RESPONSE TO FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Date of Letter: **23.July.2009 / 14.October.2009**

From: **Ann P. Miles, Director**
Division of Hydropower Licensing
Federal Energy Regulatory Commission
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To: **Normand Laberge**
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Response Dated: **06.September.2009 [Revised 14.October.2009]**

Response by: **Normand Laberge**
Tidewalker Associates
Trescott, Maine 04652

{Filed electronically and Hard Copy sent to Ms. Miles}

LIST OF ATTACHMENTS:

SECTION	**DESCRIPTION**	**REFERENCE (.pdf)**
PROJECT MAPS	BOUNDARY / TRIBAL LANDS / ROADS / TRANSMISSION LINES	HMC01Revised
PROJECT MAPS	POWERHOUSE CROSS-SECTION WITH ELEVATIONS	HMC01Aelevation
PROJECT MAPS	DETAILED VIEW OF POWERHOUSE CROSS-SECTION	HMC01B
GEOLOGICAL	COMBINATION OF HMC-13 & 14	13and14geologicalfeatures
INTERTIDAL COMPOSITION	PROJECT CONSTRUCTION	HMC15t
DETAILS: INTERTIDAL	BLOW-UP VIEW OF HMC-15	HMC16sm
SOILS	COMBINATION OF HMC-17 & 18	HMC-17-18-soils
DRAINAGE AREA	WATER RESOURCES	Drain2
ABUTTERS	LAND USE	Landabutters
** HISTORICAL EXPORATIONS	HMC-10	** ELIMINATED FROM RECORD

ADDITIONAL INFORMATION

Project Maps

Please revise FIGURE HMC-01 to show the following: a project boundary; any tribal lands; roads; transmission lines; and the physical composition, dimensions, and general configuration of the dam, powerhouse, filling / emptying gates, trashracks and any other appurtenant facilities.

A revision appears in *HMC01Revised.pdf* attached to this information. In this case, Tidewalker has delineated: (1) project boundary; (2) Tribal lands; (3) roads; and, (4) transmission lines. At the entrance to Half-Moon Cove an existing road leads to the site from both the Perry and Eastport sides. A transmission line is directly overhead from the proposed tidal barrage site and would have to be upgraded along an existing transmission corridor to Pembroke, a distance of approximately seven (7) miles.

The composition, dimensions, and general configuration of the dam, powerhouse, filling / emptying gates, and other appurtenant facilities are located in this document under the file names *HMC01Aelevations.pdf* and *HMC01B.pdf*, respectively. The project design includes the installation of stoplogs to protect turbines; however, trashracks are not considered necessary due to the basic mode of operation of the tidal barrage. Trashrack requirements will be addressed later in this response. Filling and emptying gates will be required at the entrance to Half-Moon Cove and each turbine bay will require a gate to control the level of the tidal basin when electrical production has been terminated due the lack of a sufficient hydraulic head.

Existing and Proposed Project Facilities

Please identify the bottom elevation of the turbines and draft tubes, and the extent of the area and volume of material that will need to be excavated for the headrace and tailrace.

As noted in *HMC01Aelevation.pdf* with respect to mean sea level (MSL – ft), the following specifications are listed for the tidal barrage's preliminary and conceptual design:

- centerline of the turbines will be a (-38') with an estimated diameter of 25' for units with rim-mounted generators and with the capability to operate reversibly;
- bottom and top of the draft tube sections will be at (-53') and (-23'), respectively;
- emptying filling gates (30' x 20') will have a top and bottom elevation of (-1') and (-21'), respectively;
- length of the power plant will be approximately 100' - 125' in length;
- elevation for top of barrage has been estimated at (+27') and will include a road surface as a service road or, possibly, a secondary road between Perry and Eastport.

The cross-section of the entrance to Half-Moon Cove (FIGURE HMC-03 / USGS / PAD [March 2009]) reveals a relatively wide channel with a maximum depth of (-58') to bedrock as verified by an analysis of historical data from the Maine Department of Transportation recorded during the placement of wooden piers at the former site of a toll bridge connecting Eastport to Perry. FIGURE HMC-10 from the pre-application document (PAD) filed by Tidewalker Associates with FERC indicates an agreement with Maine DOT field readings with a below surface exploration taken in 1964 at the entrance to Half-Moon Cove. A review of FIGURE HMC-01 (PAD – March 2009) also reveals that the channel extends for at least 100' in both the northerly and southerly direction from the entrance to Half-Moon Cove. Without the availability of detailed readings at the barrage site, a rough estimate for the amount of excavation is approximately 25,000 – 30,000 cubic yards of overburden for a volume area of 120' x 30' x 200'. Due to the reversing nature of the tides as a countering factor for determining requirements for a tailrace and headrace, the exact length of the excavation is an unknown variable which will be quantified during the next phase of engineering.

So staff and other participants can effectively evaluate the impacts of the proposed project on the resources of Half Moon Cove and avoid requiring unnecessary studies, please identify a preferred project design and mode of operation.

Existing and Proposed Project Facilities
Preferred Project Design and Mode of Operation:

After the FERC meeting in Eastport in June 2009, a decision was made to consider a different mode of operation in order to reduce the impact on the intertidal zone associated with increasing the low tide level by 2-3 feet. The advantage of breaching the causeway between the Passamaquoddy Pleasant Point Reservation and Carlowe Island (Maine) was also noted as a possible mitigative measure and as an engineering mechanism to control the tidal waters of Half-Moon Cove.

In summary, the preferred mode of operation is outlined below for the design requirements for the proposed tidal barrage at the entrance to Half-Moon Cove:

- Install four (4) reversible turbines with an approximate diameter of twenty-five (25) feet within four distinct entryways accompanied with stoplogs and closing gates. The dimension and elevation of the various components are depicted in Attachments *HMC01Aelevation.pdf* and *HMC01B.pdf*. A final decision has not been made on the specific type of turbine; however, specifications will be based on a unit operating under a hydraulic head ranging from 4-6 feet, circular cross-section for draft tubes, perimeter-mounted generator, reversible (without pumping capability) operation, and low rotational speed (< 60 rpm).
- Install four (4) emptying / filling gates with an approximate opening of 30' wide and 20' tall as illustrated in *HMC01B.pdf*. The gates will be raised from the top and will be sealed to ensure reliable operation. The location of the gates in the

water column will ensure sufficient capacity during the flood tide to fill the basin to normal high tide levels. Added filling / emptying capacity at the causeway will assist in raising high tide to naturally occurring levels.

- A constant head mode of production will be used during both high pool and low pool operation. High pool operation will be initiated approximately one hour after high tide and continue until one hour before low tide. As a conceptual representation, low pool operation will start 1.25 hour after low tide and continue until 1.25 before high tide. A schematic representation of the mode of operation appears in FIGURE TIDE – 01 below. For the proposed Half-Moon Cove barrage, Curve B is the preferred mode of production since it results in less reduction in the natural tidal regime within the impoundment. Curve B is also the representation which most closely resembles the natural tidal function (Curve A) except for the slight shift of approximately one hour on the horizontal scale. The key element of the process for the “environmental” case refers to the ability to completely or nearly empty the tidal basin shortly before or after low tide. Conversely, sufficient gate capacity is needed to completely fill Half-Moon Cove at the cessation of low pool production shortly before the next high tide. Curve D represents the long-time mode of production which would have the most dramatic increase in the level of low tide within the impoundment. Adding pumping capacity to the operational mode of production was considered as a way to completely drain the tidal basin; however, this option is still a possibility depending on the final choice of turbine equipment. If the units are designed to operate at lower hydraulic heads (i.e., between 1’ – 4’), this energy could be used to pump out / in the tidal basin while increasing the length of time for the production of electricity while utilizing residual energy from low-head units.

