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# Memorandum

**To:** Bill Neal, General Manager
North Beach Water District

**From:** Mike Olden, P.E., Gibbs & Olson, Inc.

**Date:** February 2, 2016

**Re:** North Beach Water District – South Sunset Sands Distribution Evaluation

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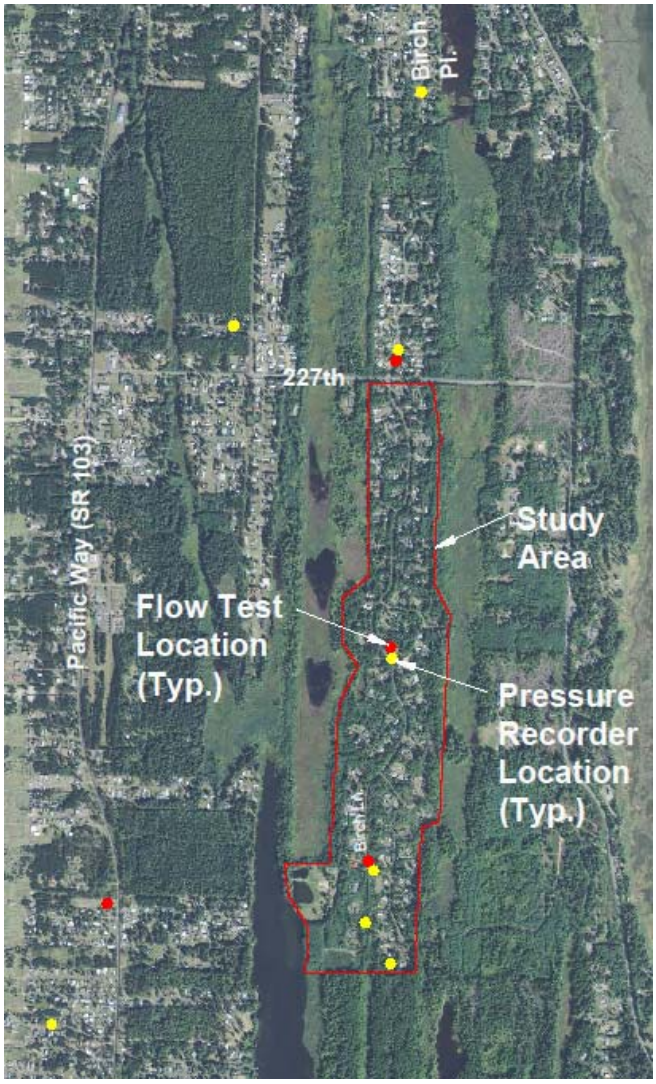
Gibbs & Olson has evaluated alternatives for addressing low pressure concerns and achieving fire flow goals on a dead end water main located on Birch Place south of 227th Place serving the Sunset Sands Community. Gibbs & Olson conducted pressure and flow tests within the Sunset Sands area on Friday October 2nd, 2015 and again on January 5th, 2016. The second round of testing was conducted after the District discovered and corrected a previously unknown restriction in the distribution system at the South Wellfield directly affecting the Sunset Sands area.



