FAIRBANKS WETLAND TRENDS ANALYSIS: CHANGES IN STATUS OF WETLANDS BETWEEN 1949 AND 2007

FINAL REPORT

Prepared for

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BACKGROUND

The Fairbanks U. S. Fish and Wildlife Service (USFWS) Field Office recently revised the National Wetland Inventory (NWI) map of the Fairbanks area (2009) to respond to the growing need for resource agencies, land-use planners, and private organizations to have access to current information on the status and distribution of wetland habitats. The revised map was produced at 1:3,000 scale, much finer than either the standard scale (1:12,000) used for the Lower 48 states, Hawaii, District of Columbia, Puerto Rico, and the Virgin Islands (Dahl et al. 2009) or that traditionally used for NWI maps in Alaska (1:63,360). The finer-scale mapping will aid in the planning of future development and infrastructure projects, as well as assisting the U.S. Army Corps of Engineers and other federal agencies in regulating the placement of fill in wetlands and any associated compensatory mitigation. A summary of the wetlands map revision effort,

including the wetland types found, their distribution, and their acreages and relative abundances is provided in Jenkins et al. (2010). The total area included in the mapping is 198,080 acres.

In addition to serving as a tool for land-use planning and regulation, the new map is being used to analyze wetland status and trends in the Fairbanks area. The new (2007) image is being compared with 1949 imagery to assess the extent to which wetlands have been gained, lost, or modified over the past 48 years. Three tasks were identified for this analysis:

1) Quantify changes in wetland habitat classes associated with filled, excavated, and cleared areas;
2) Through stratified point sampling, assess the extent to which undisturbed wetlands and uplands have been lost or altered between 1949 and 2007; and
3) Assess changes between 1949 and 2007 in the coverage of sloughs and emergent wetlands that provide high-value habitat for waterbirds and wetland-dependent birds. Changes that may have occurred include loss of wetlands due to development or natural processes, fragmentation, conversion between wetland types, and creation of wetlands by natural processes such as thaw settlement (thermokarst).

METHODS

We generally followed the national standards for classifying and delineating wetlands (Cowardin et al. 1979, Dahl and Bergeson 2009), which include minimum mapping sizes of 1 acre for wetlands and 5 acres for uplands. Many of our map units were smaller, however, because we had to divide some of the 2007 polygons into smaller polygons when classifying them based on the 1949 imagery. For emergent marshes, ponds, and other prominent wetland features, we used a minimum mapping size of 0.01 acres. With the exception of PSS/EM1, classes were simplified to include only the first class in a complex (e.g., PSS1/3 became PSS1). We reviewed both wet meadow (PEM1) and emergent scrub mosaic (PSS/EM1) polygons to assess changes to high-value habitat for waterbirds and wetland-dependent birds between the two time periods.

We were unable to classify and map habitat changes for a small portion of the study area (4.1%; 8,208.3 acres) due to missing 1949 imagery, cloud cover/shadows, or poor resolution. These areas were excluded from the analysis.

