COMMITMENT & INTEGRITY
DRIVE RESULTS

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January 5, 2017

Sean Currier, Public Works Director
Town of Hampden
106 Western Avenue
Hampden, ME 04444

Re: Souadabscook Sewer Pump Station and Force Main Review

Dear Sean:

The following is our summary review of the Souadabscook Sewer Pump Station (PS-2) and force main review per Task Order #13. We reviewed potential impacts from the upcoming Maine Department of Transportation (MDOT) Grist Mill Bridge replacement, including force main replacement and effects on pump station operation. The Grist Mill Bridge project is currently on the 2017/2018 MDOT Work Plan, along with a road rehabilitation project extending from Western Avenue to Mountainview Drive. The following tasks were included in the review:

1. Research PS and force main as-built drawings, pump model and flow curve, operational records;
2. Confirm existing conditions via site visit;
3. Perform hydraulic calculations to evaluate force main replacement;
4. Review necessity for pumping modifications if applicable;
5. Produce summary memo with findings; and
6. Develop budgetary cost estimate for force main replacement.

On June 1, 2016, Woodard & Curran (W&C) visited the Souadabscook Sewer Pump Station, located at the Hampden Water District office on Main Road North. We collected equipment information and other site-specific information.

We consulted with the Bangor Wastewater Department, who provides sewer pump station maintenance services for the Town, and Sargent Corporation, who installed the replacement force main in 2006. We also consulted with the MDOT and their bridge design consultant, T.Y. Lin International Group, regarding the new Grist Mill Bridge design and potential impacts on the utilities.

This is not intended to be a comprehensive review of the Souadabscook Sewer Pump Station for planning purposes or preliminary engineering for pump station upgrades. We have provided recommendations regarding a comprehensive pump station review later in this report.

Background

The force main crossing the Grist Mill Bridge was originally installed around 1982 as part of Interceptor Sewer Contract 1 and extends from the Souadabscook PS to the vicinity of Chickadee Lane and Sunrise Lane, where it discharges to a 20-inch ductile iron gravity sewer main. The overall length is approximately 4,040 feet based on the As-Built drawings. The Contract 1 As-Built drawings, dated February 1983, detail the original pipe as 8-inch diameter Permastran, which was an epoxy-fiberglass wrapped plastic pipe. It is not clear if the entire length of this main was Permastran, ductile iron, or other typical pressure pipe material.

The force main was partially replaced in 2006 by Sargent Corporation in conjunction with a gravity sewer replacement project, with replacement extending from the intersection of Dudley Road north to the gravity sewer transition. Per the Sargent project manager, Sean Milligan, the replacement section consisted of 12-inch diameter pressure-rated PVC (AWWA C900 pipe trademarked as Blue Brute by JM Eagle). This replacement section length is approximately 3,600 feet and did not include the section between the pump station and Dudley Road intersection. We do not have drawings for the replacement project and have relied on Town and Contractor information.

The connection point between the new 12-inch diameter pressure PVC pipe and the original force main in the Dudley Road intersection consists of a valved pipe manifold that was used to connect both the replacement force main and bypass piping to the remaining 8-inch diameter force main. Per Sargent Corporation, the valved manifold is thought to remain in place with the bypass piping end capped and gate valve operators buried.

The 8-inch diameter force main crosses the Grist Mill Bridge as a buried installation between the road surface and the concrete structure with foam board insulation above and below the pipe, although exact construction details were not available on the As-Built drawings. Discussions with the MDOT indicate that there is 3-7 feet of soil over the existing bridge concrete beam. The force main otherwise appears to be typical of buried pipe installation practices.

A 12-inch diameter PVC gravity sewer main also crosses the bridge parallel to the force main, connecting the sewer service area along Coldbrook Road and Main Road North to the Souadabscook Pump Station. Installation of this pipe appears to be similar to the force main, running approximately 155 feet between manholes with a slope of 0.024.