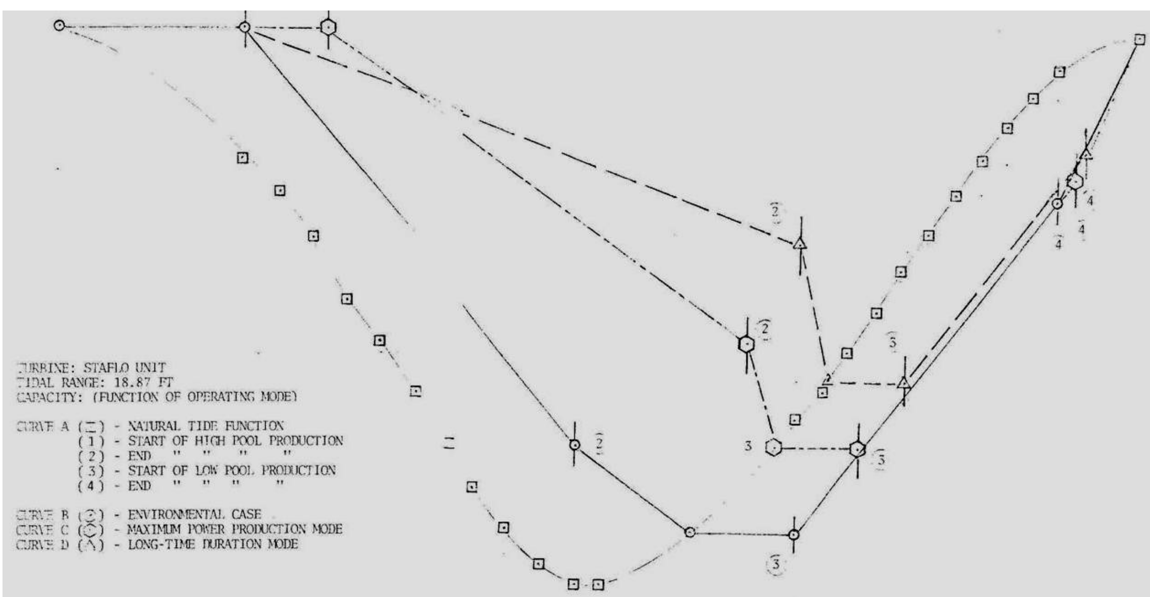


FIGURE TIDE-01 / Tidal Range versus Time for Three Modes of Operation

- Plan for the installation of filling / emptying gates within the causeway north of Carlowe Island. The gates would allow the flow of tidal waters within the vertical rise of -5' below mid-tide level to +15 above mid-tide level. The gates will be opened by raising the sealed structures to the appropriate level to allow flow under hydraulic head conditions.
- Under these specifications, the tidal barrage will generate approximately forty (40) million kilowatt-hours of predictable, though intermittent, electricity annually. Without the use of emptying / filling gates on the existing causeway and based on some preliminary calculations outlined later, an eighteen foot tide will result in an increase of 0.95' in the low tide level and a 1.2' decrease in the high tide level. The same type of result is expected for neap tide and spring tide conditions as listed below:

TIDAL RANGE – FT	INCREASE IN LOW TIDE LEVEL – FT	DECREASE IN HIGH TIDE LEVEL – FT	TOTAL LOSS OF TIDAL RANGE – FT
25	0.90	0.8	1.70
18	0.95	1.2	2.15
12	0.75	0.4	1.15

These calculations were not performed with the use of filling / emptying gates in the causeway which would have a value in being able to fill the tidal basin to natural levels. Another approach which will be investigated during the performance of hydrodynamic modeling efforts will include the termination of low pool production before the 1.25 hours assumed for these calculations. Other possibilities include: (1) the use of the turbine entryways to increase the flow into and out of Half-Moon Cove while generating additional electricity; and, (2) increasing the size of the gates. Tidewalker Associates is committed to reducing impacts on the tidal regime by investigating these options before completing a preliminary design with the assistance of hydrodynamic modeling and by optimizing turbine specifications.

Please note that these results were included in the 08.September.2009 response. Tidewalker has revised these plans in order to reduce the impacts on the tidal function within the proposed impoundment. This information has been left in the revised response in order to reflect a decision by Tidewalker to reduce electrical production in order to reduce impacts on the low tide level and high tide level under conditions which range from neap tide to spring tide elevations.

An iteration of the methodology used to estimate impacts on the high tide and low tide levels appears below based on an analysis of tidal range measurements taken within the project area which still apply to present day conditions.

TABLE TIDE-01 summarizes tidal range values for one month. A differentiation is noted for the characteristic values for the high tide to low tide range as compared to the succeeding values for the low tide to high tide range. The most notable difference refers to the fact that the time to empty the basin is approximately 21 minutes longer than the time to fill a typical tidal basin. For these measurements, the maximum tidal range is 24.9 feet and the minimum tidal range is 13.90 feet with an average value of 18.29 feet and with a standard deviation of 3.02 feet for an ebbing tide.

March 1957 / Beardsley Wharf / Eastport, Maine						
High and Low Tide Levels						
Datum: Mean Sea Level 1929						
STATISTICAL VALUE	HIGH TIDE LEVEL [FT]	LOW TIDE LEVEL [FT]	HIGH-TO-LOW TIDAL RANGE [FT]	TIME HIGH TO LOW TIDE [MIN]	LOW-TO-HIGH TIDAL RANGE [FT]	TIME LOW TO HIGH TIDE [MIN]
MAX	12.80	-6.00	24.90	403.00	24.70	382.00
MIN	7.10	-12.10	13.90	364.00	14.20	345.00
AVERAGE	9.42	-8.87	18.29	383.00	18.28	361.80
ST.DEV.	1.49	1.64	3.02	8.02	2.97	7.74
TOTAL - DAYS				15.6923		14.8236

TABLE TIDE – 01: Tidal Range Date for Lunar Cycle [High – Low Tide & Low – High Tide]

TABLE TIDE-02 lists the physical dimensions for Half-Moon Cove used to calculate water volume for a varying tide level. In this case, basin level is not referenced to mean sea level since a convenient scale was used for computational purposes. The conversion to mean sea level is accomplished by subtracting nine feet from the reference levels.

BASIN LEVEL [+/- FT]	SURFACE AREA [ACRE]	SLOPE	VOLUME [ACRE-FT] CORE	VOLUME [ACRE-FT] TRIANGLE	TOTAL VOLUME [ACRE-FT] PER SECTION	CUMULATIVE VOLUME [ACRE-FT]
-4	180					
0	290	27.50	720	220	940	940
18	800	28.33	5220	4590	9810	10750
22	850	12.50	3200	100	3300	14050

TABLE TIDE - 02: Assumed Half-Moon Water Volume Configuration

This base line data was then used to calculate energy production in accordance with data listed in TABLE TIDE – 03. These calculations were performed for both high pool (ebb tide) and low pool (flood tide) operation. On the basis of these calculations which were based on an assumed performance curve for a hypothetical turbine, the installed capacity has been set at 9000 kw and comprised of four (4) units. Since a constant head mode of operation will be used for electrical production, the estimates of energy production should be considered accurate within the limits of the assumptions.