TASK 1

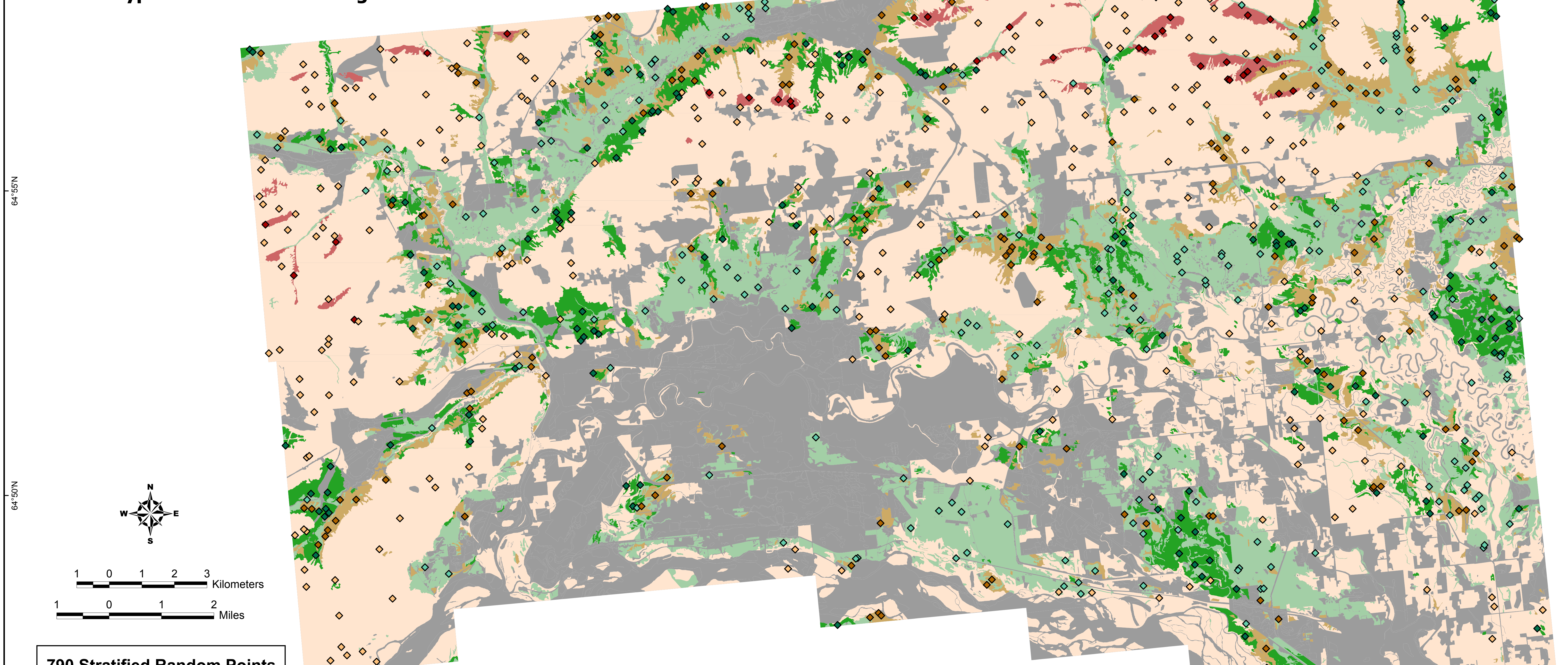
Creating a complete wetlands map for the 1949 imagery was beyond the scope of this project. Instead, we focused on assessing the extent to which wetlands and uplands in the study area were affected by development-related disturbances between 1949 and 2007. The types of disturbances were not distinguished and included fill placement, excavation, blading, and clearing. Although some landscape disturbance was delineated in the map layer provided by the USFWS, additional separation of uplands (U) and uplands resulting from disturbance (Ud) was required. These changes were incorporated into a new layer called ABR_2007_W. With the exception of a subset of high-value wetland habitats (e.g., R2UB, PEM1, PUB) and single wetland polygons that had been conspicuously modified by development, we assumed for Task 1 that all wetlands and undisturbed uplands mapped in the original 2007 map layer were unchanged since 1949. These polygons were transferred to the ABR_2007_W layer. A sample of these wetlands will be assessed as part of the Task 2 effort to estimate the degree of change in wetland and upland status that has naturally occurred between 1949 and 2007.

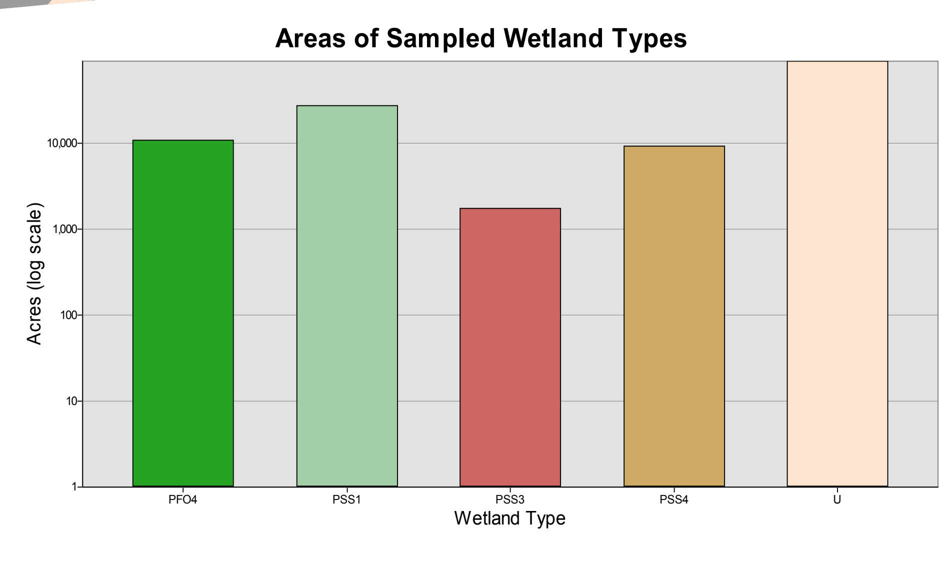
Additionally, with the assistance of the National Hydrography Dataset (NHD) (USGS 1999), we mapped drainages that only were partially delineated or were missing in the 2007 wetland layer. The NHD is managed by the U.S. Geological Survey (USGS) and Environmental Protection Agency and is a comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs, and wells. Only major drainages were added to the wetlands layer, however, not the entire NHD stream layer.