The pump station consists of two Fairbanks-Morse 5400 series vertically mounted split case solids handling pumps. A pump data sheet obtained from Fairbanks-Morse is attached for reference. One pump is active and controlled by the single variable frequency drive (VFD) with constant level control, but can also be operated as a start/stop pump station based on high and low wet well level. The pumps are rotated in operation, but the VFD cannot be taken offline.

Table 1: Existing Pump Data

Manufacturer	Fairbanks Morse
Installation Year	1983
Model/Size	B5434 4x8 inch
Stages/RPM	Single stage 1770 rpm
Impeller	13.65 inch
Rated Flow	800 gpm @ 188 ft TDH
Motor	75 HP

Evaluation

We were able to conduct a preliminary review of the hydraulic conditions using the information referenced previously. However, we were not able to directly assess the pump or force main hydraulic performance due to the lack of suction and discharge pressure gauges. The gauge taps for Pump #2 appear to have broken off and have not been repaired. Properly functioning pressure gauges and maintenance records of their readings allow an assessment of pumping conditions, particularly regarding changes in pump performance and force main flows.

At the time of the site visit, the Pump #2 speed was approximately 72% and cycling on and off based on wet well level. Based on the assumption that the pump is operating according to its published pump curve, the resulting flow rate is approximately 250-300 gpm, which is near the minimum allowable flow for that pump model. The calculated pumping capacity for the current pump arrangement and piping configuration (8-inch pipe and 12-inch pipe) is 1,600 gpm, although the actual capacity is likely limited by the motor horsepower as well as pump and pipe condition. The installed pump motor is rated for 75 HP and the full capacity of the pump exceeds that value. The capacity prior to force main replacement was approximately 980 gpm.

Force main sizing is generally dictated by minimum and maximum flow velocities to ensure that flows are adequate to maintain solids in suspension while not requiring excessive pump horsepower and power consumption. Generally, raw wastewater force mains should maintain a pipe velocity of 2 feet/second, provided that the pumping system generates a peak velocity of at least 3.5 feet/second each day to suspend settled material. The table below summarizes the current flow conditions and design parameters for the existing force main.

Table 2: Force Main Summary

Parameter	Typical Design Velocity	Estimated Flow	Estimated Forcemain Condition	
			8-inch	12-inch
Minimum	2 ft/sec	250 gpm*	1.6 ft/sec	0.8 ft/sec
Daily Maximum	3.5 ft/sec		Not recorded 700 gpm required	Not recorded 1,230 gpm required
Peak	8 ft/sec	1,600**	9.2 ft/sec	5.1 ft/sec

* Estimated from current model pump curve.

**Estimated capacity using hydraulic calculations, not field-verified.

As the table illustrates, the minimum velocity in both force main sections are below typical design values, although the velocity in the 12-inch section is less than one half the typical design condition. It is unclear if the Daily Maximum Velocity condition is achieved for either pipe section on a daily basis.

Force mains are typically designed with peak velocities up to 8 feet per second to limit headloss and power consumption. We estimated that the velocity at peak pump capacity in the 8-inch pipe exceeds this value, while the 12-inch pipe remains well below.

We evaluated using 12-inch diameter pipe for the full length of the force main and a small increase in capacity from 1,600 gpm to approximately 1,700 gpm was calculated. The relatively short length of 8-inch main has a minimal effect on overall headloss and pump power consumption.

A 20-inch diameter ductile iron gravity sewer conveys flow from the pump station force main north toward the Bangor Wastewater Treatment Plant. The minimum slope of this line is 0.0006 feet/feet per the 1983 As-Built drawings. We estimated the capacity of this 20-inch sewer main as approximately 1,400 gpm. It appears that the existing pump station capacity exceeds the capacity of the 20-inch diameter receiving gravity sewer. Any increases to the pump station capacity are likely to require additional gravity sewer capacity.

