National Wetland Inventory (NWI) Mapping of the Cache la Poudre and South Platte Rivers

March 23, 2011

Colorado Natural Heritage Program
Colorado State University
Fort Collins, CO 80523-1474

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Prepared for:

Save the Poudre: Poudre Waterkeeper
PO Box 20
Fort Collins, CO 80522

Prepared by:

Erick Carlson and Joanna Lemly
Colorado Natural Heritage Program
Warner College of Natural Resources
Colorado State University
Fort Collins, Colorado 80523-1474

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Cover photographs:

All photos taken by Colorado Natural Heritage Program Staff.

EXECUTIVE SUMMARY

Wetlands within portions of the Cache la Poudre River and South Platte River watersheds were mapped in accordance with the National Wetlands Inventory (NWI) mapping standards. Spatial data were produced from current (2009) color infra-red imagery for 17 USGS quadrangles identified by Save the Poudre: Poudre Waterkeeper. In addition to creating new wetland maps, older NWI data were converted from hardcopy paper maps to digital polygonal data. This was completed using an image recognition software and ortho-rectified scans of the original maps to produce spatial polygons that were attributed with NWI codes from the original map.

Information on the location and acreage of wetlands has been summarized in a variety of ways to illuminate patterns of wetland type and extent across the landscape. In total, 56,397 acres of wetlands and waterbodies were mapped in the study area. Of these, 19,764 acres (35.0%) are wetland features; 13,670 acres (24.2%) are riparian areas too dry to be considered wetlands; and 2,963 acres (40.7%) are waterbodies including lakes, rivers, streams, and canals. Significant portions of the mapped ponds, lakes, and intermittently flowing canals were considered artificial or modified features. Artificial lakes represent a major portion of the mapped features in the Cache la Poudre River watershed, while riparian forest and natural wetlands are more prevalent in the South Platte River corridor.

ACKNOWLEDGEMENTS

The authors would like to thank Save the Poudre: Poudre Waterkeeper for the opportunity to create a detailed dataset of wetlands and waterbodies within the Cache la Poudre and South Platte River watersheds. These are our home rivers and it has been a privilege to contribute quantitative information on their aquatic resources. We hope these data are useful for years to come and for a variety of purposes. We especially thank Mark Easter, Chair of the Board and our main contact from Save the Poudre, who initiated the project, identified quadrangles of interest, and provided helpful feedback along the way. Mark was also responsible for arranging the low-elevation flyover of the study area, which proved incredibly helpful for difficult areas to map. The flyover itself was provided by the LightHawk organization, which connects willing pilots with worthy causes. From LightHawk, we want to thank Laura Stone, who coordinated the flight; our intrepid and steady handed pilot, David Kunkel; and Save the Poudre Board Member Greg Speer. Both David and Greg were great company on an eventful journey above the cottonwood gallery forests of the South Platte River. We are also indebted to our great colleagues at the Colorado Natural Heritage Program, whose feedback and ideas continue to refine our work. In particular, Denise Culver provided helpful feedback on an early draft of the report and Joe Stevens provided continued support for wetland mapping efforts. Lastly, we would like to thank Zack Reams, former Wetland Mapping Specialist at the Colorado Natural Heritage Program, who was instrumental in launching our wetland mapping program.

1.0 INTRODUCTION

The Cache la Poudre River begins in the mountains west and north of Fort Collins, Colorado, along the northern Front Range. At its confluence with the South Platte River, the Cache la Poudre has drained a 2,019 mi^2 catchment in northern Colorado. It falls several thousand feet over its course and yields an annual native flow of approximately 280,000 acre feet, with winter flows averaging 20–30 cubic feet per second (cfs) and early-summer flows averaging over 2,000 cfs where it leaves the mountains and foothills near Fort Collins (City of Fort Collins 2001). The study area for this project focuses on the Cache la Poudre River near and downstream of the mountain front as well as portions of the South Platte River mainstem. In the study area, the Cache la Poudre River historically formed a wide floodplain with an extensive gallery forest dominated by plains and narrowleaf cottonwood *(Populus deltoides* and *P. angustifolia)*, sandbar willow *(Salix exigua)*, and various understory herbaceous species (Wohl 2001). Aggregate mining within the floodplain, conversion of wetlands to agricultural and residential uses, the growth of urban centers, and creation of water storage reservoirs have changed the structural composition of the landscape as the river exits the mountains and numerous water diversions have reduced its flows (Wohl 2001).

Major shifts in channel and floodplain morphology, vegetation communities and wetland extent naturally occurs as the river spills out onto the flatter, more erosive plains landscape (Church 2002). Additional modification by humans makes this riparian system's wetlands especially complex to interpret and map. The Cache la Poudre River meets the South Platte River just east of Greeley, Colorado, and it adds a significant amount of water and sediment to the South Platte system. Nearly 30% of the study area is below this confluence and the floodplain along the South Platte River shows significantly less direct manipulation than the within the Cache la Poudre River corridor.

1.1 Project Objectives

At the request of Save the Poudre: Poudre Waterkeeper (STP), the Colorado Natural Heritage Program (CNHP) completed wetland mapping following federal standards within selected portions of the Cache la Poudre River and South Platte River watersheds (Figure 1). The project included two specific objectives:

1) **Digitize original National Wetland Inventory maps for areas lacking digital wetland data.** Photo-interpretation of the entire study area was completed by the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) program in the late 1970s following a standardized classification and mapping methodology (Cowardin *et al.* 1979). However, these original maps were made on transparent Mylar sheets for transfer to paper and were not available in a digital, geo-rectified format. Using a process developed at CNHP, digital scans of the original NWI maps were converted into geo-rectified polygonal data.

2) **Update mapping with new photo-interpretation to produce the most accurate and current estimate of wetland acreage possible.** In addition to the original mapping, CNHP

produced all new wetland maps for the study area based on 2009 imagery. New mapping followed the Federal Geographic Data Committee standards for wetland mapping (FGDC 2009) and the most recent version of NWI's Cowardin classification. These maps were periodically reviewed by the NWI Regional Coordinator to ensure CNHP staff members were thoroughly trained in the NWI protocols for photo-interpretation. Along with the standard Cowardin classification system (Cowardin *et al.* 1979), new polygons were also attributed with a modified version of the Hydrogeomorphic (HGM) classification (Brinson 1993, Tiner 2003) to further explain the wetland data. Riparian areas not typically included in NWI mapping were also delineated following USFWS guidance (USFWS 2009). Upon completion of this project, new wetland mapping will be added into the national wetland mapping database as an update to the study area.

1.2 Project Boundary

Seventeen topographic quadrangles were selected for mapping by STP (Figure 1). Twelve quadrangles contain or border the Cache la Poudre River from Seaman Reservoir to downstream of the confluence with the South Platte River and form a contiguous group. Of these, seven had been previously mapped by CNHP through a separate project. Funding constraints did not allow a full mapping of the South Platte River floodplain; however, five additional quadrangles along the South Platte River below the confluence of the Cache la Poudre River were selected for mapping. The selected quadrangles represent approximately 40% of the South Platte River system between the confluence and the eastern state boundary and extend as far east as Sterling, Colorado. The quadrangles were selected because they appeared to contain the largest proportion of wetlands and riparian habitats.

