Appendix E. Other Supporting Information

Appendix E. Other Supporting Information

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Scoping Report

Water Resources Assessment

Water Resources Assessment for the North Ogden Watershed Environmental Assessment

Weber County, Utah

November 2018

Prepared for: Hollis Jencks
U.S. Army Corps of Engineers

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J·U·B ENGINEERS, INC.

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Introduction

J-U-B Engineers, Inc. (J-U-B) conducted a water resources assessment on May 24, 2018 for the proposed North Ogden Watershed Project. The proposed action area is located within North Ogden City in Weber County, Utah. The purpose of the project would be to construct a stormwater reservoir, irrigation reservoir and complete storm drain improvements along 2550 North in North Ogden City.

As residential and commercial development expands in Weber County, North Ogden City has experienced an increase in flood-related damages because of a diminished capacity to contain and detain stormwater runoff. Additionally, increased development and impacts from drought has increased the need for greater efficiency in irrigation-water delivery systems. The proposed project would provide flood control during high runoff events, and would create an efficient irrigation-water delivery system. The Weber-Box Elder Conservation District (WBECD) has received funding from the Natural Resource Conservation Service (NRCS) to complete a Watershed Plan and Environmental Assessment as a precursor to application for funding to complete the construction of the proposed project.

Description of the Project Action

Federal funds from NRCS would be utilized to construct a detention basin, storm drain piping, an irrigation reservoir, a pump station, and community recreation facilities. The storm water detention basin would be a 22-acre-ft basin with a controlled outlet. The irrigation reservoir would be a 14 acre-ft storage basin, which would supply the pump station. The pump station would consist of three 100 Hp pumps and one 50 Hp pump, which would serve portions of North Ogden City, Pleasant View City, and Harrisville City, covering an area of approximately 2,900 acres. The pump station would be used to meet WBECD's irrigation requirements. Recreation amenities would be included in the construction of the reservoirs, which would include a beach area, picnic tables and shelters, as well as parking stalls with restrooms and bowery amenities for general public access and use.

Methods

The WRA was conducted in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual and the Arid West Regional Supplement* (Version 2.0). Based on aerial imagery, the NRCS Soil Survey, and NWI Wetlands Survey, any location with potential to contain Waters of the U.S. or wetlands was surveyed further. The entire survey area was assessed based on topography, presence or absence of dominant hydrophytic vegetation and/or surface hydrology. Where vegetation indicated any potential for hydric soils, soil pit sampling was conducted and the results documented in accordance with the USACE *Arid West Regional Supplement*.

Environmental Setting and Evaluation

Weber County falls within the boundaries of the Lower Weber Sub-Basin, or the Lower Weber Watershed [Hydrologic Unit Code (HUC) 16020102]. There are four subwatersheds in the Lower Weber Watershed: the Mill Creek, West Weber-Weber River, Outlet Weber River-Frontal Great Salt Lake, and Fourmile Creek subwatersheds. The proposed project is situated within the Fourmile Creek subwatershed, which covers approximately 28,955 acres (HUC 160201020602).

The proposed project actions would take place in previously disturbed areas within residential agricultural settings. Approximately 10 acres would be disturbed as part of the proposed project actions. An existing pipeline diversion from North Ogden Canal would be improved and extended to connect with the proposed irrigation storage and stormwater control reservoirs. There is an existing stormwater detention basin managed by North Ogden City located next to the proposed stormwater and irrigation line improvements. Additionally, there is an existing man-made pond in the area proposed for the stormwater and agricultural reservoirs. The pond is currently located on private land, however North Ogden City plans to acquire the property prior to project implementation. The manmade pond would be removed as the footprint of the new reservoirs would encompass its location.

The project study area includes three separate sites. The first site (Site 1) includes the area starting from the North Ogden Canal to the existing stormwater detention basin. The second site (Site 2) includes the area around the outside of the existing stormwater detention basin. The third site (Site 3) includes the area south of 2550 North, where the proposed irrigation and stormwater reservoirs would be constructed (see attached Project Vicinity Map).

In Site 1, vegetation along the existing buried pipeline leading from the canal consists of upland species, such as cheat grass (*Bromus tectorum*) and Kentucky bluegrass (*Poa pratensis)*. The area is indicative of a manicured suburban lawn, as it experiences regular mowing and maintenance by the canal company. The proposed project would not disturb the existing North Ogden Canal.

Site 2 is characterized by an existing stormwater detention basin, which was likely constructed prior to U.S. Army Corps permitting (early 1960s). The proposed project would not alter the existing detention basin. Based on the surrounding vegetation and landscape, the detention basin was likely constructed in uplands and continues to naturally drain upland areas as well as receive stormwater from the surrounding development. The proposed project would construct a pipeline around the outside edge of the existing basin, which would eventually connect to the proposed dual reservoirs in Site 3. Vegetation throughout Site 2 consists primarily of upland or waste area species (see attached Photo Inventory). The dominant species included chicory (*Cichorium intybus*), teasel (*Dipsacus fullonum*), orchardgrass (*Dactylis glomerata*), cheatgrass (*Bromus tectorum*), foxtail barley (*Hordeum jubatum*), and Kentucky bluegrass. The site is mowed regularly, and is used as a recreation field in dry conditions. The proposed project would not disturb the interior of the detention basin, and thus it was not included in the WRA study area.

Site 3 is situated in an actively grazed agricultural field with a gravel lot and pre-existing, man-made pond. Vegetation within the agricultural fields is dominated by orchardgrass, alfalfa (*Medicago sativa*), white clover (*Trifolium repens*), and Kentucky bluegrass. Weedy species such as teasel, Canada thistle (*Cirsium arvense*), and dandelion (*Taraxacum officinale*) are scattered throughout the site. The proposed project would extend stormwater and irrigation pipelines south their intersection with 2550 North to connect to the proposed dual reservoirs.

Within Site 3 is a man-made pond located within an actively managed pasture. The pasture is dominated by orchardgrass and alfalfa. Fringe wetlands surround the pond as a result of the persistent hydrology. The water source for the pond appears to be ground water or a spring directly adjacent to the pond. There is no outflow for the pond, and no stream flows into the pond. The fringe wetlands are dominated by hydrophytic vegetation such as reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), coyote willow (*Salix exigua*), Baltic rush (*Juncus balticus*), hardstem bulrush (*Schoenoplectus acutus*), and western blueflag iris (*Iris missouriensis*).

A soil pit analysis was completed in the pasture, where the man-made pond is located to determine the boundary at which any seepage from the pond affects the surrounding soils and hydrology (see attached WRA Exhibit). The soil pit analysis did not find any evidence of saturated conditions beyond the wet edge of the pond. No hydric soil indicators were present in the analysis. The water table was not present within the top 24 inches of the soil profile. The soil profile was indicative of actively tilled soil. Within the top 24 inches, the profile was homogenous with a matrix color of 10YR 2/1 and no evidence of concentrations, depletions, nor a reduced matrix. Soil texture was indicative of a silty clay loam.

The Natural Resource Conservation Service (NRCS) Web Soil Survey was consulted to determine the distribution of soils within the proposed project study area (see attached NRCS Soil Survey Map). Table 1 summarizes the soils mapped by NRCS within the study area, and includes their hydric rating.

Table 1. Summary of mapped soils within the study area.

Soil Map Unit	Soil Map Unit Symbol	Hydric Rating
Parleys loam, 3 to 8 percent slopes	8012	0
Draper loam, drained, 1 to 3 percent slopes	DrB	0
Logan silty clay loam, 0 to 3 percent slopes	Lt	100
Roshe Springs silt loam, 0 to 3 percent slopes	Rw	100
Urban Land	UL	0
Woods Cross silty clay loam, drained, 0 to 3 percent slopes	Wt	100

Interstate Commerce

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) suggests that a portion of the study area could contain wetlands, and the updated 2018 FEMA Floodplain Map indicates that a portion of the project area is within an *Area of Minimal Flood Hazard*. Site conditions along the existing irrigation pipeline alignment, and the proposed pipeline alignment (Sites 1 and 2), are indicative of upland sites (see attached Project Exhibit). A dominance of upland vegetation was present in these areas. The proposed project would not disturb the detention basin, rather it would construct the proposed pipelines to run along the outside edges of the existing basin. The stormwater detention basin in its entirety would likely be an example of preamble waters, as it is an artificial detention basin that was by all available assessments constructed in uplands. No wetlands or other Waters of the U.S. were identified within the proposed project footprint.

The third portion of the project area (Site 3) is located within an agricultural field used for equestrian purposes, and an existing man-made pond. The man-made pond has no apparent connection to any known jurisdictional water features. Based on the soil pit analysis, the pond is also located within an upland pasture. Given that the feature is an artificial pond that was constructed in an upland position with no apparent connection to other jurisdictional features, it would be reasonable to assess that the pond would be considered preamble waters and would not be considered a jurisdictional water, nor would the fringe wetlands be considered jurisdictional.

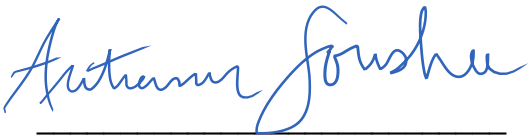
Summary

The purpose of the project would be to construct stormwater and irrigation reservoirs, to replace an existing pump station, and to complete storm drain improvements along 2550 North in North Ogden City. Given the lack of open water within the study area at Sites 1 and 2, along with the lack of apparent hydrology and dominance of upland vegetation, it is reasonable to determine that the study area in Sites 1 and 2 do not include wetlands or other Waters of the U.S. The proposed project actions at the existing detention pond would not alter the detention basin, nor would they involve any stormwater within the detention basin.

The man-made pond at Site 3 would be anticipated to be considered preamble waters because the feature is artificial and not connected to any known jurisdictional water feature. Beyond the appropriate permitting necessary to improve pre-existing stormwater infrastructure, the proposed project actions likely would not require additional permits from the U.S. Army Corps of Engineers (USACE), or the Utah Division of Water Quality (i.e. Section 404 permit or Stream Alteration Permit), as no natural streams, or Waters of the U.S., would be impacted by the proposed project actions. It should be noted that final authority for jurisdictional determinations and impacts to Waters of the U.S., including wetlands, rests with the appropriate regulatory agencies.

If you have any questions regarding this report, please contact me. I may be reached at afoushee@jub.com, or on my office phone at 801-886-9052.

Respectfully submitted by:



Date: November 15, 2018

Autumn Foushee, Ecologist
J-U-B ENGINEERS, Inc.

