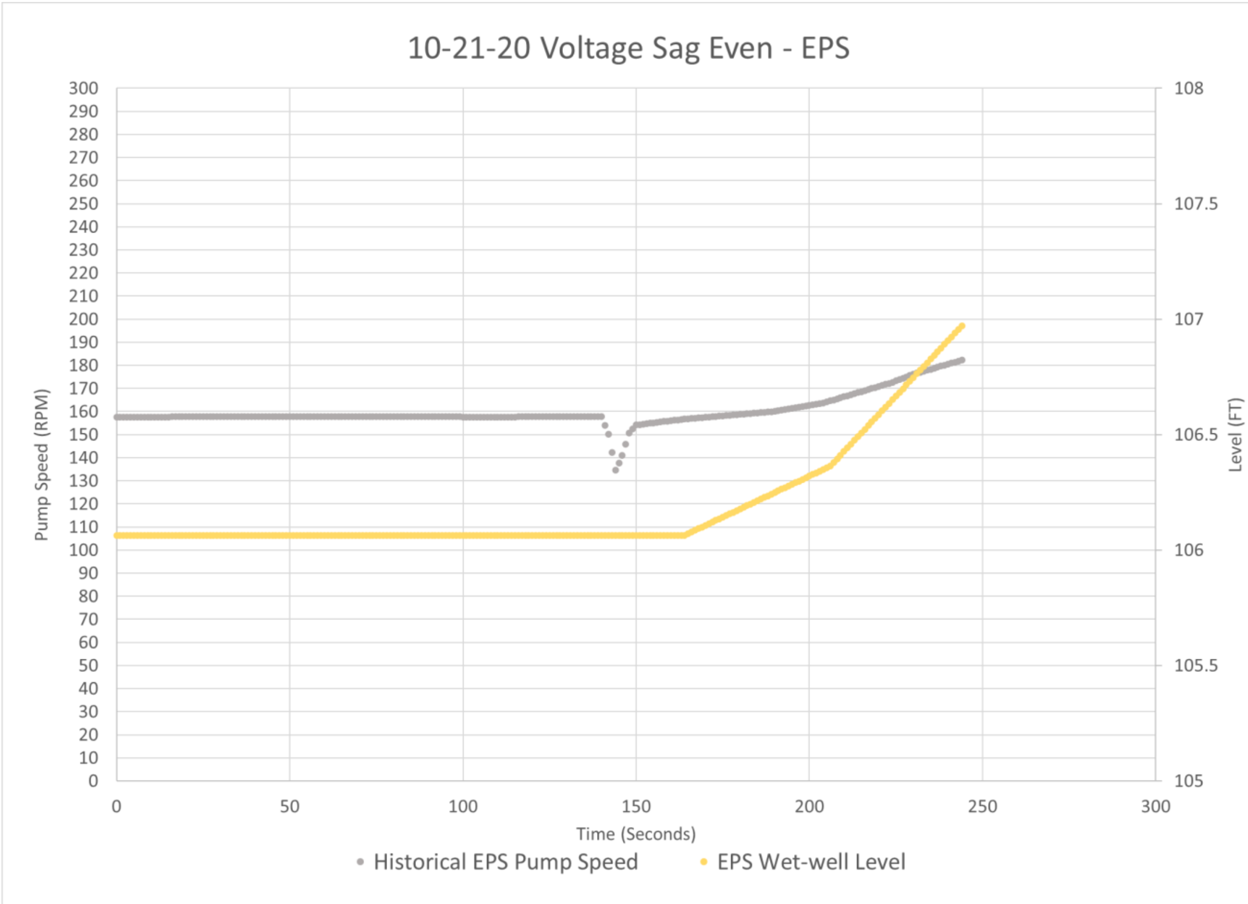



**Figure 4. Historical data of the October voltage sag at EPS.**

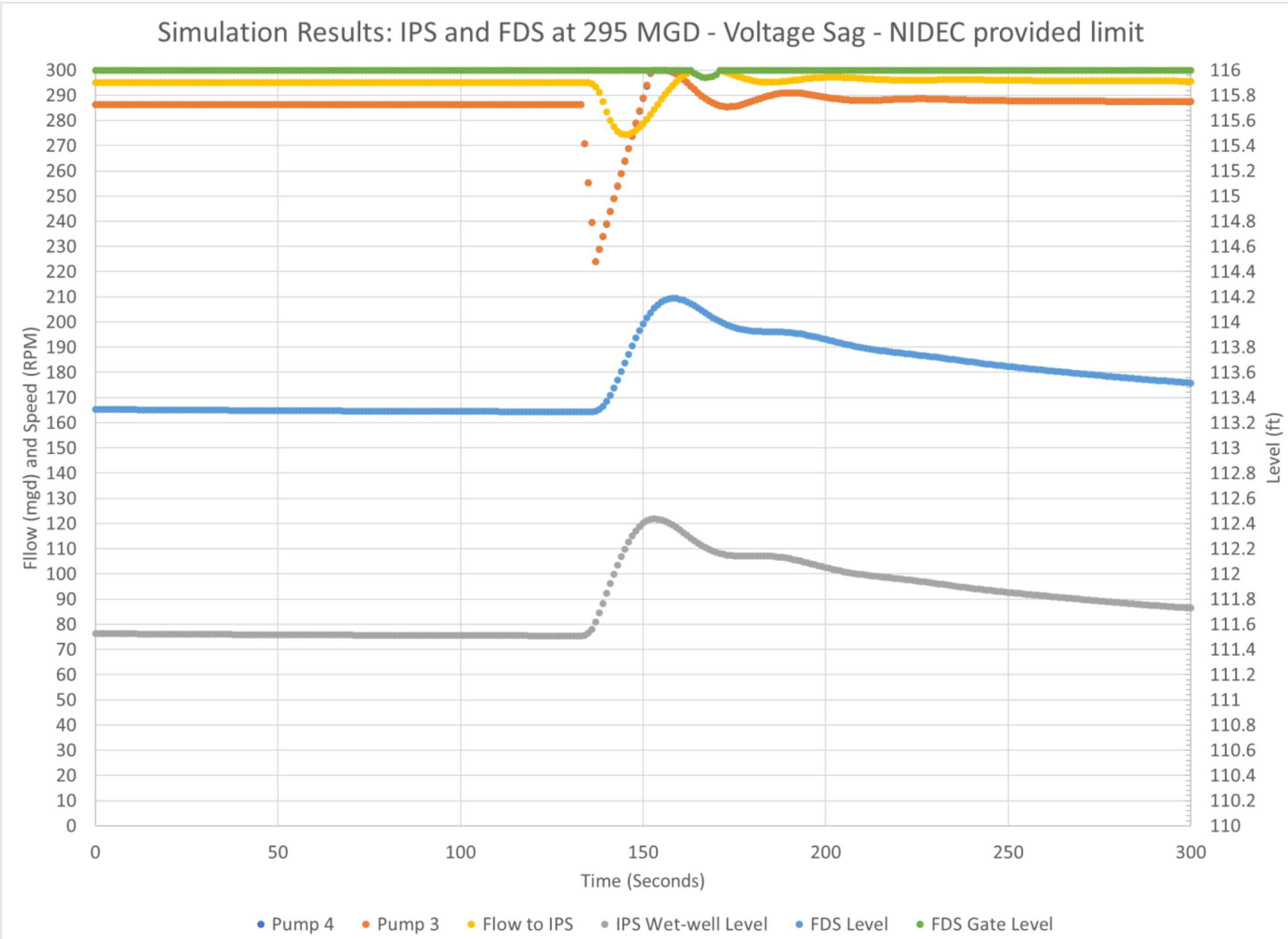
### 1.1.4 Evaluation Results

Four scenarios were analyzed to determine if the IPS and EPS pump stations can recover from a voltage sag before their wet-well level rises above a limit that activates an emergency or non-permitted bypass. For IPS, voltage sags were evaluated with the most restrictive VFD ramp limits, as well as the Nidec provided limits. At EPS, a voltage sag was simulated at a flow of 440 mgd with the most restrictive ramp limits observed. Lastly, IPS was evaluated to determine what magnitude of speed drop can be experienced before the Flow Diversion Structure (FDS) secondary bypass gates open at a flow of 295 MGD.

#### 1.1.4.1 IPS at 295 MGD with Nidec provided ramp rates (5 rpm/s)

During this scenario, a constant influent flow of 295 mgd and a voltage sag inducing a pump speed drop of 62 rpm over 4 seconds for both online pumps was simulated to determine how the IPS wet-well and FDS basin handle the sudden drop in IPS discharge flow. This flow is considered worst-case regarding the risk of unpermitted bypass occurring if the levels force the secondary bypass weirs to open and divert flow below secondary capacity of 300 mgd. The VFD ramp limits provided by Nidec were set in the model.

Figure 5 illustrates how the Replica model predicts the IPS wet-well (grey line) and FDS basin (blue line) both rising by approximately 11 inches during the voltage sag. The secondary bypass weir gates do not engage, and a bypass does not occur.

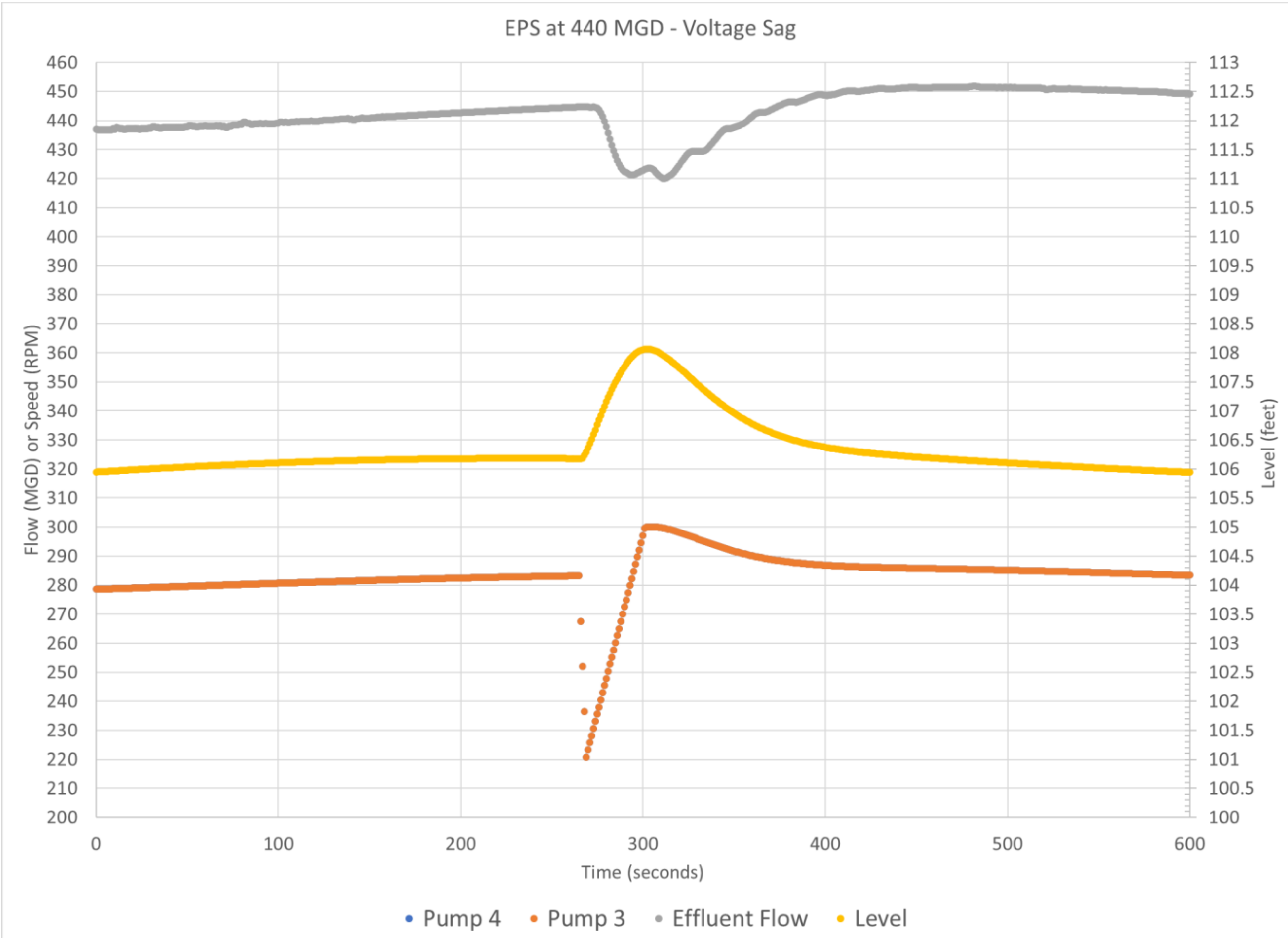



**Pump 4 data is identical to Pump 3 and therefore not visible in figure.*

**Figure 5. IPS response to a voltage sag at 295 mgd with Nidec provided ramp limits**

### 1.1.4.2 EPS at 440 MGD – 62 rpm drop over 4 seconds

Since efforts are still underway to confirm the VFD ramp limits set on the Nidec drives, the more restrictive VFD ramp limits listed for EPS in Table 1-1 as well as the slew rates listed in Table 1-4 were utilized to simulate a worst-case recovery by EPS pumps. This effectively limits speed changes to 2.25 rpm/second. It is assumed that all 3 pumps online experience a speed drop of 62 rpm over 4 seconds (15.5 rpm/s).




**Pump 4 data is identical to Pump 3 and therefore not visible in figure.*

**Figure 6. Voltage sag at EPS during a peak flow of 440 mgd**

As illustrated in Figure , the pumps all drop 62 rpm in 4 seconds and take approximately 30 seconds to recover and begin to decrease the wet-well level back down to its level setpoint of 106 feet. During the recovery, the wet-well rises from 106 to 108 feet.

### 1.1.4.3 IPS at 295 with most restrictive Ramp Rates

During this scenario, a constant influent flow of 295 mgd and voltage sag that induces a pump speed drop of 62 rpm over 4 seconds for both online pumps was simulated to determine how the IPS wet-well and FDS basin handle the sudden drop in IPS discharge flow with the most restrictive rate limits observed in the calibrated Replica model (Table 1-1).

Figure 6 illustrates how the Replica model predicts the IPS wet-well (grey line) and FDS basin (blue line) both rising by approximately 2.16 feet (26 inches) during the voltage sag. The secondary bypass weir gates do not engage, and a bypass does not occur. The assumed High Level Limit Switch in the FDS basin is 118 feet and the High-High Level Switch at IPS is assumed to be 115 feet.

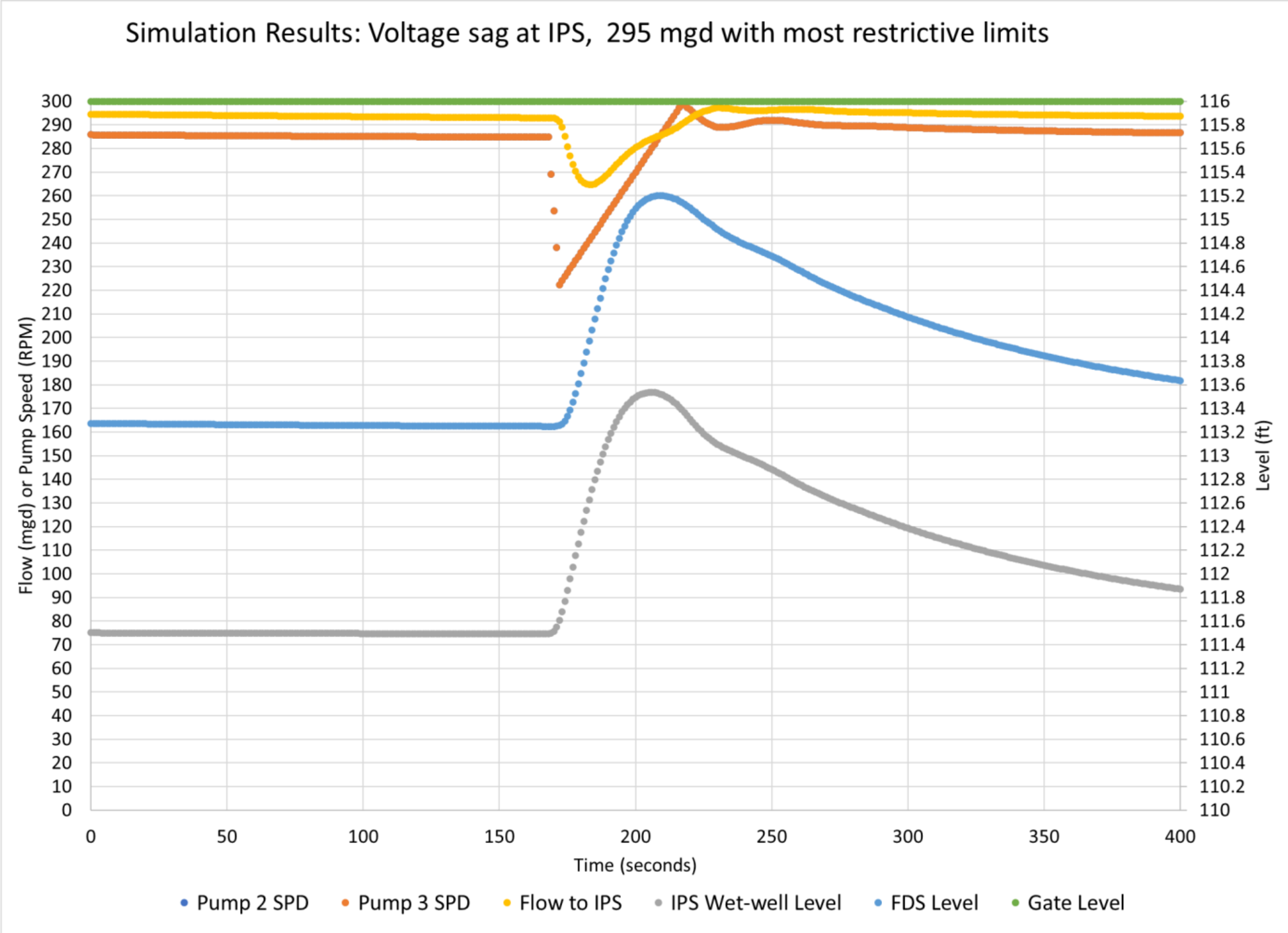



**Figure 6: Voltage Sag at IPS at 295 mgd flow through IPS. The most restrictive ramp rates observed (Table 1-1) were set in the model**

### 1.1.5 IPS – Largest sag before FDS bypass at 295 mgd with Nidec ramp limits

For this scenario, the length of time the pump decelerates was adjusted until the FDS secondary bypass gates open and flow diverts at FDS. It is assumed the pumps decelerate at 15.5 rpm per second. Figure shows that the model predicts an unpermitted secondary bypass if the voltage sag induces a pump deceleration that lasts 5.5 seconds or longer (red square) while the unpermitted bypass does not occur if the time of deceleration is 5 seconds (purple square). As illustrated in the red box of Figure , the IPS wet-well (grey line) rises to 115 feet and the FDS basin level (blue line) rises to above 116 feet which triggers the FDS secondary bypass weirs (green line) to lower when the VFD takes 5.5 seconds. When the recovery takes 5 seconds (purple box) the FDS basin level stays below 115 feet and the IPS level peaks at 113.1 feet and no secondary bypass is predicted to occur.