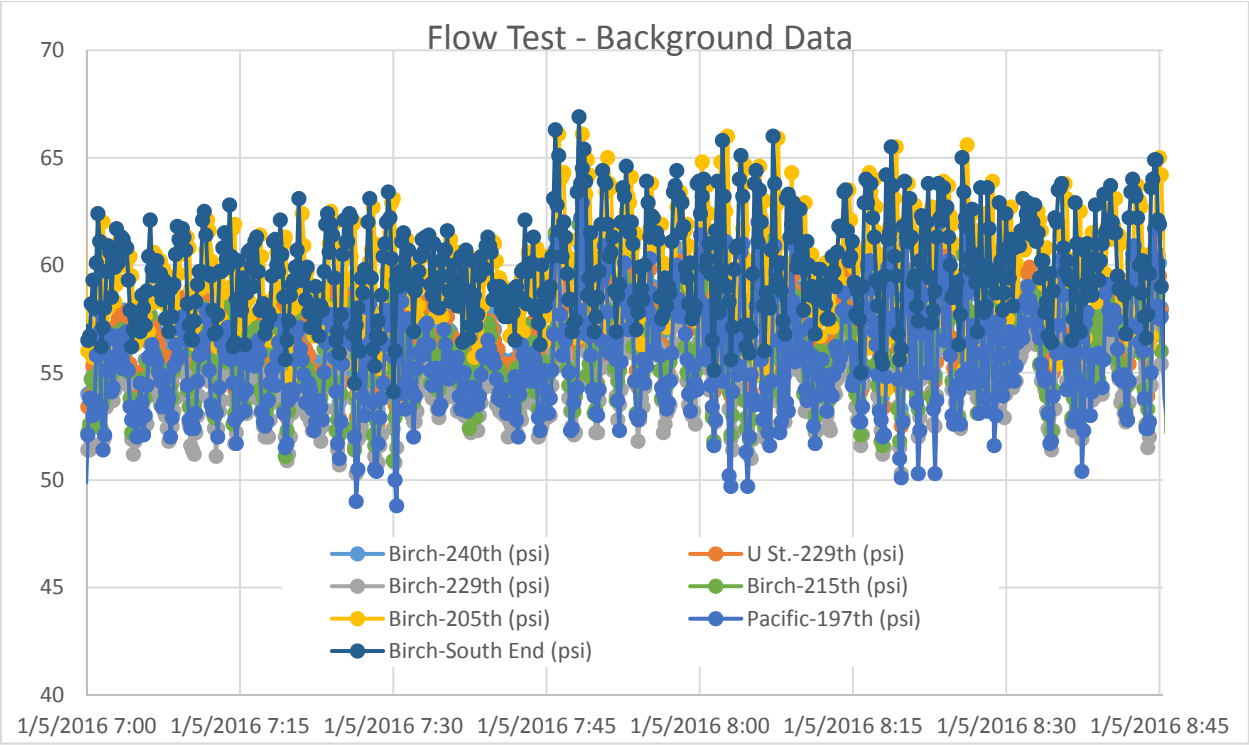

The purpose of the flow and pressure testing is to obtain field results that will be used to calibrate the parameters of the hydraulic model of the distribution system, especially within the Sunset Sands area. The calibrated hydraulic model will be used to evaluate various options to address low pressure and/or inadequate fire flow conditions within the District's distribution system, concentrating on the Sunset Sands area.

The areas in the Sunset Sands development south of 227$^{th}$ Place (shown in the figure to the right) has approximately 420 lots and 250

active services. The current Peak Hour Demand (PHD) for this area is expected to be approximately 150 gpm and the future PHD is expected to be approximately 190 gpm based on information provided in the recent NBWD Water System Plan (WSP) Update.