Appendix 1. Project Vicinity Map

Flood/Irrigation Water Inlet Pipe
Flood Water Outlet Pipe
Pump House & Public Amenities
Dual-Use Reservoir

North Ogden Watershed Plan EA

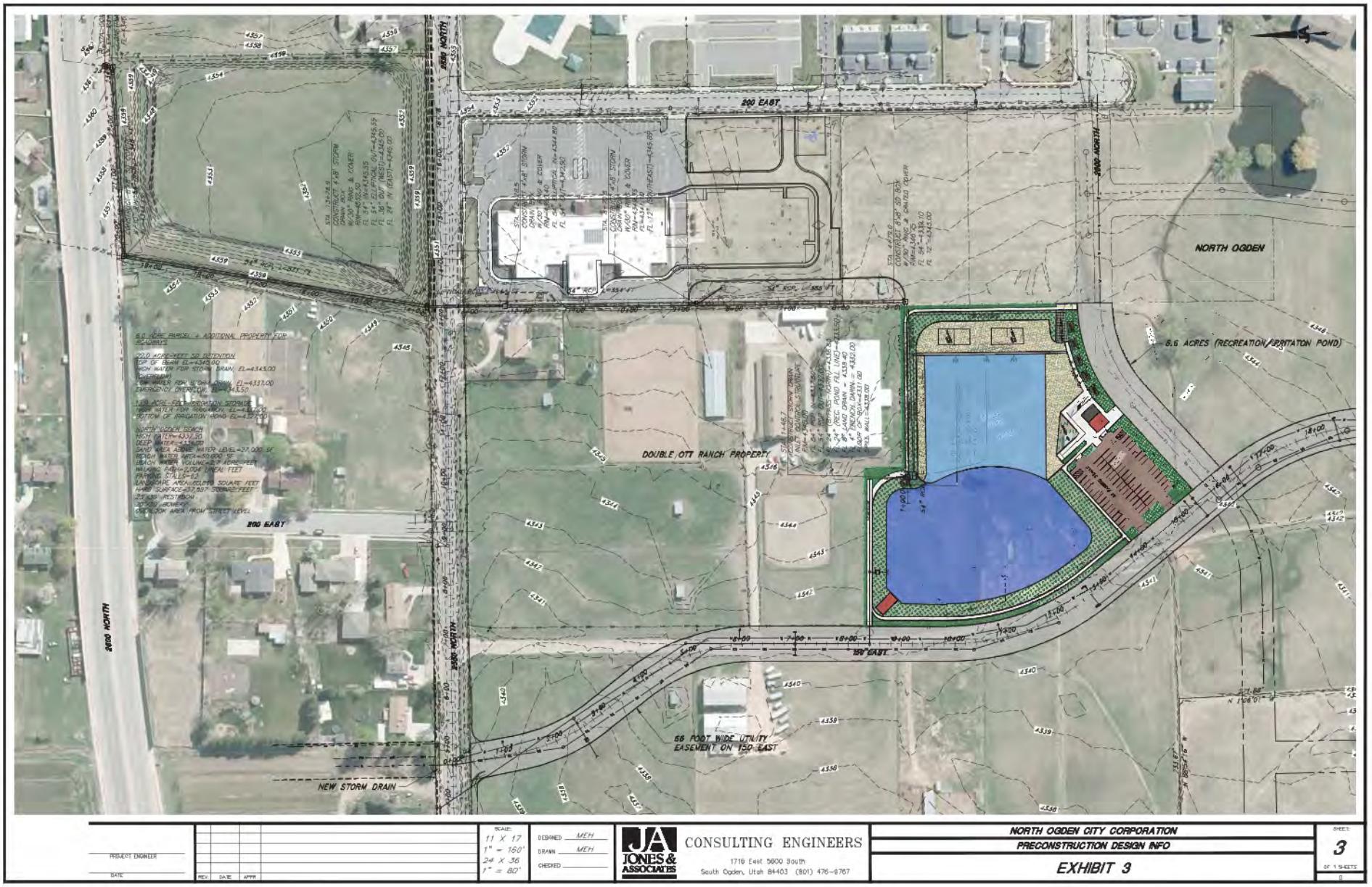
Preferred Alternative

N

0 500
Feet

J-U-B ENGINEERS, INC.

Appendix 2. Proposed Improvements Exhibit



PROJECT ENGINEER

DATE

REV.	DATE	APPR

SCALE:
11 X 17
1" = 160'
24 X 36
1" = 80'

DESIGNED MEH
DRAWN MEH
CHECKED

JONES & ASSOCIATES
CONSULTING ENGINEERS
1716 East 5600 South
South Ogden, Utah 84403 (801) 476-9767

NORTH OGDEN CITY CORPORATION
PRECONSTRUCTION DESIGN INFO
EXHIBIT 3

SHEET:
3
OF 1 SHEETS

Appendix 3. Photo Inventory

North Ogden Watershed Plan Environmental Assessment
Photo Inventory

The following 14 photos were taken during two site visits conducted on April 4, 2018 and May 24, 2018.

Photo 1: The beginning extent of Site 1, the North Ogden Canal existing pump station, is depicted in this photo. At this point, irrigation water enters the pipeline that would be replaced as part of the project. The pump station would be updated as well.

Photo 2: An alternate view of the beginning extent of Site 1 is illustrated in this photo.

Photo 3: Another portion of Site 1 of the proposed project. The pipeline, which would be replaced as part of the project, is buried from the pump station and runs south along the edge of the right-of-way toward the existing stormwater detention basin.

Photo 4: Site 2 of the proposed project, the existing stormwater detention pond, is depicted in this photo.

Photo 5: From the northeast corner of the existing stormwater detention basin, the proposed irrigation pipeline would be placed around the outside edge of the detention basin berm (Site 2).

Photo 6: From the northwest corner of the existing stormwater basin, the proposed irrigation pipeline would turn south and continue along the outside edge of the detention basin berm (Site 2).

Photo 7: From the southwestern corner of the existing detention basin, the proposed pipeline would run through an agricultural property along the main gravel road into the property.

Photo 8: The gravel lot within proposed project boundary is a component of Site 3. This location would be the site for a portion of the proposed irrigation pond and detention basin.

Photo 9: Agricultural hay field through which the proposed pipeline, irrigation reservoir and stormwater detention basin would be constructed is the second component of Site 3.

Photo 10: Agricultural pastures through which the proposed pipeline, irrigation reservoir and stormwater detention basin reservoir would be constructed is the second component of Site 3.

Photo 11: Field adjacent to existing constructed pond.

Photo 12: Emergent wetland vegetation on the perimeter of the constructed pond (Site 3).

Photo 13: View over the existing constructed pond at Site 3.

Photo 14: View over existing constructed pond located at Site 3. (April 2018)

Appendix 4. NRCS Soils Map

Soil Map—Davis-Weber Area, Utah
(North Ogden Watershed EA)

Map Scale: 1:6,040 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Davis-Weber Area, Utah
Survey Area Data: Version 12, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2013—Nov 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
IaB	Ironton silt loam, 1 to 3 percent slopes	0.1	0.3%
Lt	Logan silty clay loam, 0 to 3 percent slopes	24.8	60.7%
Rw	Roshe Springs silt loam, 0 to 3 percent slopes	15.1	36.9%
Wt	Woods Cross silty clay loam, drained, 0 to 3 percent slopes	0.8	2.0%
Totals for Area of Interest		**40.9**	**100.0%**

Hydric Rating by Map Unit—Davis-Weber Area, Utah
(North Ogden Watershed EA - Hydric Soils Rating)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Survey Area Data: Version 12, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2013—Nov 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
IaB	Ironton silt loam, 1 to 3 percent slopes	10	0.1	0.3%
Lt	Logan silty clay loam, 0 to 3 percent slopes	100	24.8	60.7%
Rw	Roshe Springs silt loam, 0 to 3 percent slopes	100	15.1	36.9%
Wt	Woods Cross silty clay loam, drained, 0 to 3 percent slopes	100	0.8	2.0%
Totals for Area of Interest			**40.9**	**100.0%**

Description

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Rating Options

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Appendix 5. NWI Map

U.S. Fish and Wildlife Service
National Wetlands Inventory

Pineview EA NWI Map

January 17, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/12/2018 at 2:27:31 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Biological Evaluation

Biological Evaluation

for the
North Ogden Watershed Plan Environmental Assessment

[Weber County, Utah]

June 2020

Prepared for: Derek Hamilton and Norm Evenstad
U.S. Department of Agriculture
Natural Resources Conservation Service

Prepared by: Autumn Foushee, Senior Biologist
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801.886.9052

J·U·B ENGINEERS, INC.

Contents

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Appendices

1 Introduction

The following Biological Evaluation (BE) has been prepared for the proposed North Ogden Project (Proposed Project) located in Weber County, Utah. This BE was prepared on behalf of the Weber-Box Elder Conservation District and North Ogden City for the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). This BE was prepared in compliance with Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1536(c)) to sufficiently document the Proposed Project's Action Area (Action Area) to assess the degree to which the Proposed Project may affect: federally threatened or endangered species; species proposed for listing; designated and proposed critical habitat; and, Utah state sensitive species managed under conservation agreements with the federal government. This BE serves as supporting documentation for the Watershed Plan Environmental Assessment (Plan-EA) developed for the Proposed Project, and as supporting rationale for effect determinations for ESA consultation purposes.

2 Location of Project Area and Description of Proposed Action

Project Area

The Proposed Project is located within Section 29 and 32, Township 7 North, Range 1 West, Salt Lake Base and Meridian, Weber County, Utah (Appendix 1, Project Vicinity Map). The project footprint is situated between East Pleasant View Drive and West 2550 North in North Ogden, Utah. The Action Area is located within an entirely urban setting in North Ogden City, Utah. The site is situated in an arid climate. For illustrations of typical conditions within the Action Area, please refer to the Photo Inventory (Appendix 2).

Proposed Action

The joint irrigation, recreation, and flood control project being evaluated in the Plan-EA would construct a 42.5-acre-foot reservoir that would be used for irrigation regulation, floodwater storage, and community recreation. The irrigation water regulated through the basin and pump system would serve portions of North Ogden City, Pleasant View City, and Harrisville City, covering an approximate 2,900-acre area. Recreational components of the facility would include open space, a walking trail, bowery with restroom, playground equipment, pickleball, kayaking and a parking area (Appendix 1). The purpose of the Proposed Project is to help North Ogden City more effectively manage floodwaters and enable the Weber-Box Elder Conservation District to better serve the needs of its water users. As residential and commercial development expands in Weber County, North Ogden City has experienced an increase in flood-related damages because of a diminished capacity to contain and detain stormwater runoff. Additionally, increased development and impacts from drought has increased the need for greater efficiency in irrigation-water delivery systems. The Proposed Project would provide flood control during high runoff events and would create an efficient irrigation-water delivery system.

Construction is anticipated to occur in fall 2020, pending project approval and securement of funding. The anticipated construction equipment that would be used during project implementation would likely include excavators, backhoes, graders, compactors, rollers, and dump trucks for hauling materials.

3 Conservation Measures

Best Management Practices (BMPs) would be in place to minimize direct, short-term and long-term construction impacts. Some of these measures would include reseeding disturbed soils with native vegetation and limiting noise-induced disturbances during construction. BMPs are mandatory and would include, but are not limited to the following:

1. Temporary Erosion and Sediment Control (TESC) implements (e.g. silt fences) shall be in place during construction to limit sediment delivery into nearby drainages or irrigation canals.
2. Excavation activities, staging areas, and stock piling areas would occur only within staked limits of the project footprint.
3. Temporary noise from construction equipment would be minimized by regular inspection and replacement of defective mufflers or parts.
4. Fueling of excavation equipment would be completed within the project footprint only after ground surface spill protection is provided. Additionally, the Contractor must have emergency spill equipment onsite at all times and must have a Spill Prevention Plan approved and in place prior to beginning construction activities. Dump trucks, pickups, and other general equipment would be refueled offsite.
5. Noxious weed management would be implemented throughout construction.
6. The Action Area would be monitored on a regular basis by a designated Construction Site Erosion and Sediment Control Lead (CESCL). Monitoring would ensure that all TESC implements are functioning appropriately to prevent any impacts to water quality. Damaged or failing TESC implements would be removed and replaced immediately.