The following is a list of other observations and conditions noted at the time of our visit:

1. Pump installation date of 1983 indicates 33 years of use. The typical guidance for replacing pumping equipment is 20 years unless regular maintenance and rehabilitation allows otherwise. Similarly, valves, piping, and electrical equipment may also require replacement due to age or to meet current code requirements.
2. Pump #2 exhibited noticeable vibration during operation, indicative of an out-of-balance condition, motor bearing issue, or other mechanical problem. The Bangor Wastewater staff were asked about this vibration and they stated that it has been ongoing for a significant amount of time without noticeably affecting operation.
3. The piping and concrete support in the stilling well installed in 1996 is severely corroded. This piping serves to contain effluent in the structure and prevent air entrainment from affecting the pump suction lines.
4. Water level in the upstream manhole (located in the grass swale adjacent to Main Road North) was near the pipe crown during relatively dry conditions. This appears to be primarily a result of backwater effect upstream of the grinder station, but does presents a risk of clogging in the gravity line due to inadequate velocity.
5. The access hatch to the north wet well has a failed hinge and did not operate properly.
6. There do not appear to be any wet well tank vents. Any vents should be equipped with odor control canisters.

Recommendations

We recommend that the Town replace the existing force main from the Souadabscook PS to Dudley Road in conjunction with the MDOT bridge project and that the pipe remain 8-inch diameter for the following reasons:

- The pumping capacity is consistent with that required of an 8-inch diameter force main.
- The receiving gravity sewer is limited to near the current estimated pumping capacity.
- The Town's permitted discharge volume and peak rate are limited.
- A larger size diameter results in low pipe velocity and risk of solids deposition and clogging.
- The additional pumping capacity and reduction in power consumption resulting from using a larger diameter force main are minor.

The replacement of the existing 12" PVC gravity sewer main will also be required as the bridge design will not allow the current installation method.

Due to the presence of ledge and pipe elevation requirements, it does not appear feasible to attempt to install the sewer utility piping to the immediate north or south of the bridge as buried piping. The Hampden

Water District has buried water main river cross to the north of the bridge, although this piping is not subject to the requirements of pressure or gravity sewer installation.

The MDOT and their design consultant have indicated that the bridge will be a traditional steel or concrete beam design without any soil cover over the bridge deck. This requires a specialized type of pipe utility installation using pipe supports, insulation, expansion joints, and heat-tracing to prevent freezing of the pipe contents. The replacement bridge span will be longer than the existing span, with approximately 115 feet compared to the existing approximately 50 feet.

The bridge is intended to be replaced in its entirety in one operation, which means that the existing bridge and utilities will be completely removed to accommodate construction of the new bridge. The MDOT intends to request a road closure for this work, extending from 30-90 days during the summer, therefore no temporary bridge structure is planned. This method of construction will require bypass sewage pumping for the gravity sewer main and a temporary sewer force main installation during this outage, and until the new utilities are installed and ready for use.

A budgetary cost estimate has been provided as an attachment. The estimate assumes the following:

- Replacement of full length of 8-inch force main between pump station and Dudley Road intersection.
- Replacement of 12-inch gravity sewer main between manholes spanning the bridge (approximately 155-feet based on As-Built drawings).
- Temporary bypass pumping is required for the gravity sewer.
- Temporary piping is required for the sewer force main.
- Town is responsible for trench width pavement repair only where it affects driveways due to concurrent MDOT road rehabilitation project.
- Town is not responsible for roadway concrete base repair.
- Installation requires a supported bridge crossing design (i.e. supported from the bridge structure and not buried).

There is a significant amount of variability in the cost of a supported bridge crossing system, depending a great deal on the bridge configuration and materials of construction. We have prepared the attached estimated project cost breakdown using costs associated with recent steel I-beam and concrete beam bridge crossing construction methods. The estimated project cost resulting from the use of a suspended bridge crossing, including engineering, construction administration, part time inspection, and contingency, is approximately $493,500 to $777,000, depending on the type of design and support system requirements.