	VOLUME [ACRE-FT]	VOLUME [FT^3]		VOLUME [ACRE-FT]	VOLUME [FT^3]
TIDE - FT	AVERAGE TIDE - HI POOL			AVERAGE TIDE - LOW POOL	
18	10750.0	468270000.0	13.5	7436.9	323950275.0
5	2744.2	119535900.0	0.95	1228.3	53504112.8
0	940.0	40946400.0			
	-				
DELTA V - TURB	8005.8	348734100.0	DELTA V - TURB	6208.6	270446162.3
DELTA V - GATE	1804.2	78589500.0	DELTA V - GATE	1228.3	53504112.8
AVE - HEAD	[FT]	6.0	AVE - HEAD	[FT]	4.0
POT - ENGY	[FT-LB(f)]	130566047040.0	POT - ENGY	[FT-LB(f)]	67503362097.6
ENERGY	[KWHR]	49171.2	ENERGY	[KWHR]	25421.8
ANN. ENGY	[10^6 KWHR/ANN]	34.8	ANN. ENGY	[10^6 KWHR/ANN]	18.0
EFFICIENCY	[---]	0.8	EFFICIENCY	[---]	0.8
NET ENGY/CYCLE	[KWHR/TIDE]	36878.4	NET ENGY/CYCLE	[KWHR/TIDE]	19066.3
NET ANN. ENGY	[KWHR/YEAR]	26073014.7	NET ANN. ENGY	[KWHR/YEAR]	13479891.5
OPER - HR		4.4	OPER - HR		3.5
POWER - KW		8413.3	POWER - KW		5396.1
VEL - FT/SEC	[FT/SEC]	19.7	VEL - FT/SEC	[FT/SEC]	16.0
C(d)	[---]	0.7	C(d)	[---]	0.7
NET VEL.	[FT/SEC]	14.2	NET VEL.	[FT/SEC]	11.6
DIA - FT	[FT]	25.0	DIA - FT	[FT]	25.0
A - CROSS SECT.	[FT^2]	490.9	A - CROSS SECT.	[FT^2]	490.9
Q - FT^3/SEC	[CFS]	6947.4	Q - FT^3/SEC	[CFS]	5672.5
		196.7			
NO. UNITS	[---]	3.2	NO. UNITS	[---]	3.7
UNITS - DESIGN	[---]	4.0	UNITS - DESIGN	[---]	4.0

TABLE TIDE – 03: Power Production Factors for 18' Tide

In TABLE TIDE – 04, an attempt was made to calculate the basin level after high pool operation consistent with the previously stated assumptions. For high pool operation, the full capacity of the emptying gates are not available since the low tide mark (- 8.0' msl) is located within the vertical range of the gates (i.e., -21' to -1' msl). For this reason, the gate opening starts at 12.0 feet and progresses down to approximately 8.0 feet at the end of the sixty minute iteration. From these calculations for a tidal range of 18.0 feet, the low tide level is increased by 0.95 feet without taking advantage of the discharge opportunities through the turbine channels. Gates at the causeway covering the range from mid-tide to high tide would not assist in draining Half-Moon Cove. The use of pumps or reversible turbines with pumping capability will assist in reducing the impacts on the tidal range function. These investigative areas will be considered with the availability of hydrodynamic modeling capability and with the use of optimum turbine specifications. An increase of 0.95' in the low tide level represents approximately 50 acres of intertidal zone which will be transformed into sub-tidal area for a tide cycle.

	GATE / ROUNDED			DELTA VOL [FT^3]	TIME - MIN
1ST ITER	WIDTH - FT	[FT]	120.0		
	C(d)	[---]	0.9		
	DIFFERENCE - FT	[FT]	5.0		
	OPENING (FT)	[FT]	12.0		
	HEAD - FT	[FT]	5.0		
	Q - FT^3 / SEC	[CFS]	23255.9		
	TIME - MINUTE	[MIN]	10.0		
	TIME - SECOND	[SEC]	600.0		
	VOLUME OUT	[FT^3]	13953533.1	CHECK W/ VOL	
APPROX.	4.25	2428.4	105780468.8	105582366.9	10.0
2ND ITER	HEAD - FT	[FT]	4.3		
	Q - FT^3 / SEC	[CFS]	21440.9		
	VOLUME OUT	[FT^3]	12864521.9		
	3.5	2128.5	92719275.0	92717844.97	20.0
3RD ITER	HEAD - FT	[FT]	3.5		
	Q - FT^3 / SEC	[CFS]	19457.3		
	VOLUME OUT	[FT^3]	11674363.4		
	2.8	1863.1	81155184.0	81043481.58	30.0
4TH ITER	HEAD - FT	[FT]	2.8		
	Q - FT^3 / SEC	[CFS]	17403.1		
	VOLUME OUT	[FT^3]	10441868.1		
	2.15	1629.0	70958604.8	70601613.52	40.0
5TH ITER	HEAD - FT	[FT]	2.2		
	Q - FT^3 / SEC	[CFS]	15249.9		
	VOLUME OUT	[FT^3]	9149943.6		
	1.5	1406.9	61283475.0	61451669.95	50.0
6TH ITER	HEAD - FT	[FT]	1.5		
	Q - FT^3 / SEC	[CFS]	12737.8		
	VOLUME OUT	[FT^3]	7642664.9		
	0.95	1228.3	53504112.8	53809005.1	60.0
	FINAL ELEV. - FT				

TABLE TIDE – 04: High Pool Iteration for Low Tide Reduction

A similar calculation is summarized in TABLE TIDE – 05 for an 18 foot tide during low pool operation. In this case, the full capacity of the filling gates are used since the basin level is above the upper level of the gates. Once again, turbine discharge is not used to assist in the filling process and the causeway gates have not been used to increase the level of high tide. Increasing gate dimensions at the entrance to Half-Moon Cove is another option for improving environmental performance. For TABLEZ TIDE – 05, the iteration period is 75 minutes which could also be increased to improve filling characteristics. The hydrodynamic model will quantify the various options while consideration of the slight slope in the tidal basin during near high tide conditions. From an engineering and environmental perspective, the need to fill the basin to natural elevations is an important objective.

	GATE / ROUNDED				
1ST ITER	WIDTH - FT	[FT]	120		
	C(d)	[---]	0.9		
	DIFFERENCE - FT	[FT]	4		
	OPENING (FT)	[FT]	20		
	HEAD - FT	[FT]	4		
	Q - FT^3 / SEC	[CFS]	34667.83178		
	TIME - MINUTE	[MIN]	10		
	VOLUME IN	[FT^3]	20800699.07		
APPROX.	14.2	7914.6	344758524	344750974	10
2ND ITER	HEAD - FT	[FT]	2.8		
	Q - FT^3 / SEC	[CFS]	29005.18905		
	VOLUME OUT	[FT^3]	17403113.43		
	14.8	8335.1	363075504	362154087	20
3RD ITER	HEAD - FT	[FT]	2.2		
	Q - FT^3 / SEC	[CFS]	25710.35216		
	VOLUME OUT	[FT^3]	15426211.29		
	15.3	8693.3	378679059	377580299	30
4TH ITER	HEAD - FT	[FT]	1.7		
	Q - FT^3 / SEC	[CFS]	22600.66123		
	VOLUME OUT	[FT^3]	13560396.74		
	15.7	8984.9	391384059	391140696	40
5TH ITER	HEAD - FT	[FT]	1.3		
	Q - FT^3 / SEC	[CFS]	19763.70492		
	VOLUME OUT	[FT^3]	11858222.95		
	16.1	9281.1	404286531	402998918	50
6TH ITER	HEAD - FT	[FT]	0.9		
	Q - FT^3 / SEC	[CFS]	16444.39649		
	VOLUME OUT	[FT^3]	9866637.895		
	16.4	9506.3	414092976	412865556	60
6TH ITER	HEAD - FT	[FT]	0.6		
	Q - FT^3 / SEC	[CFS]	13426.79351		
	VOLUME OUT	[FT^3]	12084114.16		
	16.7	9733.9	424010499	424949671	75
	FINAL ELEV. - FT				