4 Methodology

An Official Species List from the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) system was generated for the Action Area on June 30, 2020 (Appendix 3). A Utah State-listed Species list was accessed through the Utah Conservation Data Center (UCDC) on June 30, 2020. The Utah Division of Wildlife Resources' (UDWR) Utah Natural Heritage Program Database was also consulted on June 30, 2020 to determine records of ESA-listed and state sensitive species occurrence in the Action Area (Appendix 4). A field survey was conducted by a biologist with J-U-B ENGINEERS, Inc. on May 24, 2018 to assess existing environmental conditions within the Action Area.

5 Existing Environmental Conditions

The elevation of the Action Area ranges from approximately 4,370 to 4,420 feet above sea level (NGVD 29). Weber County falls within the boundaries of the Lower Weber Sub-Basin, or the Lower Weber Watershed (Hydrologic Unit Code [HUC] 16020102). There are four subwatersheds in the Lower Weber Watershed: Mill Creek, West Weber-Weber River, Outlet Weber River-Frontal Great Salt Lake, and Fourmile Creek. The Proposed Project is situated within the Fourmile Creek subwatershed, which covers approximately 28,955 acres (HUC 160201020602). The existing land use consists of single-family residential development and an agricultural property.

The Action Area consists of three distinct but connected sites. The first site encompasses the area from the North Ogden Canal to the existing stormwater detention basin. The second site is the pre-existing stormwater detention basin. The third site is an actively grazed agricultural field containing a gravel lot and a pre-existing constructed pond (Appendix 1).

Within the first site, the assemblage of vegetation consists of upland species, such as cheat grass (*Bromus tectorum*) and Kentucky bluegrass (*Poa pratensis)*. The area is actively mowed and maintained by the North Ogden Canal Company.

Vegetation throughout the second site is dominated by upland, agricultural or waste area species including: chicory (*Cichorium intybus*), teasel (*Dipsacus fullonum*), orchardgrass (*Dactylis glomerata*), cheat grass, foxtail barley (*Hordeum jubatum*), and Kentucky bluegrass. The second site is actively mowed and is seasonally used as a recreation field.

The third site is dominated by orchardgrass, alfalfa (*Medicago sativa*), white clover (*Trifolium repens*), Kentucky bluegrass, teasel, Canada thistle (*Cirsium arvense*), dandelion (*Taraxacum officinale*), and other weedy species. Vegetation surrounding the constructed pond consists of hydrophytic vegetation such as, reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), coyote willow (*Salix exigua*), Baltic rush (*Juncus balticus*), hardstem bulrush (*Schoenoplectus acutus*), and western blueflag iris (*Iris missouriensis*).

6 Status of Species and Habitat

Agency Coordination and Species of Concern

The IPaC Report (dated June 30, 2020) did not identify any ESA-listed species with the potential to occur within the Action Area (Appendix 3, IPaC Report). There is no designated critical habitat within the Action Area. The UCDC Utah State-listed Species list included 22 aquatic and terrestrial species listed as wildlife species of concern (SPC), species receiving special management under a conservation agreement in order to preclude the need for federal listing (CS), or federally-listed or candidate species under the ESA (S-ESA). Based on species data obtained from the UCDC, three ESA-listed species are known to have occurred within Weber County, Utah: the gray wolf, the June sucker, and the yellow-billed cuckoo (see Table 1). Table 1 summarizes the three ESA-listed species in Weber County.

Table 1. Summary of ESA-listed Species found within Weber County, Utah.

Common Name	Scientific Name	ESA Status	Suitable habitat conditions in Action Area?
Gray Wolf	*Canis lupus*	Endangered	No
June Sucker	*Chasmistes liorus*	Endangered	No
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	No

According to the Utah Natural Heritage Database, there are no documented occurrences for the aforementioned ESA-listed species, or any species protected under federal conservation agreements within a 2-mile radius of the Action Area (Appendix 4).

Species Descriptions

The following sections briefly discuss gray wolf, June sucker, and yellow-billed cuckoo and their associated habitat needs.

Gray Wolf

Wolves have evolved to avoid people due to many centuries of hunting pressure from humans. The gray wolf requires vast forests and mountain foothills for hunting, typically far from humans. They show little preference for special habitats, as long as there is food available. Wolves generally travel in packs of up to 25 animals. The dominant male (alpha male) and dominant female (alpha female) are the decision-makers for the group, including the timing and location of hunting. A single territory for a pack can range between 100 to 600 square miles. On a single hunt they may travel over 50 miles in pursuit of food (Maas 1997).

June Sucker

The June sucker is endemic to Utah Lake and the Provo River in Utah (UDWR 2020a; USFWS 1999). Flow alterations, pollution, drought, and introduction of non-native fish have been identified as causes for decline (UDWR 2020a). Although June sucker are endemic to Utah Lake, the decline of the species has led to small population introductions in other locations in order to prevent extinction of the species. In 1986, the USFWS listed the June sucker as endangered and designated critical habitat for the species under the ESA (USFWS 1999; 51 FR 61). As its name suggests, the June sucker is a member of the sucker family; however, they are not bottom feeders (NatureServe 2019). The species feeds primarily on zooplankton in the middle of the water column. June suckers inhabit shallow and protected areas of Utah Lake, except when spawning (NatureServe 2019; Sigler and Sigler 1987). Spawning occurs in June in shallower riffles over coarse gravel and cobbles within lower portions of the Provo River (NatureServe 2019).

Yellow-billed Cuckoo

The yellow-billed cuckoo is listed as threatened under the ESA. The western yellow-billed cuckoo (YBCU) is a federally threatened distinct population segment (DPS) of the species that is

understood to occur in 13 states, including Utah. As the name suggests, this avian species has a yellow lower mandible. It has rufous wings that contrast against the gray-brown wing coverts and upperparts. The underparts are white and they have large white spots on a long black undertail (Alsop 2001). It is a neotropical migrant, which winters in South America. Breeding often coincides with the appearance of massive numbers of cicadas, caterpillars, or other large insects (Ehrlich et al. 1992). Yellow-billed cuckoos arrive in Utah in late May or early June and breed in late June through July. Cuckoos typically start their southerly migration by late August or early September (Parrish et al. 1999). Yellow-billed cuckoos are considered a riparian obligate and are usually found in large tracts of cottonwood/willow habitats with dense sub-canopies (below 33 feet) (UDWR 2020a). Suitable breeding and nesting habitat for the species must be at least 300-feet-wide and a minimum of 12 contiguous acres.

7 Effects of the Action

Gray Wolf

As described previously, gray wolves avoid interactions with humans. Given the Action Area is within a highly disturbed, urban area that has been significantly altered by suburban and agricultural influences, it does not contain suitable habitat for the gray wolf. As a result of the lack of suitable habitat conditions for the gray wolf, it is anticipated that the Proposed Project would have **no effect** on the gray wolf, nor on any suitable habitat for the species.

June Sucker

The water features in the Action Area (North Ogden Canal and manmade pond) do not provide habitat for the June sucker. The North Ogden Canal is not connected to any known fisheries in which the June sucker has been introduced. The existing manmade pond is not connected to any known water features, but is likely fed by a small spring, which is not connected to any known fisheries containing the June sucker. Given the lack of suitable habitat in the Action Area, it is anticipated that the Proposed Project would have **no effect** on the June sucker.

Yellow-billed Cuckoo

The Action Area contains no suitable habitat for the yellow-billed cuckoo. There are a few coyote willows scattered at the existing stormwater detention pond and the constructed pond within the Action Area. However, no large tracts of cottonwood and willow habitat exist within the Action Area. In addition, if any vegetative clearing is necessary for the implementation of the Proposed Project, it would occur outside of the breeding and nesting season. Given the lack of suitable habitat and timing of construction, it is anticipated that the Proposed Project would have **no effect** on the yellow-billed cuckoo.

8 Determination of Effects

After considering the available scientific information regarding the biological requirements and the status of ESA-listed species considered in this BE, the environmental baseline for the Action

Area and the proposed BMPs, the potential effects of the Proposed Project, the following effect determinations for gray wolf, June sucker, and yellow-billed cuckoo were made:

(1) For the gray wolf, the determination of **no effect**.
(2) For the June sucker, the determination of **no effect**.
(3) For the yellow-billed cuckoo, the determination of **no effect**.

9 Migratory Bird Treaty Act / Bald & Golden Eagle Protection Act

The Action Area contains three distinct but connected sites. While field investigations found no active nests of raptors or other migratory birds, the fringe wetland located around the constructed pond could provide temporary habitat as species migrate to more preferred habitat. The Proposed Project would be timed such that construction would avoid the active breeding and nesting seasons for migratory birds. If construction cannot be suitably scheduled, then surveys for active nests would be completed prior to the commencement of construction. If a nest were identified, the NRCS Biologist and USFWS would be contacted immediately to determine the appropriate course of action.

10 Conclusion

The Proposed Project to construct an irrigation reservoir, detention basin, associated system components and recreational facilities within North Ogden, Utah would be anticipated to have **no effect** on the gray wolf, the June sucker, and the yellow-billed cuckoo. The **no effect** determination for each species is based on one or more of the following reasons: the lack of recent records of occurrence, the lack of suitable habitat conditions within the Proposed Project Action Area, the scope and location of the Proposed Project, and the timing of construction. Lastly, it should be noted that the final authority for species effect determinations rests with the appropriate regulatory authority. If you have any questions regarding this analysis, please contact me at 801-886-9052 or via email at afoushee@jub.com.

11 References

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Utah Natural Heritage Program, Biodiversity Tracking and Conservation System. 2017. Utah's State Listed Species by County.

Appendix 1. Project Vicinity Map

Flood/Irrigation Water Inlet Pipe
Flood Water Outlet Pipe
Pump House & Public Amenities
Dual-Use Reservoir

North Ogden Watershed Plan EA

Preferred Alternative

N

0 500
Feet

J-U-B ENGINEERS, INC.

Appendix 2. Photo Inventory

North Ogden Watershed Plan Environmental Assessment
Photo Inventory

The following 14 photos were taken during two site visits conducted on April 4, 2018 and May 24, 2018.

Photo 1: The beginning extent of Site 1, the North Ogden Canal existing pump station, is depicted in this photo. At this point, irrigation water enters the pipeline that would be replaced as part of the project. The pump station would be updated as well.

Photo 2: An alternate view of the beginning extent of Site 1 is illustrated in this photo.

Photo 3: Another portion of Site 1 of the proposed project. The pipeline, which would be replaced as part of the project, is buried from the pump station and runs south along the edge of the right-of-way toward the existing stormwater detention basin.

Photo 4: Site 2 of the proposed project, the existing stormwater detention pond, is depicted in this photo.

Photo 5: From the northeast corner of the existing stormwater detention basin, the proposed irrigation pipeline would be placed around the outside edge of the detention basin berm (Site 2).