TASK 2

To assess the degree to which shrub- and forest-dominated wetlands and uplands mapped in 2007 have been altered since 1949 by successional processes or indirect impacts of development, change in status was assessed for a sample of points in each habitat class (Figure 1). The points (n = 790) were generally allocated among the classes using a stratified sampling approach; larger numbers of points were sampled in the more extensive classes (in terms of area). The sampling was not, however, strictly proportional; habitat class PSS3 occupied a much smaller area than any other class, but was assigned enough points for a representative sample. Similarly, upland areas (U) comprise a total area that is several orders of magnitude higher than the other habitats,

Figure 1. Distribution of sample points in selected undisturbed wetland types evaluated for change between 1949 and 2007.





NWI[1] Wetland Class	Total Area (Acres)	% of Total Area	No. of Points	% of Points Sampled
PSS1	21,915	17	178	23
PSS3	1,723	1	40	5
PSS4	9,193	7	157	20
PFO4	10,753	8	159	20
U	86,771	67	256	32
Total	130,356	100	790	100

[1] NWI = National Wetland Inventory.

but a strictly proportional sample allocation would have resulted in a very limited sample number for these remaining habitats. In addition, based on an overall review of undisturbed upland areas between 1949 and 2007 prior to sampling, we did not identify notable landscape changes that would suggest a strictly proportional sample allocation was warranted.

We used the ArcGIS 10.0 Create Random Points tool with a 50 m minimum distance constraint to generate the specified number of random points for each type. The random points were then buffered by 25.3 m, resulting in a circle 0.5 acres in area. The 50 m minimum distance constraint ensured that the buffered areas of nearby points did not overlap. Each point and the associated buffer were then reviewed on the 1949 imagery to confirm no change in wetland or upland class had occurred between the two time periods. Only that portion of the buffer that occurred within the 2007 map polygon was considered. In cases where a change occurred, the 2007 imagery was reviewed to ensure that the differences recorded were not due to generalizations in the 2007 map polygon.

Two map classes, PFO1 and PML1 were of limited frequency and area. For these classes, instead of creating sample points, we reviewed all polygons for changes between 1949 and 2007 (n = 27 for each).

TASK 3

Several wetland classes provide high-value habitat for waterbirds and wetland-dependent birds. These include sloughs (R2UB), ponds (PUB), emergent marshes and wet meadows (PEM1), and wetland complexes comprising a combination of shrubs and emergent vegetation (PSS/EM1). We assessed changes in the status of these classes between 1949 and 2007 as a result of disturbance or natural successional processes. We also delineated portions of the Tanana River (R2UB) that were significantly altered between 1949 and 2007 and assessed the changes in status of ditches (R2UBx) and artificial lakes (L1UBx) and ponds (PUBx) since 1949, as these changes also influence habitat use by waterbirds and wetland-dependent birds.

RESULTS

TASK 1

The most notable changes in the wetland status between 1949 and 2007 were a 60.4% decrease in acreage of broadleaf deciduous shrub (PSS1) and a 45.6% decrease in needleleaf evergreen scrub (PSS4) (Table 1). The area of developed upland areas (Ud) increased by 77.8%; this was the main cause of wetland-to-upland conversion over the 48-year period (Table 2). The total loss in acreage of wetlands (16,473 acres) was only 3% higher than for uplands (16,361 acres), but represents a decline of 26.6% compared to 18.9% for uplands. The only notable increases in wetland habitats were for constructed lakes (L1UBx) and ponds (PUBx) and emergent/shrub complexes (PSS/EM1) (see Task 3).

In addition, the Moose Creek Dam and Tanana River levee (part of the Chena River Flood Control Project) have influenced wetlands and waters near the Tanana River by causing some channels of the river to shift southward and reducing the recharge of sloughs in the Fairbanks area. In addition, some sloughs associated with the Tanana River have been converted to developed upland, while other channels have been constricted and/or fragmented. The overall reduction of riverine habitat due to development and conversion to uplands is 2,546.7 acres (Table 2). The channelization or conversion of riverine habitats to wetlands or waterbodies (ponds and lakes) was more modest (250.5 acres).