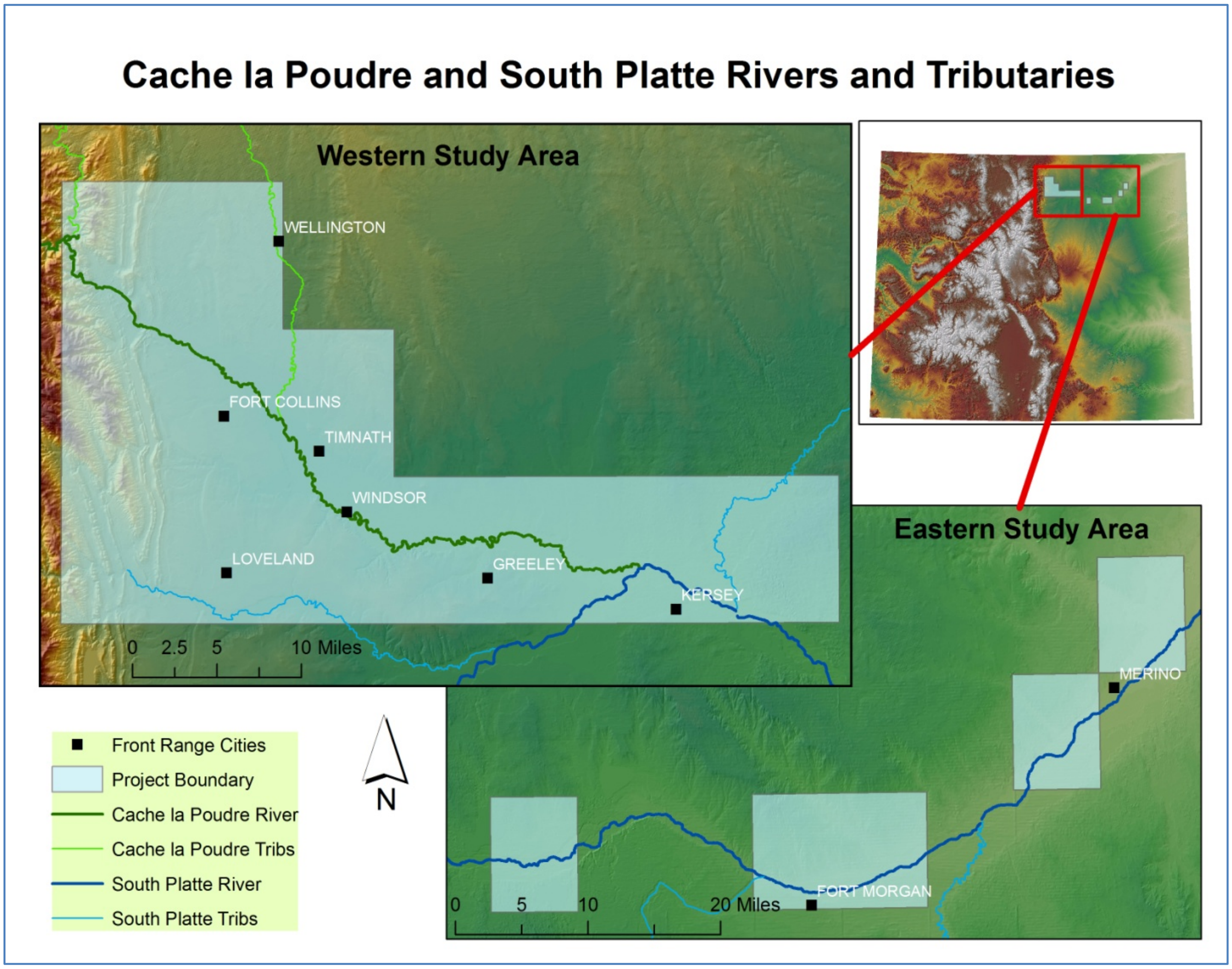

Figure 1. Topographic quadrangles selected for mapping within the Cache la Poudre and South Platte River watersheds.

2.0 METHODS

2.1 Wetland Definition

There are several definitions of wetland used by state and federal agencies. For the purpose of this project, CNHP followed the USFWS definition found within the Cowardin classification system (Cowardin *et al.* 1979):

> *"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."*

In addition to vegetated wetlands, NWI mapping also includes deep water habitats and waterbodies. Within the study area, the waterbodies include lakes > 20 acres and all rivers, including the actual river channel and unvegetated sandbars.

2.2 Data Sources and Mapping Methodology

Scanned Wetland Maps

Working with our partners in the USFWS NWI program, CNHP obtained scanned image files of the original 1977 photo-interpretation for quadrangles lacking digital data in the project area. The images were ortho-rectified and converted to digital polygonal data using Trimble eCognition Developer 8.0, an image recognition software. The specific process of selecting only wetland polygons from the scanned images and excluding other features, such as the hand drawn attribute labels and other reference lines, has been developed by CNHP employees over the past two years and is a highly efficient means of converting original NWI data into a digital format. Once polygons were extracted, any remaining jagged lines were smoothed and adjoining features were merged. Each polygon was attributed and all polygons were checked for invalid codes and minimum size requirements. In some limited cases, where distortion of the scanned image had clearly shifted the original polygons from their intended spatial location, polygons were moved to reflect the true location of wetlands. However, the purpose of converting the original NWI data was not to update or correct the photo-interpretation, but to efficiently convert a large amount of hardcopy data to a digital format.

2009 NAIP Imagery and Ancillary Data

To create new up-to-date wetland mapping, CNHP obtained color infra-red (CIR) and true color air photography flown in 2009 by the National Agricultural Imagery Program (NAIP). A combination of ancillary data sources were used to identify and classify wetland features in the study area. In addition to the 2009 NAIP CIR and true color images, 2005 true color images, topographic maps, political maps, Colorado Division of Wildlife riparian polygons (generated in early 2000's) and original NWI polygons were used to map wetlands accurately and completely. New wetland mapping was conducted on screen in ESRI ArcGIS 9.3 at a scale of 1:4500. New mapping followed the Federal Geographic Data Committee standards for wetland mapping (FGDC 2009).

2.3 Wetland Polygon Classification and Coding

National Wetland Inventory (NWI) Classification

The primary wetland classification codes used for both the original and new wetland mapping are from NWI's Cowardin classification system (Cowardin *et al.* 1979). This hierarchical treatment of wetlands describes wetlands at varying scales of specificity. For the scope of this project and the resolution of data, wetland features have been coded using the first three levels of the hierarchy: System, Subsystem and Class. In addition to these levels, additional information about a site's hydrology and the influence of human modifications was identified. The result is a 4-6 character alphanumeric code. Components of the code are described below.

SYSTEM and ***SUBSYSTEM***: The System and Subsystem together divide mapped features into a handful of aquatic resource types. System represents the first character in the code. Systems present in the study area include: Riverine (R: rivers and streams), Lacustrine (L: lakes), and Palustrine (P: vegetated wetlands, e.g., marshes, swamps, bogs, etc., even if associated with rivers or lakes). These are followed (when appropriate) by Subsystem. In the study area only the Riverine and Lacustrine systems require Subsystem division. The Riverine Subsystems present in the study area are: Lower Perennial (2: low gradient, slow moving channels), Upper Perennial (3: steep, fast moving channels), and Intermittent (4: channels that do not flow year round, including manmade ditches). The Lacustrine Subsystems present in the study area are: Limnetic (1: lake water > 2 m deep) and Littoral (2: lake water < 2 m deep).

CLASS: The third portion of the code is the Class, which identifies the dominate substrate or vegetation structure present. Class types present in the study area include: Aquatic Bed (AB: aquatic rooted or floating vegetation), Emergent (EM: herbaceous, non-woody vegetation), Scrub-shrub (SS: low woody vegetation), Forested (FO: trees), Unconsolidated Bottom (UB: unvegetated surfaces with small particle sizes not associated with river and lake edges), Unconsolidated Shore (US: unvegetated surfaces with variable small particle sized associated with river and lake edges), and Stream Bed (SB: variable substrate sizes within stream channels).

HYDROLOGIC REGIME: Additional information included about the Hydrologic Regime and Special Modifiers further describe polygons. Hydrologic Regimes describe the duration and timing of flooding. For this project, seven Hydrologic Regimes were identified, including: A (temporarily flooded), B (saturated), C (seasonally flooded), F (semi-permanently flooded), G (intermittently exposed), H (permanently flooded), and K (artificially flooded). Duration increases from A-H, though B sites are rarely flooded, but have water at or very near the surface consistently.

SPECIAL MODIFIER: Three Special Modifier codes were used in the study area. The Modifiers present information about artificially and naturally modified wetlands. No natural modifications (beaver dams) were mapped in the study area, thus all wetlands with a Modifier code are considered to be modified by humans. The codes mapped in the study include: f (farmed), h (diked/impounded) and x (excavated).