TABLE TIDE – 05 / Low Pool Iteration for High Tide Reduction

A decrease of 1.2 feet in the elevation of high tide represents a transformation of approximately 50 acres of intertidal zone into non-intertidal habitat. The mitigating factor in this impact refers to availability of a tidal function which periodically creates neap tide and spring tide conditions. Area transformed during an 18 foot tide will be re-transformed during a 19 foot or 20 foot tidal range. The only area which will be permanently transformed refers to the upper reaches during spring tides; however, the objective is to ensure natural high tide elevations by engineering procedures.

The following paragraphs describe the results of Tidewalker's calculations to allow flow through the turbines and to offer the potential to increase the time and quantity of electrical generation. The results are quite significant and have been incorporated into this response.

As a refinement of these calculations, a decision was made to re-perform the iterations to determine impacts on low tide level by include discharge through the turbines beyond the one hour period before low tide. In this case, the diameter was reduced to 22.5 feet while also including the possibility of still producing electricity when the hydraulic head drops below 4' – 5'. Under this scenario which is based on preliminary data, the low tide level is unaffected within the impoundment. Table Tide – 06 summarizes the results:

GATE / ROUNDED			DELTA VOL [FT^3]	TIME - MIN
WIDTH - FT	[FT]	120.0		
C(d)	[---]	0.9		
DIFFERENCE - FT	[FT]	5.0		
OPENING (FT)	[FT]	12.0		
HEAD - FT	[FT]	4.0		
Q - FT^3 / SEC	[CFS]	39179.6		
TIME - MINUTE	[MIN]	10.0		
TIME - SECOND	[SEC]	600.0		
VOLUME OUT	[FT^3]	23507780.3	CHECK W/ VOL	
3.7	2206.9	96134379.0	96028119.7	10.0
WIDTH - FT	[FT]	120.0		
HEAD - FT	[FT]	3.0		
Q - FT^3 / SEC	[CFS]	33646.6		
VOLUME OUT	[FT^3]	20187969.3		
2.45	1735.5	75599922.8	75840150.48	20.0
WIDTH - FT	[FT]	120.0		
HEAD - FT	[FT]	2.0		
Q - FT^3 / SEC	[CFS]	24935.1		
VOLUME OUT	[FT^3]	14961084.5		
1.45	1390.3	60560832.8	60879065.93	30.0
WIDTH - FT	[FT]	120.0		
HEAD - FT	[FT]	1.2		
Q - FT^3 / SEC	[CFS]	19560.7		
VOLUME OUT	[FT^3]	11736440.3		
0.65	1134.5	49418184.8	49142625.62	40.0
WIDTH - FT	[FT]	120.0		
HEAD - FT	[FT]	0.2		
Q - FT^3 / SEC	[CFS]	7210.4		
VOLUME OUT	[FT^3]	4326263.9		
0.3	1028.3	44791659.0	44816361.7	50.0
WIDTH - FT	[FT]	120.0		
HEAD - FT	[FT]	0.3		
Q - FT^3 / SEC	[CFS]	8830.9		
VOLUME OUT	[FT^3]	5298569.6		
0	940.0	40946400.0	39517792.14	60.0
FINAL ELEV. - FT				
0				

TABLE TIDE – 06: LOW TIDE IMPACT WITH TURBINE DISCHARGE AFTER "END OF PRODUCTION"

Under this scenario, the low tide level would not be raised during an average tide which would result in minimal impact to the intertidal zone and to the tidal function within the basin.

Table Tide-07 below performs the same calculation as above while considering electrical generation during the flood tide.

TIME - MIN		GATE / ROUNDED			
	1ST ITER	WIDTH - FT	[FT]	120	
		C(d)	[---]	0.9	
		DIFFERENCE - FT	[FT]	4	
		HEAD - FT	[FT]	3	
		Q - FT^3 / SEC	[CFS]	45939.8	
		TIME - MINUTE	[MIN]	10	
		TIME - SECOND	[SEC]	600	
		VOLUME IN	[FT^3]	27563908.41	
10.0	APPROX.	14.5	8088.5	352336602.8	351514183
	2ND ITER	WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	2.55	
		Q - FT^3 / SEC	[CFS]	42354.4	
		VOLUME OUT	[FT^3]	25412667.9	
20.0		15.3	8657.1	377104818.8	376926851
		WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	2.0	
		Q - FT^3 / SEC	[CFS]	37509.7	
		VOLUME OUT	[FT^3]	22505836.98	
30.0		16.0	9169.5	399424962.8	399432688
		WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	1.3	
		Q - FT^3 / SEC	[CFS]	30241.3	
		VOLUME OUT	[FT^3]	18144785.85	
40.0		16.6	9619.8	419037852.8	417577474
		WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	0.9	
		Q - FT^3 / SEC	[CFS]	25851.8	
		VOLUME OUT	[FT^3]	15511077.7	
50.0		17.0	9925.6	432359952.8	433088552
		WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	0.8	
		Q - FT^3 / SEC	[CFS]	23723.2	
		VOLUME OUT	[FT^3]	14233941.1	
60.0		17.4	10275.1	447583356	447322493
		WIDTH - FT	[FT]	120	
		HEAD - FT	[FT]	0.4	
		Q - FT^3 / SEC	[CFS]	15691.4	
		VOLUME OUT	[FT^3]	14122300.62	
75.0		17.8	10590.6	461325084	461444794
		FINAL ELEV. - FT			
		0.2			

TABLE TIDE – 07: ITERATION DETERMINING IMPACT ON HIGH TIDE LEVEL WITHIN THE IMPOUNDMENT

A similar summary is depicted above (TABLE TIDE – 07) for the impact on the high tide level: In this case, the high tide level would be reduced by 2” – 3” (inches) based on the assumptions listed above. An increase in the area of the filling and emptying gates would further reduce the impact at the high tide level while still retaining the opportunity of breaching the causeway into Passamaquoddy Bay which would improve the filling and emptying characteristics and water quality parameters. The tidal function within Half-Moon Cove would be flattened on the top and bottom ends of the spectrum and the sinusoidal curve would be shifted to the right. By allowing flow through the turbines during the one hour period before low tide also extends the period of energy production before the hydraulic head drops to less than one foot. The use of this residual flow also increases the amount of electricity generated per tide cycle. The following chart summarizes the impact of the proposed mode of operation on the level of low tide and high tide within the impoundment.