As noted previously, we recommend a comprehensive pump station evaluation be conducted as part of a Preliminary Engineering Design prior to the implementation of any significant pump station modifications. The following is an example of Preliminary Engineering scope items related to long-term planning for the pump station, capacity, and sewer collection system impacts:

1. Assess current wastewater flows using available records.
2. Identify potential for infiltration/inflow removal and impacts on pump station operation.

3. Assess pump design, capacity, operation strategy, wet well configuration, electrical system, and control system.
4. Assess the hydraulic profile of the existing pump station and modify to reduce pipe surcharging.
5. Present upgrade options for review and evaluation.
6. Identify permitting requirements.
7. Prepare Design Basis Memorandum identifying the intended scope of upgrades and preliminary cost estimate for final design, construction, and contingency costs.
8. It is understood that infiltration and inflow (I/I) continue to affect the entire collection system. In addition to the current program of sewer main replacement, we recommend that the Town consider additional efforts at identifying and eliminating I/I.

We recommend that the Town allow for a Preliminary Engineering Design budget of $15,000 based on the scope presented. We can provide a detailed scope and budget for this work at your request.

We trust the information provided within this letter is useful to the Town for budget planning. We would be happy to continue our work with Town to prioritize the improvements discussed in this letter and to assist with implementation. If you have any questions or concerns, please don't hesitate to contact me at 207-945-5105 or via email at kcorbeil@woodardcurran.com.

Sincerely,

WOODARD & CURRAN

Kyle Corbeil, P.E.
Project Engineer

KMC/eap

cc: Jim Wilson, P.E. – Woodard & Curran

PN: 213302.00 013

Cok Industries Pump Division

C.C. MILES NEAL

SEE PAGE 2 FOR TEST BEFORE IMPELLER TRIM

FACTORY PUMP SPECIFICATIONS AND BILL OF MATERIAL

US Motor, R2110855

DATE ENTERED	DATE PROMISED	DATE SHIPPED	MOTOR S/N	PUMP SERIAL NO.
4-19-82	153	5-26-83	9302556-663 R2110636	K3J1-060314

CUSTOMERS NAME	CUSTOMER P.O.	
BRECIA CONSTRUCTION CO. (HAMPDEN, MAINE)	LETTER 4-9-82	THRU

BUILD 2 PUMPS ON THIS ORDER AND 0 OTHER PUMPS ON THIS ORDER

SPEC. WRITER: R.VANKIRK 1-6-83 | CHECKER | K3J1-060314-1

PUMP DESCRIPTION		GENERAL	OPERATING CONDITIONS		
SIZE 4x8	DIS. POS. # 13	SUCTION PROJ. —	GPM 800	TDH 188	CERTIFIED CURVES ☒ YES ☐ NO
FIGURE NO. B5434	36	DISCH. PROJ. —	SUCTION LIFT / SUCTION HEAD		CURVES APPR'D. BEFORE SHPM'T. ☒ YES ☐ NO
PUMP FITTING IF	ROTATION CCW	TUBE PROJ. —	PUMP RPM 1770 (F/L)	MTR. S.F. 1.15	WITNESS TEST ☐ YES ☒ NO
CURVE NO. CK3J1-060314	GUARANTEE (YES) 61%	SUCTION SIZE 8"	MTR. HP 75	MTR. TYPE RV-9	HYDRO TEST 150 PSI ☒ YES ☐ NO
SHIP ASSEMBLED ☒ YES ☐ NO		DISCH. SIZE 4"	IMPELLER T4DIAQ	DIA. OR "b" DIM. 14.0 JM	DATE PUMP TESTED
DRIVER MOUNTED BY (FACTORY) CUSTOMER		MIN. END PLAY	SOLD OVERLOAD YES NO	SP GRAVITY	TESTED BY

SPECIAL INSTRUCTIONS

300-350 BHN SLEEVE, BRONZE SEAL HOUSING & GLAND, SS IMP. & CAS RINGS, SS IMP. CAPSCREW & WASHER, MECH SEAL FILTER, SS GLAND BOLTS, THERMOSWITCH MOUNTED ON VOLUTE

NOTE: SEE SPECIAL INSTR. PAGE 2

SPARE PARTS PAGE 8

Ref- T4D1B

DYN BAL & POLISH & COAT IMP.