One disturbed wetland class (PUSx) identified in 1949 was absent in 2007 (Table 1). This class was associated with bladed or excavated areas that showed surface drainage features in 1949 (206.9 acres). By 2007, these areas had become impoundments, disturbed emergent wetlands, or developed areas.

TASK 2

The extent of change in the sampled wetland and upland habitats between 1949 and 2007, due to natural processes or indirect impacts of development impacts, was relatively modest (Table 3). We detected the greatest frequency of change for class PFO4 (14%); at 15 of the 23 sample points where change was detected, the class in 1949 was PSS4. Among the remaining polygons sampled comprising the other classes, between 4% and 10% of the sampled points changed class between 1949 and 2007. The classes present at these points in 1949 included a

Table 1. Changes in acreage of wetland and upland classes between 1949 and 2007, Fairbanks, Alaska. Bolded numbers highlight the most notable habitat changes. Polygons not classified in 1949 because of missing or obscured imagery were omitted from both years.

	Year (acres)		Change	
NWI Class	1949	2007	Acres	%
R2UB	9,152.3	7,604.5	-1,547.8	**-20.4**
R2UBx	124.4	120.6	-3.8	-3.1
L1UB	25.1	25.1	0.0	0.0
L1UBx		1,108.5	1,108.5	
PUB	369.4	511.4	141.9	**-27.8**
PUBx	187.8	1,011.8	824.0	**+81.4**
PUSx	206.9			
PML1	1.0	8.6	7.6	+88.4
PEM1	3570.5	2,695.9	-874.6	**-32.4**
PEM1x	52.8	136.8	84.0	+61.4
PSS/EM1[a]	2,529.4	4,925.2	2,395.8	**+48.6**
PSS1	35,148.0	21,914.9	-13,233.1	**-60.4**
PSS3	1,728.0	1,723.4	-4.6	-0.3
PSS4	13,387.2	9,193.4	-4,193.9	**-45.6**
PFO1	264.5	188.3	-76.2	-40.5
PFO4	11,647.4	10,753.5	-8,94.0	-8.3
U	103,132.0	86,771.0	-16,361.0	-18.9
Ud	9,344.9	42,179.0	32,834.0	**+77.8**
Total Wetlands	78,394.9	61,921.9	-16,473.0	**-26.6**
Total Uplands/ Disturbed Uplands	112,476.9	128,949.9	16,473.0	12.8
Total	190,871.8	190,871.8		

[a] This complex class was included as part of the Task 3 analysis.

broader range of habitats (for each 2007 class) (Table 3). For the two habitats (PFO1 and PML1) where change was classified and mapped for all polygons, the predominant changes detected were: 1) 40.4 acres (21%) of PFO1 habitat had been PSS1 in 1949 and 2) 5 acres (58%) of PML1 habitats were PSS1 in 1949 (Table 2). Note, however, that both of these habitats represent < 0.5% of the total wetland habitats present (in both years). We attribute most of the changes detected to successional processes associated with paludification (peat accumulation and rising water table). In some cases, successional changes were due to plant communities maturing in terms of structure (e.g., changing from shrub- to forest-dominated communities).

Table 2. Changes in wetland status, for individual wetland classes, between 1949 and 2007, Fairbanks, AK. Outlined values represent numbers of acres unchanged between 1949 and 2007; bolded numbers indicate the most notable habitat conversions. Polygons not classified in 1949 because of missing or obscured imagery were omitted from both years.