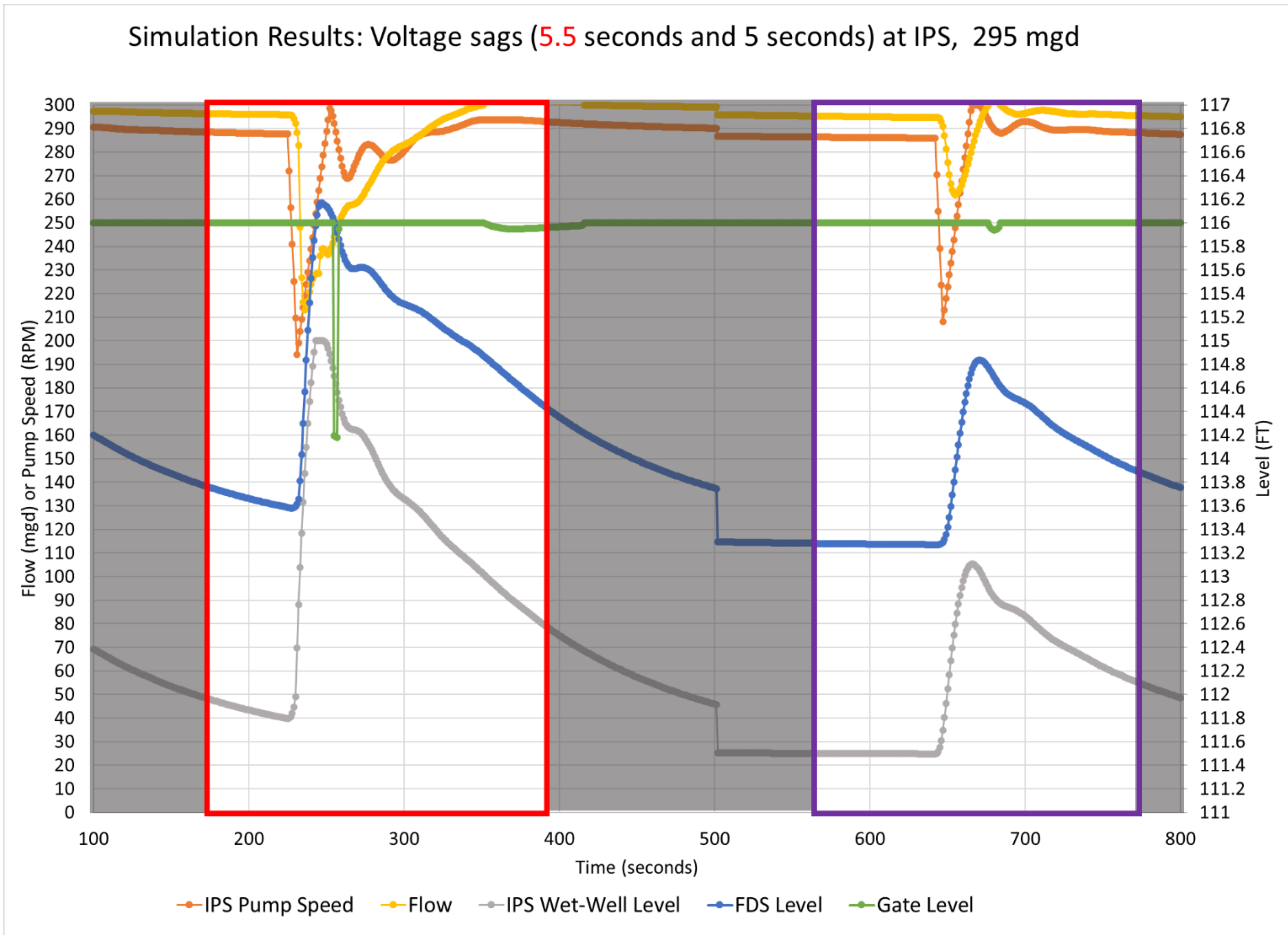



**Figure 7: Voltage sags of 5.5 seconds and 5 seconds at IPS. If the IPS pumps decelerate for 5.5 seconds, flow is diverted via the secondary bypass weirs at FDS. If the pump deceleration lasts 5 seconds, no bypass occurs.**

### 1.1.6 Conclusion

The results of this analysis indicate with a reasonable degree of confidence that for both IPS and EPS, the programming changes recently made to Ovation by WTD should continue to allow pumps to recover from most standalone voltage sag events where the VFDs are able to recover within 5 seconds. Back-to-back to back voltage sag events were not evaluated or modeled. Given that the ramp limits are still being confirmed, the Replica model was used to predict voltage sag response at both IPS and EPS with a range of settings. Both the VFD settings provided by Nidec (5 rpm/s limit) and those previously observed with historical data to calibrate the Replica model in 2015 (Table 1-1) were used during the analysis. Ovation settings provided by WTD (Table 1-5) and previously assumed ramp and Ovation limits established during the EPS cutover from PLC logic to Ovation (Table 1-4) were also assessed to ensure the EPS pump station can withstand significant voltage sags across all feasible settings.

Additional work must be done to examine potential adverse consequences, if any, of hydraulic transients related to increasing the limit. Replica, the modelling software applied to this analysis of sag event impacts upon wet well levels, is not intended to analyze hydraulic transients. Assuming a transient analysis is conducted, the proposed Nidec ramp rate limits (Table 1-2 and Table 1-3) and Ovation settings provided by WTD (Table 1-5) should be sufficient to allow IPS and EPS pumps to recover from most significant voltage sags while avoiding unpermitted bypass flows.

## 1.2 IPS and EPS Pump Engineering Analysis

The IPS and EPS pumps have had their VFDs replaced with Nidec drives (installed May 2018 thru August 2020). Recent changes were made to two of these drives, IPS1 and EPS4, as a means to reduce their susceptibility to shutdown on voltage sag. Assuming successful operation over a trial period, the remaining IPS and EPS drives will be similarly modified. Nidec has informed that these changes reduce the output power factor of the drive by 4.5 percent which, in turn, reduces the power that the VFD can deliver to the pump motor.

The following analysis utilizes historical data of high head/high flow events to determine the maximum expected power utilized by the EPS and IPS pumps during high head/high flow events and if the new Nidec drives would have an impact on plant operation.

### 1.2.1 Data Review and Assumptions

#### 1.2.1.1 Data Gathered

Historical data relating to the IPS and EPS pumps was supplied for the following dates:

- 01/12/21
- 12/20/19
- 12/29/17
- 02/09/17
- 01/29/18
- 01/18/17
- 01/12/17
- 11/15/16
- 10/20/16
- 03/09/16
- 12/09/15
- 12/07/15
- 11/28/14
- 03/05/14

Data was provided in Microsoft Excel spreadsheets for several hours of each day, on at least a minute-by-minute basis. Data included:

- Time stamp
- Tide level (ft)
- Final effluent flow (MGD)
- Primary effluent flow (MGD)
- EPS wet well level (ft)
- Individual pump heads (ft)
- Individual pump speeds (rpm)

Fluke Meter data relating to EPS pumps 1 and 4 was supplied for November 19, 2021 through November 30, 2021. PDF report includes information on power quality for the three-phase power supplied.

#### 1.2.1.2 Assumptions

The Goulds pump curve (March 1992) was utilized to establish pump efficiencies to correspond to head/flow data for IPS pumps and EPS pumps 1, 2, and 3.

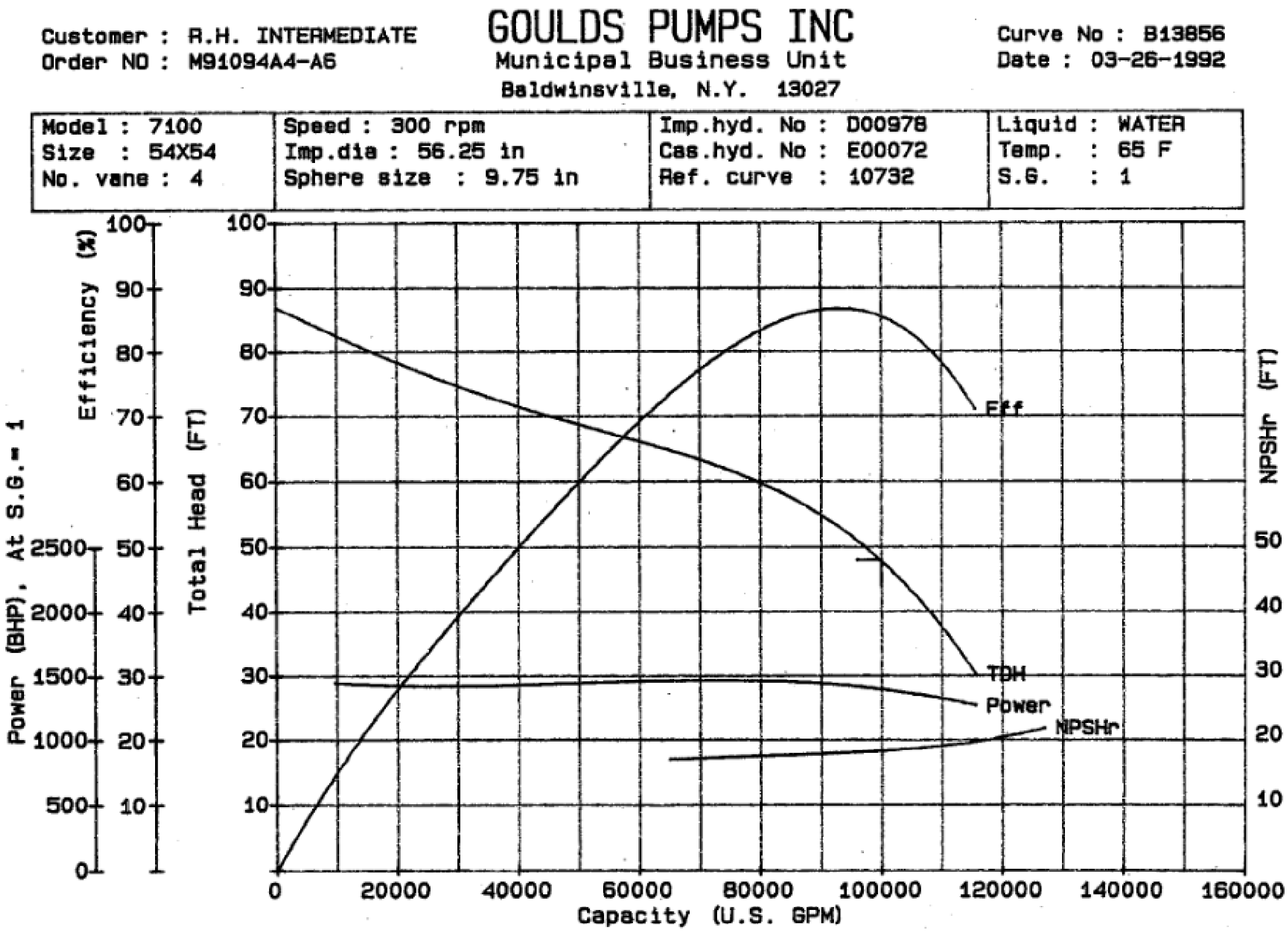



Figure 8. Goulds Pump Curve

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The Ebara pump curve (August 1997) was utilized to establish pump efficiencies to correspond to head/flow data for EPS pump 4.

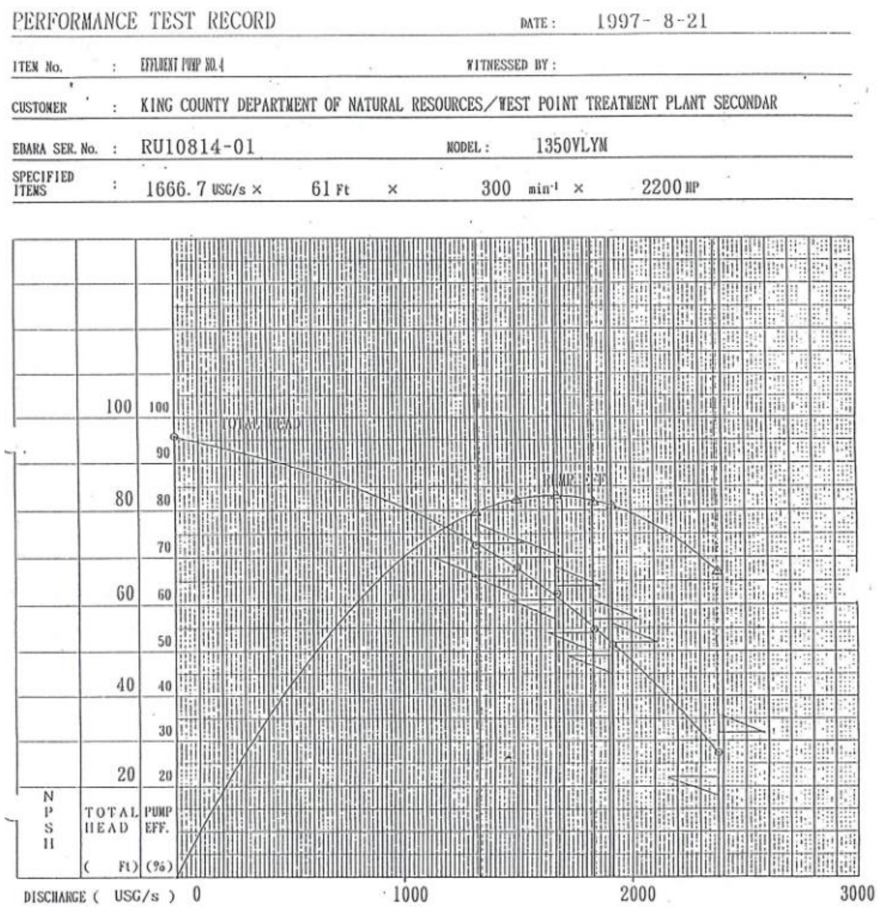



**Figure 9. Ebara Pump Curve**

Brake Horsepower (power applied at the pump) was a calculated value, assumed to be “Flow x Head / (Pump eff x 3960)”

### 1.2.2 Data Analysis - Overview

The goal of the data analysis was to determine the maximum power utilized by the pumps during high flow/high head events.

The data was split into days and into EPS and IPS sets. Results are based off of data from a four hour period on 12-20-2019, which was determined out of the existing data sets to have the highest combination of flow and head.

The initial calculations were to establish Brake Horsepower applied to the pumps. Using the data for Differential Pressure (FT) for each pump values were calculated for pump flow and pump efficiency using the two pump curves as reference.