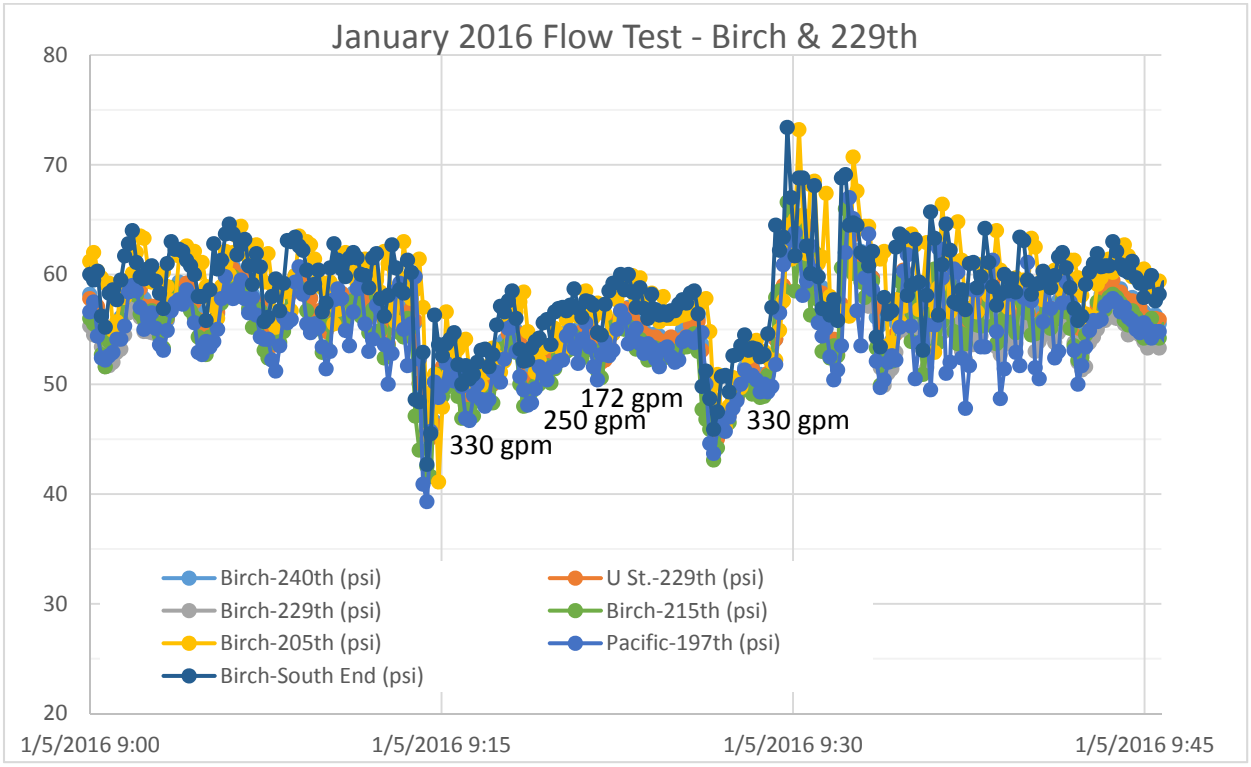
**Testing and Data Evaluation**

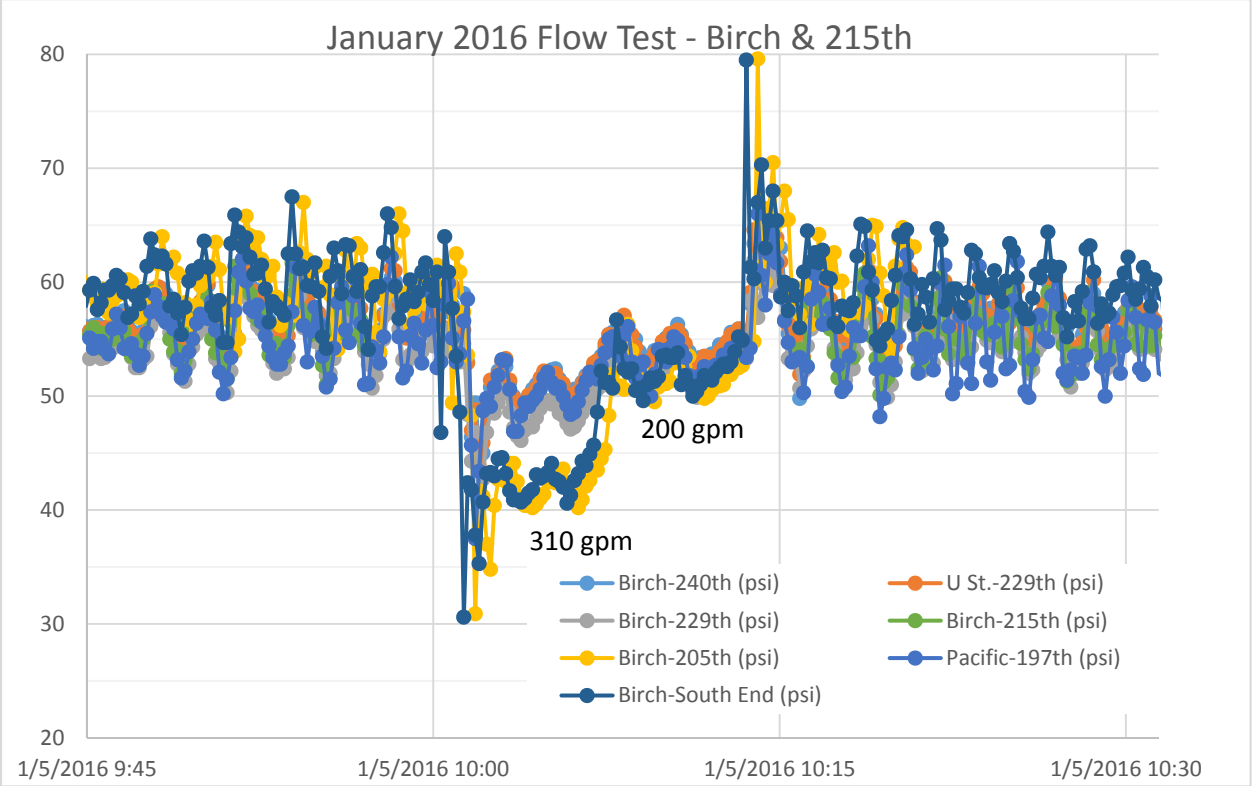
The basic strategy for flow and pressure testing is to deploy pressure recorders at locations upstream and downstream of hydrant flows and conduct multiple hydrant tests at various flow rates. The location of the pressure recorders are shown on the above figure. All pressure data is collected at 10 second intervals. Background pressure data was collected to establish a baseline for pressure within the distribution system during normal operating conditions. Distribution system pressure is provided from the North Pump Station and the South Pump Station. The South Pump Station is typically shut down from 6 PM to 8AM to better manage storage levels. The South Pump Station will be operated continuously (24 hours per day) after future source and treatment modifications are completed at the South Well Field. Typical operating pressure with and without the South Pump Station are shown on the following chart:

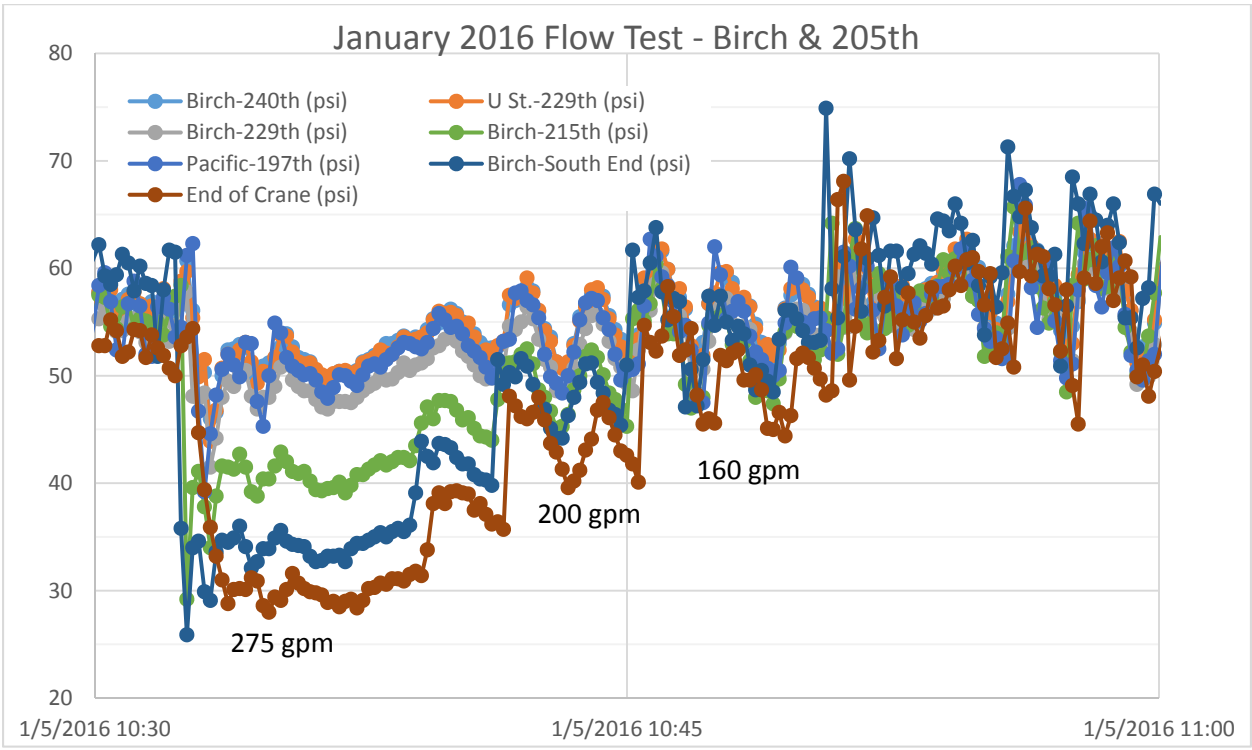


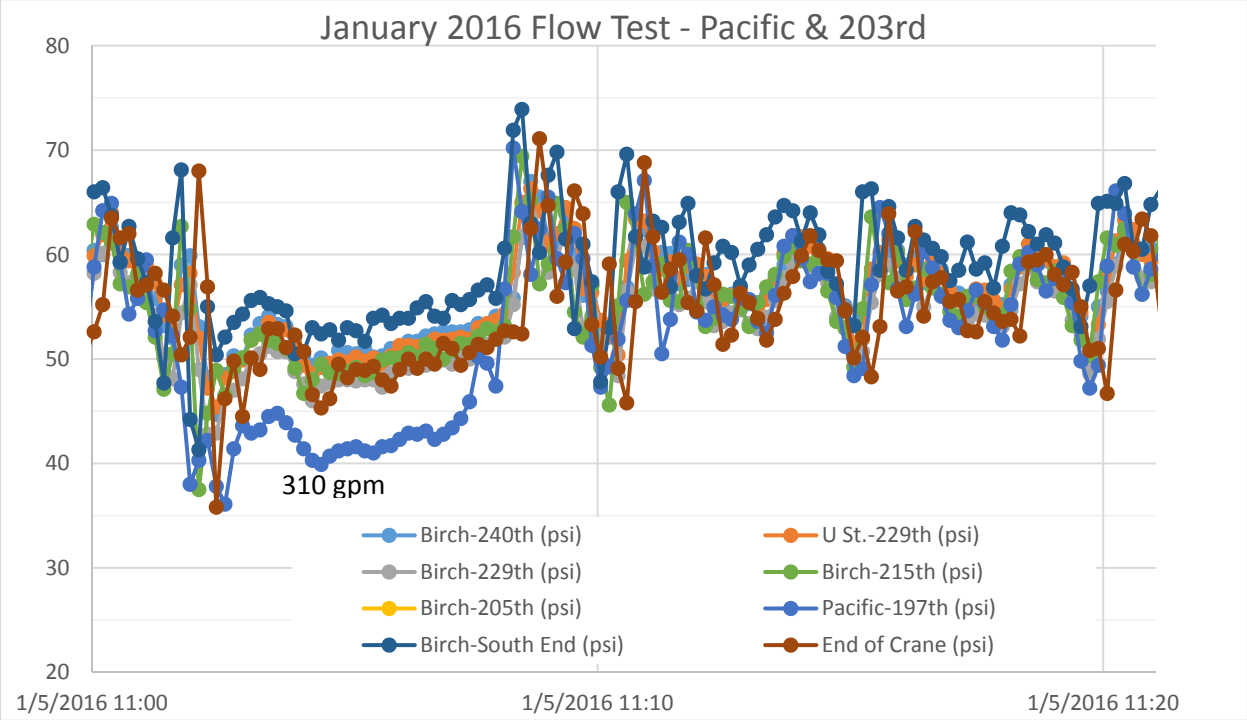

In this case, the South Pump Station was turned on at about 7:45 AM. Both flow tests were conducted after 9:00 in the morning. The South Pump Station was in service for both tests. The flow tests were conducted with very little background water demand present within the system, which generally allows for more consistent model calibration. A pitot gauge and diffuser were

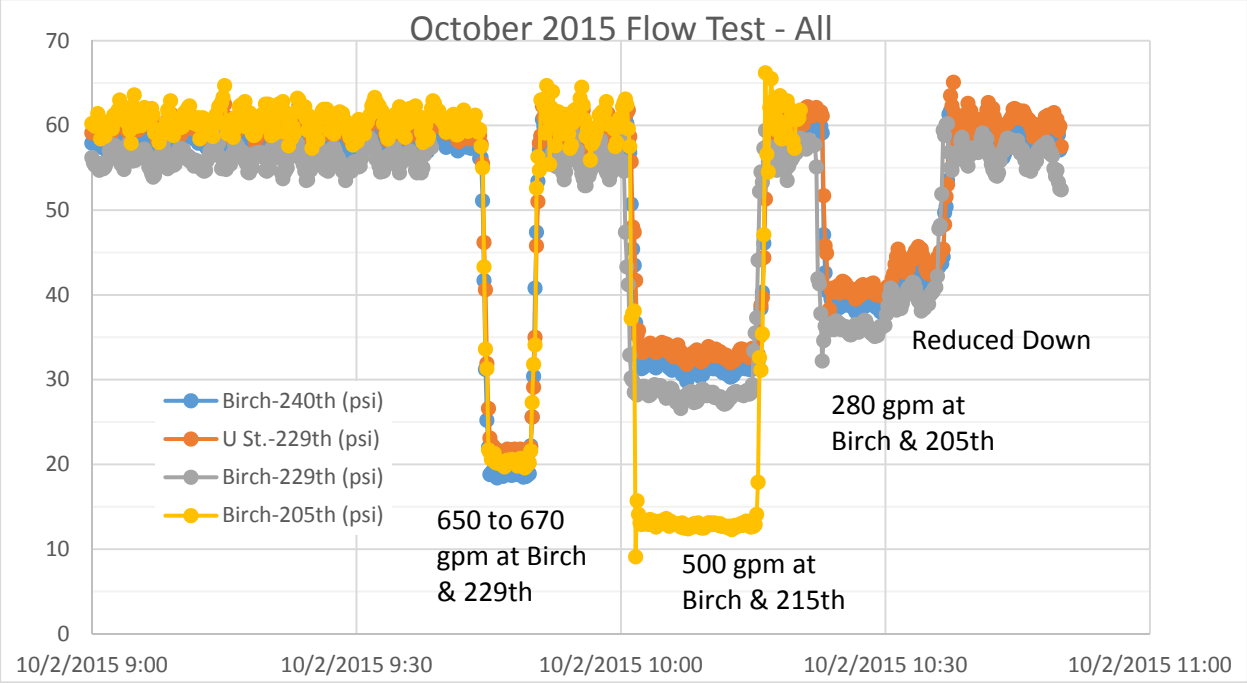
utilized for October 2015 flow testing. A turbine style hydrant meter was used to conduct the January 2016 tests in order to obtain relatively accurate flow data for better approximating Peak Hour Demand (PHD) conditions. January 2016 tests were conducted at varying flow rates between 160 gpm and 330 gpm. This flow range also allowed for use of the typical duty pumps for better estimation of how the distribution system will respond to PHD, as opposed to fire flow conditions that were evaluated in the October 2015 testing. Results of the January 2016 and October 2015 flow tests are provided in the following charts:



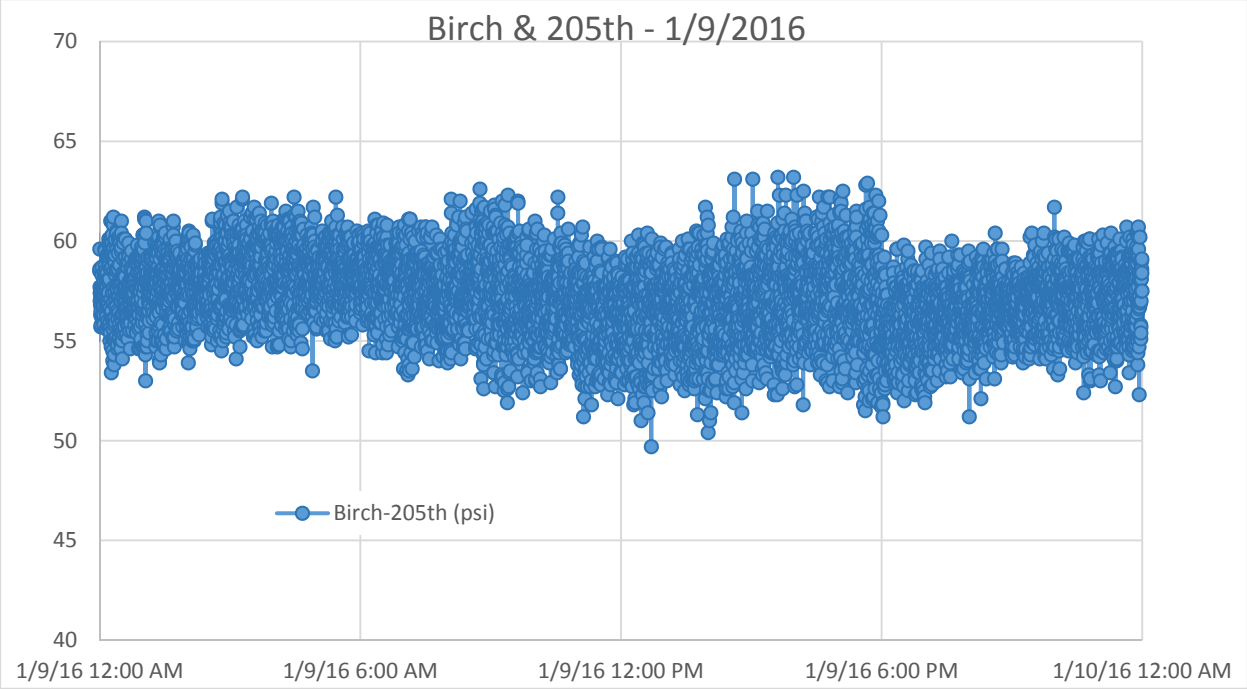

January 2016 Flow Test - Birch & 215th
80
70
60
50
40
30
20
1/5/2016 9:45
1/5/2016 10:00
1/5/2016 10:15
1/5/2016 10:30
200 gpm
310 gpm
Birch-240th (psi)
U St.-229th (psi)
Birch-229th (psi)
Birch-215th (psi)
Birch-205th (psi)
Pacific-197th (psi)
Birch-South End (psi)


January 2016 Flow Test - Birch & 205th
80
70
60
50
40
30
20
1/5/2016 10:30
1/5/2016 10:45
1/5/2016 11:00
Birch-240th (psi)
U St.-229th (psi)
Birch-229th (psi)
Birch-215th (psi)
Pacific-197th (psi)
Birch-South End (psi)
End of Crane (psi)
275 gpm
200 gpm
160 gpm




Multi-day pressure data was also collected at the south end of Birch Lane to evaluate pressure loss trends and peaks in the distribution system during periods of high demands. The pressure data during the Saturday of the most recent open clam digging period is shown in the following chart




The multi-day data confirms the pressure at the south end of Birch Lane, although slightly lower than average distribution system pressure, was between 55 psi and 60 psi throughout the high use period. This is similar to the pressure drop that is shown in the January 2016 flow testing at current PHD conditions. The October 2015 flow test data indicated the pressure drop in the southern Sunset Sands area was 10 psi to 15 psi at current PHD. In contrast, the January 2016 flow test indicates a pressure drop of 5 psi in the southern Sunset Sands area at current PHD. The field data from the January 2016 flow test indicates that low pressure conditions experienced in the Sunset Sands community may be alleviated to a great extent by the recent distribution system modifications at the South Wellfield.

**Hydraulic Models and Alternatives**

A partial model of the southern distribution was created using EPANET2 developed by EPA's Water Supply and Water Resources Division. EPANET2 is open source software developed to primarily model water distribution piping systems. The general calibration criteria established by AWWA for long range planning is to conduct steady state modeling that results in variations of less than 5 psi for pressure measurements or 10% for flow measurements when compared to modeled values. Adjustments were made to the piping between the source/pumps, represented as a pressure reducing valve, and the south primary distribution grid components to simulate the looped network feeding the south portion of the system. The model was originally calibrated to the October 2015 data and then adjusted to address the recent distribution modifications by calibrating to the January 2016 field data. Overall, the partial south distribution model calibrates well to field data (within 3 psi in all cases). The model was utilized to evaluate the following improvement scenarios. Estimated probable cost for each improvement scenario is provided in the attachments.