TIDAL RANGE – FT	% FLOW THROUGH TURBINE	INCREASE IN LOW TIDE LEVEL – FT	DECREASE IN HIGH TIDE LEVEL – FT	TOTAL LOSS OF TIDAL RANGE – FT
26	**83.5 [7.6*]**	**0.00**	**0.40**	**0.40**
18	**83.5**	**0.00**	**0.20**	**0.20**
12	**70.1**	**0.15**	**0.10**	**0.25**

The values listed above represent a rough estimate on the changes anticipated on the tidal regime. The second column represents the percentage of tidal waters passing through the turbines. For the spring tide, emptying gates will be partially open during energy production to allow excess flow to discharge from Half-Moon Cove since the design criteria is based on the barrage operation under average tide conditions. As a footnote, a neap tide is expected to increase the low tide level by 0.15’ based on these preliminary calculations. An increase in the size of emptying gates will allow a negligible increase in the low tide level. The anticipated decrease in high tide level will be reduced by increasing filling gate capacity and by the placement of gates on the causeway between Half-Moon Cove and Passamaquoddy Bay. The use of hydrological model will allow for a refinement of these estimates while allowing an investigation of various permutations including the possibility of breaching the causeway on the eastern edge of Half-Moon Cove.

Historically, the construction of the causeway(s) in the 1930s had a negative impact on the marine productivity of Half-Moon Cove since the flow of tidal waters from Passamaquoddy Bay was prevented by the rockfill obstruction. Several years ago, the Corps of Engineers (COE) requested a study to determine the feasibility of breaching the causeway as part of an environmental restoration project. A reference to this project appears in the pre-application document filed by Tidewalker Associates with FERC in March 2009. In order to recreate historical flow characteristics, the Corps of Engineer proposed an arrangement which would allow tidal waters from Half-Moon Cove to discharge into Passamaquoddy Bay during an ebb tide and also allow tidal waters from Passamaquoddy Bay to flow into Half-Moon Cove on a flood tide. The COE study required a substantial amount of dredging in order to recreate historical conditions.

Our preferred mode of production includes provisions to install filling / emptying gates in the causeway between the Passamaquoddy Pleasant Point Reservation and Carlowe

Island. In our case, the gates would span the water column from mid-tide to highest high tide in order to minimize the amount of dredging required for the project and to reduce permitting / licensing requirements. This arrangement would allow the proposed Half-Moon Cove project to fill the impoundment starting shortly after mid-tide on the Passamaquoddy Bay side of the structure. Through the installation of filling / emptying gates, Tidewalker Associates should be able to fill Half-Moon Cove to naturally occurring high tide levels and introduce cooler tidal waters during the summer and warmer tidal waters during the winter to counter any changes induced in the water temperature regime of the proposed impoundment.

The capability of being able to fill the basin shortly after mid-tide and to empty the basin shortly after high-tide will have an insignificant effect on the production of electricity and will serve as an environmental mitigation measure while adding operational flexibility by controlling impoundment levels during the range from neap tide to spring tide conditions. The discharge of Half-Moon Cove waters into Passamaquoddy Bay would occur shortly after high tide after an acceptable elevation differential was created between the two water bodies. This operation would allow the water level at the upper reaches of Half-Moon Cove to lower quicker and deeper than the lower end and continue until the mid-tide level was reached in the impoundment near the causeway gate.

The proposed causeway with emptying / filling gates is illustrated below in an architectural rendition of the proposed facility (FIGURE TIDE – 02):

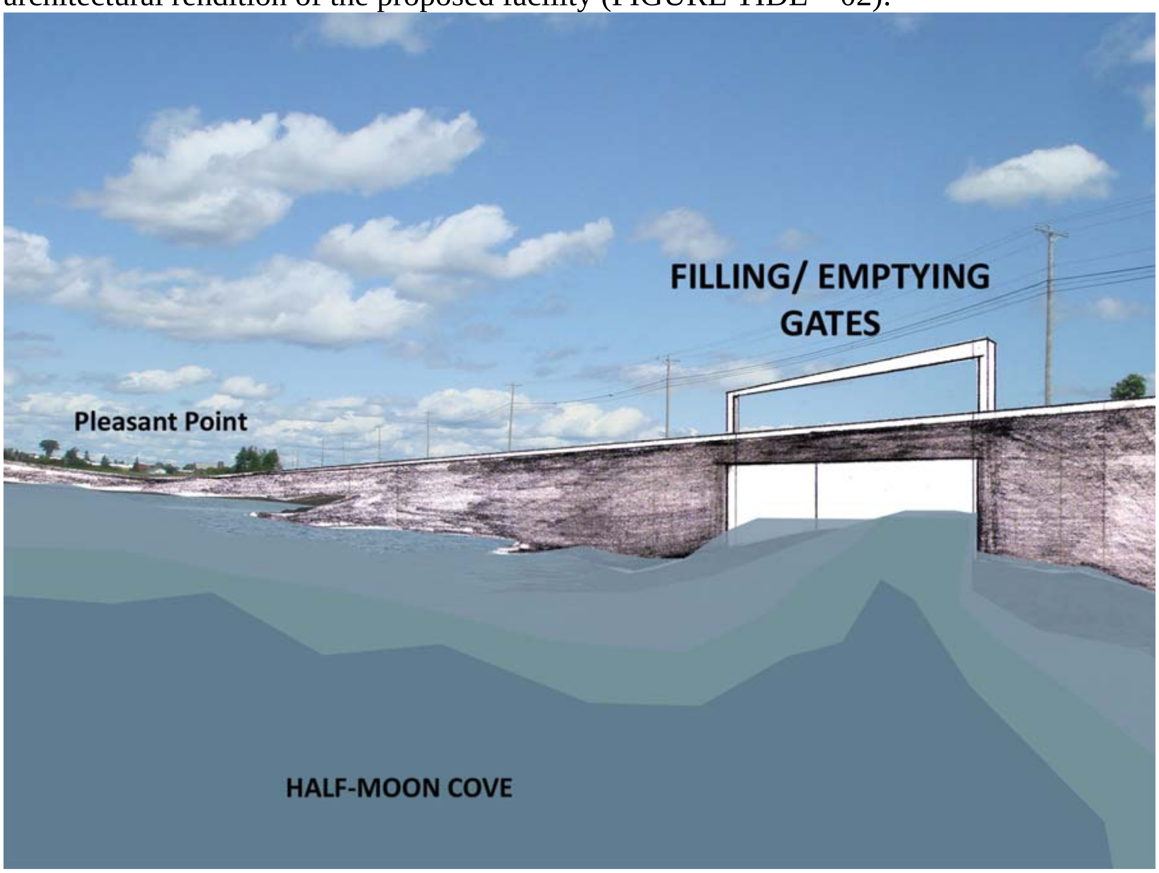


FIGURE TIDE – 02 / Causeway View

The size of the gates is expected to be 60’ x 20’ and will operate from approximately 5’ below mid-tide level to 15’ above mid-tide level (msl – reference). Operation of the gates will be initiated with the availability of a four foot (or less for neap tides) elevation differential between Passamaquoddy Bay and Half-Moon Cove and will continue until the level of the upper water body falls below mid-tide level. During the Corps of Engineers study on the causeway, a discovery was made that a time differential of approximately 15-30 minutes existed between the respective tidal regimes on both sides of the causeway in question. This phenomenon will be investigated in greater detail during the proposed hydrodynamic modeling of the proposed tidal barrage project. Due to the sinusoidal nature of the tidal function, the elevation difference is more pronounced shortly before and after mid-tide levels on the appropriate side of the causeway.

Discussions have been initiated with the Passamaquoddy Tribal Council at the Pleasant Point Reservation on plans to breach the causeway north of Carlowe Island. The Passamaquoddy Tribe supports the breaching of the causeway in question and the diversion of traffic from the Pleasant Point Reservation to another location which might include the placement of a road across the proposed tidal barrage at the entrance to Half-Moon Cove. If plans for the causeway emptying / filling gates are not finalized during the final design phase of the tidal barrage, additional discharge capacity will be added to the specifications for the emptying / filling gates at the entrance to Half-Moon Cove. As previously mentioned, the possibility of sluicing through the turbines will also be considered as an optional method for increasing the capacity to empty and fill Half-Moon Cove to naturally occurring levels.