### 1.2.3 Data Analysis - EPS

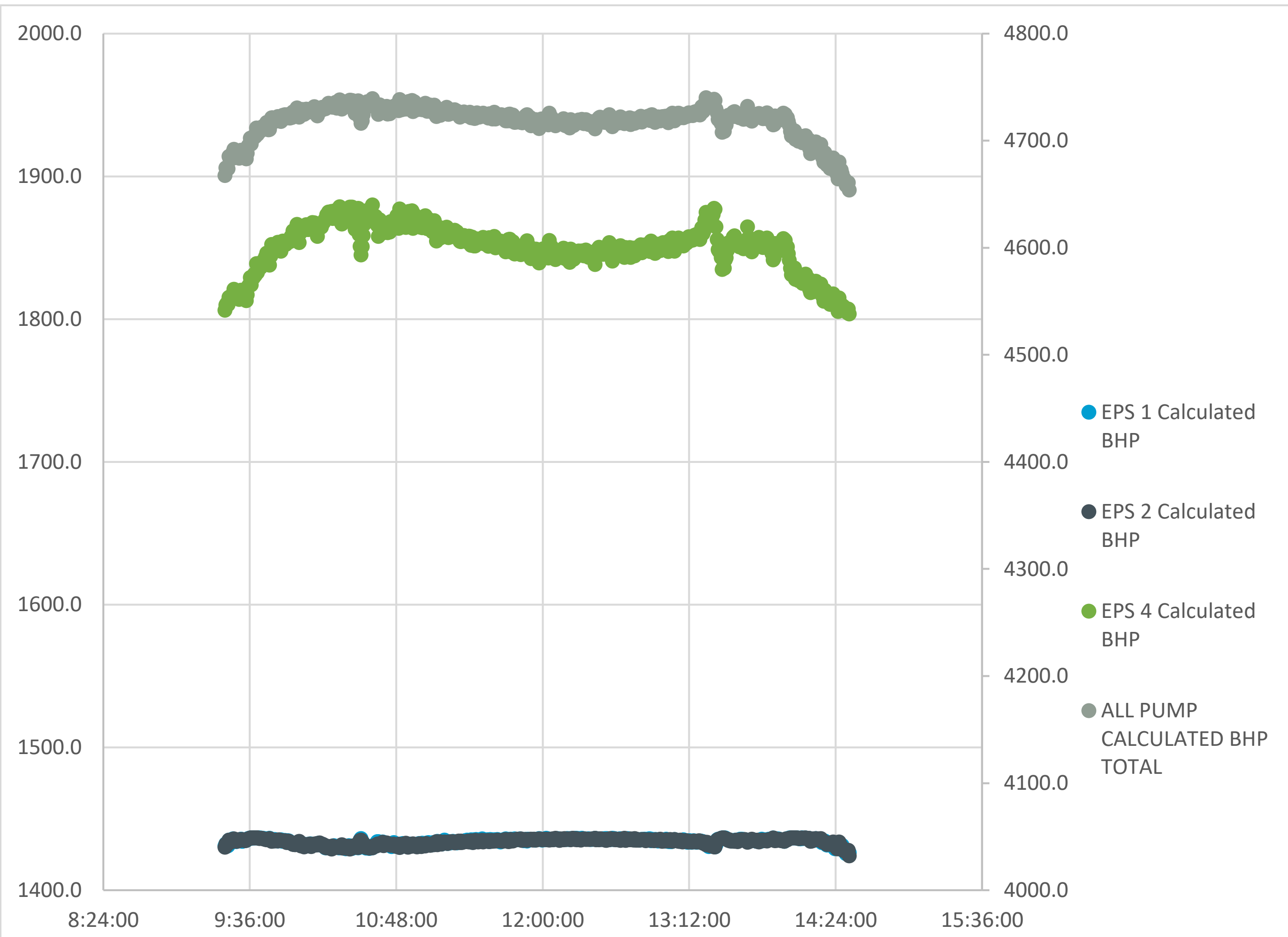
The focused data set was plotted to show calculated Brake Horsepower by time. The combined calculated Brake Horsepower is shown on the right side Y-axis scale.

The blue and purple datapoints for EPS1 and EPS2 utilize the Gould curve and are similar enough given the slight differences in differential pressure readings, to overlap in the dataset. Both (left side Y-axis scale) show a maximum Brake Horsepower needed for the pump at around 1430 BHP.

The green datapoints for EPS4, utilize the Ebara curve, which shows higher flowrates for respective differential pressure readings. Thus the higher range of 1800-1875 BHP.

The grey datapoints are a combined value of all the EPS1/EPS2/EPS4 BHP, which is in the 4650-4750 BHP range.

Another issue of interest at EPS is the duration of time to de-energize individual EPS pumps. Currently the EPS Ovation logic is configured to stop pumps over a controlled ramp down in speed of 10 minutes. Preliminary data from the hydraulic transient analysis being conducted by Flow Science indicates that this somewhat lengthy 10 minute duration is not necessary in terms of protecting the outfall from adverse hydraulic transients. The Flow Science analysis recommends a ramp down time of no less than one minute.



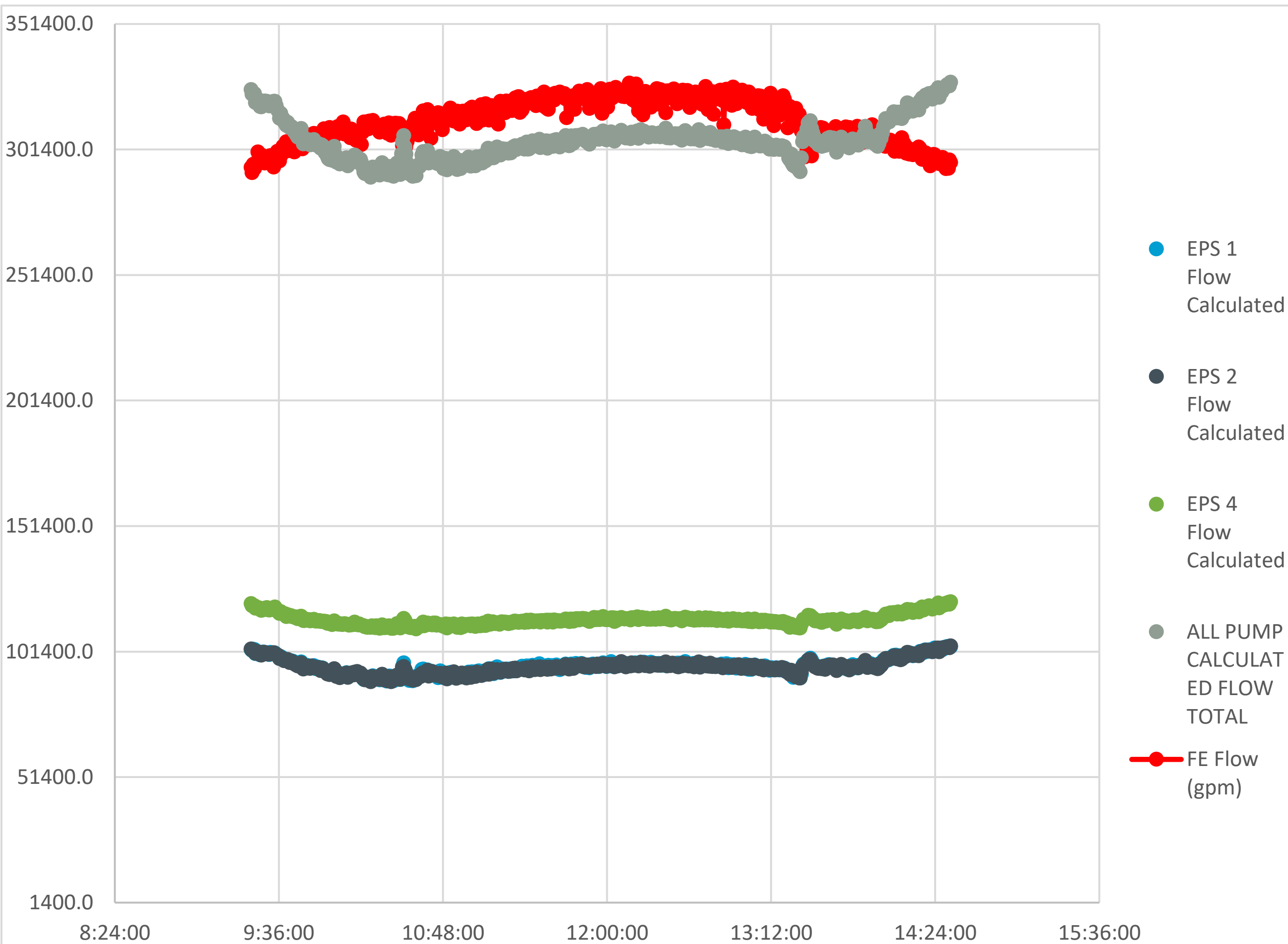

**EPS 1 data is identical to EPS 2 and therefore not visible in figure.*

**Figure 10. 12.20.19 Data Set – Brake Horsepower (EPS1/EPS2/EPS4/Combined)**

#### 1.2.3.1 Calculated Values of Flow from Pump Curve

It should be noted that there is a discrepancy in the dataset when comparing the flow calculated utilizing the differential pressures and the pump curves, versus the total Final Effluent Flowmeter data that represents the combined flow from the EPS Pumps. In Figure 11 the red dataset shows the combined EPS flow in gallons per minute. The grey dataset shows the combined EPS flow when using the calculated flow values (pump head / pump curve). There is a consistent 20,000 gpm difference in the main part of the dataset where the flow read off the flowmeter is higher than what we calculate the flow should be if the pump curves are accurate.

At 50 ft of head across the pumps (similar to the condition on 12/20.19), 20,000 gpm equates to approximately 300 BHP. At this point there is not enough information to determine between the Pump Curve and the FE Flow measurements which is the more accurate, only that there is potentially a 300 BHP range of uncertainty in the maximum BHP estimations.

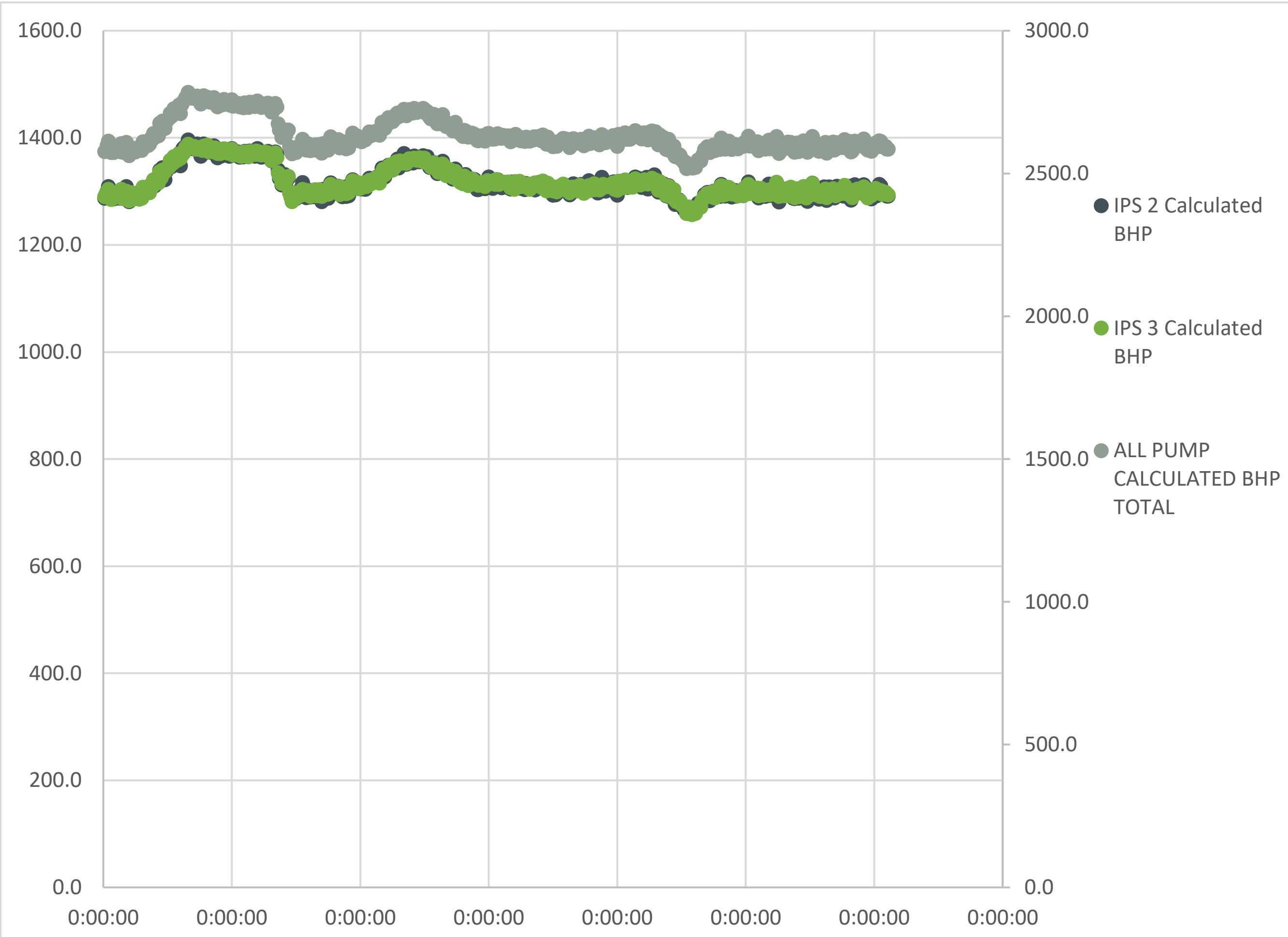



**EPS 1 data is identical to EPS 2 and therefore not visible in figure.*

**Figure 11. 12.20.19 Data Set - Flow Comparison**

### 1.2.4 Data Analysis - IPS

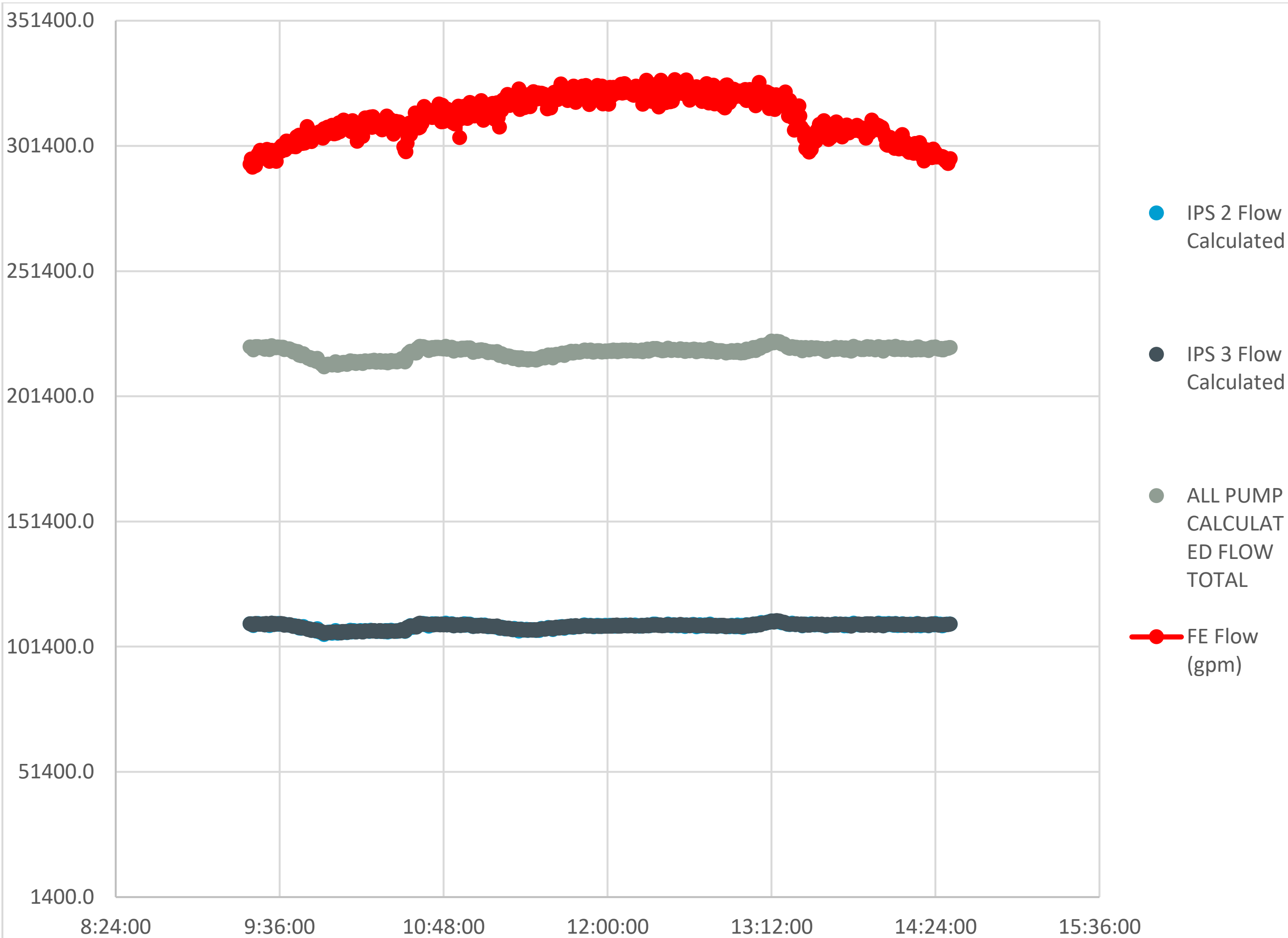
The same days data set was calculated and plotted for the IPS pumps as shown in Figure 12. Note that only two IPS pumps (IPS2 and IPS3) are active.