Photo 6: From the northwest corner of the existing stormwater basin, the proposed irrigation pipeline would turn south and continue along the outside edge of the detention basin berm (Site 2).

Photo 7: From the southwestern corner of the existing detention basin, the proposed pipeline would run through an agricultural property along the main gravel road into the property.

Photo 8: The gravel lot within proposed project boundary is a component of Site 3. This location would be the site for a portion of the proposed irrigation pond and detention basin.

Photo 9: Agricultural hay field through which the proposed pipeline, irrigation reservoir and stormwater detention basin would be constructed is the second component of Site 3.

Photo 10: Agricultural pastures through which the proposed pipeline, irrigation reservoir and stormwater detention basin reservoir would be constructed is the second component of Site 3.

Photo 11: Field adjacent to existing constructed pond.

Photo 12: Emergent wetland vegetation on the perimeter of the constructed pond (Site 3).

Photo 13: View over the existing constructed pond at Site 3.

Photo 14: View over existing constructed pond located at Site 3. (April 2018)

Appendix 3. USFWS IPaC Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331
http://www.fws.gov
http://www.fws.gov/utahfieldoffice/

In Reply Refer To: June 30, 2020
Consultation Code: 06E23000-2020-SLI-0433
Event Code: 06E23000-2020-E-01623
Project Name: North Ogden Project

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

Project Summary

Consultation Code: 06E23000-2020-SLI-0433

Event Code: 06E23000-2020-E-01623

Project Name: North Ogden Project

Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Description: The proposed project action would include the construction of a reservoir. Pressurization of the irrigation delivery system would be from the existing diversion on the North Ogden Canal and pump station. The stormwater system improvements would include the piping of the diversion structure, associated outlet works and discharge pumping equipment.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/41.30430918433146N111.9742539661813W

Counties: Weber, UT

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Brewer's Sparrow *Spizella breweri* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9291	Breeds May 15 to Aug 10

NAME	BREEDING SEASON
Green-tailed Towhee *Pipilo chlorurus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9444	Breeds May 1 to Aug 10
Virginia's Warbler *Vermivora virginiae* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9441	Breeds May 1 to Jul 31
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5
Willow Flycatcher *Empidonax traillii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3482	Breeds May 20 to Aug 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ “Proper Interpretation and Use of Your Migratory Bird Report” before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence

in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

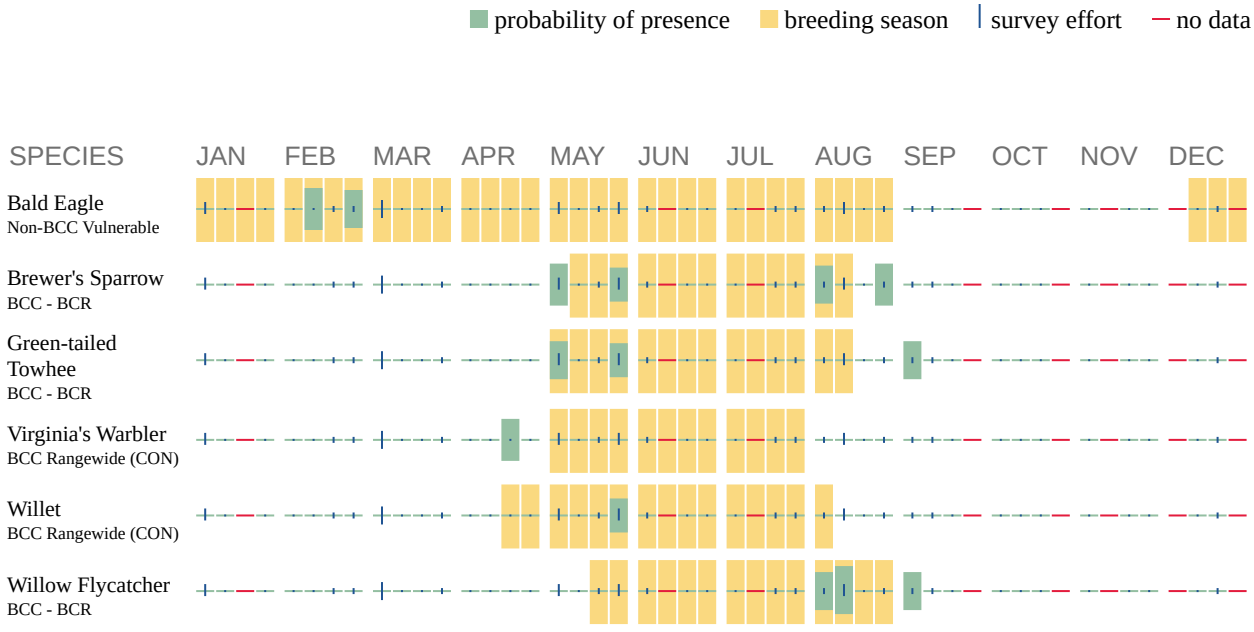
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.
Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical

Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331

In Reply Refer To:
Project Code: 2023-0070535
Project Name: North Ogden Project

April 18, 2023

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

PROJECT SUMMARY

Project Code: 2023-0070535
Project Name: North Ogden Project
Project Type: Stream/Waterbody - Channel/Diversion Structures
Project Description: The proposed project action would include the construction of a reservoir. Pressurization of the irrigation delivery system would be from the existing diversion on the North Odgen Canal and pump station. The stormwater system improvements would include the piping of the diversion structure, associated outlet works, and discharge pumping equipment.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@41.30495675,-111.97413499960811,14z

Counties: Weber County, Utah

ENDANGERED SPECIES ACT SPECIES

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPAC USER CONTACT INFORMATION

Agency:	J-U-B Engineers, Inc.
Name:	Kira Coff
Address:	392 Winchester Street
Address Line 2:	Ste. 300
City:	Salt Lake City
State:	UT
Zip:	84107
Email	kcoff@jub.com
Phone:	8018869052

Appendix 4. Utah Natural Heritage Program Online Species Search Report

Utah Division of Wildlife Resources
Utah Natural Heritage Program
1594 W. North Temple
PO Box 146301
Salt Lake City, UT 84116

Report Number: 1471
June 30, 2020

Utah Natural Heritage Program Online Species Search Report

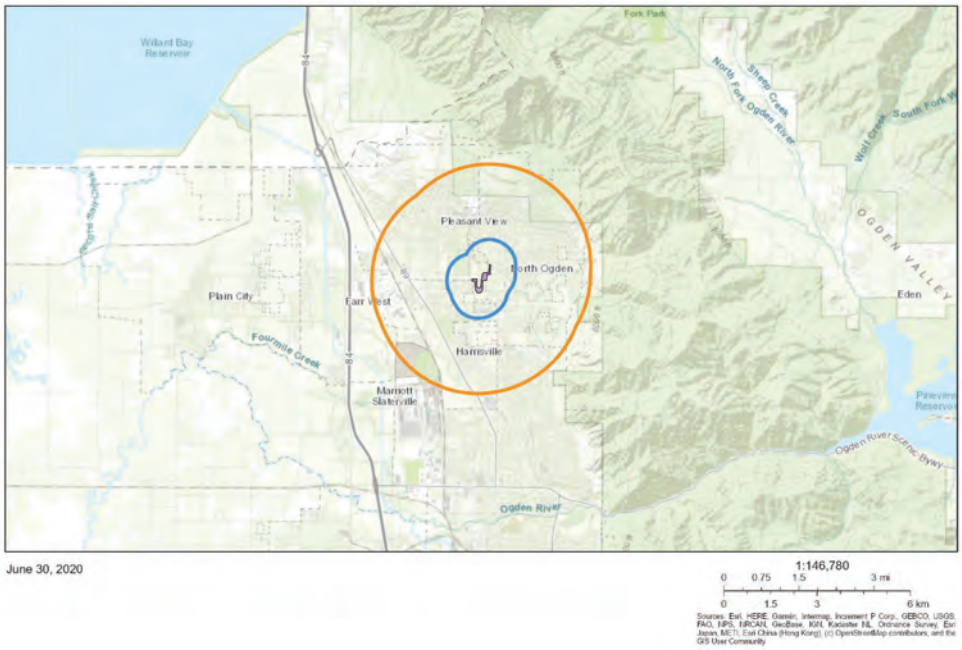
Project Information

Project Name
North Ogden Project

Project Description

The proposed project action would include the construction of a reservoir. Pressurization of the irrigation delivery system would be from the existing diversion on the North Ogden Canal and pump station. The stormwater system improvements would include the piping of the diversion structure, associated outlet works and discharge pumping equipment.

Location Description
North Ogden, Utah



Animals within 1/2 mile radius

Common Name	Scientific Name	State Protection Status	U.S. ESA Status	Last Observation Year
Grasshopper Sparrow	Ammodramus savannarum	SPC		1893

Plants within a 1/2 mile radius

Common Name	Scientific Name	State Protection Status	U.S. ESA Status	Last Observation Year
No Species Found				

Animals within a 2 mile radius

Common Name	Scientific Name	State Protection Status	U.S. ESA Status	Last Observation Year
Grasshopper Sparrow	Ammodramus Savannarum	SPC		1893

Plants within a 2 mile radius

Common Name	Scientific Name	State Protection Status	U.S. ESA Status	Last Observation Year
No Species Found				

Definitions

State Protection Status

S-ESA	Federally-listed or candidate species under the Endangered Species Act
SPC	Wildlife species of concern
CS	Species receiving special management under a Conservation Agreement in order to preclude the need for Federal listing

U.S. Endangered Species Act

LE	A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction
LT	A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered
LE;XN	An "endangered" taxon that is considered by the U.S. Fish and Wildlife Service to be "experimental and nonessential" in its designated use areas in Utah
C	A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as endangered or threatened
PT/PE	A taxon "proposed" to be listed as "endangered" or "threatened" by the U.s. Fish and Wildlife Service

Disclaimer

The information provided in this report is based on data existing in the Utah Division of Wildlife Resources' central database at the time of the request. It should not be regarded as a final statement on the occurrence of any species on or near the designated site, nor should it be considered a substitute for on-the-ground biological surveys. Moreover, because the Utah Division of Wildlife Resources' central database is continually updated, any given response is only appropriate for its respective request.

The UDWR provides no warranty, nor accepts any liability, occurring from any incorrect, incomplete, or misleading use of these data.

The results are a query of species tracked by the Utah Natural Heritage Program, which includes all species listed under the US Endangered Species Act and species on the Utah Sensitive Species List. Other significant wildlife values might also be present on the designated site. Please contact UDWR's regional habitat manager if you have any questions.

Contact the U.S. Fish and Wildlife Service at (801) 975-3330 for the purpose of consultation under the Endangered Species Act.

Please contact our office at (801) 538-4759 or habitat@utah.gov if you require further assistance.

Your project is located in the following UDWR region(s): Northern region

Report Generated for:
Lexie Yoder
J-U-B Engineers, Inc.
422 W Riverside Ave Suite 304
Spokane, WA 99201
(509) 458-3727
lyoder@jub.com

Technical Memorandum No.1

J·U·B ENGINEERS, INC.