For the preferred alternative, please plot the water surface levels in Half Moon Cove and Cobscook Bay for one lunar cycle using the hydraulic characteristics of the proposed turbines and of the proposed filling / emptying gates.

Please refer to the previous pages for a description of the preferred mode of operation and the resultant effects on the tidal regime of Half-Moon Cove. Calculations have been performed for a neap tide, average tide, and spring tide and results appear above. The periodic and predictable nature of the tidal function enables an accurate depiction of the water levels of Half-Moon Cove based on assumed operational parameters. By optimizing turbine specifications and by taking full advantage of enhanced hydraulic opportunities (e.g., causeway gates), an ability exists to minimize impacts to the tidal regime within the proposed impoundment.

Please quantify the “slight volume of permanent storage” and “slight reduction of water transfer across Half Moon Cove” described on page 3-11.

The term, “slight volume of permanent storage” refers to the volume area created during spring tides at the lower end of the tidal spectrum. By increasing the level of low tide by a fixed amount (e.g., 0.9 feet), an area will be permanently transformed from “sometime” intertidal into permanently submerged regardless of the tidal range. The net effect of reducing the tidal range within the impoundment will also decrease the volume of tidal waters flowing in and out of Half-Moon Cove. A spring tide represents the extreme conditions for the establishment of the highest high tide level and the lowest low tide level. The difference between lowest low tide and highest low tide is approximately seven feet. For a 0.9’ increase in the low tide level for a spring tide, a permanently transformed area from “sometimes” intertidal to sub-tidal habitat will be established in a volume area with an average surface area of approximately 50 acres and a vertical dimension of 0.9’.

By allowing discharge through the turbines, the impacts to the tide levels are less than 0.5’ with the possibility of reducing this impact by increasing gate capacity. The use of this mechanism will result in the virtual elimination of a permanent storage volume except for neap tide conditions at low tide and impacts expected at the upper end of the tidal spectrum which will have the effect of reducing effective volume.

If the high tide level is decreased by a fixed amount, a similar area will be created at the upper end of the tide spectrum during spring tide conditions. An unspecified surface area will be transformed from “sometimes” intertidal into permanently non-intertidal and never sub-tidal. The term “sometimes” is used because the habitat at the upper end of the tidal spectrum is considered intertidal only during extreme spring tide conditions. For a neap tide, the area between lowest high tide and highest high tide is not covered by tidal waters. The intent is to minimize the impact on the high tide level for environmental and engineering objectives.

Project Operation and Maintenance

Please describe how the project will be operated during storm surges and how the project would provide benefits during storm surges.

In a practical sense, the tidal barrage has the capability to limit additional tidal flow into Half-Moon Cove. The tidal barrage serves as a barrier and buffer to high seas entering from Cobscook Bay. The barrage will be designed to handle structural loading from storm surges. Since the turbines are located below lowest low tide, the turbines will be isolated and protected from storm surges. Since the drainage area around Half-Moon Cove is relatively minor in surface area, storm surges within the impoundment will not create additional risks as compared to current conditions.

Please describe the following:

> *a. How the proposed turbines would be protected from fouling by debris and any plans to manage the debris that collects at the turbines and dam.*

Since a tidal barrage operates with tidal flows in opposite and reversing directions, debris collected near the power house on both sides of the barrage will be washed away on a periodic basis. Stoplog systems will be installed to protect damage to turbines from inadvertent entry of large objects. Fouling of turbines and hoisting mechanisms will be monitored during the course of the project; however, similar experiences at comparable facilities in the marine environments have resulted in a conclusion that trashracks are not needed for the tidal barrage. Exclusion zones will be established around both sides of the barrage to prevent access to recreational boats.

Marine fouling in a coastal environment will be addressed with the use of coatings and the possible use of bubble generating devices. Both of these options will be investigated during subsequent phases of engineering and operational designs.

b. How the project would be operated to accommodate ice floes.

Since turbines are located below lowest low tide levels and since stoplogs will be installed for protection on both sides of the barrage, ice floes are not considered as an operational and functional problem area. Thickness of ice in Half-Moon Cove is generally less than 3-4 feet which should not pose a problem for turbine operation. The filling / emptying gates are sufficiently grand and appropriately positioned in the tidal spectrum to allow ice floe in an out of Half-Moon Cove.

c. When the turbines are off-line, how flow would enter and exit Half Moon Cove, and would water surface elevations in the cove change from the on-line condition?

Under present plans, tidal flow through turbines would be terminated with the cessation of energy production. A possibility exists with the use of appropriate turbines to extend the period of production down to hydraulic head conditions approaching 1.0’. At or around low tide, the entrances to turbines would be closed in order to build hydraulic head with the flooding tide in preparation for low pool production. The process repeats for each succeeding tide.

In the revised submittal, discharge through the turbines has been assumed for the period from one hour before low tide to low tide and for the period 1.25 hours before high tide to high tide as a way to reduce the impacts associated with a modified tidal regime within the impoundment.

Project Construction

Please clarify which estimates are correct and describe any land use impacts that would result from installation, operation, and removal of a ready-mix concrete plant. Also, please identify where the construction lay-down area is proposed to be located.

At present, float-in construction for the power house is being planned for the project’s development. A small area will be designated within the construction lay-down area for a small ready-mix concrete plant. Details of the lay-down area appear later in this document.

Section 4 of the PAD describes the geology and soils of the project area. Page 4-1 states that soils information will be submitted to comply with Section 5.6(d)(3)(ii) of the Commission's regulations. Please submit this information within 30 days.

Appropriate soil information has been transcribed onto Attachment *HMC-17-18-soils.pdf*. The original PAD included the relevant information in an inappropriate format.

FIGUREs HMC-10, 13, 14, 15, 16, 17 and 18 in the PAD are not legible. Please provide legible copies at a scale that clearly displays the data.

Attachments in this request for additional information contain figures and charts which have attempted to improve the presentation appearing in original PAD documents.

Please provide a description of, and the data that was developed for, the historic explorations that are presented in FIGURE HMC-10.

A decision has been made to remove FIGURE HMC-10 from the official record. The PAD still contains relevant information on the sub-surface condition of the entrance to Half-Moon Cove which has been referenced elsewhere in this report.

Page 4-11 of the PAD states that operation of the proposed dam will not impact the stability of the soils around Half Moon Cove. Please provide the methodology, data sources, and copies of any computer models that were used to determine that operation of the proposed project will not have an impact on the stability of the shoreline of Half Moon Cove.

Since the operation of the proposed tidal barrage will not increase the level of high tide, an engineering conclusion was expressed that the shoreline around Half-Moon Cove would not experience any additional risks for erosion and sedimentation beyond present conditions. In the proposed hydrodynamic model for the next phase of investigations, impacts to the shoreline will be considered as part of the assessment process. The ability for the barrage to muffle or control storm surges is considered a direct attribute of the project's value for protecting the stability of the shoreline of Half-Moon Cove from storm surges and from predicted and potential accelerated increases to sea level.