**IPS 2 data is identical to IPS 3 and therefore not visible in figure.*

**Figure 12. 12.20.19 Data Set – Brake Horsepower (IPS2/IPS3/Combined)**

The blue and green datapoints for IPS2 and IPS3, utilize the Gould curve, and are similar enough given the slight differences in differential pressure readings, to overlap in the dataset. Both show a maximum Brake Horsepower needed for the pump at around 1430 BHP and a combined around 2860 BHP.




**IPS 2 data is identical to IPS 3 and therefore not visible in figure.*

**Figure 13. 12.20.19 Data Set - Flow Comparison**

In Figure 13 the red dataset shows the combined IPS flow in gallons per minute. The grey dataset shows the combined IPS flow when using the calculated flow values (pump head / pump curve). There is a consistent 70,000 gpm difference during the main part of the data where the flow read off the flowmeter is higher than what we calculate the flow should be if the pump curves are accurate.

This is a similar issue to what is occurring with the EPS dataset and referencing the Gould pump curve.

### 1.2.5 Conclusion

Based on the analysis of pump curves and data obtained in the field a reduction of 4.5% of the power factor will have no effect on pump performance. This conclusion is supported by field testing and analysis of name-plate data of the VFDs and motors.

# Hydraulic Transient Analysis

# Technical Memorandum

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Prepared for: King County

Project Title: WPTP Power Quality Assessment

Contract: Work Order 03

Project No.: 156452

**Technical Memorandum**

Subject: Hydraulic Transient Analysis: EPS and IPS Systems

Date: April 15, 2022

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# Section 1: Introduction

The West Point Treatment Plant (WPTP) has experienced past unauthorized flow bypasses, some of which were related to voltage sags occurring in Seattle City Light's electrical utility power supply to the WPTP's main electrical power system. The objective of the WPTP Power Quality Assessment project is to address power quality problems at the WPTP that have resulted in unauthorized bypass events. The Washington Department of Ecology issued Administrative Order 19477 to King County on February 2, 2021, requiring King County to take corrective measures. This project is being carried out under an Emergency Declaration issued by Executive Dow Constantine on February 25, 2021.

An overview of the main pump stations at the WPTP is shown in Figure 1-1. The Raw Sewage Pump Station (RSPS) supplies the primary treatment process, the Intermediate Pump Station (IPS) supplies the secondary treatment process, and the Effluent Pump Station (EPS) delivers treated flow to the ocean outfall. The RSPS currently comprises gas engine-driven pumps that are planned for replacement with electric motor-driven pumps (future). The IPS and EPS comprise existing electric motor-driven pumps. The scope of this analysis is to evaluate the predicted hydraulic transients associated with planned corrective measures for voltage sag events occurring at the IPS and EPS (see further description of scope below). Evaluation of the RSPS system is *not* within the scope of this analysis, as transients for the RSPS are being evaluated as part of the WPTP Raw Sewage Pump Replacement Project.

Currently, during a voltage sag event, the plant power voltage may drop below the threshold at which a pump motor variable frequency drive (VFD) temporarily switches off the power feeding the motor as a programmed protective measure. This action can result in initiating an unnecessary complete pump shutdown even if the voltage sag event is brief and full voltage is quickly restored and again made available to the pump VFD.

In the near term, the Power Quality Assessment project is working to optimize VFD settings and pump operation with the goal of reducing the impacts caused by short-duration voltage sag events. For the EPS and IPS at the WPTP, the optimization work includes efforts to revise the pump controls to quickly restore power to the pump as soon as power becomes again available. Such a power restoration may result in a catch "on the fly" restart wherein the pump motor is coasting down in speed due to a reduction in voltage or a complete loss of power, and then re-energized without first initiating/waiting for a complete shutdown of the pump.

In the longer term, the addition of an online uninterrupted power supply (UPS) system is planned to "condition" the power feeding the IPS and EPS pumps and further minimize the effects of voltage sags in the utility feed to the WPTP. The online UPS may further enable a controlled, battery-powered ramp down of the pumps in the event of sustained loss of utility power.

Given that modifications to the VFD settings will impact pumping operations, this hydraulic transient analysis has been commissioned to evaluate the magnitude of pressure surges that may occur in the IPS and EPS piping systems as a result of VFD control changes and the planned future online UPS addition.

## 1.1 Scope of Work

This hydraulic transient analysis evaluates a) the magnitude of predicted pressure surges that may occur in the IPS and EPS piping systems during catch "on the fly" restart events associated with short duration voltage sags and b) provides recommended minimum safe controlled ramp down rates for the pumps when utility grid power has been lost to the plant and the pumps operate on short-term battery power supplied from a future online UPS.

The technical memorandum (TM) begins with a brief general discussion of surge and water hammer. It then describes the methods of analysis, the results obtained, and the recommendations derived from the analysis.

This TM was prepared by Flow Science Incorporated (Flow Science) of Pasadena, California, acting under agreement with Jacobs Engineering Group Inc., acting under agreement with Brown and Caldwell on behalf of King County, Washington.

## 1.2 General Background: Water Hammer and Pressure Surges

The following paragraphs provide a general, non-project-specific overview of surge and water hammer considerations. Project-specific information and recommendations may be found immediately afterward in Section 2 “Physical Facilities” and Section 3 “Transient Analysis Description and Results.”

Water hammer and pressure surges in piping systems are created when a change in the pipeline flowrate occurs. The source of the change in flowrate may be normal operations, such as the starting or stopping of a pump, or the opening or closing of a valve. In addition, sudden and unplanned changes in flow can occur as a consequence of loss of power to pumps.

When a pumping system is shut down as part of normal operations, or by power failure, the hydraulic grade line (HGL) downstream of the pumping station falls rapidly. The rapidity of the pressure drop is controlled primarily by the polar moment of inertia of the pump/motor system. The pressure drop (created by loss of power to the pump) travels out along the downstream pipeline as a pressure drop wave (i.e., low pressure wave) moving at a speed of 500 to 4,500 feet per second, depending upon the pipe material and dimensions and the properties of the fluid. Subsequent reflection of the pressure drop wave at the end of the pipeline creates a pipeline re-pressurization wave that returns to the pump station. Depending on the magnitude of the pressure drop wave and the re-pressurization wave, and the profile of the downstream piping system, problematic low minimum pressures (possibly reaching vapor pressure) and high maximum surge pressures may be formed.

The pressures created by changing flow conditions in piping systems can be determined accurately by the application of Newton's Laws of Motion up to the condition where a vapor cavity forms in the pipeline. Flow Science has developed a set of computer programs that solve the water hammer wave equations (Newton's Laws) for situations involving pump power failure, pump startup, and valve operations. These computer codes, which use the method-of-characteristics solution technique for the appropriate equations, allow computation of the pressure and flow at any point in a distribution network at prescribed times after power failure or valve operation. The codes have been developed over a period of 35+ years and have been extensively tested and validated in the field, including successful application on numerous past projects for King County.

# Section 2: Physical Facilities

A map of the WPTP with an overview of the EPS and IPS systems is shown in Figure 2-1. The EPS system has a nominal design capacity to deliver 440 million gallons per day (mgd) of final effluent (FE) to the outfall. The IPS system has a nominal design capacity to deliver 300 mgd of primary effluent (PE) to the aeration tanks.

## 2.1 EPS System

A schematic of the EPS system is shown in Figure 2-2 and a profile of EPS system pipelines as modelled is shown in Figure 3-2.

The EPS comprises four pumps (three duty + one standby) that deliver treated FE from the pump station wetwell through the 108-inch diameter FE pipeline to the 96-inch diameter ocean outfall. The FE pipeline is approximately 2,000 ft long and runs from the EPS through the WPTP site and connects to the Marine Outfall Control Structure near the shoreline. The ocean outfall pipeline has a length of approximately 3,700 ft and includes approximately 200 diffuser ports of size ranging from 4.5-inch, 5-inch, and 5.75-inch diameter spaced along the last several hundred feet of its discharge end to a depth of approximately -160 ft (King County/Metro Datum referenced throughout this TM). Both the FE and outfall comprise concrete pipe, predominantly, while the pump discharge and header comprise steel pipe at the EPS.

Table 2-1 shows the EPS pump characteristics used for the analysis based on the provided pump curve data. The combined polar moment of inertia ($WR^2$) value shown for the EPS pump/motor units was estimated based on the manufacturer listed inertia value for the motor of approximately 35,900 pound square foot ($lb\text{-}ft^2$) and a conservatively assumed pump inertia value of approximately 9,000 $lb\text{-}ft^2$. A comparison of the model predicted inertial spin-down of the EPS pumps to field data was made at the start of the analysis to evaluate the pump inertia assumption, see later discussion in the TM. Based on the information provided, future replacement of the EPS pumps may eventually be required. Therefore, in order to provide a slightly conservative basis for the surge analysis, the larger capacity of the Ebara pump was assumed for all pumps to cover possible future upsizing to a similar capacity. If pumps of a capacity larger than the existing Ebara pump are later provided, the surge analysis should be updated.

**Table 2-1. Existing EPS Pump Characteristics Used for the Transient Analysis**

| | Pump Characteristic | Existing EPS | |
|---|---|---|---|
| 1 | Number of pumps (total for EPS) | 4 (3 duty + 1 standby) | |
| 2 | Pump type and number | Ebara (1 pump) | Goulds (3 pumps) |
| 3 | Number of stages | 1 | 1 |
| 4 | Rated flow, mgd | 146 | 144 |
| 5 | Rated head, feet | 61 | 48 |
| 6 | Maximum speed, rpm | 300 | 300 |
| 7 | Speed control | Variable | Variable |
| 8 | Motor horsepower | 2,200 | 2,200 |
| 9 | Estimated total $WR^2$, $lb\text{-}ft^2$ | 44,900 | 44,900 |

*$lb\text{-}ft^2$ = pound square foot = polar moment of inertia*
*rpm = rotation(s) per minute*

The pipe parameters estimated for the EPS system analysis are shown in Table 2-2. The values of “a” are estimated water hammer wave speeds and “f” are Darcy-Weisbach friction factors estimated from the Moody diagram based on pipe material and Reynolds number at peak flow.

Note that the presence of small quantities of air in the FE can greatly reduce the water hammer wave speed of the fluid because air is much more compressible than liquids at normal temperatures. Research shows that as little as 1 percent by volume air entrainment of a fluid can reduce the acoustic wave speed of a pressure wave by up to 75 percent of its non-air-entrained value (for reference, see Wylie, E. B., and Streeter, V. L. [1993], *Fluid Transients in Systems*, page 10, and Chaudhry, M. H. [1979], *Applied Hydraulic Transients*, page 279).

The high and low water hammer wave speeds shown in Table 2-2 were evaluated to determine worst-case surge conditions. Based on the analysis, high wave speeds resulted in predicted maximum surge conditions, and results for this condition are shown in the figures. A range of pipeline friction factors was also evaluated; based on the calibration effort, the higher friction factors shown in Table 2-2 provided a better match to the field data, and results for this condition are shown in the figures.

**Table 2-2. Pipeline Parameters Used for the EPS Transient Analysis**

| | Diameter (inches) | Wave Speed, a (feet per second) | Darcy-Weisbach, f |
|---|---|---|---|
| 1 | 60 | 3,500–875 | 0.014–0.0165 |
| 2 | 96 | 3,500–875 | 0.013–0.016 |
| 3 | 108 | 3,500–875 | 0.0125–0.0155 |

The EPS pumps each include a 60-inch diameter, hydraulically actuated, butterfly type pressure control valve (PCV) on the discharge side of the pump. For the analysis, a valve flow coefficient of 116,130 gpm/√ft was assumed based on reference values for a Pratt Triton butterfly valve. Based on the information provided, differential pressure is monitored across the PCVs, and the valves are operated to act as flow check valves, opening and closing in 133 seconds. During normal startup, a pump can only be started against a closed PCV. The PCV opens when approximately 3+ ft of differential pressure is developed, measured between the upstream side and downstream side of the PCV. . The PCVs include hydraulic accumulators to enable actuation of the valves during a power loss condition. For the analysis of a voltage sag condition, the PCV is initially assumed fully open when the pump is at full speed.

The EPS includes two parallel 54-inch diameter bypass pipelines that each include a 54-inch diameter mechanical check valve. The bypass automatically delivers flow around the pumps whenever conditions allow for gravity flow, depending on wetwell level and tide.

The EPS pumps operate between a wetwell level of 108 ft (EPS pump start) to a maximum of 115 ft (high-high alarm). At a wetwell level below 108 ft, the pumps are shut down and flow is allowed to proceed by gravity.

The analysis evaluated a range of tide levels from a low tide of 88.9 ft to a future King tide of 111.3 ft, accounting for salt density.

Note that the pressure class of the EPS system piping was not provided for the analysis. This will be discussed further in the results section of the TM.

## 2.2 IPS System

A schematic of the IPS system is shown in Figure 2-3 and a profile of EPS system pipelines as modelled is shown in Figure 3-5.

The IPS comprises three pumps (two duty + one standby) that deliver PE from the pump station wetwell through the 108-inch diameter PE pipeline to six aeration tanks. The PE pipeline reduces in diameter from 108 inches to 72 inches past Aeration Tanks 3 and 4, and then reduces again to 42 inches as it branches to each aeration tank. The total pipe length from the IPS to the Aeration Tank 5 and 6 branch piping is approximately 1,700 ft. The IPS system comprises steel pipe.

Table 2-3 shows the IPS pump characteristics used for the analysis based on the provided pump curve data. The combined polar moment of inertia ($WR^2$) value shown for the IPS pump/motor units was estimated based on the manufacturer listed inertia value for the motor of approximately 35,900 lb-ft$^2$ and a conservatively assumed pump inertia value of approximately 9,000 lb-ft$^2$, similar to that assumed for the EPS analysis (see previous EPS inertia discussion). In addition, the analysis evaluated lower inertia values to test the sensitivity of the analysis results to the inertia estimate. This will be discussed in the results section for the IPS.

**Table 2-3. Existing IPS Pump Characteristics Used for the Transient Analysis**

| | Pump Characteristic | Existing IPS |
|---|---|---|
| 1 | Pump type and number | Goulds 3 (2 duty + 1 standby) |
| 2 | Number of stages | 1 |
| 3 | Rated flow, mgd | 144 |
| 4 | Rated head, feet | 48 |
| 5 | Maximum speed, rpm | 300 |
| 6 | Speed control | Variable |
| 7 | Motor horsepower | 2,200 |
| 8 | Estimated total WR$^2$, lb-ft$^2$ | 44,900 |

The pipe parameters estimated for the IPS system analysis are shown in Table 2-4.

As noted previously, the presence of small quantities of air can greatly reduce the water hammer wave speed of the fluid (see previous discussion of wave speed for the EPS, above). The high and low water hammer wave speeds shown in Table 2-4 were evaluated to determine worst-case surge conditions. Based on the analysis, high wave speeds resulted in predicted maximum surge conditions, and results for this condition are shown in the figures. Note that slight variations in wave speed for a given pipe diameter were evaluated for the IPS system; however, based on the analysis, the surge results were found to not exhibit significant sensitivity to wave speed, due in part to the overall short pipeline lengths of the IPS system.

**Table 2-4. Pipeline Parameters Used for the IPS Transient Analysis**

| | Diameter (inches) | Wave Speed, a (feet per second) | Darcy-Weisbach, f |
|---|---|---|---|
| 1 | 42 | 3,500–875 | 0.016 |
| 2 | 60 | 3,300–825 | 0.0145 |
| 3 | 72 | 3,200–800 | 0.0145 |
| 4 | 108 | 3,000–875 | 0.012 |

Similar to the EPS system, the IPS pumps each include a 60-inch diameter, hydraulically actuated, butterfly type PCV on the discharge side of the pump. A valve flow coefficient of 116,130 gpm/√ft was assumed based on reference values for a Pratt Triton butterfly valve. Based on the information provided, differential pressure is monitored across the PCVs, and the valves are operated to act as flow check valves, opening and closing in 133 seconds. During normal startup, a pump can only be started against a closed PCV. The PCV opens when approximately 3+ ft of differential pressure is developed, measured between the upstream side and downstream side of the PCV. The PCVs include hydraulic accumulators to enable actuation of the valves during a power loss condition. The PCVs include hydraulic accumulators to enable actuation of the valves during a power loss condition. For the analysis of a voltage sag condition, the PCV is initially assumed fully open when the pump is at full speed.

Based on the information provided, the IPS pumps operate between a wetwell level of 111.5 ft to a maximum of 115 ft. A water surface elevation (WSEL) of 131.6 ft was assumed for the aeration tanks. Note that based on the elevation of the header piping at the aeration tanks, siphon flow conditions are possible in the headers, depending on the WSEL in the aeration tanks. Based on the information provided, current typical aeration tank operation comprises plug-flow with flow delivered to the first stage of the aeration tank.

Note that the pressure class of the IPS system piping was not provided for the analysis. This will be discussed further in the results section of the TM.

# Section 3: Transient Analysis Description and Results

The steady-state flow conditions outlined below and the system geometry, summarized above, form the basis for the pressure transient analysis of the EPS and IPS systems.

