Appendix F: Ecology

F-13 Peregrine Falcon Monitoring Report

1-1 EXECUTIVE SUMMARY

A monitoring plan approved by the New York State Department of Environmental Conservation (NYSDEC) was implemented to document any disturbance from the Pile Installation and Demonstration Program (PIDP) to the resident pair of peregrine falcons on the Tappan Zee Hudson River Crossing. Scan sampling was used to measure and compare peregrine falcon time budgets before and during a range of PIDP activities that were categorized by their expected potential to cause disturbance. Low disturbance activities included preliminary set-up work, such as towing cranes and other heavy equipment to the test pile locations, assembling vibration and impact hammers, installing bubble curtains, and similar in-water actions leading up to the driving of test piles. Activities of moderate disturbance potential included the construction of falsework and framing (temporary wooden or metal framework built to support a structure under construction) and the vibration of lower pile segments. Impact hammering, which was the loudest PIDP activity, was categorized as having high potential for disturbance. A total of 45 hours of observation on 15 separate days provided no indication that the birds' behavior was altered by the PIDP activities occurring at the time. The falcons were most often observed perched, and usually in the same distinct locations, independent of the PIDP work simultaneously occurring in the river below. There was no observation of any PIDP activity, including impact hammering, causing the birds to flush or otherwise respond. The birds were observed engaging in typical behaviors such as sharing food, provisioning young, and preening, which also suggests the birds were not in duress. The exposure and habituation of the peregrine falcons to extensive baseline levels of noise and other activity on the bridge under normal conditions has likely led to a high disturbance threshold in these individuals, possibly explaining why they did not appear to have any negative reaction to the PIDP. Further, the high noise levels on the bridge from traffic, maintenance operations, and wind likely masked much of the noise produced by PIDP work in the river below, including impact hammering. Impact hammering could not be heard by the peregrine falcon monitors from the observation point on the main span, and it is possible the impact hammering was inaudible to the birds as well. Bridge-nesting peregrine falcons inherently have a high tolerance of human disturbances, and on the basis of the monitoring summarized in this report, the resident pair on the Tappan Zee Hudson River Crossing does not appear to be sensitive to in-water construction activities such as those undertaken for the PIDP.

1-2 INTRODUCTION

Behavioral observations of the Tappan Zee Hudson River Crossing's resident pair of peregrine falcons were made before and during the Pile Installation Demonstration Program (PIDP) to investigate potential disturbance caused by the in-water construction

activity. The methodology and schedule for the peregrine falcon monitoring were reviewed and approved by NYSDEC in advance. The PIDP took place at four locations within the river, referred to as PLT1-PLT4, during the spring of 2012. A total of seven test piles were driven among these four locations (two piles in each of three locations and one pile in the fourth location). PLT1 and PLT2 were located within the Rockland County side of the project area, well west of the peregrine falcon nest box on the existing bridge's main span, whereas PLT3 and PLT4 were in closer proximity to the nest box location on the Westchester County side of the project area (**Figure 1**).

Initial site preparation included activities such as towing cranes and other heavy equipment to the test pile locations, assembling vibration and impact hammers, installing bubble curtains, and similar in-water actions leading up to the driving of test piles. Subsequent work included the installation of falsework piles (ancillary piles to support load frames) and framing (temporary wooden or metal framework built to support a structure under construction). Next, a low-noise, vibratory hammer was used to install the lower segment of each test pile. The upper segment was welded to the bottom segment, and then driven deeper into the riverbed by hydraulic impact hammering. Peregrine falcon monitoring spanned the range of these different PIDP activities, and included pre-PIDP observations as well as observations after all test piles had been installed. This report quantifies and compares the peregrine falcon behaviors observed during these periods.

1-3 METHODS

Observations were made from a closed lane on the bridge's main span road deck, which offered the best accessible vantage point. Lane closure schedules, however, greatly constrained the dates and times during which monitoring could occur. Generally, peregrine falcon monitoring was limited to weekdays, between approximately 9:30am and 12:00pm. For this reason, the peregrine falcons could not be comprehensively monitored throughout the full range of PIDP activities. However, dates and times of peregrine falcon monitoring were able to coincide with pile driving and other significant PIDP activities on at least one occasion. Observation dates and times, and the corresponding PIDP activities, are shown in **Table 1**.