TECHNICAL MEMORANDUM 001

Date:	December 12, 2022
To:	NRCS - Utah
Cc:	
From:	Bryce Wilcox, PE J-U-B Engineers, Inc.
Project:	North Ogden Project Plan-EA
Subject:	Technical Memorandum No. 001 - Hydraulics and Hydrology

Revision No.	Revision Date	Note
1	2/14/2020	First Draft Sent to NRCS for Review
2	3/9/2020	Revised and Resubmitted to NRCS
3	9/21/2020	Revised and Resubmitted to NRCS
4	11/19/2020	Revised and Resubmitted to NRCS
5	5/3/2021	Revised and Resubmitted to NRCS
6	12/12/2022	Revised and Resubmitted to NRCS

1.0 Introduction

The Weber-Box Elder Conservation District (District) contracted with J-U-B Engineers, Inc. (J-U-B) to complete a Supplemental Watershed Plan-Environmental Assessment (Plan-EA) of the North Pine Reservoir. Part of the Scope of Work includes analysis of the hydraulics and hydrology for both flood water and agricultural water management.

1.1 Purpose

The purpose of Technical Memorandum (TM) No. 001 is to present a summary of the methodology and results of the flood water and agricultural water hydraulics and hydrology analysis conducted for the North Pine Reservoir in support of the Plan-EA. The information presented in this TM will be used to determine flood and agricultural water needs for the project.

2.0 Flood Water Analysis

The flood water system was analyzed as part of the North Ogden City Corporation Storm Water Capital Facilities Plan. Refer to the Storm Water Capital Facilities Plan completed by Jones and Associates in December 2018 for a more detailed report on the flood water modeling and analysis.

2.1 North Ogden System Overview

The North Ogden flood control system currently serves all areas within the city boundaries as shown in Figure 1. Six main drainage channels convey water through the city. They are Barrett Canyon, Willow Springs, Mountain Water, Rice Creek, North Ogden Canyon, and Coldwater.

These drainage channels are collected and the flood waters are transferred through the North Ogden system. The city has constructed large regional basins to hold water from large storm events. These regional basins act as debris basins and detention basins to restrict downstream flows and prevent flooding of the city. These basins vary in size based on the capacity of the existing channels and pipes. Most of these basins are located within the city limits and not necessarily at the base of a canyon.

2.2 North Ogden System Model

The North Ogden drainage system was modeled by North Ogden City as part of their Storm Water Capital Facilities Plan. The method selected for modeling their study was HEC-1 and a list of the input parameters can be found in Capital Facilities Plan. The parameters include soil conditions, rainfall loss methods, storm events, rainfall distribution, and lag time. The Capital Facilities Plan states “After collaboration with consultants that work with the Federal Emergency Management Agency (FEMA) it was decided to analyze the city’s drainage system using the (NOAA) 6-hour storm event with a Temporal Distribution Area 1, 2nd Quartile, 50% probability for the Semiarid Southwest.” These are the storm and hydrographs that were used in the model. Since the North Pine Reservoir lies within the North Ogden drainage system, it was reasonable to use the same storm and model to size the North Pine Reservoir. Pipe capacities are typically sized for the 10-year storm and detention facilities are typically sized for the 25-year storm event.

2.2 Flood Model

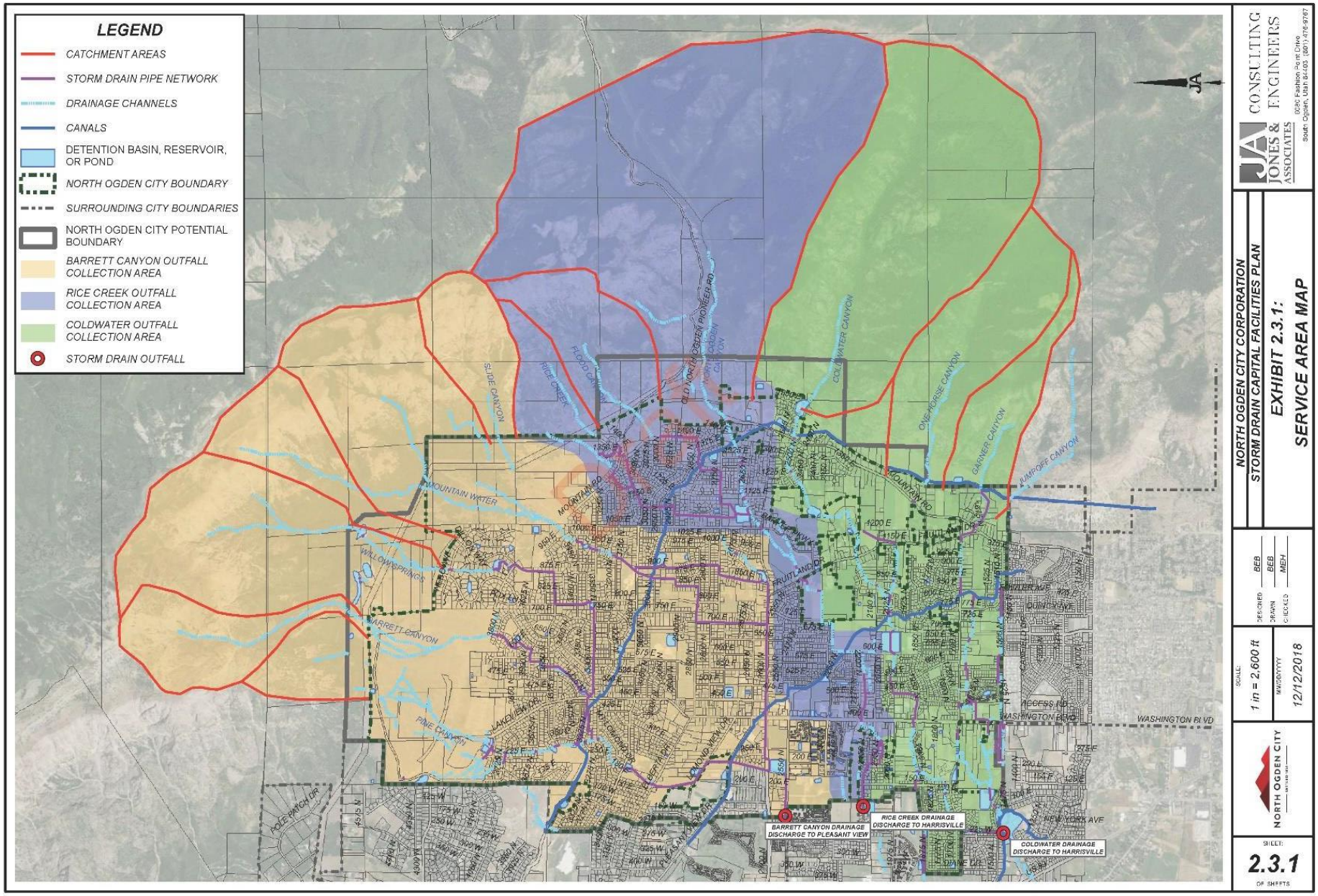
J-U-B analyzed the existing detention pond located at 2700 N and 200 E in North Ogden to determine flooding limits during various storm events. The system was then analyzed with the proposed detention pond with the same storm events.

The North Ogden drainage model was completed in Water Modeling System (WMS) by Jones and Associates in 2018. The WMS model was utilized for this evaluation to determine the inflow hydrographs of the existing detention pond for the 500-, 100-, 50-, 25-, 10-, 5-, and 2-year storm events. The hydrographs are in Table 6 to Table 12 at the end of the memo. Jones and Associates also provided pipe size, pipe alignment, and rim and invert elevations for the existing drainage system.

2.2.1 Existing System Model Analysis

The inflow hydrographs were input into an Infoswmm model, which was used to model the routing of water through the existing 18.9 ac-ft pond including the outlet piping and the emergency overflow weir. The stage storage curve for the existing detention pond was delineated from 2011 lidar data and was input into the model. The existing detention pond outlets through a 15” orifice into the UDOT drainage system in 2700 North. The storm drain piping in 2700 North flows to the West and eventually drains into the Western Canal. There is also a 24” outlet on the Southwest corner of the existing pond that outlets to the storm drain system in 2550 North. This system also flows to the West and discharges to the Western Canal. The Western Canal eventually discharges into the Great Salt Lake. There is an emergency overflow that spills onto 2700 North. Any flows would then enter the UDOT system or continue West to the Western Canal.

Figure 1: North Ogden City Flood Control and Storm Drain Service Area



The Infoswmm model identified the peak flooding rates discharging from the existing detention pond or downstream piping for the above referenced storm events.

Table 1 below shows the totalized flooding flows and volumes for each of the storm events. Flooding was identified as flow over the emergency spillway of the existing detention pond and flows spilling from manholes in the Infoswmm model. Flooding over the principal spillway to 2700 North and out the top of the manhole downstream of the outlet works on 2550 North during the existing 50-, 100-, and 500-year storm events. Both storm drain systems in 2550 North and 2700 North are at or exceed system capacity for these storm events and the flood waters are conveyed through the roadways to the west along 2550 North and 2700 North. The area between 2550 North and 2700 North is flooded, See Figures 6 and 8. This is mainly due to no curb and gutter or roadside drainage swale along 2550 North for approximately 1,000 feet before curb and gutter begins to the west of the existing detention basin. The existing 500-year flood path travels west similar to the existing 50- and 100-year flood events but, also flows to the southwest, See figure 4. The flood flows were then loaded into a Surface-water Modeling System (SMS) model. Flooding depth in roadways and at structures varies, see table 2 for existing flooding impacts.

Table 1: Totalized Flooding For Existing Scenario

Storm Event	Sum Peak Flooding (cfs)	Flooding Volume (ac-ft)	Peaking Time / Flooding Duration (hrs)
2 Year	0.0	0.0	0.00 / 0.00
5 Year	0.0	0.0	0.00 / 0.00
10 Year	0.0	0.0	0.00 / 0.00
25 Year	0.0	0.0	0.00 / 0.00
50 Year	8.4	2.6	2.08 / 6.00
100 Year	53.4	8.22	2.08 / 8.83
500 Year	547.7	117.7	2.50 / 11.92

The SMS model is a 2-dimmensional surface water model that calculates where water will travel in all directions via overland flow. Figure 4 to Figure 8 show the results from the SMS model are included at the end of the memo. The SMS model was used to identify the number of structures and agricultural land that would be flooded during each storm event. Table 2 identifies the total number of homes, commercial buildings, and acres of agriculture land that would be flooded with the existing detention pond.