USFWS Riparian Area Mapping

In the years since the original Cowardin classification was introduced in the late 1970s, USFWS realized the need to map riparian areas that may not meet the criteria used for wetland mapping. This need is particularly great in the western U.S. where numerous wildlife species depend on riparian habitats in an otherwise arid landscape. To identify, map, and classify riparian areas across a broad spectrum, USFWS issued guidance in a document titled *A System for Mapping Riparian Areas in the Western United States* (USFWS 2009).

This system is fully integrated into the Cowardin classification scheme and also includes System, Subsystem and Class. The System is a single unit category of Rp (riparian vegetation). Subsystem defines the water source: 1 (lotic or flowing water associated with rivers) and 2 (lentic or standing water associated with lakes). Class denotes the dominant life form of riparian vegetation: FO (forested), SS (scrub-shrub), and EM (herbaceous). No water regime or modifiers are applied.

Modified Hydrogeomorphic (HGM) Wetland Classification

Compared to structural vegetation classes of the Cowardin classification, the Hydrogeomorphic (HGM) classification (Brinson 1993) places greater emphasis on wetland function stemming from geomorphic setting and hydrology. Tiner (2003) developed a modified version of HGM as a means to expand the coding within NWI wetland mapping. The methodology is not a “one -to-one” conversion but rather groups and splits Cowardin codes based on wetland settings and functions. This process was completed for the updated NWI dataset to further inform the wetland data.

Though the Cowardin and HGM wetland classification schemes cannot be compared one-to-one, much of the spatial information critical to HGM coding is readily available through GIS. To gather the spatial information about geomorphic setting, water sources, and hydrodynamics which are integral to the HGM (Brinson 1993), Tiner’s methodology emphasizes Landscape position, Landform, Water flow path, and Waterbody type (LLWW: Tiner 2003). This approach adds geomorphically relevant information to the NWI mapping without the detail required for a complete HGM coding. The LLWW uses strictly spatial data (position, slope, size) to code wetlands, while the HGM requires other information about water chemistry, substrate and groundwater movement.

The LLWW shares some terminology with the original HGM classification and introduces new classes and modifiers. For example, HGM depressional wetlands are equivalent to LLWW basin wetlands. To avoid confusion, the LLWW classification stays away from HGM terminology that is already used in the Cowardin classification. For instance, within Brinson’s HGM, wetlands associated with lakes are called Lacustrine wetlands. However, in the Cowardin classification, Lacustrine features are the actual lakes themselves and not vegetated wetlands on the margins of lakes. In the LLWW, Tiner opts for the word Lentic to describe wetland features associated with lakes.

In order to bridge the gap between NWI and HGM, the Montana Natural Heritage Program developed a process to crosswalk Cowardin coded wetlands to LLWW (Burns and Newlon 2009). This process was modified by CNHP and extensively documented in Appendix A. The semi-automated queries create and utilize spatial data (slope, position, adjacency, etc.) to identify characteristics integral to Tiner's LLWW method (Tiner 2003). The components of the LLWW method are described below.

WATERBODY TYPE: The first split in the LLWW classification divides actual waterbodies from wetland features. Because NWI mapping includes waterbodies as well as wetlands, this is easily done by querying the Cowardin System and Subsystem. The three actual waterbody types are Deep Water (DW: lakes), River (RV: larger channels), and Streams (ST: smaller channels).

LANDSCAPE POSITION: Once waterbodies have been filtered out, the remaining wetland features are assigned a landscape position based on their location in or along a waterbody, in a drainageway, or in isolation (i.e., surrounded by upland). The landscape positions within the study area are Lentic (LE: wetlands associated with lakes, in HGM terminology this is called Lacustrine); Lotic River (LR: wetlands associated with larger rivers, in HGM terminology this is called Riverine); Lotic Streams (LS: wetlands associated with smaller streams, in HGM terminology this is called Riverine); and Terrene (TE: wetlands not associated with either a lake, river, or stream, in HGM terminology this could have various names).

DESCRIPTORS FOR WATERBODIES AND ASSOCIATED WETLANDS: All three waterbodies and the wetlands associated with them are attributed with an additional code that further describes the waterbodies. For lakes (DW) and lentic wetlands (LE), the modifiers include: natural lake (1), damned lake (3), and excavated lake (4). For rivers (RV), streams (ST), and lotic wetlands (LR and LS), the modifiers include: low gradient < 2% slope (1), middle gradient 2-4% slope (2), high gradient >4% slope (3), and intermittent (4). Terrene wetlands do not receive a modifier because they are not associated with a waterbody.

LANDFORM: For all wetland features, the next step in the classification is the landform. Waterbodies (DW, RV, ST) do not receive a landform code. Landforms are specific to wetland landscape position, meaning not every landform can occur with every landscape position. The following landforms are used in the study area: Island (IL: wetlands located on islands completely surrounded by water in lakes, rivers, or streams), Fringe (FR: very wet wetlands on the margins of lakes, river, or streams), Floodplain (FP: drier wetlands located within the floodplain of rivers and streams), Basin (BA: depressional landforms), and Slope (SL: sloping wetlands not associated with a waterbody).

WATER FLOWPATH: The final main component of the LLWW system is water flowpath. All rivers (RV), streams (ST), and lotic wetlands (LR and LS) are assigned a throughflow (TH) flowpath. Lakes are individually assigned inflow (IN), outflow (OU), throughflow (TH) or isolated (IS) depending on position. Lentic wetlands immediately on lakeshores receive a bidirectional (BI) flowpath to denote the rise and fall of water on the lake shore. All other lentic wetlands are assigned throughflow (TH). Terrene wetlands are assigned either isolated (IS) if they occur more than 20 m from another wetland, or as a complex (CO) if several wetlands occur together.

POND MODIFIER: Ponds can occur in a variety of settings, including in isolated depressions or within backwater channels on river floodplains. Ponds are coded separately within the Cowardin classification and are therefore easy to pull out within the LLWW. Any wetland coded as a pond in the Cowardin system (PUB/PAB) receives a separate pond modifier code (p).

ADDITIONAL MODIFIERS: The LLWW also takes advantage of all the modifier codes within Cowardin system, such as b (beaver), d (partially ditched/drained), f (farmed), h (diked/impounded) and x (excavated).

2.4 Scale of Wetland Mapping

The original NWI mapping was completed using black and white aerial imagery flown in the mid-late 1970s. The scale of the original mapping is between 1:58,000 and 1:80,000 for Colorado and the western States (Tuggle and Cooper, 2004). The updated mapping effort used higher resolution images and was able to improve the scale of the mapping to 1:4,500. This changed the minimum area of a wetland feature from 1–3 acres to 0.1 acres.

2.5 Quality Assurance and Control

On the Ground

CNHP photo-interpreters took periodic trips to the study area to ground-truth the image interpretation. This familiarized the interpreters with photo signatures of specific wetland complexes. GPS points and geo-tagged images were utilized to document the location of specific wetland types to then be reference on the wetland map being created. Public land was accessed by foot and private land was viewed from roadside vantage points.

Low Elevation Flyover

A low altitude, low speed flight was taken by CNHP photo-interpreters to examine inaccessible lands and cover a large area. This was made possible through the LightHawk organization, by the arrangement of STP. The flight took off from the Fort Collins/Loveland Municipal Airport and traveled along the Cache la Poudre River corridor east to the confluence with the South Platte river and continued East past Brush, Colorado. The flight path returned on the north side of the rivers to examine large roadless and private areas. The flight provided a new perspective both physically and seasonally, as it took place in early December while the images viewed were taken between May and September. Viewing wetland features in the study area from the air during the leaf-off season when light angles were low provided an invaluable perspective on understory growth and hydrology.

Final Automated Check

To ensure accuracy in coding, a final automated procedure checked the data layer for invalid wetland codes, size limitations and topological errors. Each error flagged was identified and carefully examined using multiple data layers and on-the-ground and in-the-air field truthing to reconcile errors.