## 3.1 EPS System Transient Analysis

The hydraulic transient analysis of the EPS system a) evaluated the magnitude of predicted pressure surges that may occur in the EPS piping system during catch "on the fly" restart events associated with short duration voltage sags and b) developed recommended minimum safe controlled ramp down rates for the pumps when utility grid power has been lost to the plant and the pumps operate on short-term battery power supplied from a future online UPS (or if a minimum controlled ramp down is desired while utility power is available).

For the EPS transient analysis, numerous possible operating conditions were evaluated including 1, 2, or 3 pumps operating, high and low wetwell levels, high and low tides, high and low friction, and high and low water hammer wave speeds. From the analysis, representative worst-case surge conditions for the EPS system generally resulted with three pumps operating and high water hammer wave speeds. Low WSELs generally resulted in worst-case minimum pipeline surge pressures, and high WSELs resulted in maximum pipeline surge pressures. However, all conditions produced generally similar surge results, and the recommendations provided in this TM are valid for the full range of operating conditions stated.

### 3.1.1 Comparison of EPS Transient Model Response to Historical Event Data

The analysis of the EPS system began with a comparison of the recorded historical operating data for the WPTP gathered during a pump power loss event at the EPS to the model-predicted response to evaluate the pump inertia estimate used in the transient model.

On January 13, 2021, at approximately 12:03 am, the EPS was delivering high flows when a sudden loss of power was experienced at the WPTP. Figure 3-1 shows FE flow and EPS pump speed data at the time of the January 2021 power loss event. Prior to losing pump power, the EPS system was delivering approximately 484 mgd (108 percent of the nominal 450 mgd design capacity for the system) with three pumps operating at approximately 98 percent speed. After pump power was lost, the station flow and pump speeds decreased as shown. The pumps were later restarted beginning approximately 47 seconds after the initial loss of power. Note that pressure head data at the station was not recorded during the power loss event, precluding an evaluation of the field observed rate of pressure drop.

The steady state condition for the EPS system model was then initialized to approximately match the operating conditions at the time of the January 13, 2021, event. Pump power loss was then simulated in the transient model. Predicted model results for flowrate versus time are plotted in Figure 3-1 along with the field data. Note that the field data suggests some stagger in the loss of pump power for the three operating pump units, while the transient model simulation evaluated simultaneous loss of power to the pumps. Also note that the model run simulated pump power loss alone without subsequent pump restart. A comparison of the slope of the model predicted flowrate drop to the field recorded flowrate drop during the period bracketed in

Figure 3-1 shows an acceptable/good match. Given this match, the estimated pump inertia value listed in Table 2-1 was used for the remaining analysis without further adjustment.

### 3.1.2 EPS Catch "On the Fly" Pump Restart

As described in the introduction, in the near term, the Power Quality Assessment project is working to optimize VFD settings and pump operation with the goal of reducing the impacts caused by short-duration voltage sag events. The optimization work includes efforts to revise the EPS pump controls to restore power to the pump if power is rapidly recovered . Such a power restoration may result in a catch "on the fly" restart wherein the pump motor is coasting down in speed due to a reduction in voltage or a complete loss in power, and then re-energized without first initiating/waiting for a complete shutdown of the pump.

Based on the information provided by the project team, voltage sag events are typically short, on the order of tenths of seconds, and the short duration voltage sag often results in only a partial reduction in voltage - below 100 percent, but not dropping completely to zero (full power loss). Given this information, the project team anticipates substantial benefit for WPTP operations if the pump controls and VFDs can be safely reprogrammed to immediately repower the pump motor, i.e., initiate a catch "on the fly" restart, if voltage is restored within the first 3 seconds from the start of the voltage loss/sag. *If the voltage sag exceeds 3 seconds and drops below the voltage threshold of the drive (now set at 79% of nominal), the controls will initiate a normal pump restart sequence (following a drive reset) rather than re-energizing all pumps simultaneously*.

The project team has further outlined that the existing and planned ramp rate for a pump restart is 5 rpm/sec. This is consistent with the original configuration of the Ross Hill drives and represents an established track record of successful pump operation. Furthermore, recent model runs using Jacobs' Replica process simulation software demonstrated that the 5 RPM/second rate was sufficient for even the most taxing application at WPTP, i.e. IPS wet well level control.

Based on the results of the transient analysis for the EPS system, the following recommendations are made for operating the EPS pumps experiencing a voltage sag event:

- If the voltage sag event duration is 3 seconds or less, the VFDs can initiate a catch "on the fly" restart and immediately re-energize the pump motors bringing them back up to speed *at a ramp rate not faster than 5 rpm/sec.*
- If a voltage sag event of sufficient magnitude and a duration exceeding 3 seconds occurs the VFDs will fault and require a reset. Ovation should then initiate a controlled staggered restart sequence for the pumps, ramping each pump up to speed. The VFD's limit the *ramp rate to 5 rpm/sec. It is recommended that Ovation ensure that a minimum 20-second lag (or longer) be maintained between staggered pump starts,* i.e., after the first pump is started, the second pump should be started 20 seconds (or longer) after the first pump, and the third pump should be started 20 seconds (or longer) after the second pump.
- As a safety precaution for the pump, the VFD controls should be programmed to preclude energizing the pump if a reverse rpm condition is occurring.

Results for an example catch "on the fly" restart under a worst-case sag event duration lasting 3 seconds with recommendations of the first bullet, above, observed are shown in Figures 3-2 and 3-3. For purposes of continuity, the same steady state high flow (484 mgd) operating condition evaluated for the January 13, 2021, event discussed in Section 3.1.1 was selected as a representative baseline condition for the results shown. Note that the analysis showed similar but slightly less severe predicted surge pressures for shorter voltage sag events with catch "on the fly" restart initiated sooner than 3 seconds.

Figure 3-2 shows the EPS system pipeline profile (in red), the steady state HGL prior to the loss of pump power (in green), and the maximum surge HGL (in dark blue) and minimum surge HGL (in light blue) following the loss of pump power and subsequent catch "on the fly" restart of the pumps.

Following the loss of pump power, a low pressure drop wave is generated at the EPS and travels out along the FE pipelines, dropping the minimum pressure head to approximately -11 ft in the pipelines near the 108-inch by 96-inch transition location shown. Worst-case minimum surge pressure heads for a low WSEL condition (not shown) result in a minimum pressure head of approximately -19 ft. These minimum surge pressure heads are brief and safely above vapor pressure (-34 ft, approximately). The pipeline is therefore not predicted to be at risk of vapor cavity formation. The ability of the system pipelines to resist collapse under short-duration negative surge pressures cannot be explicitly validated by this analysis. Furthermore, a field assessment of the condition of the piping is beyond the scope of the surge analysis. However, the system has likely experienced multiple pump power loss events in the past. Observations of past damage to or failure of the system piping were not noted in the information provided.

At a time 3 seconds after pump power loss, the predicted inertial spin-down of the pumps for the case shown predicts pump speeds of approximately 150 rpm when catch “on the fly” restart of the pumps is then initiated. At the recommended 5 rpm/sec ramp rate, the pumps would return to full speed in approximately 30 seconds from the initiation of restart for the case shown. Restarting of the pumps results in the maximum surge HGL shown, with an approximate 15-ft pressure head rise above the steady state HGL predicted for the case shown. As noted previously, the design pressure class of the EPS/FE system pipelines was not provided for the analysis, nor is the condition of the existing pipelines known. However, the modest rise in predicted pressure shown is anticipated to likely be acceptable for the system.

Figure 3-3 shows predicted pressure head records at the EPS header and at the 108-inch by 96-inch pipeline transition following the loss of power and subsequent catch “on the fly” restart 3 seconds after pump power loss. Note the steep drop in system pressure predicted following full pump power loss and the gradual increase in pressure as the pumps are ramped back up to speed over 30 seconds.

### 3.1.3 EPS Recommended Controlled Ramp Down

As described previously, in the longer term, the addition of an online UPS is planned to “condition” the power fed to the EPS pumps and further minimize the effects of voltage sags in the utility power feed to the WPTP. The project team has expressed interest in a recommended minimum safe controlled ramp down rate for the EPS pumps for both a case where a) a minimum safe ramp down rate is desired while utility power is available and b) for a future case where an online UPS has been installed, a utility power loss event occurs, and the online UPS is used to allow a controlled, battery-powered ramp down of the EPS system. Note for reference, per the information provided by the project team, the current operational procedure for a powered ramp down of the EPS is approximately 10 minutes, and this time duration can present operational challenges.

Based on the transient analysis, the following action is recommended for a minimum duration controlled ramp down of the EPS system:

- During a controlled EPS system pump shutdown, the pumps should be ramped down *at a ramp rate not faster than 5 rpm/sec.*

Results for an example controlled ramp down of the EPS system at the recommended ramp down rate of 5 rpm/sec per the recommendation above are shown in Figure 3-4. For purposes of continuity, the same steady state high flow (484 mgd) operating condition evaluated for the January 13, 2021, event discussed in Section 3.1.1 was again selected as a representative baseline condition for the results shown.

Figure 3-4 shows the predicted HGLs for the system for the pumps ramping down at the recommended rate of 5rpm/sec. For the pumps initially operating at approximately 300 rpm, this rate equates to shutdown of the pumps to 0 rpm in 60 seconds. As shown, the predicted maximum surge HGL does not exceed the steady state HGL, and the minimum surge pressure heads remain predominantly positive throughout the system.

## 3.2 IPS System Transient Analysis

The hydraulic transient analysis of the IPS system a) evaluated the magnitude of predicted pressure surges that may occur in the IPS piping system during catch "on the fly" restart events associated with short duration voltage sags and b) developed recommended minimum safe controlled ramp down rates for the pumps when utility grid power has been lost to the plant and the pumps operate on short-term battery power supplied from a future online UPS (or if a minimum controlled ramp down is desired while utility power is available).

For the IPS transient analysis, numerous possible operating conditions were evaluated including one or two pumps operating, high and low wetwell levels, and high and low water hammer wave speeds. From the analysis, representative worst-case surge conditions for the IPS system generally resulted with two pumps operating and high water hammer wave speeds. Low WSELs generally resulted in worst-case minimum pipeline surge pressures, and high WSELs resulted in maximum pipeline surge pressures. However, all conditions produced generally similar surge results, and the recommendations provided in this TM are valid for the full range of operating conditions stated. Further note that tests of the predicted response at estimated pump inertia values lower than that listed in Table 2-3 showed modest sensitivity to the pump inertia estimate, due in part to the relatively short system pipeline lengths.

### 3.2.1 IPS Catch "On the Fly" Pump Restart

The goals and parameters of the IPS transient analysis are the same as the goals and parameters described in detail for the EPS transient analysis; refer to Section 3.1.2, above.

Based on the results of the transient analysis for the IPS system, the following recommendations are made for operating the IPS pumps experiencing a voltage sag event (identical recommendations as provided for EPS system):

- If the voltage sag event duration is 3 seconds or less, the VFDs can initiate a catch "on the fly" restart and immediately re-energize the pump motors bringing them back up to speed *at a ramp rate not faster than 5 rpm/sec.*
- If a voltage sag event of sufficient magnitude and a duration exceeding 3 seconds occurs the VFDs will fault and require a reset. Ovation should then initiate a controlled staggered restart sequence for the pumps, ramping each pump up to speed. The VFD's limit the *ramp rate to 5 rpm/sec. It is recommended that Ovation ensure that a minimum 20-second lag (or longer) be maintained between staggered pump starts,* i.e., after the first pump is started, the second pump should be started 20 seconds (or longer) after the first pump, and the third pump should be started 20 seconds (or longer) after the second pump.
- As a safety precaution for the pump, the VFD controls should be programmed to preclude energizing the pump if a reverse rpm condition is occurring.

Results for an example catch "on the fly" restart under a worst-case sag event duration lasting 3 seconds with recommendations of the first bullet, above, observed are shown in Figures 3-5 and 3-6. Note that the analysis showed similar but slightly less severe predicted surge pressures for shorter voltage sag events with catch "on the fly" restart initiated sooner than 3 seconds. Figure 3-5 shows IPS system pipeline profile (in red), the steady state HGL prior to the loss of pump power (in green), and the maximum surge HGL (in dark blue) and minimum surge HGL (in light blue) following the loss of pump power and subsequent catch "on the fly" restart of the pumps.

Following the loss of pump power, a low pressure drop wave is generated at the IPS and travels out along the PE pipelines, dropping the minimum pressure head to approximately -6 ft below the pipeline crown downstream of the IPS, while the aeration header piping experiences approximately -12 ft negative pressure due primarily to initial steady state siphon conditions as shown. These minimum surge pressure heads are brief and safely above vapor pressure. The pipeline is therefore not predicted to be at risk of vapor cavity formation. As indicated previously, data on the pressure class of the steel piping for the IPS system was not provided. It is anticipated that the minimum surge pressures predicted are not a concern for the IPS piping to be at risk of collapse; however, this cannot be explicitly validated by this analysis. Note, however, for reference, that the results shown for a pump power loss condition have likely been experienced by the IPS system in the past, and if damage has not been observed, then this is likely an indication of acceptable conditions for the pipelines.

At a time 3 seconds after pump power loss, the predicted inertial spindown of the pumps for the case shown predicts pump speeds of approximately 120 rpm when catch "on the fly" restart of the pumps is then initiated. At the recommended 5 rpm/sec ramp rate, the pumps would return to full speed in approximately 36 seconds from the initiation of restart for the case shown. Restarting of the pumps results in the maximum surge HGL shown, with an approximate 7 ft rise above the steady state predicted for the case shown. As noted previously, the design pressure class of the IPS/PE system pipelines was not provided for the analysis, nor is the condition of the existing pipelines known. However, the modest rise in pressure predicted is expected to likely be acceptable for the system.

Figure 3-6 shows predicted pressure head records at the IPS header and at the tee to Aeration Tank 5 following the loss of power and subsequent catch "on the fly" restart 3 seconds after pump power loss. Note the drop in system pressure predicted following full pump power loss and the gradual increase in pressure as the pumps are ramped back up to speed over 36 seconds.

### 3.2.2 IPS Recommended Controlled Ramp Down

For a background description regarding controlled ramp down and the planned future addition of the online UPS, please refer to the description provided for the EPS system, Section 3.1.3, above.

Based on the transient analysis, the following action is recommended for a minimum duration controlled ramp down of the IPS system (identical recommendations as provided for EPS system):

- During a controlled IPS system pump shutdown, the pumps should be ramped down *at a ramp rate not faster than 5 rpm/sec.*

Results for an example controlled ramp down of the IPS system at the recommended ramp down rate of 5 rpm/sec per the recommendation above are shown in Figure 3-7.

Figure 3-7 shows the predicted HGLs for the system for the pumps ramping down at the recommended rate of 5 rpm/sec. For the pumps initially at approximately 300 rpm, this rate equates to shutdown of the pumps to 0 rpm in 60 seconds. As shown, the predicted maximum surge HGL exhibits a modest 6-ft rise over the steady state HGL, and the minimum surge pressure heads remain predominantly positive throughout the system with the exception of the aeration tank headers due to siphon flow under steady state conditions.

# Section 4: Conclusions

Based on the analysis, the following actions are recommended for both the EPS and IPS systems:

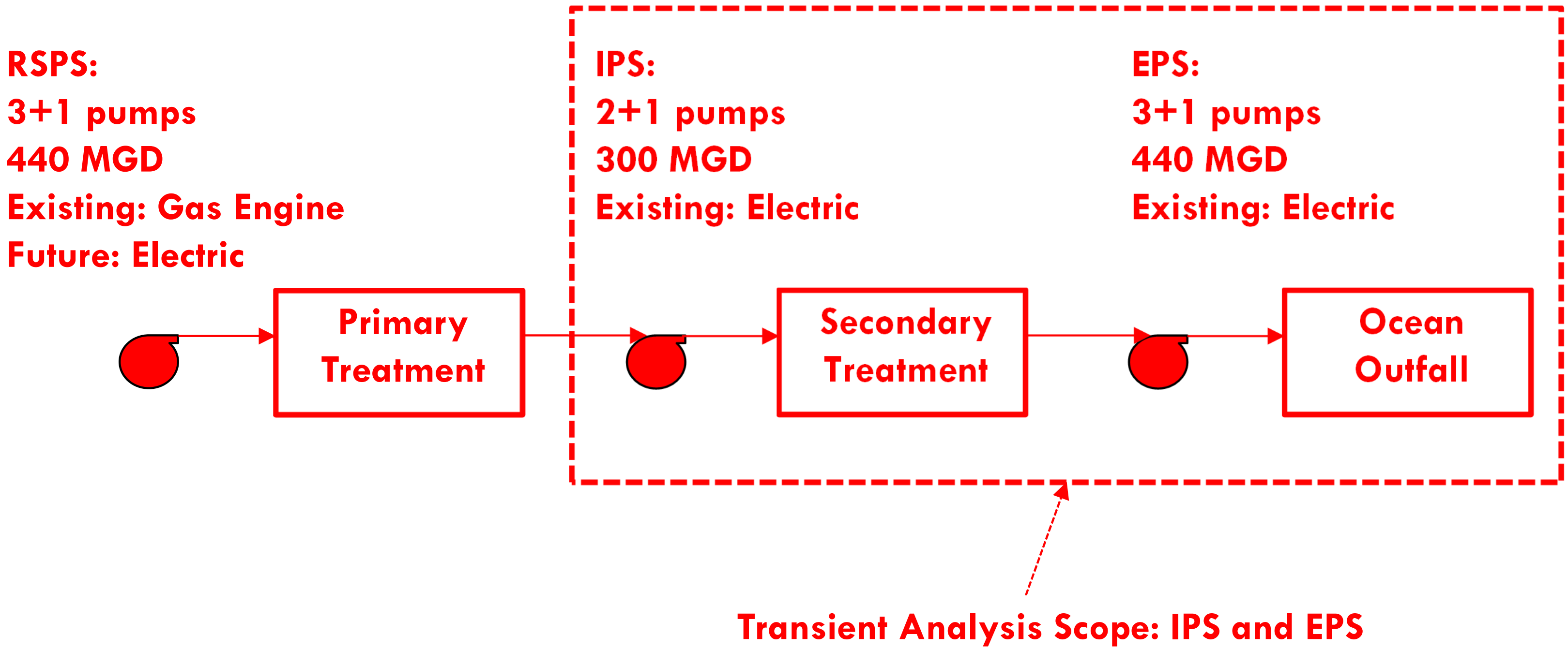
- If a voltage sag event duration is 3 seconds or less, the VFDs can initiate a catch "on the fly" restart and immediately re-energize the pump motors bringing them back up to speed *at a ramp rate not faster than 5 rpm/sec.*
- If a voltage sag event of sufficient magnitude and a duration exceeding 3 seconds occurs the VFDs will fault and require a reset. Ovation should then initiate a controlled staggered restart sequence for the pumps, ramping each pump up to speed. The VFD's limit the *ramp rate to 5 rpm/sec. It is recommended that Ovation ensure that a minimum 20-second lag (or longer) be maintained between staggered pump starts,* i.e., after the first pump is started, the second pump should be started 20 seconds (or longer) after the first pump, and the third pump should be started 20 seconds (or longer) after the second pump.