Table 2: Summary of Flooding Impacts of Existing Detention Pond

Storm Event	Depth Ranges	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Number of Residential Homes Flooded	< 0.5	0	0	0	0	0	0	11
	0.5 - 1	0	0	0	0	36	24	218
	1 - 3	0	0	0	0	9	34	53
	> 3	0	0	0	0	0	0	1
Number of Commercial Properties Flooded	< 0.5	0	0	0	0	0	0	2
	0.5 - 1	0	0	0	0	0	3	9
	1 - 3	0	0	0	0	0	5	1
	> 3	0	0	0	0	0	0	0
Number of Apartment Buildings Flooded	< 0.5	0	0	0	0	0	0	0
	0.5 - 1	0	0	0	0	0	0	2
	1 - 3	0	0	0	0	0	0	0
	> 3	0	0	0	0	0	0	0
Total Acres of Ag Land Flooded	< 0.5	0	0	0	0	0	0	0
	0.5 - 1	0	0	0	0	0.8	15.0	16.0
	1 - 3	0	0	0	0	0	9.9	66.4
	> 3	0	0	0	0	2.7	0	21.5
Maximum Flood Depth (Feet)		0	0	0	0	2.4	2.7	3.0

2.2.2 Proposed System Model Analysis

The existing detention pond was removed from the Infoswmm model and replaced with the proposed detention pond to compare flooding impacts. The capacity of the proposed detention pond is 22 ac-ft, with an additional 10 ac-ft capacity in the Pineview Irrigation portion of the pond that can be pumped down prior to a storm event. Long-range forecasting would be used to determine the need for pumping the detention pond down prior to a storm event. The existing Unit I system demand is 28 ac-ft per day (20.5 ac-ft from North Pine and 7.5 ac-ft from West View) This water would be supplied through the pressure irrigation system and applied by users in Unit I. The District would need to reduce the supply to the pond by 5 cfs for one day in order for the pump station to pump down the pond to create the additional 10 acre-feet of storage for a storm event. A standard operation procedure will be developed for North Ogden City to notify the District 24-48 hours in advance of a forecasted storm event to adjust operations to increase the capacity for storage in the pond.

The storm events listed above were routed through the proposed piping and the proposed detention pond and the flooding totals were calculated. Table 3 shows the totalized flood flows and volumes for this scenario.

Storm Event	Sum Peak Flooding (cfs)	Flooding Volume (ac-ft)	Peaking Time / Flooding Duration (hrs)
2 Year	0	0	0 / 0
5 Year	0	0	0 / 0
10 Year	0	0	0 / 0
25 Year	0	0	0 / 0
50 Year	0	0	0 / 0
100 Year	16.3	2.7	1.25 / 3.17
500 Year	483.0	106.4	3.17 / 5.42

The flows from Table 3 were loaded into the SMS model to determine the flooding extents for each of the storm events. Table 4 shows the totalized impacts of the storm event scenarios in the SMS model

Table 4: Summary of Flooding Impacts of Proposed Detention Pond

Storm Event	Depth Ranges	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Number of Residential Homes Flooded	<0.5	0	0	0	0	0	3	12
	0.5 - 1	0	0	0	0	0	34	207
	1 - 3	0	0	0	0	0	12	35
	>3	0	0	0	0	0	0	0
Number of Commercial Properties Flooded	<0.5	0	0	0	0	0	0	2
	0.5 - 1	0	0	0	0	0	3	8
	1 - 3	0	0	0	0	0	3	1
	>3	0	0	0	0	0	0	0
Number of Apartment Buildings Flooded	<0.5	0	0	0	0	0	0	0
	0.5 - 1	0	0	0	0	0	0	2
	1 - 3	0	0	0	0	0	0	0
	>3	0	0	0	0	0	0	0
Total Acres of Ag Land Flooded	<0.5	0	0	0	0	0	0	0.1
	0.5 - 1	0	0	0	0	0	1.6	21.1
	1 - 3	0	0	0	0	0	2.7	64.3
	>3	0	0	0	0	0	0	16.5
Maximum Flood Depth (Feet)		0	0	0	0	0	1.0	2.2

2.3 Flood Control Ponds and Flood Route

To be able to control and minimize flooding, North Ogden City needs a 22-acre-foot pond to act as a debris/detention pond. This pond will restrict outflows into the piped system to reduce the risk of downstream flooding. The detention pond is being moved to a new location and the existing pond will be decommissioned. To keep the flood path the same from the major storm events, concrete boxes with weir walls and restrictions will be installed on the piping system at 2550 North and at 2700 North street crossings. At 2700 North the restriction to the pond will be 125 cfs with flows above 125 cfs going into the piped system in 2700 North or be conveyed in the roadway. At 2550 North the restriction to the pond will be 75 cfs with flows above 75 cfs going into the piped system in 2550 North or be conveyed in the roadway.

2.4 Spillways

The main spillway for the pond will be a concrete box structure located inside of the pond. The concrete structure will be piped through the embankment and connect onto the storm drain system of North Ogden City. The storm drain system has a maximum capacity of 20 cfs. Flows above 20 cfs will be detained in the pond and released at 20 cfs.

The auxiliary spillway is designed to for 150 cfs. The width of the auxiliary spillway is 30 feet. The auxiliary spillway will be concrete-lined from inside the pond to the street approximately 15 feet away. The auxiliary spillway will match the slope of the embankment at 4:1 or 25%. All of the spillway area will be protected with a concrete liner and discharged onto an asphalt street. With concrete liner, asphalt, and low berm height, there is very minimal, if any, threat of eroding the embankment from flows in the auxiliary spillway.

3.0 Agricultural Water Analysis

The Weber-Box Elder Conservation District provides pressure irrigation for lawn and garden use in North Ogden and surrounding cities. The system has been modeled for current and futures demands. A summary of the model is given in sections 3.1 to 3.3. For additional information see the preliminary design report completed in 2018 by J-U-B Engineers.

3.1 District System Overview

The system will provide pressure irrigation water for Unit I of the District's system. Unit I has an area of 2,753 acres and serves 2,309 parcels. Irrigation water will be delivered to the North Pine Reservoir from the North Ogden Canal to the storage pond beginning at a rate of 5 cfs. This will increase over time to approximately 9 cfs as demand on the pressure irrigation system increases with development. The irrigation water will be brought from the canal to the flood control piping in two locations. Through an existing 36" pipe and a 12" pipe.

The West View Reservoir is an existing pond that currently serves the Unit I service area and is located at 1248 West and Pleasant View Drive. This reservoir will remain in service after North Pine reservoir is constructed and brought in service. The West View Reservoir has 7.4 ac-ft of storage and is supplied water from the North Ogden Canal. The Unit I service area is provided water from the West View Reservoir and Pressure Reducing Valves (PRV's) from Unit C. It is anticipated that when the pump station at the North Pine Reservoir is completed, the PRV's will be decommissioned.
Although the West View Reservoir is smaller than the proposed North Pine Reservoir, it fills directly from the canal and is able to stay full throughout the day. The North Pine Reservoir is at the end of the North Ogden Canal.

3.2 Pressure Irrigation Model

The system was modelled using 8.5 gpm per developed acre for the peak hour demand for the existing and future buildout scenarios. This demand was calculated by using a water meter from the West View Reservoir pump station and dividing the peak hour flowrate by the total developed parcel acreage of the service area for the West View Reservoir. This demand factor was then used for all of the parcel areas in Unit I. The existing peak hour demand is 9,470 gpm. The future peak hour demand is 20,950 gpm. The HGL elevation of the pumps must maintain the same pressures in the existing Unit I system of 70 psi or 162' of head.

The storage requirement to meet the demand in Unit I is 28.0-acre feet. The water will be stored in two ponds and then pumped into the existing piped system. Most of the piping for Unit I is currently in place. Only a few distribution pipes near the pump house for the North Pine Reservoir are needed to operate the pump station. Figure 2 shows the existing distribution system as obtained from the pipe network model. Figure 3 shows the future distribution system. Table 5 below shows how the values for demand, reservoir volume, and hydraulic grade lines (HGL) are split between the existing West View pump station and the proposed North Ogden booster pump station.

Table 5. Unit I Pump Station Summary

Category	Total Unit I	West View Pump Station	North Pine Pump Station
Total Area	2,753 Acres	1,025 Acres	1,728 Acres
Existing Developed Area	888 Acres	398 Acres	490 Acres
Existing Peak Instantaneous (8.5 gpm/developed acre)	7,550gpm	3,386 gpm	4,164 gpm
Future Developed Area	2,464	398 Acres	2,066 Acres
Future Peak Instantaneous (8.5 gpm/developed acre)	20,950 gpm	3,386 gpm	17,564 gpm
Reservoir Volume	28.0 Ac-ft	7.5 Ac-ft	20.5 Ac-ft
HGL (From pump station)	-	4,529 ft	4,506 ft

3.3 Agricultural Requirements

To meet the agricultural demands on the system, a 20.5 acre-foot irrigation water storage pond will need to be constructed. A pump station will also need to be constructed that is capable of delivering the required peak day and peak hour demands and match the existing system pressure.

3.4 Agricultural Water Savings

In July 2017 an evaluation was made of the undeveloped parcels in the Service Area boundary for Unit I of the District. In this evaluation, there were 24 large, undeveloped parcels identified with a sum of 837 Acres. This equates to 30% of the 2,753 Acres of the intended Unit I Service Area.

The current allocation of water according to the State Division of Water Rights for Irrigation use is 4.0 acre-feet per acre per year (see Utah Duty Values Map, Utah Division of Water Rights). The District has determined that their usage with pressure irrigation is approximately 2.0 acre-feet per acre. (A nearby secondary water company, Weber Basin Water Conservancy District has shown amounts as low as 1.6 acre-feet per acre per year). This reduction is due to the efficiency of pressure irrigation systems and conservation efforts of the users.

At 4.0 acre-feet per acre per year, the 837 Acres of un-developed land would have used approximately 3,348 acre-feet per year with flood irrigation. As development occurs and irrigation use changes from flood irrigation to pressure irrigation, the overall usage of water will decrease. At 2.0 acre-ft per acre for developed property for irrigation, the 837 acres will then use 1,674 acre-feet of water in a year. By converting from flood irrigation to pressure irrigation, a water savings of 1,674 acre-feet per year will be recognized. Water saved by converting from flood irrigation to pressure irrigation will allow the water to be stored in Pineview Reservoir and will provide drought resiliency for the irrigation district.