Behavioral data were collected using an instantaneous scan sampling method (Gaibani and Csermely 2007), whereby the location and behavior of the birds were recorded at five minute intervals during the observation period and coded according to the ethogram in **Table 2** (adapted from Walter 1983). The sex of the birds could not be directly determined because peregrine falcons are not sexually dimorphic, aside from subtle differences in body size. Birds were seldom in close enough proximity to each other for size differences to be apparent. Instead, sex was presumed on the basis of the birds' behavior and all behavioral data are herein analyzed as such. For example, one bird often remained perched in front of the nest while the other bird flew long distances up- or down-river, or was otherwise out of view for extended periods of time. The bird that remained near the nest box was presumed to be female and the bird that would be absent for long periods was presumed to be male. Similarly, one bird often remained in (or near) the nest box while the other was perched on the top of the main span's north tower. The former was presumed to be female and the latter was presumed to be male. Even though male peregrine falcons contribute to incubation and nest attendance, the female performs these duties the majority of the time (White et al. 2002).

Often the birds (particularly the male) were not observable due to the limited range of visibility from the road deck. The male frequently perched somewhere out of view on or below the bridge, and often flew long distances down-river from the bridge until it could no longer be seen. Consequently, bird behaviors often had to be recorded as "unknown" during scan sampling. Also, the inside of the nest box could not be seen from the observation point, and a bird was only recorded as being inside the nest box if it had been seen entering or exiting the box at some point during the observation period.

Table #1
Peregrine Falcon Monitoring Schedule

Date	Monitoring time (EST)	Major PIDP activity	Location	Estimated breeding stage
5-Mar	10:00-11:40	None	N/A	Courtship
7-Mar	9:45-11:55	None	N/A	Courtship
8-Mar	10:10-12:10	None	N/A	Courtship
13-Mar	9:55-13:55	Equipment set-up	N/A	Courtship
19-Mar	9:50-11:50	Falsework / framing	PLT2	Courtship
2-Apr*	9:30-11:00	Falsework / framing	PLT3	Incubation
24-Apr	9:40-11:40	Equipment set-up	PLT4	Incubation
25-Apr	10:35-12:35	Equipment set-up	PLT3	Incubation
26-Apr	9:50-13:50	Equipment set-up	PLT3	Incubation
7-May	9:30-14:30	None- postponed	N/A	Chick rearing
8-May	9:35-12:45	Impact	PLT3	Chick rearing
14-May	10:00-13:00	Impact	PLT4	Chick rearing
16-May*	11:05-13:25	Impact*	PLT2	Chick rearing
18-May	9:40-13:20	Vibration & impact**	PLT3	Chick rearing
30-May	9:30-11:30	None***	N/A	Chick rearing

Notes:

*No birds were seen during Apr 2 and May 16 monitoring.

**Impact hammering occurred after the monitoring period ended.

***Re-driving of piles 2A and 2B occurred over a span of approximately 8 minutes at 9:00; otherwise no major PIDP activity with potential to disturb the peregrine falcons occurred. The May 30 monitoring period is therefore considered a post-impact-hammering follow-up visit.

Table #2
Peregrine Falcon Ethogram[1]

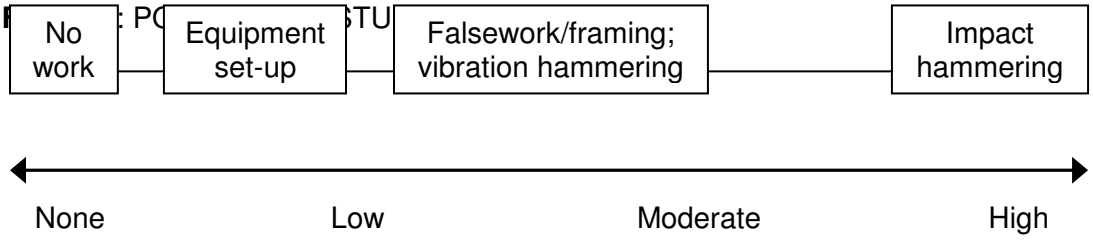
Behavioral Classification	Identification	Defining Action
Physical Status	P1	perched
	P2	in flight, but not in pursuit of prey or sexual display
	P3	lying down
	P4	hopping, walking
	P5	other
Feeding and Body Care	F1	feeding self
	F2	drinking
	F3	asleep
	F4	panting
	F5	preening, cleaning
	F6	scratching
	F7	shaking feathers, sunning
	F8	pellet extraction/defecating
	F9	other
Hunting	H1	prey chase, pursuit , stoop flight
	H2	prey capture, in possession of prey
	H3	prey transport
	H4	other
Agnostic Behavior and Human Impact	A1	physically harassing, attacking bird or other animal
	A2	physically harassing, attacking human
	A3	threat display towards animal (e.g., gaping, wings open)
	A4	threat display towards human
	A5	fleeing from human disturbance
	A6	other
Sexual Behavior	S1	display from perch (e.g., bowing)
	S2	aerial display
	S3	allopreening, billing, other contact
	S4	offering food
	S5	receiving food
	S6	copulation
	S7	other
Nest-Related Behavior	N1	inside nest box
	N2	feeding young
Vocalization	V1	vocalizing directed at mate
	V2	vocalizing at other conspecific
	V3	undirected vocalization
	V4	other
	-	(threat vocalization under a3 and a4)

Notes: [1] a descriptive list of the known behaviors of a given species that is used to study animal behavior.