3.0 RESULTS AND DISCUSSION

3.1 Mapped Wetland Acreage in the Cache la Poudre and South Platte Rivers

Based on photo-interpretation of 2009 aerial imagery, wetlands, riparian areas and waterbodies mapped within the study area total 56,397 acres. Of these, 19,764 acres (35.0%) are wetland features; 13,670 acres (24.2%) are riparian areas too dry to be considered wetlands; and 2,963 acres (40.7%) are waterbodies, including lakes, rivers, streams, and canals (Figure 2; Table 1). The Cowardin classification includes certain types of modification to wetlands and waterbodies. Within the study area, the most common modifications were diked/impounded (h) and excavated (x). These modifiers were documented extensively on ponds, lakes, and intermittently flowing canals, accounting for 80.3%, 99.5%, and 99.8%, respectively, of the area mapped within those groups (Table 1). Though there are numerous diversion structures and run-of-the-river dams on both the Cache la Poudre and South Platte Rivers, these types of partial impoundments are not mapped as impoundments in the Cowardin methodology. The major river features, therefore, are not mapped as modified, though it is known that hydrologic modifications do exist.

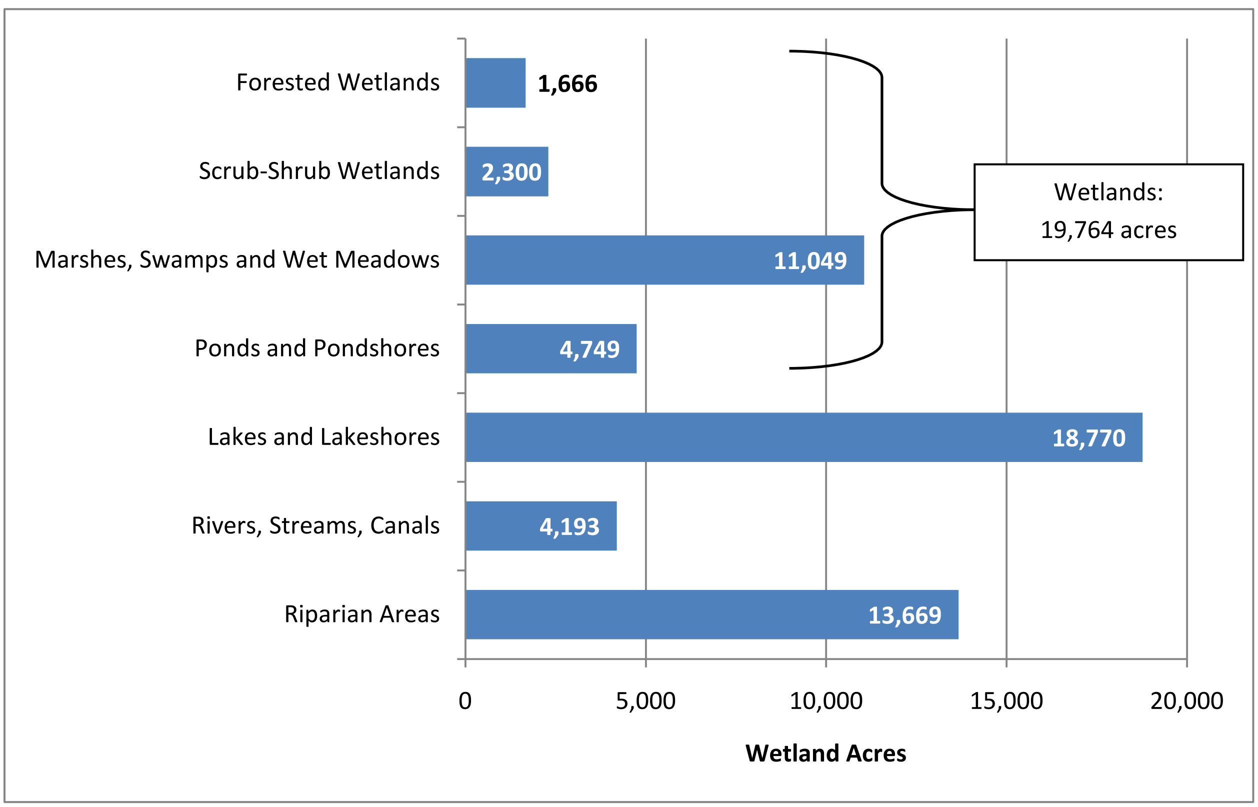

Figure 2: Mapped wetland acreage in the study area by major NWI group.

Table 1: Mapped wetlands in the entire study area by major NWI code group and percent modified.

NWI Group	*Count*	*Mean Acres*	*Sum Acres*	*Acres Modified*	*Acres Natural*	*% Modified*
Forested Wetlands	524	3.2	1,666	8	1,658	.5
Scrub-Shrub Wetlands	1,680	1.4	2,300	24	2,276	1.0
Marshes, Swamps and Wet Meadows	6,139	1.8	11,049	1,420	9,629	12.9
Ponds and Pondshores	3,025	1.6	4,749	3,813	936	80.3
Lakes and Lakeshores	228	82.3	18,770	18,684	86	99.5
Intermittently Flowing Canals and Channels	318	7.7	1,639	1,635	4	99.8
Rivers/Riverbanks and Stream/Streambanks and Bars	659	5.3	2,555	0	2,555	0
Riparian Areas	4,499	3.9	13,669	34	13,635	.2
TOTAL	**15,827**		**56,397**	**25,617**	**30,779**	**45.4**

In addition to the overall summary, several methods were used to summarize the wetland data within different portions of the study region. The study region is diverse in wetland types, geomorphic setting, land use dominance, human influence and surface water use. The combinations shown below (Tables 2–7) reflect the major geomorphic break between the Cache la Poudre and South Platte watersheds. Data are presented first by the two major regions of the study area (Tables 2 & 3) and second by quandrangle within each region (Tables 4–7). The summary tables attempt to capture patterns of wetland position and characterization by location and type. The most striking difference between the two major regions of the study area is the abundance of lakes and lakeshores found along the Cache la Poudre River corridor. These lakes are primarily artificially dug features from past gravel mining of the floodplain. Within the South Platte River corridor, lakes represent a much lower proportion of the mapped area, instead replaced by much more extensive riparian forests (Figure 3).

For initial interpretation of the data, an informed "grouping" wetland types has been made for both the NWI and the HGM/LLWW. For example, we have grouped all Forested wetlands together, ignoring their flooding regime or any modifiers. Each type of analysis is explained in a caption to ensure correct use. It should be noted that small discrepancies in acreage may be present in tables that dissect the study area, as some wetland features extend into one or more regions/quadrangles. Effort was made to limit overlap. The original data from which these tables are developed from are available to the project partners (CNHP and STP).

Table 2: Mapped wetlands in the western portion of the study area (Cache la Poudre River) by major NWI group and percent modified.

NWI Group	*Count*	*Mean Acres*	*Sum Acres*	*Acres Modified*	*Acres Natural*	*% Modified*
Forested Wetlands	97	3.5	341	4	337	1.2
Scrub-Shrub Wetlands	759	1.1	869	14	855	1.6
Marshes, Swamps and Wet Meadows	2,936	1.6	4,800	654	4,146	13.6
Ponds and Pondshores	1,832	1.8	3,294	3,018	276	91.6
Lakes and Lakeshores	216	70.9	15,322	15,239	83	99.5
Intermittently Flowing Canals and Channels	165	5.8	954	950	4	99.6
Rivers/Riverbanks and Stream/Streambanks and Bars	246	3.6	884	0	884	0
Riparian Areas	2,437	1.4	3,395	30	3,365	.9
TOTAL	**8,688**		**29,859**	**19,909**	**9,950**	**66.7**

Table 3: Mapped wetlands in the eastern portion of the study area (South Platte River) by major NWI group and percent modified.