Figure 2: Weber-Box Elder Conservation District Unit I Existing System

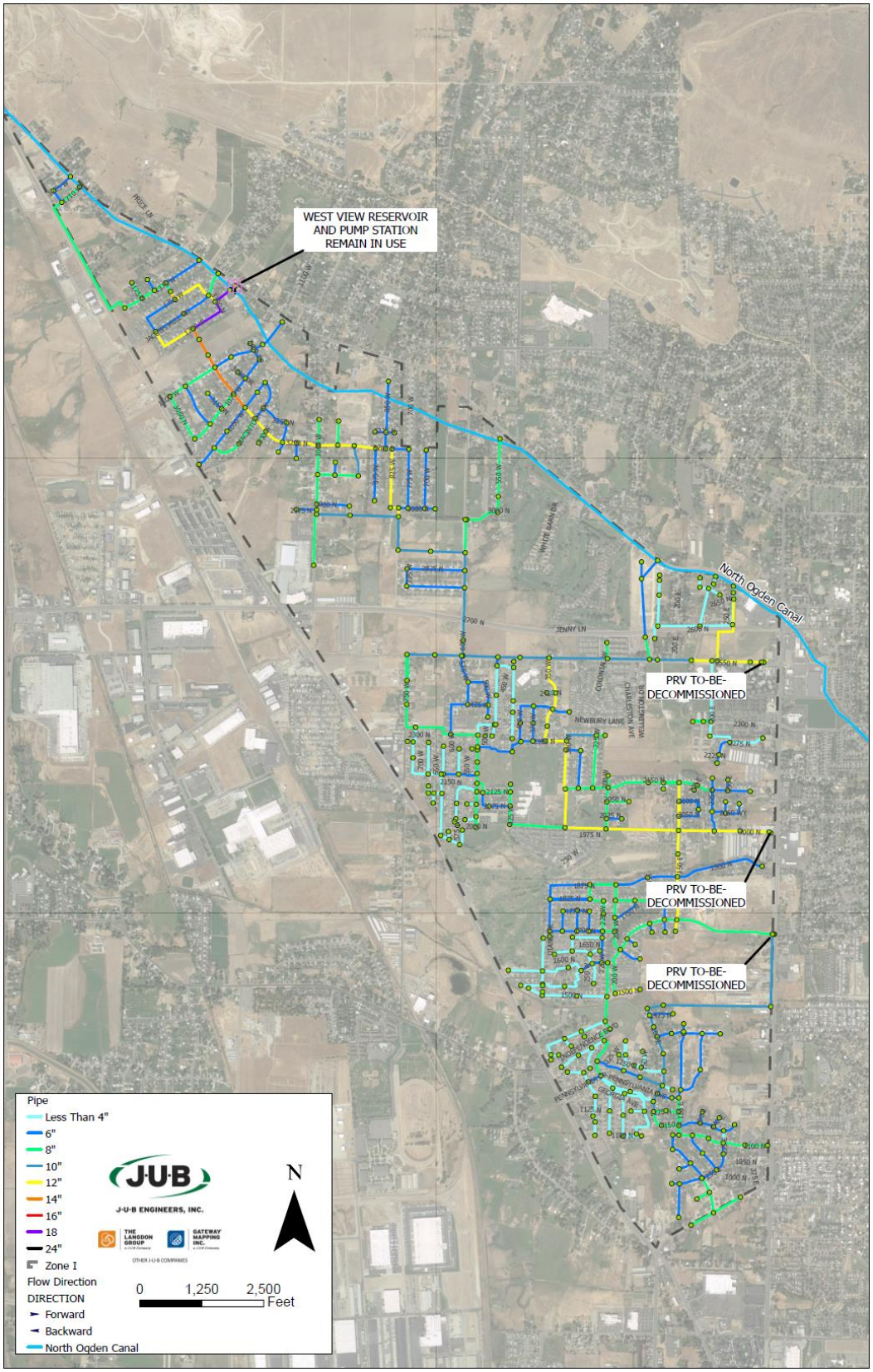
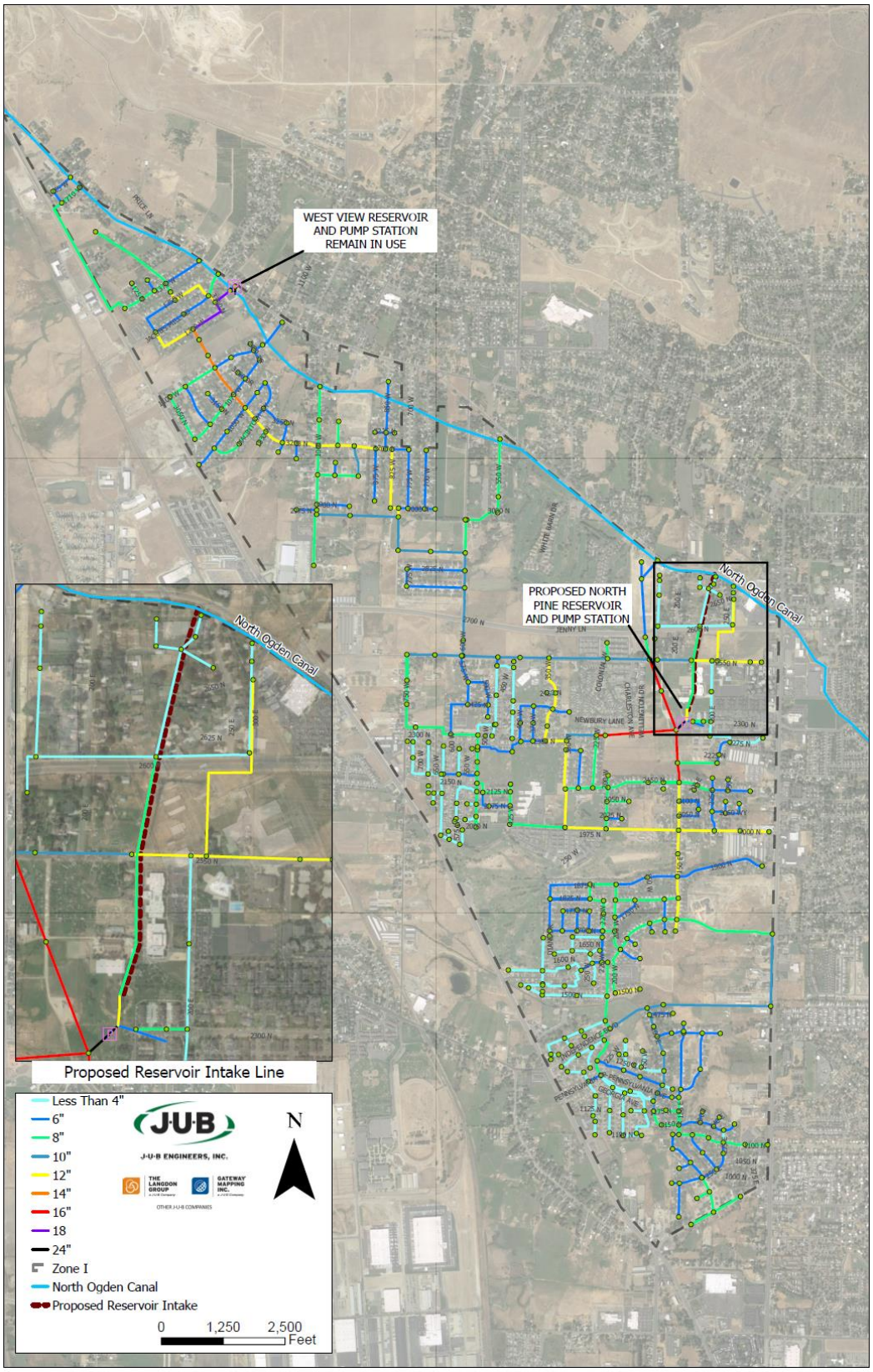


Figure 3: Weber-Box Elder Conservation District Unit I Proposed System



4.0 Conclusions

This report presents a summary of the methodology and results of the flood water and agricultural water hydraulic and hydrology analysis conducted for North Pine Reservoir as part of the Plan-EA. Key results of the analyses include the following:

- Flood water detention requirement is 22 acre-feet
- Irrigation storage water requirement is 20.5 acre-feet
- The water storage systems may be combined into one pond with 20.5 acre-feet for irrigation on the bottom and 22 acre-feet of capacity on top for flood control.
- Irrigation demand of 8.5 gpm/developed acre
- Pump station to match existing system pressure of 70 psi.
- Pump station to be capable of delivering peak instantaneous flow of 17,564 gpm.

5.0 Statement of Limitations

This document represents J-U-B Engineers, Inc.'s professional judgement based on the information available at the time of its completion and as appropriate for the project Scope of Work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. No warranty, express or implied, is made.

6.0 References

Infowater Suite Version 12.4, Innovyze, 2019

ESRI ArcMAP Version 10.6.1

Figure 4: Existing 500-year Floodplain Depths (ft)

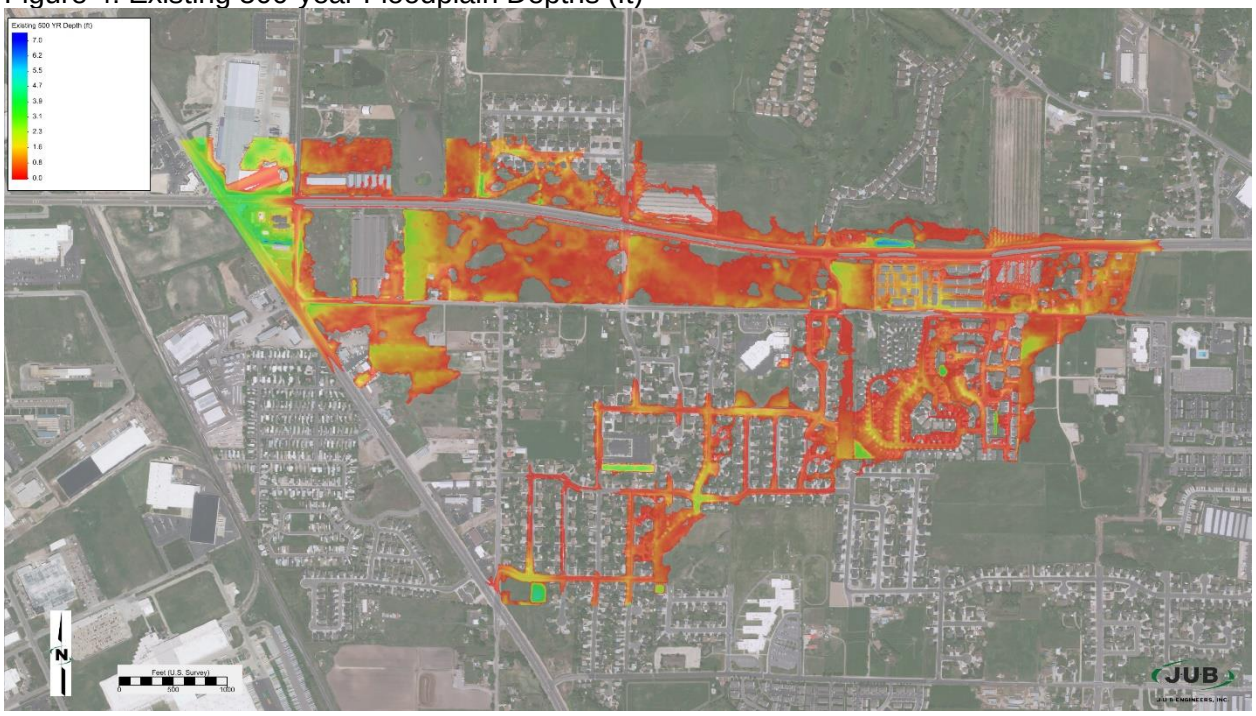


Figure 5: Proposed 500-year Floodplain Depths (ft)