- As a safety precaution for the pump, the VFD controls should be programmed to preclude energizing the pump if a reverse rpm condition is occurring.
- During a controlled system pump shutdown, the pumps should be ramped down *at a ramp rate not faster than 5 rpm/sec*.

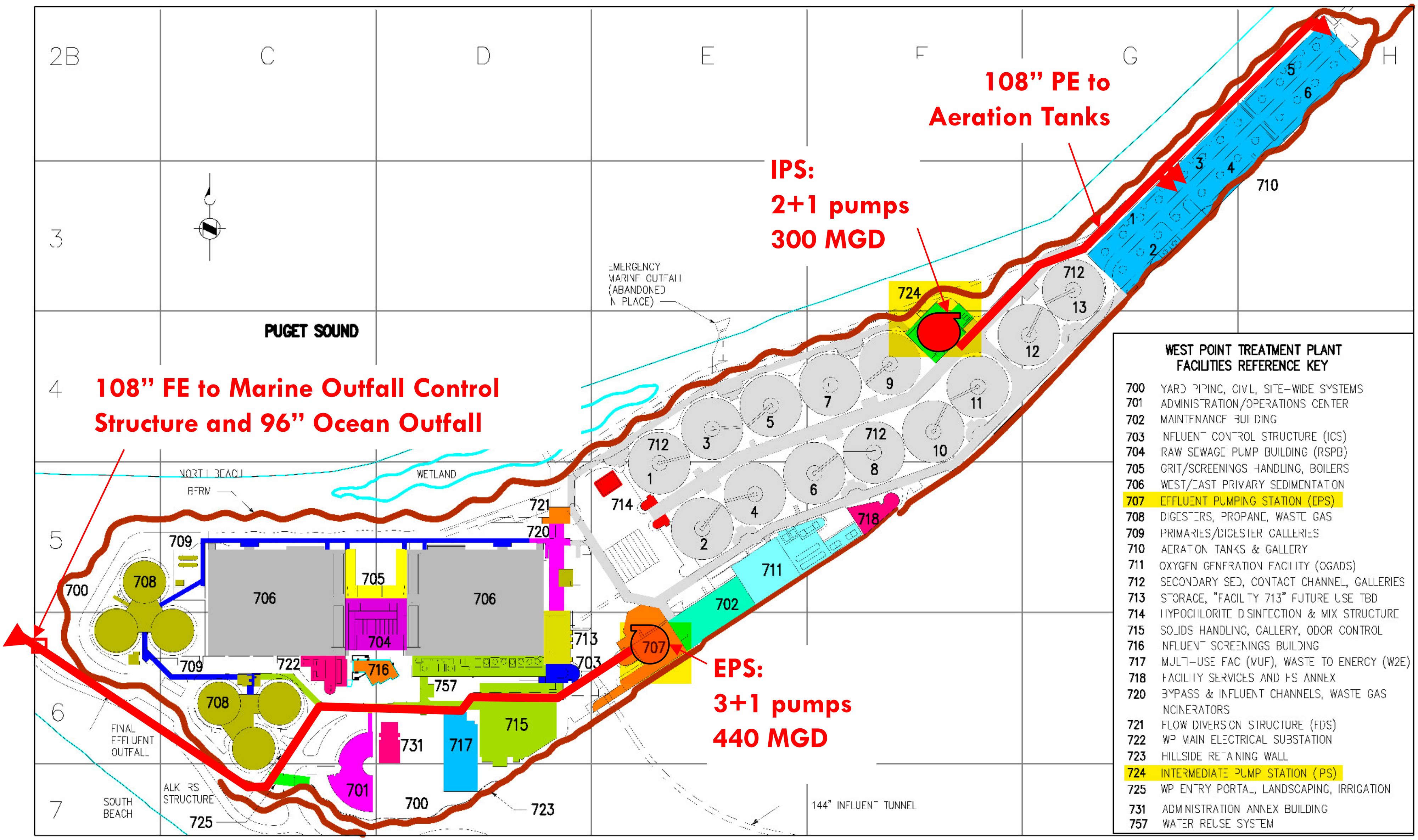
# Figures

# West Point Power Quality Assessment – Hydraulic Transient Analysis

## Figure 1-1 – West Point Treatment Plant – Pumping Overview



## Figure 2-1 – West Point Treatment Plant – EPS and IPS Overview



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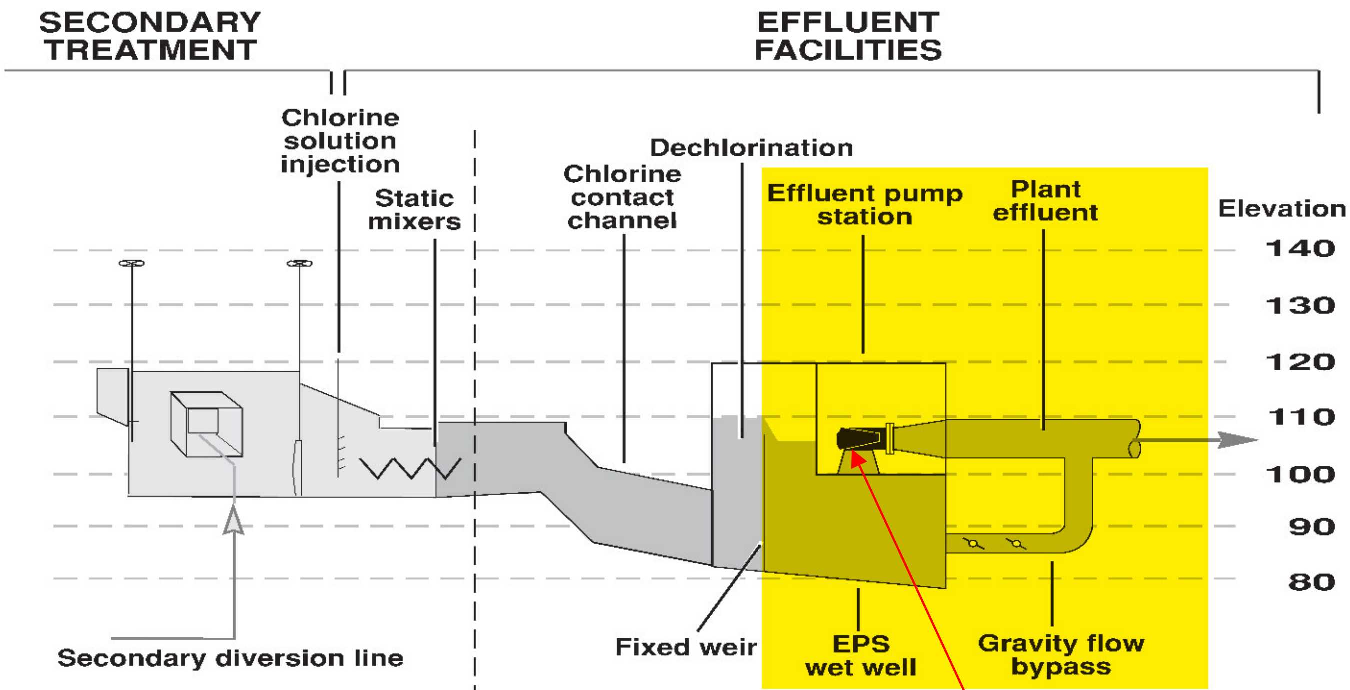
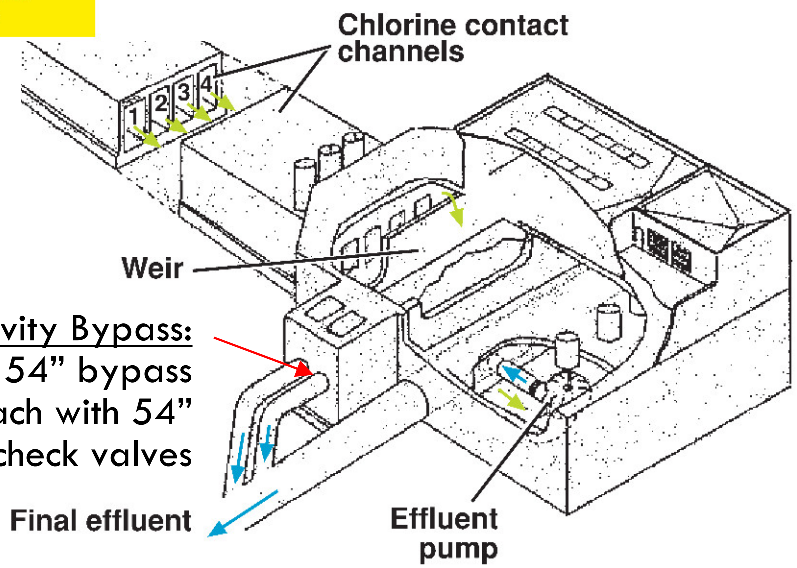
# West Point Power Quality Assessment – Hydraulic Transient Analysis

## Figure 2-2 – EPS schematic




(108” to
96” Ocean Outfall)

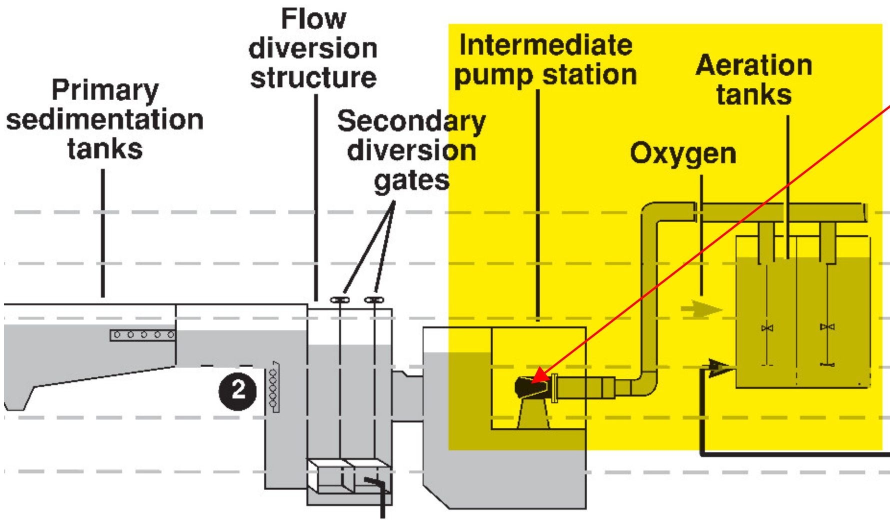
440 MGD, 4 pumps (3 duty + 1 standby)
2250 HP motors with VFDs
60” Diameter Butterfly Pump Control Valve
Differential loss: 3’-10’, Acts as Check Valve, 133 Sec Close



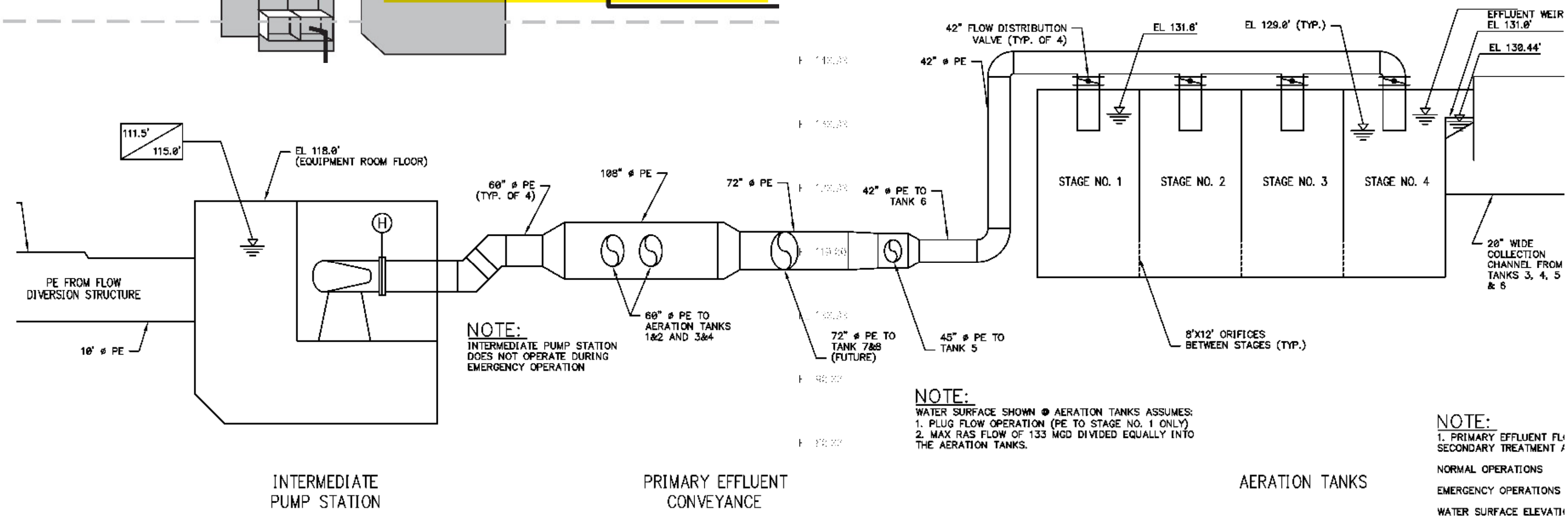

<u>Gravity Bypass:</u>
2 parallel 54” bypass
pipelines each with 54”
mechanical check valves

# West Point Power Quality Assessment – Hydraulic Transient Analysis

## Figure 2-3 – IPS schematic




300 MGD,
3 pumps (2 duty + 1 standby)
2250 HP with VFDs
60” Diameter Butterfly Pump Control Valve
Differential loss: 3’-10’, Acts as Check Valve,
133 Sec Close