NWI Group	*Count*	*Mean Acres*	*Sum Acres*	*Acres Modified*	*Acres Natural*	*% Modified*
Forested Wetlands	427	3.1	1,325	4	1,321	.3
Scrub-Shrub Wetlands	921	1.6	1,431	10	1,421	.7
Marshes, Swamps and Wet Meadows	3,203	2.0	6,249	766	5,483	12.3
Ponds and Pondshores	1,193	1.2	1,455	795	660	54.6
Lakes and Lakeshores	12	287.4	3,448	3445	3	99.9
Intermittently Flowing Canals and Channels	153	14.3	685	685	0	100
Rivers/Riverbanks and Stream/Streambanks and Bars	413	7.1	1,671	0	1,671	0
Riparian Areas	2,062	9.3	10,274	4	10,270	.03
TOTAL	**7,139**		**26,539**	**5,709**	**20,829**	**21.5**

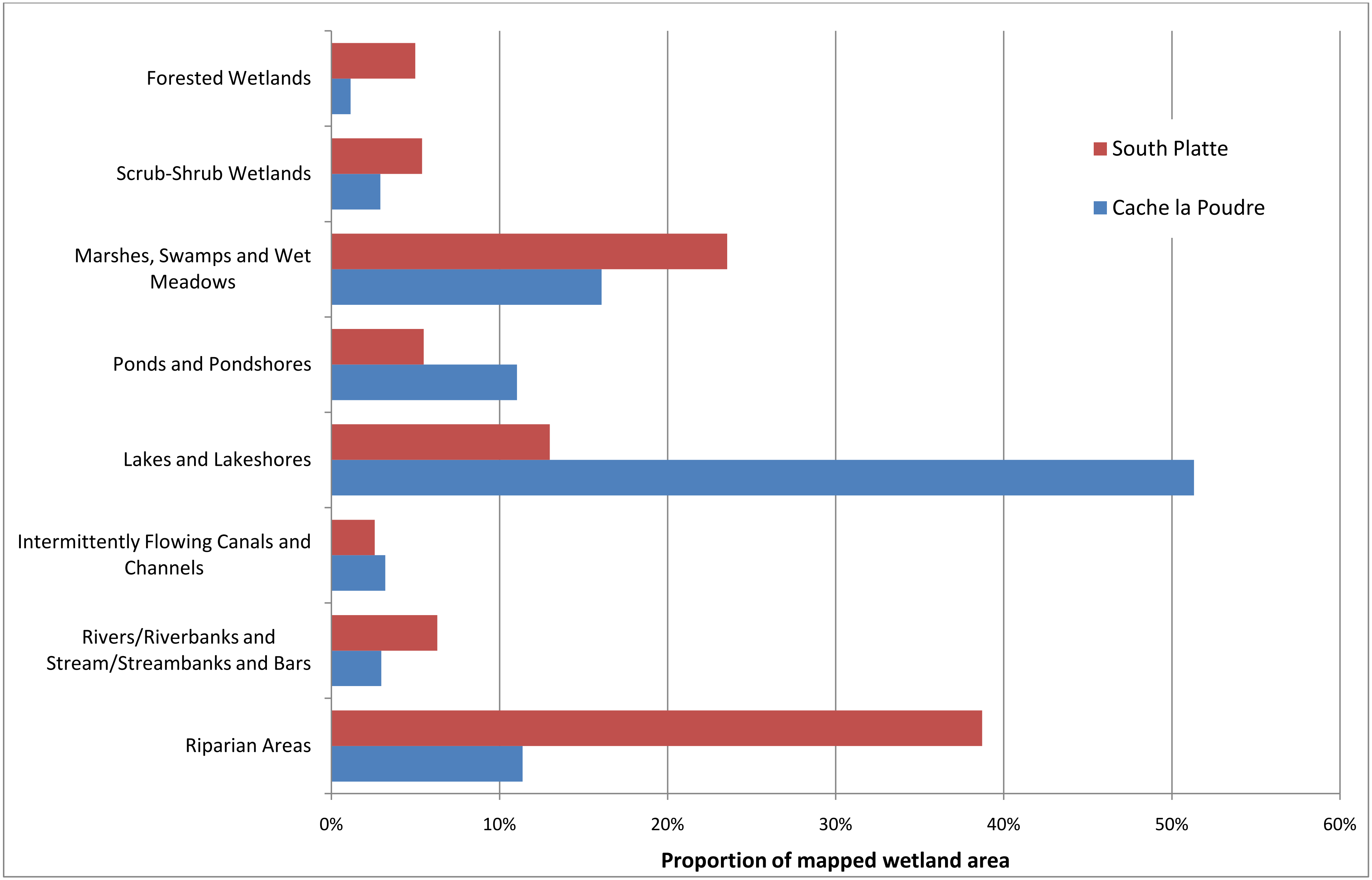

Figure 3: Proportion of mapped wetland area within major NWI groups shown separately for the Cache la Poudre and South Platte River regions of the study area. Red bars represent the South Platte River corridor; blue bars represent the Cache la Poudre River corridor.

Table 4: Mapped wetland features by quad and by major NWI group. Quadrangles are separated by the western and eastern portions of the study area and generally arranged west to east and north to south.

	Quadrangles in the western portion of the study area (Cache la Poudre River)										*Quadrangles in the eastern portion of the study area (South Platte River)*							
NWI Group	*Laporte*	*Wellington*	*Horsetooth Reservoir*	*Fort Collins*	*Timnath*	*Masonville*	*Loveland*	*Windsor*	*Bracewell*	*Greeley*	*Kersey*	*Barnesville*	*Masters*	*Fort Morgan*	*Brush West*	*Messex*	*Atwood*	**Total Wetland Features**
Forested Wetlands	19	14	3	19	12	3	6	5	2	14	21	15	166	66	80	33	46	
Scrub-Shrub Wetlands	56	110	40	126	96	26	97	78	73	57	67	30	197	251	152	180	44	
Marshes, Swamps and Wet Meadows	187	419	95	313	397	125	424	379	371	226	429	235	524	558	535	719	203	
Ponds and Pondshores	90	131	85	276	221	110	226	226	291	176	266	96	234	204	148	139	106	
Lakes and Lakeshores	6	39	10	15	20	19	48	21	7	31	3	2	3	0	2	2	0	
Intermittently Flowing Canals and Channels	13	8	3	4	5	39	17	17	27	32	11	5	9	110	5	8	5	
Rivers/Riverbanks Stream/Streambanks and Bars	9	0	4	8	1	4	7	67	61	85	56	14	24	203	44	64	8	
Riparian Areas	208	68	159	167	73	386	372	280	372	352	196	63	174	1,155	140	209	125	
TOTAL	**588**	**789**	**399**	**928**	**825**	**712**	**1,197**	**1,073**	**1,204**	**973**	**1,049**	**460**	**1,331**	**1,302**	**1,106**	**1,354**	**537**	**15,827**

Table 5: Mapped wetland acres by quad and by major NWI group. Quadrangles are separated by the western and eastern portions of the study area and generally arranged west to east and north to south.

	Quadrangles in the western portion of the study area (Cache la Poudre River)										*Quadrangles in the eastern portion of the study area (South Platte River)*							
NWI Group	*Laporte*	*Wellington*	*Horsetooth Reservoir*	*Fort Collins*	*Timnath*	*Masonville*	*Loveland*	*Windsor*	*Bracewell*	*Greeley*	*Kersey*	*Barnesville*	*Masters*	*Fort Morgan*	*Brush West*	*Messex*	*Atwood*	**Total Acreage**
Forested Wetlands	79	36	5	102	30	25	12	9	5	37	130	120	454	112	180	159	169	
Scrub-Shrub Wetlands	96	181	46	185	140	18	61	62	31	49	93	31	353	312	261	318	62	
Marshes, Swamps and Wet Meadows	354	789	95	520	900	94	589	564	574	322	827	792	1,498	664	757	1,430	281	
Ponds and Pondshores	115	176	80	642	444	101	628	429	351	329	228	89	395	234	180	226	103	
Lakes and Lakeshores	383	3841	1,968	798	2,145	609	3,913	860	237	568	85	89	3,053	0	219	3	0	
Intermittently Flowing Canals and Channels	126	99	9	58	152	99	65	117	101	128	97	22	188	110	48	152	69	
Rivers/Riverbanks Stream/Streambanks and Bars	159	0	14	105	51	46	42	153	120	195	389	155	294	203	214	239	175	
Riparian Areas	389	124	313	341	115	654	339	373	319	427	1,496	419	1,433	1,155	1,828	2,861	1,082	
TOTAL	**1700**	**5,246**	**2,530**	**2,750**	**3,977**	**1,646**	**5,648**	**2,567**	**1,738**	**2,054**	**3,345**	**1,717**	**7,668**	**2,792**	**3,686**	**5,388**	**1,942**	**56,397**

Table 6: Mapped wetland features by quad and by major HGM/LLWW group. Quadrangles are separated by the western and eastern portions of the study area and generally arranged west to east and north to south.