SETTING PLAN SK3J1-060314

SPECIAL AND VARIABLE PARTS ON THIS ORDER

QUANTITY	SYMBOL	MATERIAL	LEVEL CODE	PRODUCT CODE	DESCRIPTION	REFERENCE	LINE
2	993	9906	F		FENWALL THERMOSWITCH SERIES 32400 MINIATURE CONTROLS (TO MOUNT ON VOLUTE)	"A" STATE	
2 (SETS)	993	9906	F		RONNINGEN & PETTER ISO-RING PRESSURE INSTRUMENT PROTECTORS W/ASHCROFT # 1379 4 1/2 0-60PSI GAGES. (1 SET INCLUDES (1) 4" SUCT. & (1) 8" DISCH PROTECTOR W/ GAGE)		
2	993	9906	F		U.S. ELECTRIC 75HP 1800RPM 3/60 460 VOLT WP-1 VCC CORROSION PROTECTION, 416 SS SHAFT, WINDING THERMOSTATS, W/H4D62D2 SHAFT EXTENSIONS		
1	993	9906	F		ROBICON VFD CONTROL SYSTEM INCLUDES FRT & STARTUP/TRAINING OF 1 TRIP NOT TO EXCEED 5 DAYS	"B" STATE	

KC 675 B

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TOWN OF HAMPDEN
SOUADABSCOOK SEWER PUMP STATION FORCEMAIN AND SEWER REPLACEMENT
PRELIMINARY COST ESTIMATE
PROJECT NO. 213302
December 28, 2016

Preliminary Estimate							
				Steel I-beam Bridge Design		Concrete Beam Bridge Design	
No.	Description	Unit	Estimated Quantity	Unit Price	Value	Unit Price	Value
1	Administrative (5% of Subtotal)	LS	1	$15,000.00	$15,000.00	$25,000.00	$25,000.00
2	Rock Excavation*	CY	10	$200.00	$2,000.00	$200.00	$2,000.00
3	Excavation Below Normal Grade*	CY	25	$30.00	$750.00	$30.00	$750.00
4	Select Backfill*	CY	25	$30.00	$750.00	$30.00	$750.00
5	Provide 8" Class 52 Ductile Iron Forcemain	LF	335	$100.00	$33,500.00	$100.00	$33,500.00
6	Provide Forcemain Bridge Crossing	LS	1	$80,000.00	$80,000.00	$180,000.00	$180,000.00
7	Provide 12" SDR 35 Gravity Sewer Pipe	LF	50	$140.00	$7,000.00	$140.00	$7,000.00
8	Provide Gravity Sewer Bridge Crossing	LS	1	$100,000.00	$100,000.00	$200,000.00	$200,000.00
9	Provide 2" Rigid Insulation	LF	200	$5.00	$1,000.00	$5.00	$1,000.00
10	Bituminous Pavement Repair	SY	25	$140.00	$3,500.00	$140.00	$3,500.00
11	Test Pits	EA	2	$1,000.00	$2,000.00	$1,000.00	$2,000.00
12	Testing Allowance	ALLOW	1	$2,000.00	$2,000.00	$2,000.00	$2,000.00
13	Temporary Bypass Pumping	LS	1	$50,000.00	$50,000.00	$50,000.00	$50,000.00
14	Temporary Forcemain Piping	LS	1	$25,000.00	$25,000.00	$25,000.00	$25,000.00
				CONSTRUCTION SUBTOTAL	**$322,500.00**		**$532,500.00**
				ENGINEERING, CONSTRUCTION ADMIN, PART TIME INSPECTION, CONTINGENCY (35%)	$112,900.00		$186,400.00
				TOTAL	**$435,400.00**		**$718,900.00**