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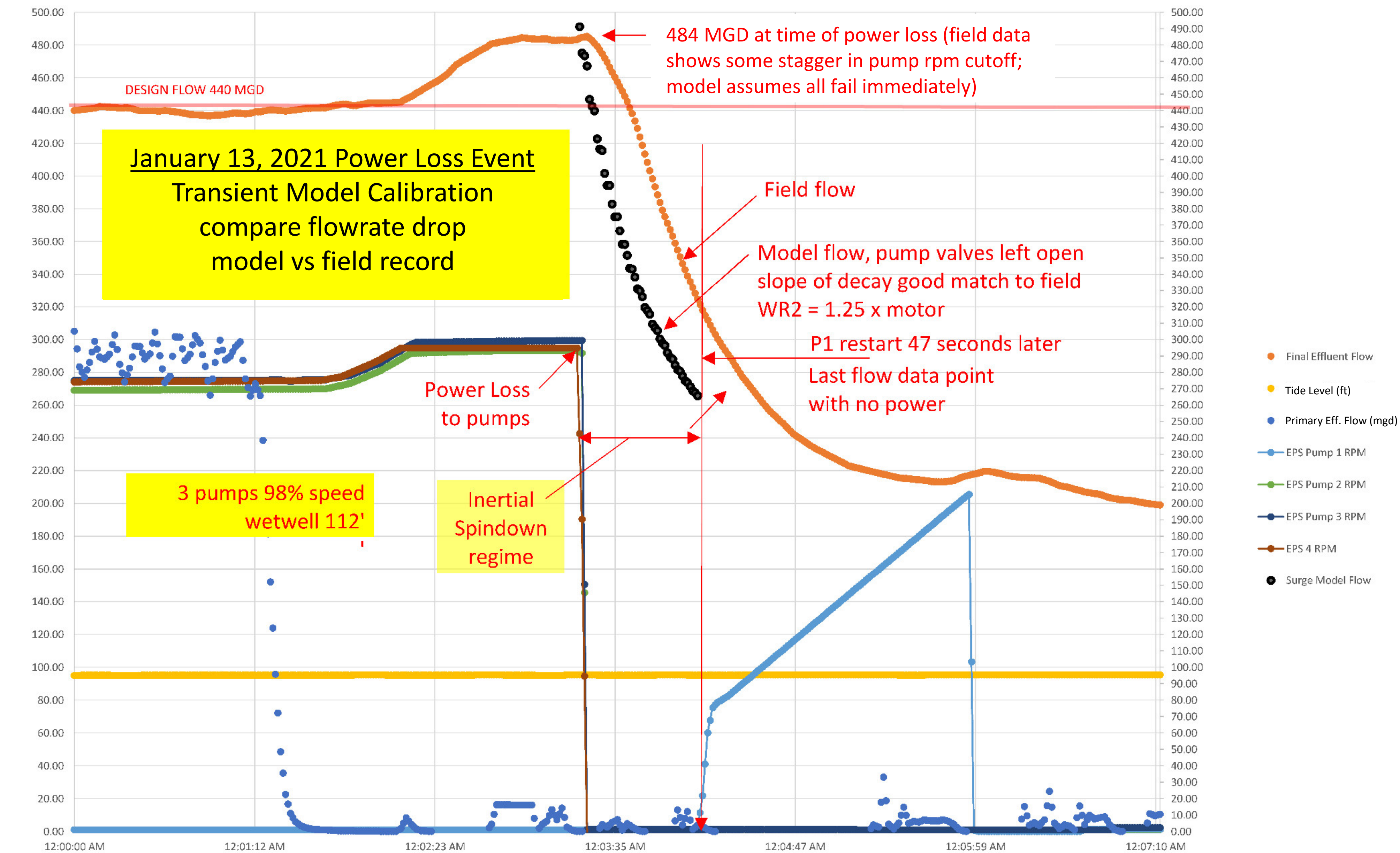
# West Point Power Quality Assessment – Hydraulic Transient Analysis

## Figure 3-1 – EPS January 13, 2021 pump trip event - comparison of model to field data



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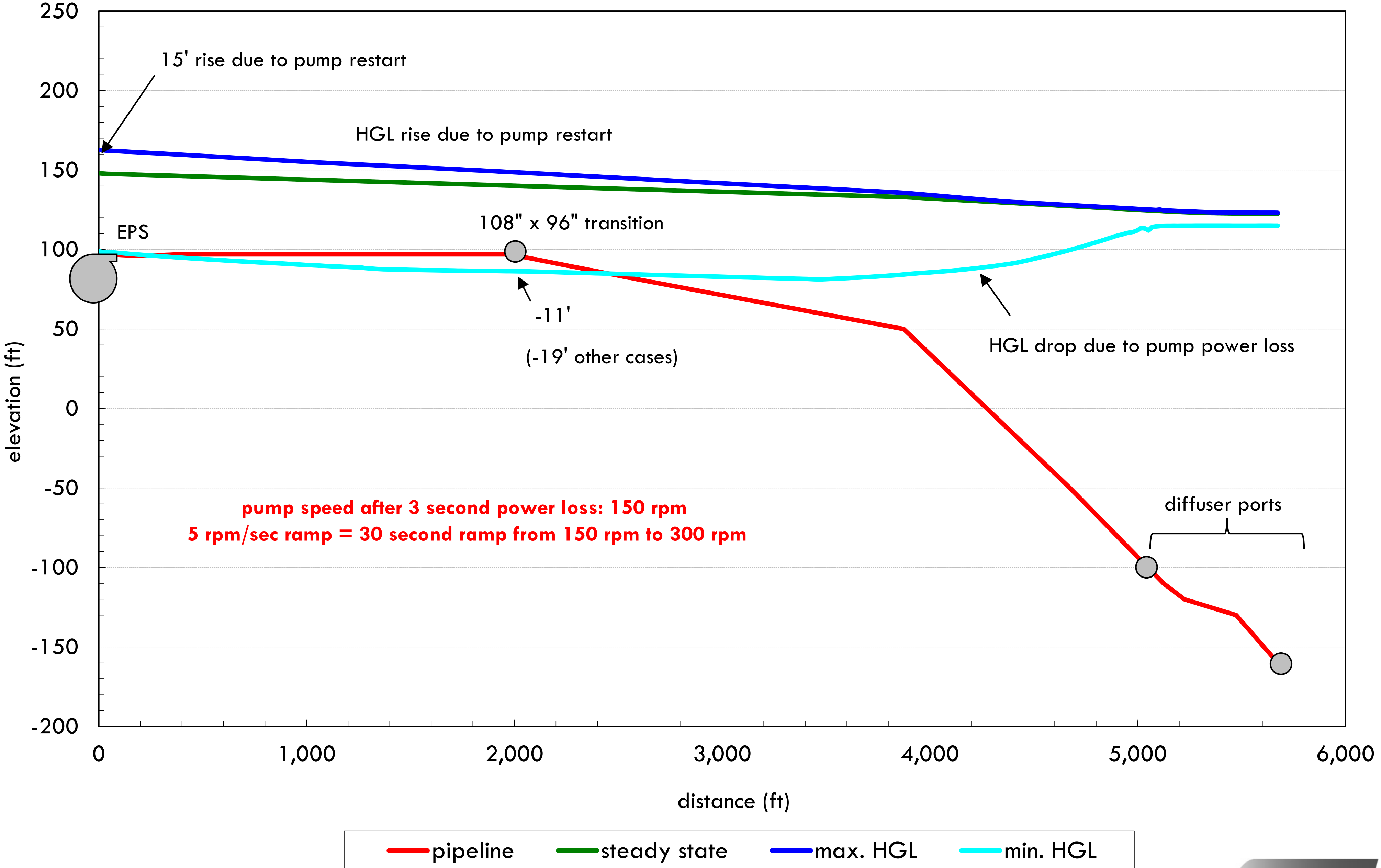
## West Point Power Quality Assessment – Hydraulic Transient Analysis

**Figure 3-2; HGL elevations following loss of pump power and catch "on the fly" restart of EPS system**
**484 mgd – 3 pumps full power loss, 3 seconds delay, 5 rpm/sec ramp rate**

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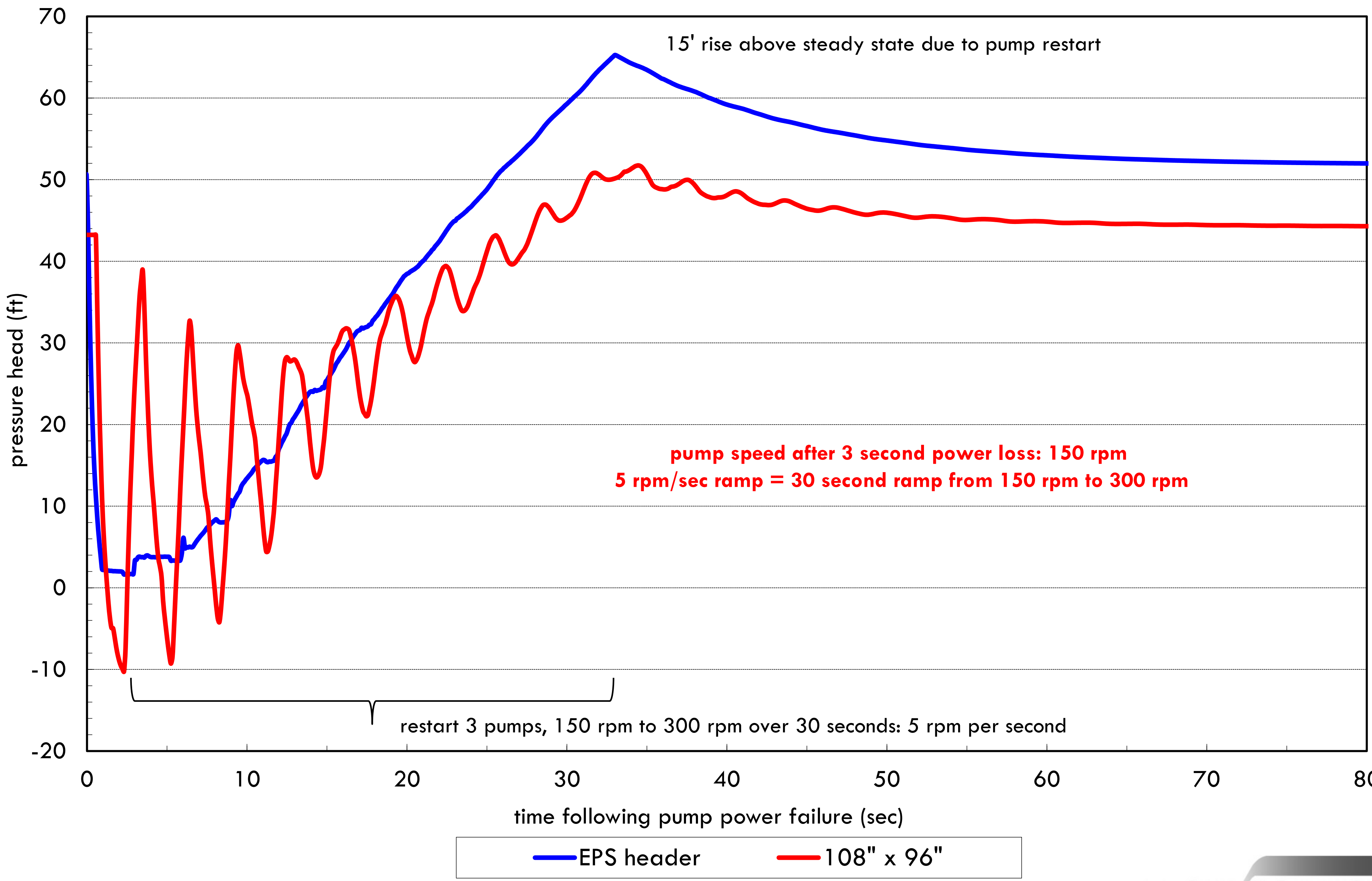
211038 April 2, 2022

## West Point Power Quality Assessment – Hydraulic Transient Analysis

**Figure 3-3; predicted pressure head records following loss of pump power and catch "on the fly" restart**

**EPS system 484 mgd – 3 pumps full power loss, 3 seconds delay, 5 rpm/sec ramp rate**

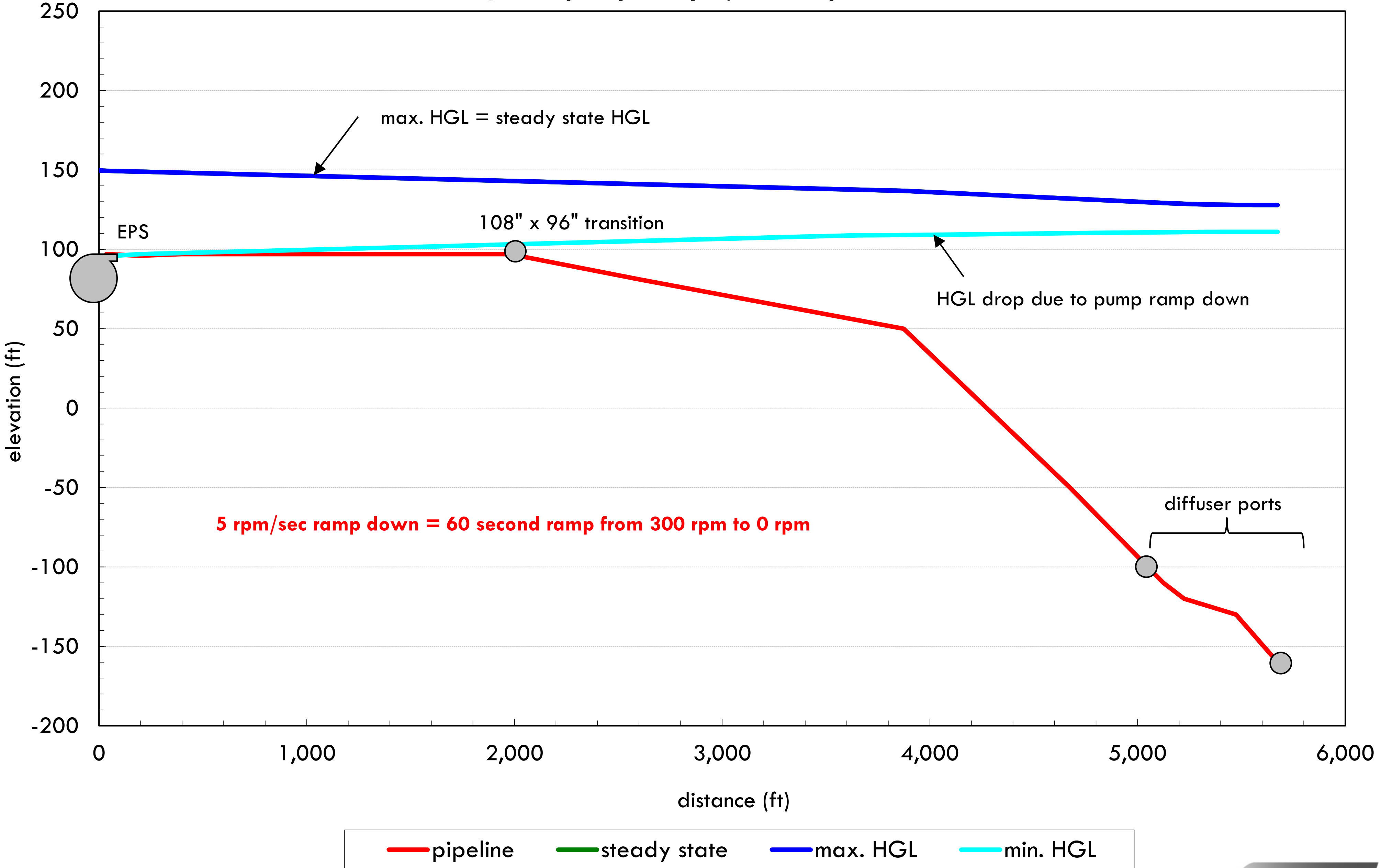



211038 April 2, 2022

# West Point Power Quality Assessment – Hydraulic Transient Analysis

**Figure 3-4; HGL elevations following controlled ramp down of the EPS system**

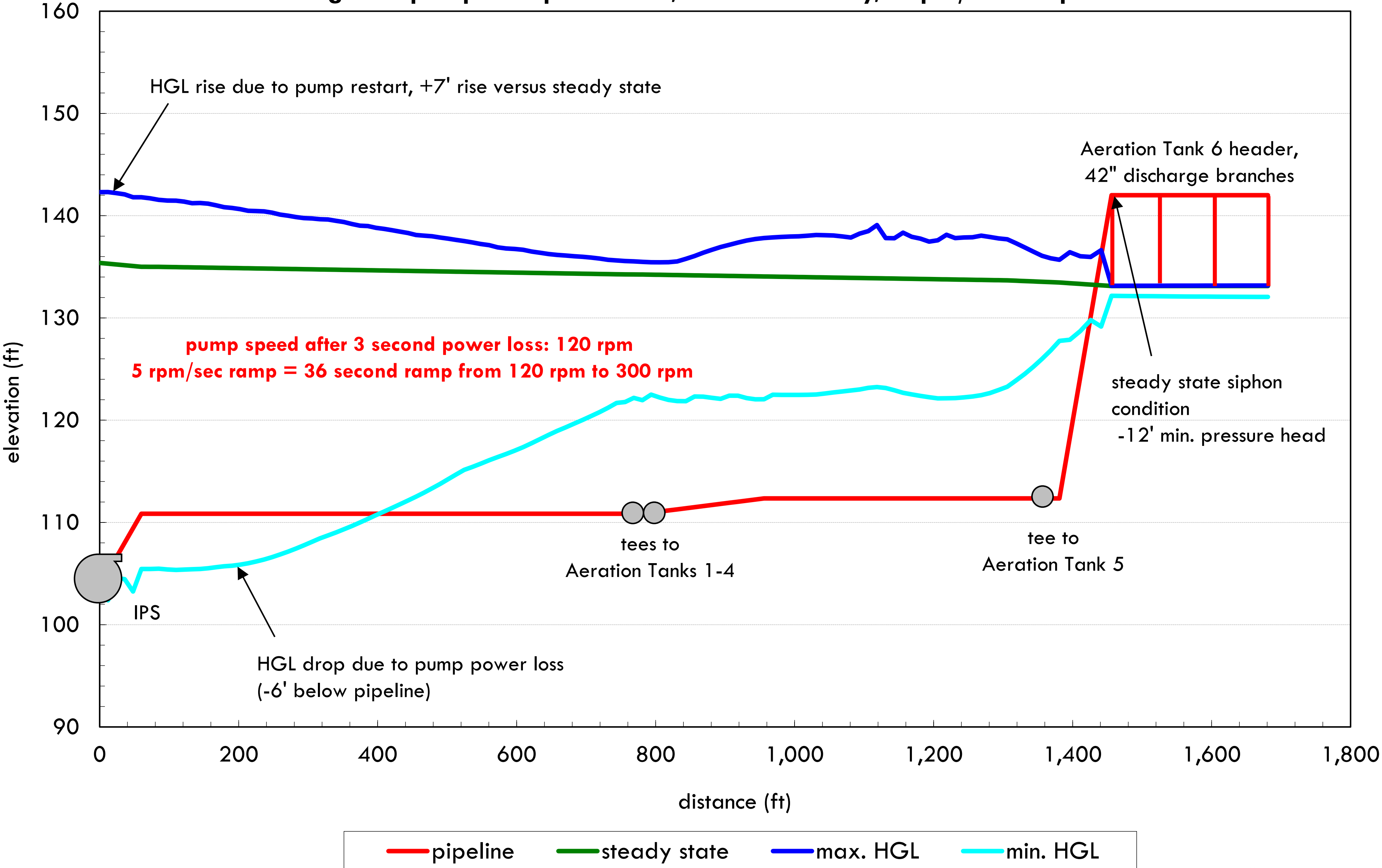
**484 mgd – 3 pumps, 5 rpm/sec ramp down rate**