The behavioral data collected from instantaneous scan sampling were used to calculate time budgets of the birds (i.e., proportion of the observation time that birds were

engaged in a given behavior). Time budgets were then compared among different phases of the PIDP that were categorized by their expected potential to cause disturbance to peregrine falcons (**Figure 2**). “No disturbance” periods include the pre-PIDP monitoring conducted on March 5, 7, and 8, and monitoring conducted on May 7 when equipment failure caused a suspension of the scheduled work. “Low disturbance potential” events include heavy equipment mobilization, set-up, and assembly at test pile locations during monitoring periods on March 13, April 24, 25, 26, and May 16. “Moderate disturbance potential” periods include the falsework and framing work performed on March 19 and the vibration hammering on May 18. “High disturbance potential” includes impact hammering on May 8 (at PLT3, the closest test location to the falcons’ nest site). On May 14, impact hammering (at PLT4) began prior to the morning lane closure and was completed approximately 0.5 hr after peregrine falcon monitoring was able to begin. Observation data collected during the 0.5 hr overlap of impact hammering at PLT4 and peregrine falcon monitoring were included in the analysis of “high disturbance potential” data. Observation data from the hour after impact hammering on May 14 had ended were also included to capture the birds’ behavior following the potential disturbance of impact hammering. All other impact hammering occurred on dates and at times when no lane was closed on the bridge and peregrine falcon monitoring was not feasible.

No birds were seen during the peregrine falcon monitoring conducted on April 2, and on May 16, only one bird was observed briefly (flying east from the bridge). On March 5 and May 18, only the female was seen. Overall, the male was not seen nearly as often as the female, and as such, sample sizes of behavioral data for the male are small.



PIDP work activities were categorized by their expected potential to cause disturbance to peregrine falcons. “Equipment set-up” included activities such as towing cranes and other heavy equipment to the test pile locations, assembling vibration and impact hammers, installing bubble curtains, and similar in-water actions leading up to the driving of test piles that were considered to have low potential to cause disturbance. Constructing falsework and framing, and vibrating lower pile segments were considered to have moderate potential to disturb peregrine falcons. Impact hammering was the loudest PIDP activity and considered to have the highest potential to cause disturbance.

1-4 RESULTS

Peregrine falcon monitoring was conducted for a total of approximately 45 hours over 15 different days. Behaviors of the female that were recorded by scan sampling included perching, nest attendance, receiving food, and feeding young (i.e., entering the next box with food at a time when the nest was expected to contain nestlings). Male

behaviors included perching, nest attendance, flying, offering food, and preening (**Table 3**).

In March and April, prior to egg laying, one bird (presumably female) would often be seen for the majority of the monitoring period, usually near the nest box, whereas the other bird (presumably male) would only be seen intermittently and would be absent for extended periods of time. Later in the season, when the pair was expected to have eggs, the presumed female was often in the nest box while the presumed male was often either perched on the top of the main span's north tower or was out of view for long periods of time.

As discussed above, monitoring effort differed among different phases of the PIDP and often could not be conducted during primary PIDP activities because of lane closure schedules, construction delays, and other logistical constraints. Further, birds were often unseen during the monitoring periods and their behavior could not be recorded. Sample sizes of behavioral data were particularly small for the male. Because of these disparities, the unevenness of the monitoring effort across PIDP phases, and the small sample sizes, data were not analyzed statistically. Qualitatively, there were no noticeable trends in the birds' behaviors during phases of the PIDP with different expected levels of potential disturbance (**Table 3**). Time budgets in the days preceding initiation of the PIDP were similar to those measured during the PIDP, including periods of impact hammering. Anecdotally, there was also no evidence to suggest that the peregrine falcons were in any way disturbed by the PIDP.

Table #3

Time budgets (expressed as percentages) of peregrine falcons on the Tappan Zee Hudson River Crossing before and during PIDP stages categorized by their potential to cause disturbance

Expected Disturbance Level	Number*	Behavior (% of scan samples)						
		Perched	In Nest Box	In Flight	Offering Food	Receiving Food	Feeding Young	Preening
Female								
None	108	19	79				2	
Low	124	20	78			2		
Medium	38	97	3					
High	47	11	87			2		
Follow-up**	24	100						
Male								
None	22	86	9	5				
Low	19	68	5	16				11
Medium	17	94		6				
High	3	1 of 3		1 of 3	1 of 3			
Follow-up**	14	86						14

Notes: See Table 1 and Figure 1 for corresponding dates and PIDP activities.