Scenario 1 – Pump Station at 227th Place: The first scenario evaluated is the provision of a pump station at the intersection of 227th Place and Birch Place as recommended in the WSP. In order to get at least 500 gpm fire flow plus a Maximum Day Demand of 80 gpm (future 400+ lots) with a required 20 psi residual at the hydrant at the south end of Birch Lane, the pumping head at 227th would have to approach 100 psi. This is not considered to be an acceptable operating pressure based on discussions with NBWD staff. If the 1,300' of 4" water main at the south end of Birch Lane along with 1,200' of 6" water main north of the 4" water main is replaced with 8" water main, the pump station can meet fire flow plus MDD conditions with an operating pressure of 65 psi. The estimated total cost for the booster station is $300,000 and the estimated cost for the water main replacement is $300,000. Total cost for this option is $600,000.

Scenario 2 - Pump Station South of 277th: The next scenario is to move the pump station downstream from 227th Place to the vicinity of 212th to 217th. This allows for operating the pump station below 75 psi without upgrading the 4" pipe. However, under this scenario, the demand on the suction side of the pump drops the distribution pressure upstream to less than 15 psi. There is no location along the current distribution grid that will allow for meeting required operational pressure both upstream and downstream of the proposed pump station without having to complete water main upgrades similar to those discussed in Scenario 1. Therefore, the cost for this option will be similar to the cost for Scenario 1.

Scenario 3 – South Loop: The south loop project includes installation of an 850' pipe crossing through Loomis Lake and approximately 1,600' of 8" piping to complete the loop through Sunset Sands Park and 201st Street. Under this scenario, the hydrant at the end of Birch Place is able to provide 500 gpm at 20 psi under MDD conditions. The loop also addresses operating pressure issues caused by future PHD conditions. With a future PHD of 190 gpm applied to the south end of Birch Lane, the pressure drop is predicted to be 7 psi with the proposed loop, as opposed to a pressure drop of 19 psi for the south Sunset Sands area without the loop. The PHD pressure drop is the same if the lake crossing pipe is 8" nominal HDPE (7" actual inside diameter) or 10" nominal HDPE. The projected 7 psi pressure drop is not considered to be significant. However, as more build-out occurs in the water distribution system, the District could implement a booster station in the south end of the system to mitigate the PHD pressure drop if the PHD is substantially greater than currently anticipated. The estimated total project cost for the water main loop is $370,000.

Scenario 4 – Booster Station and Storage Tank: The tank and booster station option includes constructing a 60,000 gallon concrete tank and booster pump station at the Sunset Sands Park. The booster station would include two VFD driven duty pumps one high capacity pump for fire flow with a maximum operating head of about 130'. The preliminary tank size is based on meeting minimum fire flow goals and providing a significant amount of capacity for equalizing, longer duration fire flow and operational flexibility. Maximum operating pressure of the station would only have to be in the range of 60 psi to 65 psi in order to meet basic operational conditions and fire flow requirements.

No upgrades to existing water mains are required. The tank would fill during off peak hours and the duty pumps would operate in a range of 55 to 65 psi to alleviate low pressure in the south end during higher demand in the rest of the system. There would not be any pressure drop in the southern Sunset Sands area under this scenario. The booster station could be set up to serve the 201st Street area with a future loop under Loomis Lake. The estimated cost for a tank and booster station is $440,000. The estimated cost for the piping to connect the booster station to the distribution system is $100,000. The estimated total project cost for the south end tank and booster station is $540,000.

The most feasible improvement scenario to address future operating pressure concerns and allow for meeting fire flow goals is the south loop project. Current operating pressure issues have mostly been addressed with the completion of the recent distribution system upgrades at the South Well Field. The project has the least capital cost and the lowest long term operational cost. A schematic of the general project layout is attached. The first stage of the project is to acquire easement and verify right of way for piping corridors. After the final piping corridors are established, the District will need to go through the SEPA process and apply for permits to cross Loomis Lake. Loomis Lake is relatively shallow (9' maximum depth per WDFW). The HDPE pipe thickness will be SDR 11 HDPE or fusible C900 to provide sufficient thickness for protection and strength for pulling. The crossing pipe will either be pulled through the top of the lake bed sediments or drilled 10' to 15' below the bottom of the lake at the crossing location. If drilling is required, project cost could increase by $50,000 to $80,000 (which is reflected in the attached cost estimates). Even with this potential cost increase, the pipe loop is still the most cost effective project to address pressure complaints and allow the District to meet fire flow goals. The decision regarding the construction method will be determined after more information is collected through the design process. In the interim, it is recommended to consider increasing the discharge pressure at the pump stations by about 5 psi during summer months to address the moderate pressure drop that is expected to occur at peak use times.