211038 April 2, 2022

# West Point Power Quality Assessment – Hydraulic Transient Analysis

**Figure 3-5; HGL elevations following loss of pump power and catch "on the fly" restart – IPS system**
**300 mgd – 2 pumps full power loss, 3 seconds delay, 5 rpm/sec ramp rate**

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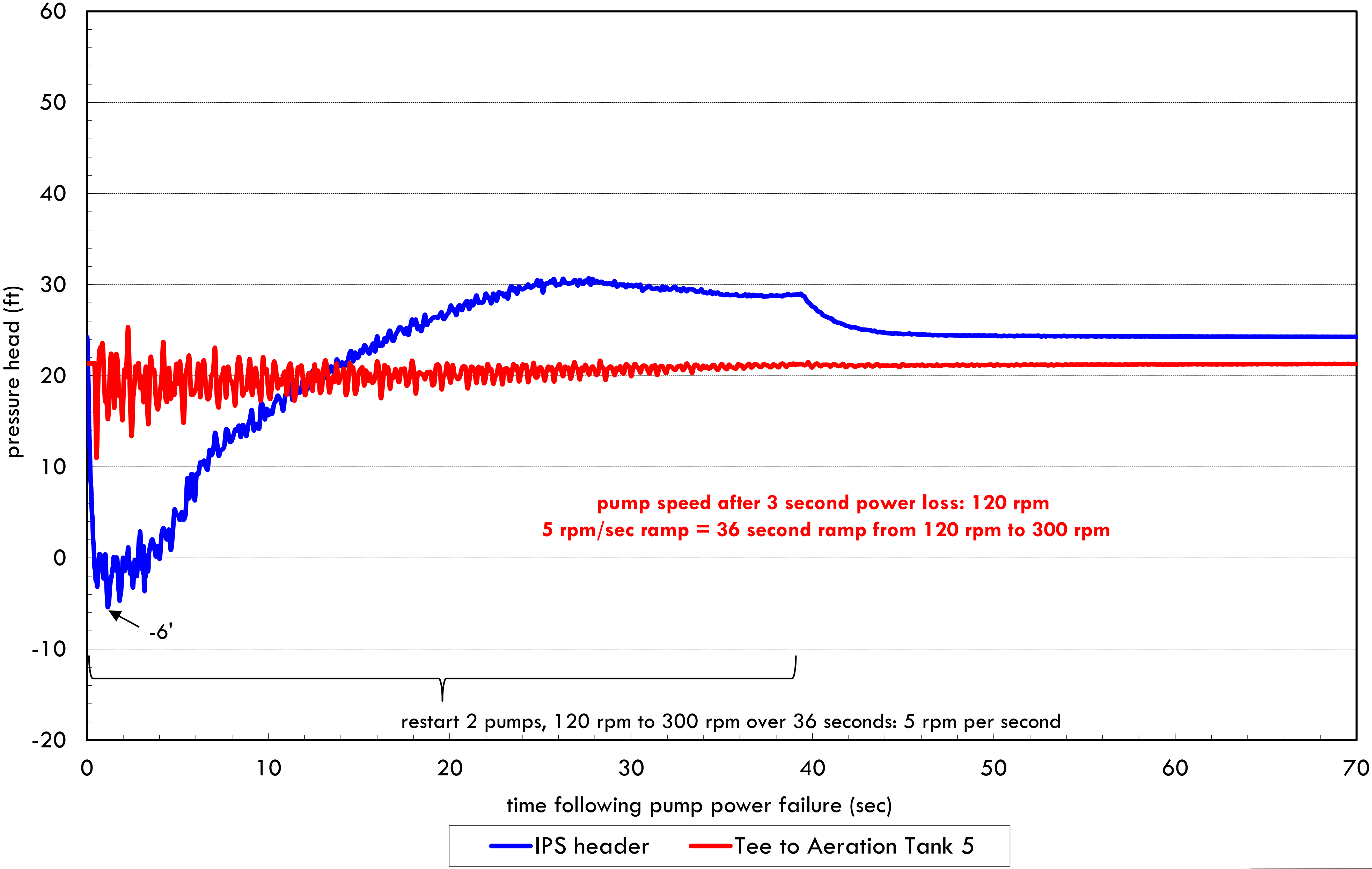
## West Point Power Quality Assessment – Hydraulic Transient Analysis

**Figure 3-6; predicted pressure head records following loss of pump power and catch "on the fly" restart**
**IPS system 300 mgd – 2 pumps full power loss, 3 seconds delay, 5 rpm/sec ramp rate**

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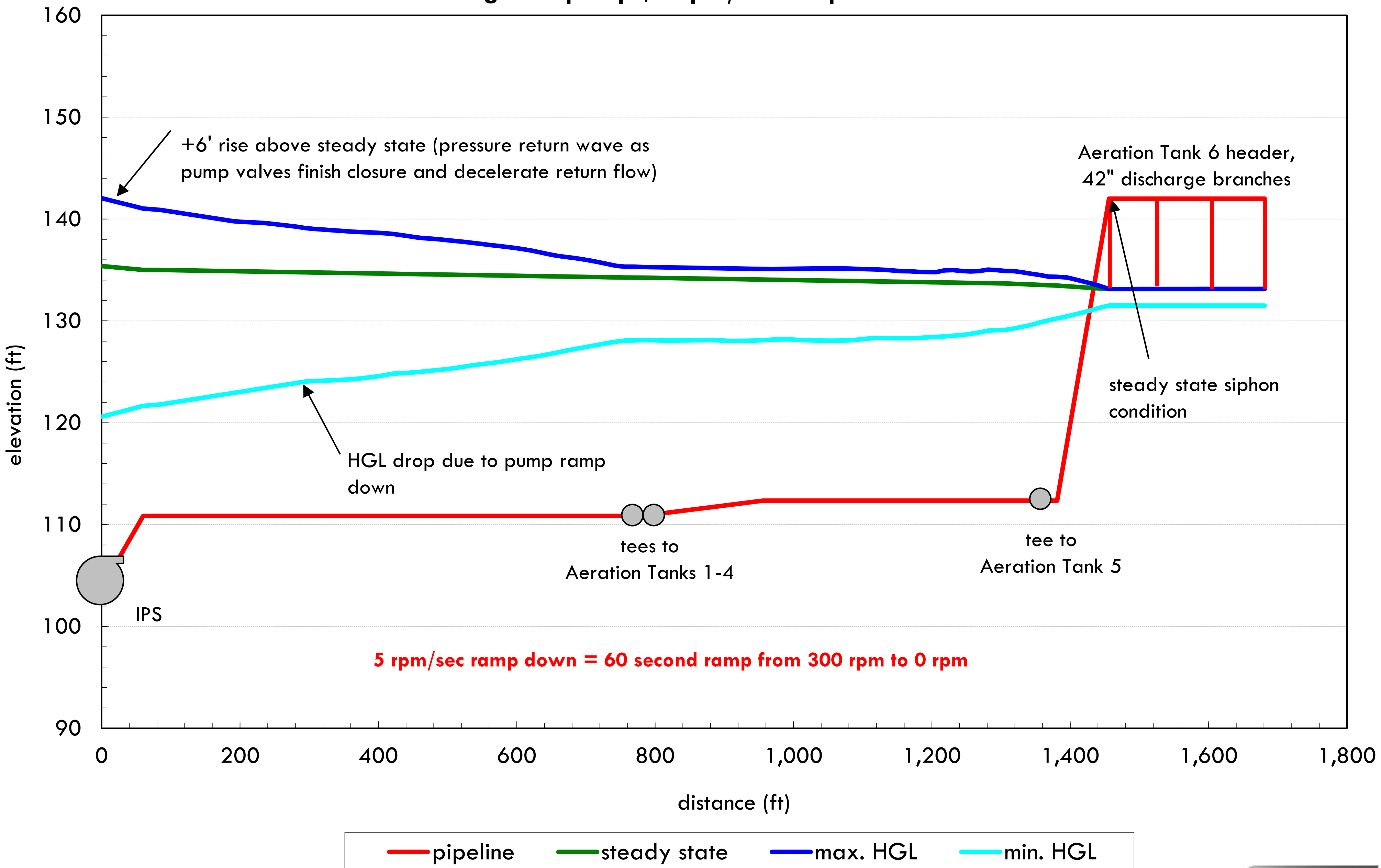
## West Point Power Quality Assessment – Hydraulic Transient Analysis
### Figure 3-7; HGL elevations following controlled ramp down of the IPS system
### 300 mgd – 2 pumps, 5 rpm/sec ramp down rate




211038 April 2, 2022

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# APPENDIX E – DEADLINES IN THE AGREEMENT

## SECTION II. TRIBAL MITIGATION

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE | DEADLINE FOR PAYMENT OF PENALTY |
|---|---|---|---|---|
| 3. | County to transmit $2.5 million payment to Tribe for compensation for Tribal impacts | 30 days from Effective Date of Agreement | Not applicable | Not applicable |
| **PARAGRAPH NUMBER** | **VIOLATIONS TRIGGERING ACTIONS** | **DEADLINE** | **PENALTY FOR MISSED DEADLINE** | **DEADLINE FOR PAYMENT OF PENALTY** |
| 4. | County to pay $50,000 to Tribe for any Emergency Bypass Event beginning 01/01/2025 thru 12/31/2026 | 60 days after the day Emergency Bypass Event begins | Not applicable | Not applicable |
| 5. | County to report Emergency Bypass Events to Tribe beginning on Effective Date thru Completion Date of Agreement | 3 days from the day Emergency Bypass Event begins | Not applicable | Not applicable |
| 5. | County to provide to Tribe any completed investigation reports regarding Emergency Bypass Event | County to promptly provide to Tribe | Not applicable | Not applicable |

## SECTION III. SUPPLEMENTAL ENVIROMENTAL PROJECT

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE | DEADLINE FOR PAYMENT OF PENALTY |
|---|---|---|---|---|
| 6. | County to fund one or more Supplemental Environmental Projects ("SEPs") in amount of $2.4 million | SEP project(s) to be completed within 5 years from Completion Date of Agreement | Not applicable | Not applicable |
| 7. | Parties to determine which SEP(s) to fund, draft goals for each SEP, identify implementing entity(s) to be awarded, determine | 90 days from Effective Date of Agreement | Not applicable | Not applicable |

| | | | | |
|---|---|---|---|---|
| | amount of SEP for each implementing entity, and establish reporting requirements for such implementing entities | | | |
| 11. | Parties to provide comments on proposed plan and timeline for completion of project submitted by each implementing entity | 60 days from receipt of such plan and timeline | Not applicable | Not applicable |
| 11. | Implementing entity to submit final plan and timeline to Parties | 60 days from receipt of comments of Parties | Not applicable | Not applicable |
| 14. | Completion of SEP project(s) | 5 years from Effective Date of Agreement | Not applicable | Not applicable |
| **PARAGRAPH NUMBER** | **EVENTS TRIGGERING ACTIONS** | **DEADLINE** | **PENALTY FOR MISSED DEADLINE** | **DEADLINE FOR PAYMENT OF PENALTY** |
| 13. | If a Material Alteration occurs or if entity implementing SEP becomes aware a Material Alteration is likely to occur, implementing entity to notify Parties | 5 days of becoming aware of Material Alteration or of becoming aware that Material Alteration is likely to occur | Not applicable | Not applicable |

**SECTION IV. INFRASTRUCTURE**

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE (Paragraph 21) | DEADLINE FOR PAYMENT OF PENALTY (Paragraph 21) |
|---|---|---|---|---|
| 17a. | County to replace UPS 703-UPS01 at WPTP | September 30, 2022 | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed deadline until | Within 30 days from incurrence of penalty |

| | | | | |
|---|---|---|---|---|
| | | | Construction Completion | |
| 17b. | County to achieve Construction Completion for replacement of 11 UPSs at WPTP identified in Appendix B | 2 years from Effective Date of Agreement | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed deadline until Construction Completion | Within 30 days from incurrence of penalty |
| 17c. | County to develop proposed written UPS replacement and rehabilitation program and provide copy to Tribe | 18 months from Effective Date of Agreement | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed deadline until Construction Completion | Within 30 days from incurrence of penalty |
| 17c. | Tribe has option to comment on UPS replacement and rehabilitation program | 45 days of receipt of proposed program | Not applicable | Not applicable |
| 17c. | The UPS replacement and rehabilitation program to go into effect | 2 years from the Effective Date of Agreement | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed | Within 30 days from incurrence of penalty |

| | | | | |
|---|---|---|---|---|
| | | | deadline until Construction Completion | |
| 18a. | County to complete VFD Optimization at WPTP within protective threshold set points for IPS and EPS pumps | County achieved Construction Completion on April 14, 2022 | Not applicable | Not applicable |
| 18b. | County to install battery-powered UPS for EPS and IPS capable of maintaining power in the event of a voltage sag or power interruption | December 31, 2024 | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed deadline until Construction Completion | Within 30 days from incurrence of penalty |
| 19a. | County to replace the four existing raw sewage pumps at WPTP | 10 years from Effective Date of Agreement | First-time penalty of $40,000 for failure to meet deadline | Within 30 days from incurrence of penalty |
| | | | Additional $10,000 for every month of delay beginning 31 days after initial missed deadline until Construction Completion | Within 30 days from incurrence of penalty |
| 20. | County to complete alternatives analysis of long-term projects to address unauthorized discharges at the Elliott West CSO Treatment Plant | County completed analysis on December 21, 2021 and transmitted to Tribe on March 4, 2022 | Not applicable | Not applicable |
| 20. | Tribe to comment on Elliott West CSO Treatment Plant alternatives analysis | 60 days from Effective Date of Agreement | Not applicable | Not applicable |

## SECTION VI. FORCE MAJEURE AND RECALCULATION DEADLINES

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE | DEADLINE FOR PAYMENT OF PENALTY |
|---|---|---|---|---|
| 25. | If any event occurs or has occurred that may delay performance of any obligation, whether caused by Force Majeure or not, County shall provide notice orally or by electronic transmission to the Tribe | 10 days from when County knew or should have known of such event | County precluded from asserting any claim of Force Majeure for that event and delay caused by such event | Not applicable |
| 25. | County to provide written explanation and description of reasons for delay; anticipated duration of delay; etc. | 10 days from oral or electronically transmitted notice from County | County precluded from asserting any claim of Force Majeure for that event and delay caused by such event | Not applicable |
| 26. | If Tribe agrees that a Force Majeure event has occurred, Tribe to provide agreement via letter or email | 10 days from notice from County | Not applicable | Not applicable |
| 27. | If Tribe does not agree that Force Majeure event has occurred or to County's proposed extension for such an event, Tribe to notify County in writing | Not applicable | Not applicable | Not applicable |
| 28. | County to invoke dispute resolution procedures should it not agree with Tribe's written decision | 15 days from receipt of Tribe's written decision | Not applicable | Not applicable |

## SECTION VII. REPORTING

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE | DEADLINE FOR PAYMENT OF PENALTY |
|---|---|---|---|---|
| 29. | County to provide written annual report to Tribe | First annual report due on January 31, 2023, and each subsequent annual report due | Not applicable | Not applicable |

| | | | | |
|---|---|---|---|---|
| | | on January 31st of the following year through the January 31st of the year immediately after Completion Date of the Agreement | | |
| 30. | County to report to Tribe whether project associated with a deadline under Section IV of the Agreement has achieved Construction Completion | 7 days from deadline established in Section IV of Agreement | Not applicable | Not applicable |
| 30. | If project has not been completed by the deadline established under Section IV, County to report to Tribe until the project has been completed | Monthly following missed deadline until Construction Completion | Not applicable | Not applicable |

**<u>SECTION VIII. ATTORNEY AND EXPERT FEES AND COSTS</u>**

| PARAGRAPH NUMBER | REQUIRED ACTION | DEADLINE | PENALTY FOR MISSED DEADLINE | DEADLINE FOR PAYMENT OF PENALTY |
|---|---|---|---|---|
| 31. | County to pay $240,000 in attorney and expert fees and costs | 30 days from Effective Date of Agreement | Not applicable | Not applicable |