*Number of scan samples during which the bird was seen and behavior could be determined.

**Follow-up monitoring on May 30 after driving of all test piles had concluded.

1-5 DISCUSSION

In New York City and many other metropolitan areas, peregrine falcons nest on bridges, high-rise buildings, and other tall artificial structures amidst the high levels of noise and human activity associated with an urban environment, thus demonstrating a high tolerance of disturbance and an ability to exploit resources in human-dominated landscapes (Cade et al. 1996, White et al. 2002). Peregrine falcons began nesting on the Tappan Zee Bridge in the 1980's (Mildner 1988, Frank 1994) and continue to do so to this day.

Existing conditions for peregrine falcons nesting on the Tappan Zee Bridge are characterized by consistent and extensive levels of human activity. Vehicular traffic and strong winds create a remarkably noisy environment. The resident pair of peregrine falcons' selection of the nest site inherently indicates a tolerance of these conditions, and based on the direct observations of the birds throughout the monitoring program, it is apparent that the birds are indifferent to the human activity around them. In addition to the high traffic volume passing below their nest site, painters and other bridge maintenance/repair crews were highly active in close proximity to the nest location throughout the monitoring period. At no point did the birds appear to react to the crews or work vehicles operating below them.

A comparison of the peregrine falcons' time budgets before and during PIDP activities indicates that the birds' behavior was unaffected. Birds were most often observed perched, and usually in the same distinct locations, independent of the concomitant PIDP work occurring in the river below. The presumed female was almost always inside the nest box or perched on the supporting cross beam within approximately 20 feet of the nest. The male most commonly perched on the top of the main span's north tower, over the southbound traffic lanes. For both sexes, the proportion of time perched was comparable between the periods with no in-water work and the PIDP activities that ranged from low to high disturbance potential. There was no indication that any PIDP activity, including impact hammering, caused the birds to flush or otherwise respond. The birds engaged in other typical behaviors during the PIDP as well, including sharing food, provisioning young, and preening, which also suggests the birds were not in duress. On May 8, the female remained inside the nest box throughout the impact hammering of test pile 3A (the closest test pile location to the nest) that occurred from 10:05am to 11:30am. Birds usually flush from their nest when approached or otherwise disturbed. At no point did the female peregrine falcon appear to flush from the nest box or otherwise flee the area in panic flight.

The exposure and habituation of the peregrine falcons to the extensive baseline levels of noise and other activity on the bridge has likely led to a high disturbance threshold in these individuals and likely explains why they did not appear to have any negative reaction to the PIDP. Further, the high noise levels on the bridge from traffic, maintenance operations, and wind likely masked the majority of the noise produced by the PIDP work in the river below, including impact hammering. Neither of the two peregrine falcon monitors that were on the bridge on May 8 and 14 heard the impact hammering of test piles 3A and 4A that took place during the monitoring period. Both monitors were unaware that the impact hammering had occurred until they were later informed by the engineer in charge. The impact hammering (and other PIDP activities) may have been inaudible to the peregrine falcons above the high ambient noise levels around their nest site and other areas of frequent occurrence on the bridge.

In conclusion, 45 hours of observations provided no evidence that peregrine falcons nesting on the Tappan Zee Hudson River Crossing were affected by the PIDP, including the impact hammering of test piles in close proximity to the nest site. No signs of disturbance or altered behavior, such as avoidance of the nest site, repeated displacement from typical areas of occurrence, threat displays (erect feathers on head, back, and/or breast), or open-mouth breathing, were observed. The birds, particularly the female, continued to engage in typical behaviors throughout the various stages of in-water activity. Nest attendance did not appear to be altered in any way. As impact hammering of test pile 4A was in progress relatively close to the nest, the male was observed delivering prey to the female at the nest, which suggests both birds were indifferent to any noise or visual disturbance generated by the pile driving. These overall findings are consistent with observations of peregrine falcons successfully nesting on the San Francisco-Oakland Bay Bridge during the bridge's earthquake retrofitting project in the early 2000's and the current, ongoing construction of its replacement bridge (Stewart 2011). Bridge-nesting peregrine falcons inherently have a high tolerance of human disturbances, and on the basis of the monitoring summarized in this report, the resident pair on the Tappan Zee Hudson River Crossing is not sensitive to in-water construction activities such as those undertaken for the PIDP. Similarly, future construction of a replacement bridge is not expected to cause nest-site abandonment or otherwise negatively impact peregrine falcons nesting on the existing bridge.

1-6 REFERENCES

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