	Quadrangles in the western portion of the study area (Cache la Poudre River)										*Quadrangles in the eastern portion of the study area (South Platte River)*							
HGM/LLWW Group	*Laporte*	*Wellington*	*Horsetooth Reservoir*	*Fort Collins*	*Timnath*	*Masonville*	*Loveland*	*Windsor*	*Bracewell*	*Greeley*	*Kersey*	*Barnesville*	*Masters*	*Fort Morgan*	*Brush West*	*Messex*	*Atwood*	**Total Wetland Features**
Modified Basin	43	88	50	143	139	61	111	139	162	82	171	69	50	132	118	83	79	
Modified Slope	1	0	0	0	1	0	0	0	0	0	0	1	0	3	0	0	0	
Modified Lentic	8	100	11	16	75	20	176	28	16	70	6	1	43	0	3	0	0	
Modified Lakes	4	23	7	14	18	4	19	14	6	16	3	2	2	0	2		0	
Modified Lotic	47	30	18	133	78	42	102	94	88	78	80	30	35	68	30	89	21	
Modified Rivers and Streams	13	8	3	4	5	38	16	16	24	30	11	5	9	5	5	8	5	
Natural Basin	157	326	122	249	240	92	244	229	220	124	215	119	511	415	275	497	98	
Natural Slope	149	43	121	45	25	216	107	37	57	16	19	13	28	34	13	16	21	
Natural Lentic	2	21	1	8	14	3	36	13	14	18	4	0	23	0	1	8	0	
Natural Lake	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Natural Lotic	160	149	65	315	229	243	384	500	613	536	539	219	629	644	658	650	312	
Natural Rivers and Streams	4	0	1	1	1	2	2	3	4	3	1	1	1	1	1	3	1	
TOTAL	**588**	**789**	**399**	**928**	**825**	**712**	**1,197**	**1,073**	**1,204**	**937**	**1,049**	**460**	**1,331**	**1,302**	**1,106**	**1,354**	**537**	**15,827**

Table 7: Mapped wetland acres by quad and by major HGM/LLWW group. Quadrangles are separated by the western and eastern portions of the study area and generally arranged west to east and north to south.

	Quadrangles in the western portion of the study area (Cache la Poudre River)										*Quadrangles in the eastern portion of the study area (South Platte River)*							
HGM/LLWW Group	*Laporte*	*Wellington*	*Horsetooth Reservoir*	*Fort Collins*	*Timnath*	*Masonville*	*Loveland*	*Windsor*	*Bracewell*	*Greeley*	*Kersey*	*Barnesville*	*Masters*	*Fort Morgan*	*Brush West*	*Messex*	*Atwood*	**Total Acreage**
Modified Basin	55	93	34	245	192	52	238	229	180	117	128	68	62	130	97	108	92	
Modified Slope	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	
Modified Lentic	29	201	12	31	322	32	261	67	9	73	6	1	273	0	7	0	0	
Modified Lakes	381	3,777	1,965	790	2,131	584	3,879	853	237	543	85	89	3,039	0	219	0	0	
Modified Lotic	93	120	13	501	214	48	391	239	182	210	102	136	74	146	81	231	48	
Modified Rivers and Streams	126	99	9	58	152	99	64	116	99	127	97	22	188	110	48	152	69	
Natural Basin	290	533	156	332	470	77	211	318	266	134	314	158	706	329	360	761	133	
Natural Slope	212	70	245	65	31	363	80	51	52	12	26	34	48	38	25	10	19	
Natural Lentic	1	54	1	17	18	3	39	10	5	12	3	0	25	0	6	67	0	
Natural Lakes	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Natural Lotic	358	252	81	610	395	343	444	560	607	660	2,259	1,063	2,993	1,851	2,675	3,906	1,414	
Natural Rivers and Streams	156	0	13	100	51	46	41	125	101	164	325	146	259	188	168	154	166	
TOTAL	**1,700**	**5,246**	**2,530**	**2,750**	**3,977**	**1,646**	**5,648**	**2,567**	**1,738**	**2,054**	**3,345**	**1,718**	**7,668**	**2,792**	**3,686**	**5,388**	**1,942**	**56,397**

3.2 Discrepancies Between Old and New Mapping

During the approximately 35 years that have elapsed since the original NWI mapping was completed, significant land surface change has occurred in portions of the study region. Mapping with new infra-red imagery captured in 2009 provides the most up-to-date snapshot of wetland features for the study area of this project. While the two datasets are not directly comparable because of scale discrepancies, it is important to have some baseline data when addressing certain questions about wetlands. Tables 8 and 9 show total acreages of wetland types logically grouped. What is evident in these tables is that the number of polygon features has increased dramatically with the new mapping, while the mean size of each feature had decreased.

Table 8: Original NWI wetland mapping summarized by major NWI group.

NWI Group	*Count*	*Mean Wetland Area (ac)*	*Sum of Wetland Area (ac)*
Forested Wetlands	349	26.4	9,202
Scrub-shrub Wetlands	50	12.0	599
Marshes, Swamps and Wet Meadows	1,206	9.3	11,204
Ponds and Pond shores	765	3.2	2,462
Lakes and Lakeshores	114	157.6	17,967
Rivers/Riverbanks and Stream/Streambanks	143	16.4	2,343
Intermittently Flowing Ditches and Channels	13	6.2	81
TOTAL	**2,640**	**16.6**	**43,858**

Table 9: Updated NWI wetland mapping summarized by major NWI group. Note the addition of the Riparian group, not designated in the original NWI effort.

NWI Group	*Count*	*Mean Wetland Area (ac)*	*Sum of Wetland Area (ac)*
Forested Wetlands	524	3.2	1,665
Scrub-shrub Wetlands	1,680	1.4	2,301
Marshes, Swamps and Wet Meadows	6,139	1.8	11,049
Ponds and Pond shores	3,025	1.6	4,750
Lakes and Lakeshores	228	82.3	18,770
Rivers/Riverbanks and Stream/Streambanks	481	5.3	2,554
Intermittently Flowing Ditches and Channels	213	7.7	1,639
Riparian Areas	3,537	3.9	13,670
TOTAL	**15,827**	**3.5**	**56,397**

In general, new (2009) digitized wetland polygons are more detailed than the original wetland maps. Figure 4 shows the difference of individual polygon resolution and illustrates a major difference between the two mapping datasets in the Forest Wetlands class, as shown in Tables 8 and 9. These two mapping efforts occurred ~35 years apart, with the most notable change is the reduction in Forested Wetlands and the addition of Riparian features. A subtle shift in methodology has led to categorizing riverside vegetation as riparian instead of wetland because of the influence of flowing water and seasonality on water regime, disturbance, and biomass exchange. A large portion of the dramatic drop in Forested Wetland acreage in the new mapping could be attributed to those features now being mapped as riparian forest. Further analysis of land use change, aerial photographs, etc. would be required to accurately gauge a decrease or increase in acreage.