If you would like to move forward with design and implementation of the South Loop project, we can provide you with a revised engineering agreement. If you have any questions or need additional information, please call me at (360) 791-1390.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North Beach Water District
South Water Main Loop
Preliminary Design layout

**NBWD South Water Main Loop**

| Item | Description | Quantity | Unit | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Miscellaneous Construction | 1 | L.S. | $15,000 | $ 15,000 |
| 2 | Mobilization | 1 | L.S. | $20,000 | $ 20,000 |
| 3 | Crushed Surfacing Base Course | 180 | TON | $40 | $ 7,200 |
| 4 | Crushed Surfacing Top Course | 40 | TON | $40 | $ 1,600 |
| 5 | Trench Safety Systems | 1 | LS | $5,000 | $ 5,000 |
| 6 | Imported Trench Backfill Material | 60 | TON | $40 | $ 2,400 |
| 7 | HMA Patch | 40 | TON | $200 | $ 8,000 |
| 8 | 8" HDPE Drilled Water Mater Main | 850 | LF | $130 | $ 110,500 |
| 9 | 8" Water Main Pipe & Fittings | 1,600 | LF | $55 | $ 88,000 |
| 10 | Connect to Existing | 3 | EA | $2,500 | $ 7,500 |
| 11 | 8" Gate Valve | 2 | EA | $1,800 | $ 3,600 |
| 12 | 4" Gate Valve | 2 | EA | $1,200 | $ 2,400 |
| 13 | Hydrant | 1 | EA | $5,500 | $ 5,500 |
| | | | | | |
| | Subtotal | | | | $ 276,700 |
| | Sales Tax | @ | 7.9% | | $ 21,900 |
| | Construction Cost | | | | $ 298,600 |
| | Contingency | @ | 10% | | $ 29,900 |
| | Design & Survey | | | | $ 22,000 |
| | Bid, Ad and Award Services | | | | $ 4,000 |
| | Limited CM Support | | | | $ 10,000 |
| | Total | | | | $ 364,500 |

**NBWD South Booster Station w/ Tank**

| Item | Description | Quantity | Unit | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Miscellaneous Construction | 1 | L.S. | $20,000 | $ 20,000 |
| 2 | Mobilization | 1 | L.S. | $30,000 | $ 30,000 |
| 3 | Crushed Surfacing Base Course | 300 | TON | $40 | $ 12,000 |
| 4 | Crushed Surfacing Top Course | 100 | TON | $40 | $ 4,000 |
| 5 | Trench Safety Systems | 1 | LS | $3,000 | $ 3,000 |
| 6 | Imported Trench Backfill Material | 400 | TON | $25 | $ 10,000 |
| 7 | 60,000 Concrete Tank | 1 | LS | $80,000 | $ 80,000 |
| 7 | Baker-Monitor Housings | 1 | LS | $30,000 | $ 30,000 |
| 8 | Pumps and Appurtenances | 1 | LS | $35,000 | $ 35,000 |
| 9 | Miscellaneous Piping | 1 | LS | $15,000 | $ 15,000 |
| 10 | Connect to Exisitng | 1 | EA | $5,000 | $ 5,000 |
| 11 | Electrical & Controls | 1 | LS | $60,000 | $ 60,000 |
| | | | | | |
| | Subtotal | | | | $ 304,000 |
| | Sales Tax | @ | 7.9% | | $ 24,000 |
| | Construction Cost | | | | $ 328,000 |
| | Contingency | @ | 20% | | $ 65,600 |
| | Design | | | | $ 24,000 |
| | Geotechnical Support | | | | $ 10,000 |
| | Bid, Ad and Award Services | | | | $ 5,000 |
| | Limited CM Support | | | | $ 10,000 |
| | Total | | | | $ 442,600 |

**NBWD South Booster Station w/o Tank**

| Item | Description | Quantity | Unit | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Miscellaneous Construction | 1 | L.S. | $15,000 | $ 15,000 |
| 2 | Mobilization | 1 | L.S. | $25,000 | $ 25,000 |
| 3 | Crushed Surfacing Base Course | 300 | TON | $40 | $ 12,000 |
| 4 | Crushed Surfacing Top Course | 100 | TON | $40 | $ 4,000 |
| 5 | Trench Safety Systems | 1 | LS | $3,000 | $ 3,000 |
| 6 | Imported Trench Backfill Material | 50 | TON | $30 | $ 1,500 |
| 7 | Baker-Monitor Housings | 1 | LS | $30,000 | $ 30,000 |
| 8 | Pumps and Appurtenances | 1 | LS | $35,000 | $ 35,000 |
| 9 | Miscellaneous Piping | 1 | LS | $10,000 | $ 10,000 |
| 10 | Connect to Exisitng | 1 | EA | $5,000 | $ 5,000 |
| 11 | Electrical & Controls | 1 | LS | $60,000 | $ 60,000 |
| | | | | | |
| | Subtotal | | | | $ 200,500 |
| | Sales Tax | @ | 7.9% | | $ 15,800 |
| | Construction Cost | | | | $ 216,300 |
| | Contingency | @ | 20% | | $ 43,300 |
| | Design | | | | $ 22,000 |
| | Bid, Ad and Award Services | | | | $ 5,000 |
| | Limited CM Support | | | | $ 10,000 |
| | Total | | | | $ 296,600 |