In attempting to answer this question, a doubt existed on the definition of "shoreline" since the water perimeter changes with time in accordance with the tidal function. As explained earlier, the tidal function as previously described will be shifted slightly and systematically with time and the high tide and low tide peaks and valleys, respectively, will be replaced a plateau at the corresponding times of high and low tides. The plateaus will exist for one hour and 1.25 hours for high tide and low tide, respectively. The establishment of a constant slope for tidal discharge will also change the dynamics for an ebbing and flood tide.

Water Resources

Please provide the total land area that drains to Half Moon Cove, delineated at the proposed location of the dam.

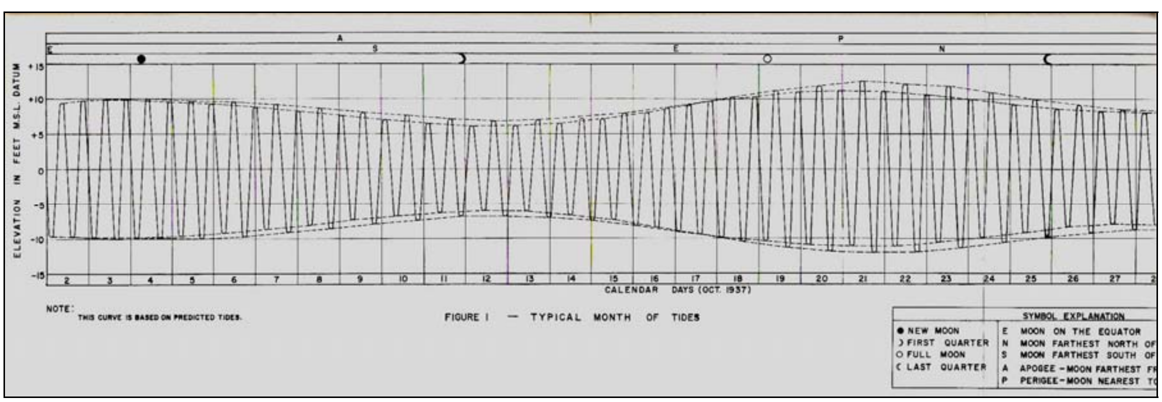
The water shed for Half-Moon Cove is approximately 1700 acres as illustrated in Attachment *Drain2.pdf*.

Page 15-2 of the PAD states that there are no dams in the basin. However, Page 2-14 describes the construction of two dams on both sides of Carlow Island along the eastern side of the proposed project. Please provide a description of these dams.

The two causeways on opposite sides of Carlowe Island were installed in the 1930s during the construction of a never completed Passamaquoddy Tidal Project. A description of the dams appears in the Corps of Engineer assessment of the causeway breaching project. During the 1950s a decision was made to re-locate the road into Eastport from the toll bridge at the entrance to Half-Moon Cove through the Pleasant Point Reservation and onto the two causeways in question. The causeways are rockfill structures and have survived more than seventy years and are still in excellent condition. The north causeway is being considered for the location of filling / emptying gates with environmental restoration and mitigation objectives.

Page 5-3 of the PAD states that the flow duration curve is not a relative function for a tidal power plant. It is unclear, then, how the project's dependable capacity was determined? Please provide the data and the assumptions used to determine the project's dependable capacity. Indicate the period of record and the location of the tide gage(s), including gage identification number(s).

A diagram of the tidal function for the Eastport area is depicted below for one month in a graphical representation of tidal elevation versus time.



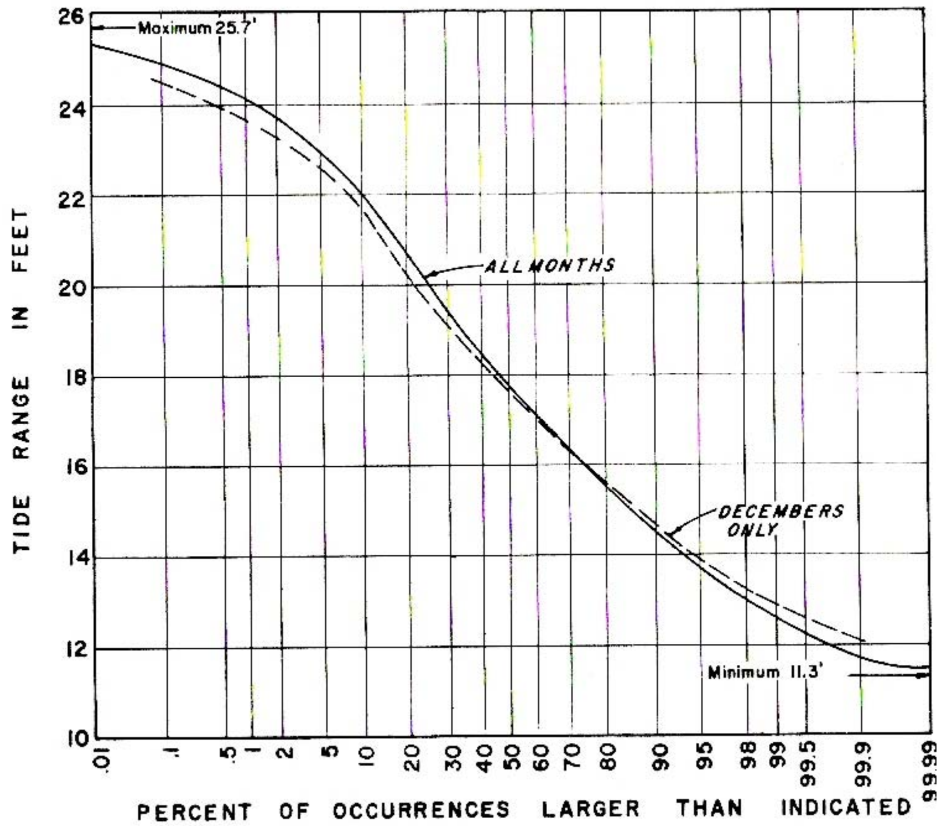


FIGURE 2 — TIDE RANGE OCCURRENCE CURVE

Figure 2 above was prepared during an earlier investigation of tidal power in Passamaquoddy Bay and Cobscook Bay. Figure 2 essentially represents a flow duration curve to reflect differences between predicted and actual tidal range values. In selecting an installed capacity for the tidal barrage, the root-mean-square value of the tidal ranges (i.e., 18.9 feet) was used for engineering calculations. A previous section of this response contains an explanation on selecting an appropriate installed capacity. The procedure for calculating installed capacity for a tidal barrage is substantially different than the process used for a "run-of-river" hydro-electric facility since tidal flows are predictable in both time and intensity. A tidal barrage is essentially a "run-of-tide" facility which controls potential energy within a relatively narrow band of tidal flows to levelize production during the range from neap tide to spring tide conditions.

Section 5.6(d)(3)(iii)(H) of the Commission's regulations requires the surface area, volume, maximum depth, flushing rate, shoreline length, and substrate composition of any existing or proposed reservoir. Page 5-13 states that this is not applicable. Please provide the rationale as to why this section of the Commission's regulations is not applicable. It is our understanding that the proposed dam will impound the waters of Half Moon Cove, which will act as a reservoir. Therefore, for Half Moon Cove, please provide these data for mean high tide, mean tide, and mean low tide.

The term “reservoir” is different for a “run-of-tide” barrage than for a conventional hydro-electric facility. Tidewalker Associates did not wish to give the impression that FERC regulations did not apply to this project. In a previous section, details for the tidal basin were presented to calculate volume based on an assumed geometrical configuration (TABLE TIDE -02). The depth is provided by the tidal range. The flushing rate is provided by considering statistical data appearing in TABLE TIDE-01 and substrate composition is characterized in Attachments *HMC15t.pdf* and *HMC16sm.pdf*. Shoreline length appears in Attachment *Landabutters.pdf* in terms of property dimensions for owners bordering Half-Moon Cove.