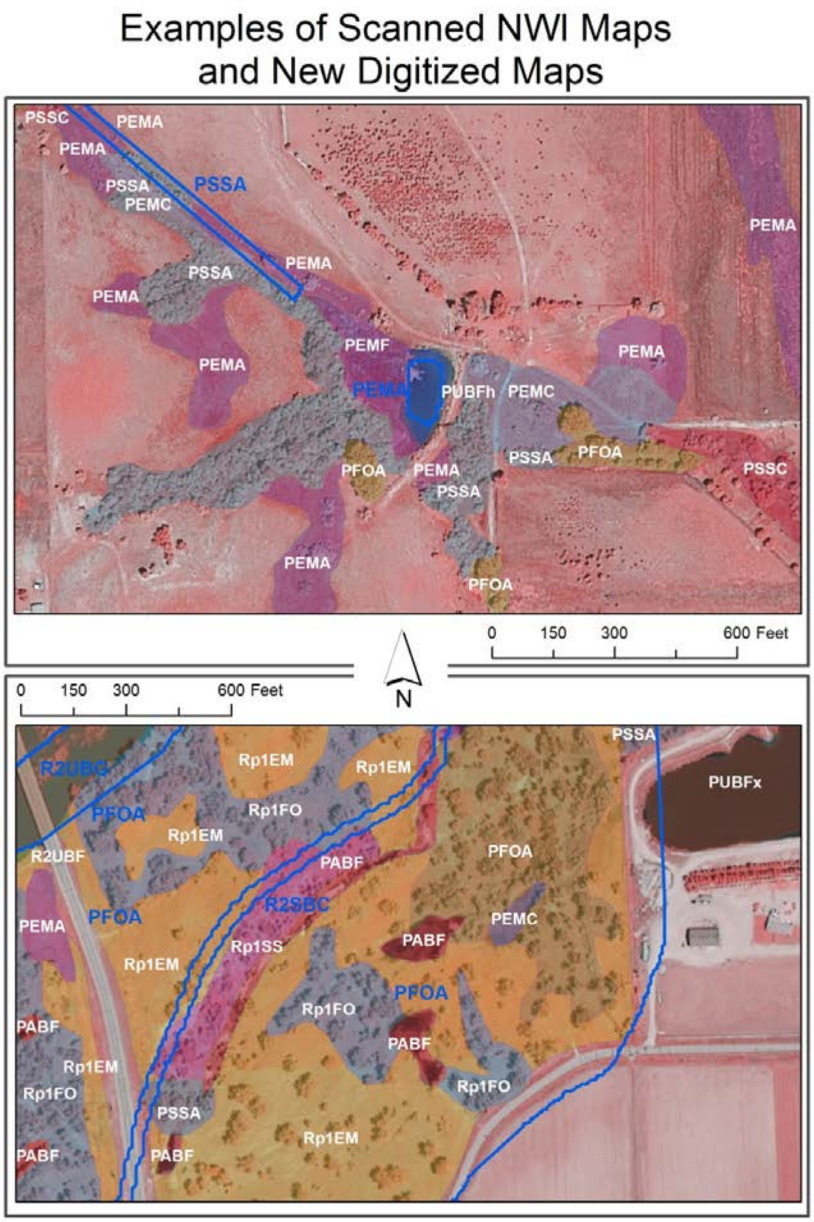

Figure 4: Screen shots from ArcGIS showing the difference between new (2009) and old (~1970's) wetland polygons. The blue outlines and labels are old wetland polygons and the multi-colored shaded areas with white labels are new wetland polygons.

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APPENDIX A: LLWW Coding Procedures (adjusted from Burns and Newlon 2009)

Updated 12-28-2010

ArcGIS SQL protocol and procedures for converting Cowardin Wetland Classification codes into LLWW Classification codes to obtain HGM style information. The procedure is designed to be mutually exclusive in the end product.

Notes that will aid in reading this procedure:

- wetland_polygon = spatial layer of wetland polygons created and coded to NWI classification.
- '' two single quotes in a query indicate there has been no value entered
- Blue_text = Output files
- Red_text = Input Files
- Green text = Field names in attribute tables
- All queries are completed in the wetland_polygon attribute table
    - Unless otherwise stated, all queries are **Select by Attributes**
- '' two single quotes in a query indicate there has been no value entered
- % allows for a variety of characters to be present. Example: a query for "PUB%" could yield: PUBF, PUBG, PUBH, PUBGx, PUBFx, PUBGh, etc.

A: Waterbody Classification		
Step #	***Action***	***Procedure and Query Strings***
Step A1	Run Slope using 10m DEM	***Spatial Analyst>Slope***: percent_rise *INPUT*: 10m_dem *OUTPUT*: 10m_slope
Step A2	Run Zonal Stats as Table	***Spatial Analyst>Zonal>Zonal Stats as Table*** *INPUT FEATURE:* wetland_polygon *ZONE FIELD:* **ObjectID** *INPUT VALUE RASTER:* 10m_slope *OUTPUT:* Zonal_stat_wetlands
Step A3	Join field to wetland polygon table	***Data Management>Joins>Join Field*** *INPUT DATASET:* wetland_polygon *INPUT JOIN FIELD:* **ObjectID** *JOIN TABLE:* Zonal_stat_wetlands *OUTPUT JOIN FIELD:* **Value** *JOIN FIELDS:* **Mean**
Note for large datasets	Join Field will not work on tables with more than 10,000 entries. For large tables select <10,000 entries in each table, then run Join Field. Each time it will create a new "Mean" field. After all data is successfully joined, create a new field, "Mean_Grad". Select entries joined by each successive join, i.e. the first 7,000 entries and use the Field Calculator: = "Mean". This will copy the values into the new "Mean_Grad" column. Repeat until the "Mean_Grad" column contains all the data from all successive joins.	
Step A4	Add fields to wetland_polygon table	**Waterbody** (text), **Gradient** (short int), **Lake_Mod** (short int), **Water_Flow** (short int), **Pond** (text), **Spec_Mod** (text), **Landform** (text), **Flow_Path** (text)
Step A5	Classify all L1 as "DW" (deep water)	"**nwi_code**" LIKE 'L1%'
Step A6	Classify all L2 as "LE" (lentic)	"**nwi_code**" LIKE 'L2%' AND "**Waterbody**" = ''

Step A7	Classify all wetlands within 40m of lakes ***AND*** with a slope less than 4% as "LE" also	1. "**Waterbody**" = 'DW' OR "**Waterbody**" = 'LE' 2. Remove from current selection "**nwi_code**" LIKE 'L2US%' 3. Use ***Selection>Select by Location***: select features from …wetland_polygon…THAT…are completely within…40m of selected. 4. Then ***Select by Attributes*** again: Select from current selection "**Mean**" < 4 AND "**Waterbody**" = ''
Step A8	Classify all rivers with the following code as "RV" (river)	"**nwi_code**" = 'R2UBH' OR "**nwi_code**" = 'R3UBH'
Step A9	Classify remaining flowing water as "ST" (streams)	1. "**nwi_code**" LIKE 'R2%'(but not R2US%, shore will be classified as LR) OR "**nwi_code**" LIKE 'R3%' OR "**nwi_code**" LIKE 'R4%' 2. Then Select from current selection "**Waterbody**" = ''
Step A10	Classify all wetlands within 300m of rivers ***AND*** with a slope less than 4% as "LR" (lotic river)	1. "**Waterbody**" = 'RV' 2. ***Selection>Select by Location***: select features from … wetland_polygon…THAT…intersect…currently selected features. 3. Then ***Select by Attributes:*** Select from current selection "**Waterbody**" = '' 4. Then ***Select by Attibutes:*** select features from selected "**Mean**" < 4. = "LR" 5. "**Waterbody**" = 'RV' 6. ***Selection>Select by Location***: select features from … wetland_polygon …THAT…are completely within…300m of selected features. 7. Then ***Select by Attributes:*** select from current selection "**Waterbody**" = '' 8. Then ***Select by Attributes:*** Select from current selection "**Mean**" < 4 = "LR"
Step A11	Classify all wetlands within 100m of streams ***AND*** with a slope less than 4% as "LS" (lotic stream)	1. "**Waterbody**" = 'ST' 2. Use ***Selection>Select by Location***: select features from … wetland_polygon…THAT…are completely within…100m of selected. 3. Then ***Select by Attributes*** again: Select from current selection "**Mean**" < 4 AND "**Waterbody**" = ''
Step A12	Use NHD_stream layer. Select all perennial and intermittent streams. Classify as wetlands within 100m as "LS" (lotic stream)	Use ***Selection>Select by Location***: select features from… THE FOLLOWING LAYER_… wetland_polygon…THAT… intersect…THE FEATURES IN THIS LAYER…NHD_stream… (check "Use selected features") (check "Apply a buffer…") …80m of selected. (100 is an arbitrary number ID'd by MT that should be corrected for each unique watershed)
Step A13	Use NHD_stream layer. Select all ephemeral streams. Classify wetlands within 20m as "LS" (lotic stream)	Use ***Selection>Select by Location***: select features from… THE FOLLOWING LAYER_… wetland_polygon…THAT… intersect…THE FEATURES IN THIS LAYER…NHD_stream… (check "Use selected features") (check "Apply a buffer…") …20m of selected. (20 is an arbitrary number ID'd by MT that should be corrected for each unique watershed)