	1949 NWI Class																
2007 NWI[a] Class	R2UB	R2UBx	L1UB	PUB	PUBx	PUSx	PML1	PEM1	PEM1x	PSS/EM1	PSS1	PSS3	PSS4	PFO1	PFO4	U	Ud
R2UB	6,203.7			1.8				9.6			98.1		3.5			1,284.9	2.8
R2UBx	17.7	70.3						1.0			3.3		0.4			26.0	1.9
L1UB			25.1														
L1UBx	68.7	4.3		0.7	22.6			59.1			467.9		106.2			218.8	160.4
PUB	140.4			240.8				57.5			38.1				1.8	29.4	1.3
PUBx	23.7	3.7		4.7	40.8	1.2		56.1			307.0	0.3	84.2	6.0	10.0	328.3	145.9
PML1							1.0	1.7			5.0		0.5		0.4		
PEM1	74.6	0.0		69.6				2,236.8		29.7	207.6		16.3	0.8	13.5	45.2	1.9
PEM1x	7.4			0.6	1.5	1.6			14.3		99.5				0.1	3.3	8.6
PSS/EM1	38.9			4.3				82.1		2,499.8	2,286.7			5.1	6.1	1.3	0.8
PSS1	28.7			9.4				168.0			21,702.2						6.6
PSS3												1723.4					
PSS4								1.4			42.9		9,149.0				
PFO1											40.4		2.8	145.1			
PFO4	1.9			0.4				0.2							10,750.9		
U	**1,523.2**	13.1		13.0	1.4			79.3			3.1					84,777.8	360.2
Ud	**1,023.5**	33.0		23.9	121.6	204.2		817.6	38.5		**9,846.2**	4.3	**4,021.9**	107.5	864.6	**16,416.9**	8,655.0

[a] NWI = National Wetland Inventory.

TASK 3

The most notable change in the status of high-value habitats between 1949 and 2007 was a 32.4% decrease (874.6 acres) (Table 1) in the extent of emergent marshes and wet meadows (PEM1). The extent of sloughs, rivers, and streams (R2UB) was reduced by 20.4%, primarily due to narrowing, or in some areas complete loss, of these habitats as a result of development. The acreage of ditches and other confined perennial channels (R2UBx) was similar in 1949 (124.4 acres) and 2007 (120.6 acres). Many of these habitats are associated with mining operations or industrial areas that were active in 1949.

The only increases in high-value waterbird habitats detected between 1949 and 2007 were for natural ponds (PUB) and emergent/shrub complexes (PSS/EM1) (Table 1). Coverage by natural ponds increased by 27.8% (141.9 acres) and the areal extent of emergent/shrub complexes (PSS/EM1) increased by 48.6%. More than 1,100 acres of impounded lakes (L1UBx) (none were present in 1949) and the number of created ponds (PUBx) increased by 824 acres (81.4%). Most of these waterbodies are associated with gravel pits, float plane ponds, and placer mining operations. Although impoundments associated with gravel pits and other disturbed uplands provide some habitat for waterbirds, their overall productivity is considerably lower than for natural waterbodies. In a study conducted on the bird use of habitats in the Badger Road Watershed (Martin et al. 1995), the lack of a shallow littoral zone and emergent vegetation appeared to be the main factors limiting the use of gravel pits by waterbirds. A sizeable area of scrub shrub lowlands (PSS1) also was converted to lakes (467.9 acres) and ponds (307 acres) between 1949 and 2007 (Table 2), but assessing the extent to which emergent vegetation was associated with these ponds was beyond the scope of this study. We suspect, however, that bird use of these ponds would be higher than that found for ponds constructed in gravel pits.

The remaining types of habitat conversions that occurred between 1949 and 2007 are presented in Table 2. As previously noted, most losses of aquatic habitat were caused by development. Sloughs were either eliminated or fragmented, resulting in the creation of impoundments. This is at least partially reflected in the increase of impoundments and channelized emergent habitats (PEM1x) delineated in 2007, which increased by 61.4% between the two time periods. The placement of fill was the most important contributor to the loss of

emergent habitats, although some of these habitats also were converted to ponds and impoundments.

Changes to high-value waterbird and wetland-dependent habitats as a result of succession or other natural processes were somewhat variable (Table 2). Ponds and emergent and wet meadow habitats that were not impacted by development remained relatively stable over the past 48 years, whereas some broadleaf deciduous shrub habitats (PSS1) became wetter and developed PSS/EM1 complexes. More than 2,280 acres of wetland classified as PSS1 in 1949 were classified as PSS/EM1 in 2007. In contrast, only 69.6 acres of ponds developed into emergent habitats and 57.5 acres of emergent habitats were converted to ponds between 1949 and 2007.

Table 3. Distribution of sample points (n = 790) and percent change in wetland class between 1949 and 2007. See Figure 1 for map of the sample distribution within each class.

2007 NWI Class	1949 NWI Class *n*	PEM1	PSS1	PSS3	PSS4	PFO4	U	% Change
PSS1	178	2	164		7	3	2	8
PSS3	40		1	36	3			10
PSS4	157		6		146	4	1	7
PFO4	159		4		15	136	4	14
U	256		6		1	2	247	4

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