Page 5-8 of the PAD summarizes the results of salinity and turbidity monitoring conducted in Half Moon Cove in 2006. Please provide the complete report from this monitoring effort.

As part of proposed studies, detailed measurements of salinity and turbidity are being planned in conjunction with hydrodynamic modeling objectives. The data contained on Page 5-8 was referenced from the Quoddy Bay LNG application to FERC for a liquefied natural gas facility proposed near and through Half-Moon Cove.

Aquatic Resources

In Section 6 of the PAD, numerous studies are cited in the sections describing the aquatic biota of the project area, including algae, shellfish and other invertebrates, fish, sea turtles, and marine mammals. Summary tables are provided as well as text summarizing the results of various field surveys. However, many of the FIGUREs and tables cited in the text are not provided. So we can determine whether existing information on the project area’s aquatic biota and essential fish habitat is adequate for an analysis of potential effects, we need to review the entire reports which you cite. Please make these reports available either by making and distributing CDs, posting the full reports on your website in a downloadable format, or filing the reports with the Commission.

References appearing in Section 6 of the PAD within borders of dashed lines were pasted from studies conducted during the 1970s for a different version of the Half-Moon Cove tidal power project being proposed by the Passamaquoddy Tribe at the Pleasant Point Reservation. The references were included to reflect historical conditions as compared to present conditions. Since these references are outdated, Tidewalker Associates withdraws these references for consideration during the present review of the Half-Moon Cove Tidal Power Barrage. References appearing in the Quoddy Bay LNG application are more current and relevant. If there are other requests beyond the ones referring to the 1970s investigation, Tidewalker Associates will provide this information as requested during the review of project plans; however, Tidewalker believes that most, if not all, the disconnections refer to the 1970s report. Tidewalker retains these references, but we do not believe that relevance is appropriate for this review. Tidewalker wishes to discuss specific citations with FERC within an appropriate forum.

Therefore, please provide the design specifications of the proposed trashracks, including dimensions, clear spacing between bars, and an estimate of maximum through-rack water velocity on both the incoming and outgoing tides. If you are not proposing trashracks, then please explain how you propose to protect fish and other aquatic biota from injury and mortality due to turbine entrainment.

Tidewalker believes that a stoplog system (e.g., grid size 2” x 2”) combined with the presence of turbines with low rotational speeds (< 60 rpm) will acceptably limit fish mortality through the turbines. During investigatory studies, fish mortality as related to specific turbine characteristics will be considered in full detail. Based on presently available information, Tidewalker does not believe that trashracks are needed for this tidal barrage project; however, Tidewalker is open-minded to any discussions which will document the need for trashracks.

<u>Terrestrial Resources</u>

Please clarify if the transmission line corridor will be constructed or if it already exists.

An existing transmission corridor is available to upgrade the line from the entrance to Half-Moon Cove to Pembroke, a distance of approximately seven (7) miles. Since Tidewalker has proposed to reduce installed capacity from 16 mW to 9 mW in this response, a reconsideration of the transmission options is planned as part of the regulatory review process.

Please provide a description of wildlife and vegetation resources located along the corridor.

Tidewalker Associates is under the impression that regulations allow an upgrade to the existing Bangor Hydroelectric transmission line under normal operation and maintenance provisions. Tidewalker will research this requirement to ensure compliance with any upgrading requirements.

Section 5.6(d)(3)(vi) of the Commission’s regulations requires that the PAD include a description of wetlands, riparian, and littoral habitat, including a list of plant and animal species that use these habitats, a map delineating the wetlands, riparian, and littoral habitats, and estimates of acreage for each type of wetland, riparian, and littoral habitat, including variability as a function of storage (change in natural water level regime). Please provide the required information pertaining to wetland, riparian, and littoral habit in the project area.

Under proposed studies expressed in the PAD (March 2009), a need was stated to refine resource characterization. A deferral to this information is requested to the study phase of project review in order to fully address stakeholder and regulatory agency concerns in an appropriate forum.

On page 3-17 of the PAD you state, "since the bird community generally feeds along the upper reaches of the tidal spectrum as the tide recedes, the impacts on the birdfeeding habitat are not deemed significant…" Please provide data to support this conclusion.

Texts appearing on Page 3-17 refer to assessments conducted during the 1970s. Tidewalker has requested the removal of these references since they are out-dated and since the tidal project proposed in the 1970s assumed a 50-60% reduction in the tidal range within the impoundment. The present mode of operation for the proposed tidal barrage would reduce the low tide level by less than one foot and Tidewalker is committed to formulating a mode of operation which has minimal impact on the high tide level within the impoundment. The assessment of impacts to feeding birds will be addressed during the study phase of the project planned for next summer (2010).

Threatened and Endangered Species

Page 9-5 of the PAD describes the roseate tern, but does not describe the preferred habitat of the bird. Please provide a description of the preferred habitat of the roseate tern and whether this habitat is present in the project area.

A cursory investigation of roseate tern observations in Maine has concluded that the species has not been observed in the Eastport area and that the most likely habitat is on off-shore islands with rocky shorelines. Once again, Tidewalker refers to the objectives of proposed studies to address specific issues related to threatened and endangered species and for other disciplines.

Land Use

The PAD cites the Pleasant Point Reservation of the Passamaquoddy Tribe as an affected community bordering the northeastern segment of Half-Moon Cove, and FIGURE HMC-01 shows the general location of the Pleasant Point Reservation in relation to the proposed project area. However, the specific location and relative size of these lands are not clearly identified. Please show this information on the Exhibit G drawings.

Attachment *Landabutters.pdf* contains information on the ownership, location, and relative size of property bordering Half-Moon Cove.

Additionally, Section 4.41(h)(4) of the Commission's regulations requires Exhibit G to show (i) lands owned in fee by the applicant and lands that the applicant plans to acquire in fee; and (ii) lands over which the applicant has acquired or plans to acquire rights to occupancy and use other than fee title, including rights acquired or to be acquired by easement or lease. Section 5.6(d)(3)(viii)(J) of the PAD cites there is potential for the project area to involve Tree Growth or Open Space designations, managed under State of Maine guidance. However, the locations of these lands are not identified. Please identify land property ownership and provide this information on the Exhibit G drawings. This information should include the quantified amount of land (in acreage) that will be *inundated by the variance in tidal ranges for all proposed modes of operation and design.*

Tidewalker Associates plan to secure land near the entrance to Half-Moon Cove for a lay-down area and for field offices during the construction phase of the proposed tidal barrage. A draft comprehensive plan for the Town of Perry includes a proposed industrial site near the barrage site which would be suitable for project requirements. At present, Tidewalker does not possess any property or land rights within the project boundary. Tidewalker understands the need and requirement to eventually negotiate a submerged lands lease with the State of Maine for property / rights impacted by the proposed tidal barrage project.

<u>Resource Management Plans</u>

Please provide a list of the existing management plans that were reviewed in preparing the PAD along with citations.

Tidewalker requests a deferral of this requirement until a meeting is held with stakeholders and regulatory agencies which was initially mandated before 06.October.2009. A review of selected management plans were conducted during the preparation of the PAD. The management plans cited by regulatory agencies serve as an existing listing of pertinent documents.