Step A14	Classify all remaining wetlands without a "**Waterbody**" as "TE" (Terene)	"**Waterbody**" = ''
B: Gradient for Rivers and Streams		
Step B1	For rivers and streams with a mean gradient less than 2% give a "1" (low) for "**Gradient**"	"**Mean**" < 2
Step B2	For rivers and streams with a mean gradient between 2and 4% give a "2" (moderate) for "**Gradient**"	"**Mean**" ≥ 2 AND "**Mean**" < 4
Step B3	For rivers and streams with a mean gradient greater than 4 give a "3" (high) for "**Gradient**"	"**Mean**" ≥ 4
Step B4	For R4SB and all streams with an "F" (semi-permanently flooded water regime, classify "**Water_Flow**" as 4	"**nwi_code**" LIKE 'R4SB%' OR "**nwi_code**" LIKE 'R%%%F'
C: Lake Modifier		
Step C1	Dammed lakes are classified "**Lake_Mod**" = 3	"**nwi_code**" LIKE 'L%%%h'
Step C2	Excavated lakes are classified "**Lake_Mod**" = 4	"**nwi_code**" LIKE 'L%%%x'
Step C3	Natural lakes are classified "**Lake_Mod**" = 1	"**nwi_code**" LIKE 'L%%%' AND "**Waterbody**" = ''
Step C4	Lentic wetlands associated with dammed lakes are also given a "**Lake_Mod**" of 3	1. "**Lake_Mod**" = 3 2. Use ***Selection>Select by Location***: add to the currently selected features in... THE FOLLOWING LAYER_... wetland_polygon...THAT... touch the boundary of...THE FEATURES IN THIS LAYER...NWI_polygon... (check "Use selected features")
Step C5	Lentic wetlands associated with excavated lakes are also given a "**Lake_Mod**" of 4	1. "**Lake_Mod**" = 4 2. Use ***Selection>Select by Location***: add to the currently selected features in... THE FOLLOWING LAYER_... wetland_polygon...THAT... touch the boundary of...THE FEATURES IN THIS LAYER... wetland_polygon ... (check "Use selected features")
Step C6	Lentic wetlands associated with natural lakes are also given a "**Lake_Mod**" of 1	1. "**Lake_Mod**" = 1 2. Use ***Selection>Select by Location***: add to the currently selected features in... THE FOLLOWING LAYER_... wetland_polygon...THAT... touch the boundary of...THE FEATURES IN THIS LAYER... wetland_polygon ... (check "Use selected features")
D: Special Modifiers		
Step D1	Classify all beaver influenced wetlands with "**Spec_Mod** = "b"	"**nwi_code**" LIKE '%b'
Step D2	Classify all dammed or impounded wetlands with	"**nwi_code**" LIKE '%h'

	"**Spec_Mod** = "h"	
Step D3	Classify all excavated wetlands with "**Spec_Mod** = "x"	"**nwi_code**" LIKE '%x'
Step D4	Classify all drained wetlands with "**Spec_Mod** = "d"	"**nwi_code**" LIKE '%d'
Step D5	Classify all farmed wetlands with "**Spec_Mod** = "f"	"**nwi_code**" LIKE '%f'
E: Pond Modifier		
Step E1	All ponds are given a "p" in "**Ponds**" with NWI Codes including PAB and PUB	"**nwi_code**" LIKE 'PAB%' OR "**nwi_code**" LIKE "PUB%'
F: Landform Type		
Step F1	"**Landform**" = IL for islands	Search in large lakes for islands manually.
Step F2	"**Landform**" = "BA" (basin) for all wetlands with water regimes A and C, and all ponds ("**Pond**"="p")	"**nwi_code**" LIKE '%A%' OR "**nwi_code**" LIKE '%C%' OR "**Pond**" = 'p'
Step F3	"**Landform**" = "FR" (fringe) for all wetlands with water regimes B and F, and all shore wetlands ("%US%")	1. <u>Create a new selection</u>: "**nwi_code**" LIKE '%B%' OR "**nwi_code**" LIKE '%F%' OR "**nwi_code**" LIKE '%US%' AND "**Landform**" = '' 2. <u>Remove from current selection</u>: "**nwi_code**" = 'PFOA' OR "**nwi_code**" = 'PFOC'
Step F4	All other wetlands with a "**Waterbody**" = "LS" are classified as "**Landform**" = "BA" unless they were classified as "FR" in **Step 31** above	"**Waterbody**" = 'LS' AND "**Landform**" = ''
Step F5	All other wetlands with a "**Waterbody**" = "LR" are classified as "**Landform**" = "FP" unless they were classified as "FR" in **Step 31** above	"**Waterbody**" = 'LR' AND "**Landform**" = '
Step F6	All wetlands with a "**Waterbody**" = "TE" are classified as "BA" if "**Mean**" less than 4%	"**Waterbody**" = 'TE' AND "**Landform**" = '' AND "**Mean**" < 4
Step F7	All wetlands with a "**Waterbody**" = "TE" are classified as "SL" if "**Mean**" greater than 4%	"**Waterbody**" = 'TE' AND "**Landform**" = '' AND " **Mean** " >= 4
G: Flow Path		
Step G1	All rivers and streams are classified as "TH" (through flow)	"**Waterbody**" = 'RV' AND "**Waterbody**" = 'ST'
Step G2	All wetlands associated with "**nwi_code**" L2, or with a water regime B or F, or a shore (US), but not a pond is classified "BI" (bi-directional)	1. <u>Create a new selection</u>: "**nwi_code**" = 'L2%' OR "**nwi_code**" LIKE '%B%' OR "**nwi_code**" LIKE '%F%' OR "**nwi_code**" LIKE '%US%' AND "**Flow_Path**" = '' 2. <u>Remove from current selection</u>: "**nwi_code**" = 'PFOA' OR "**nwi_code**" = 'PFOC' OR "**Pond**" = 'p'
Step G3	All other lentic wetlands classified as "TH"	"**Waterbody**" = 'LE' AND "**Flow_Path**" = '

Step G4	All dammed lakes are classified "TH"	"**Waterbody**" = 'DW' OR "**Waterbody**" = 'LE' AND "**Spec_Mod** = 'h' AND "**Flow_Path**" = ''
Step G5	All deep water lakes (DW) are classified as "IN" (inflow)	"**Waterbody**" = 'DW' and "**Flow_Path**" = ''
Step G6	Remaining Terene wetlands are isolated (greater than 20m from another wetland) and classified as "IS" (isolated)	***Spatial Analyst>Distance>Euclidean Allocation*** INPUT FEATURE: NWI_polygon SOURCE FIELD: **ObjectID** OUTPUT ALLOCATION RASTER: Euc_allo MAXIMUM DISTNACE: 25 OUTPUT CELL SIZE: 10 OUTPUT DISTANCE RASTER: Euc_dist *Then.....* ***Spatial Analyst>Zonal>Zonal Fill*** INPUT ZONE RASTER: Euc_allo INPUT WEIGHT RASTER: Euc_dist OUPUT RASTER: Zonal_fill *Then.....* ***Spatial Analyst>Math>Int*** INPUT: Zonal_fill OUTPUT: Int_Zonal *Then.....* ***Spatial Analyst>Zonal>Zonal Statistics as Table*** INPUT FEATURE: NWI_polygon ZONE FIELD: **ObjectID** INPUT VALUE RASTER: Int_Zonal OUTPUT TABLE: Zonal_Stat_Table *Then.....* ***Data Management>Joins>Join Field*** INPUT DATASET: NWI_polygon INPUT JOIN FIELD: **ObjectID** JOIN TABLE: Zonal_Stat_Table OUTPUT JOIN FIELD: **Value** JOIN FIELDS: **Mean** *Then.....* ***Select by Attributes***: "**Waterbody**" = "TE" ***Select by Attributes/Select from Current Selection***: "**Mean**" = 14" **"Flow Path"** = "IS" ***Select by Attributes***: "**Waterbody**" = "TE" ***Select by Attributes/Select from Current Selection***: "Flow Path" = ''