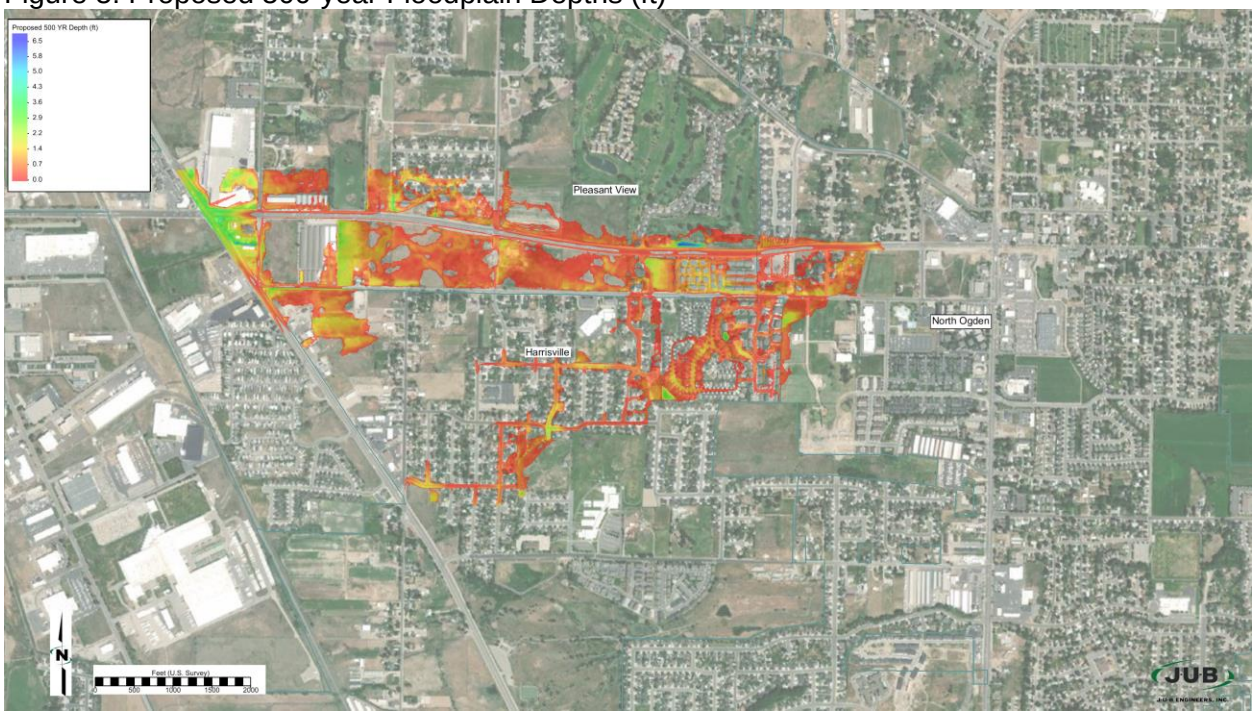


Figure 6: Existing 100-year Floodplain Depths (ft)

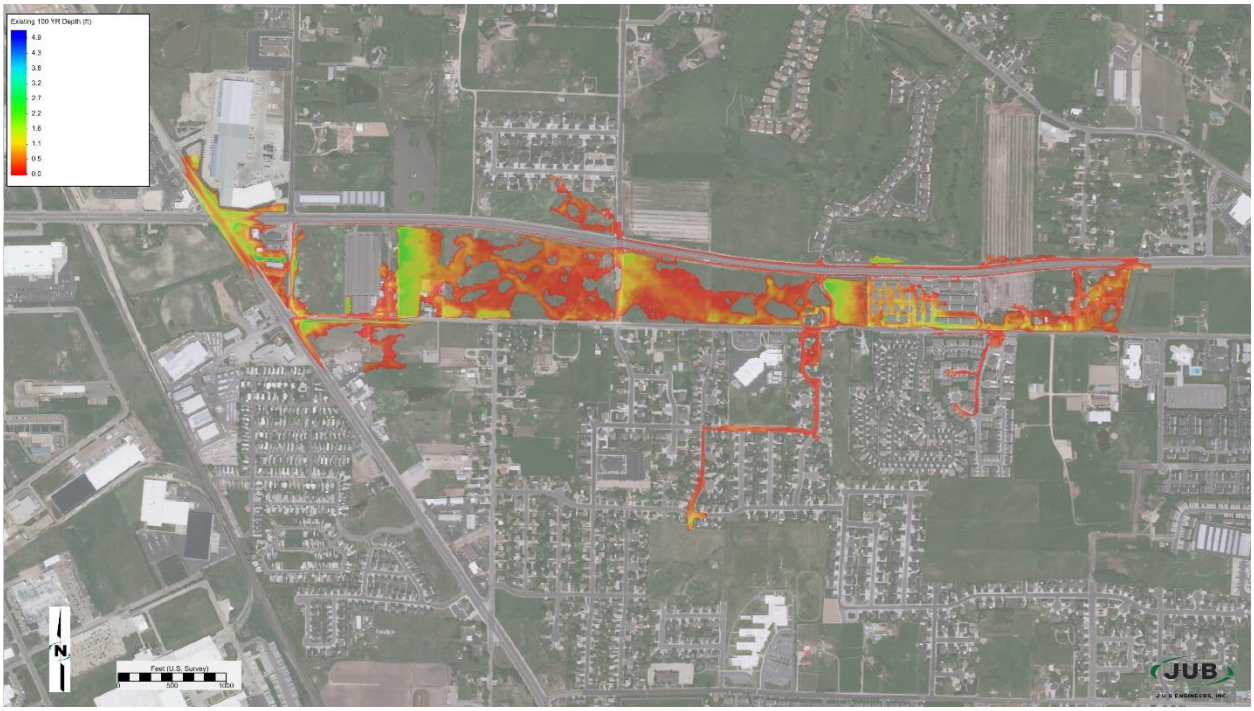


Figure 7: Proposed 100-year Floodplain Depths (ft)

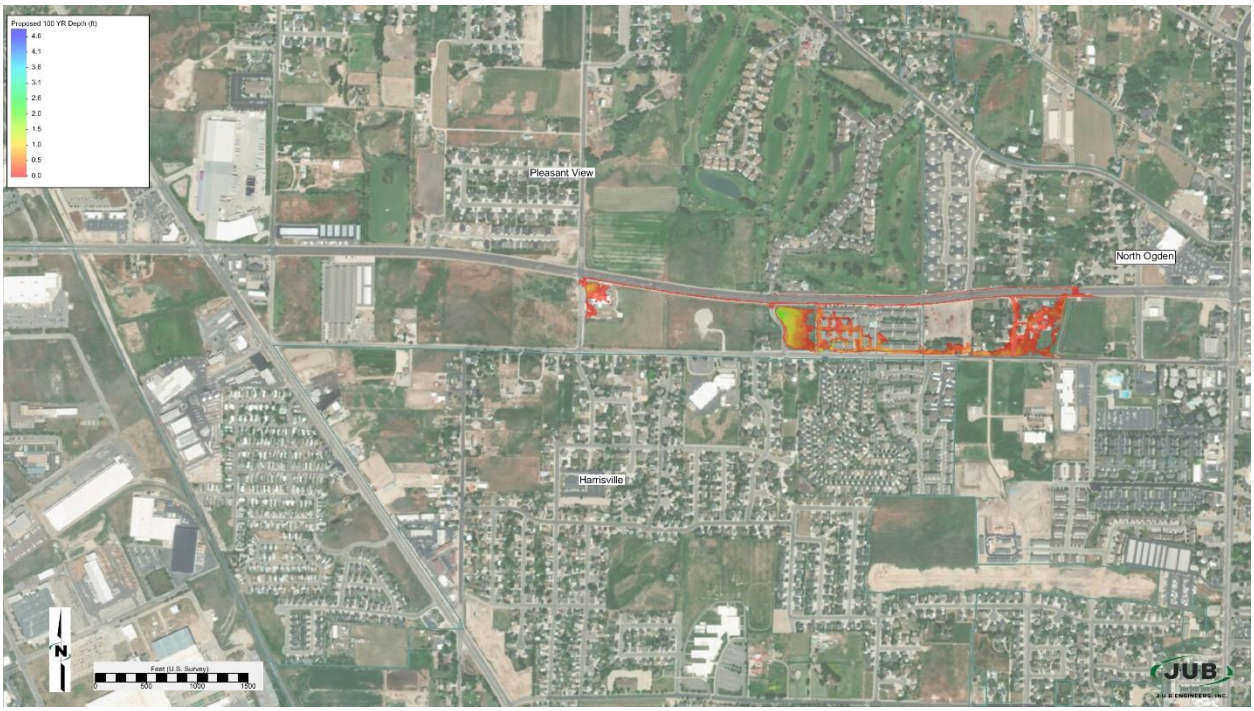


Figure 8: Existing 50-year Floodplain Depths (ft)

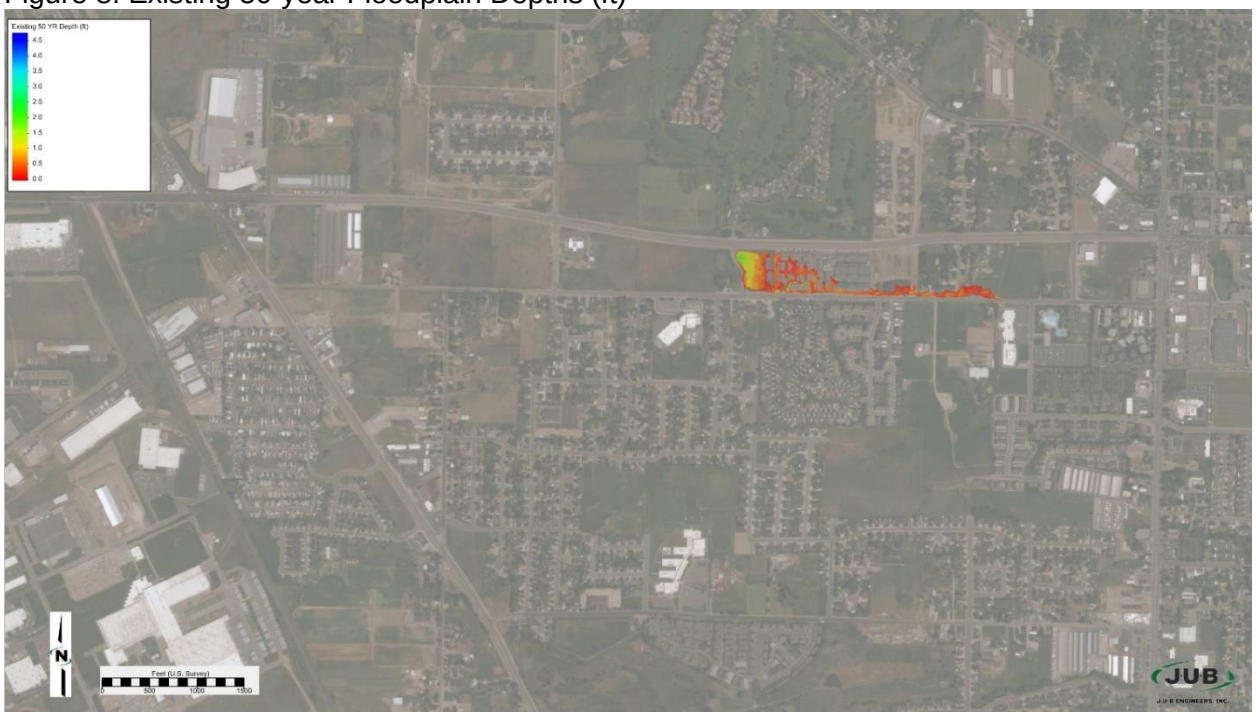


Table 6: 500-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	305.5	360	617.7	540	84.4	720	56.5	900	43.0	1080	32.6
5	0.1	185	326.6	365	609.5	545	82.9	725	56.1	905	42.7	1085	32.4
10	0.8	190	342.9	370	596.8	550	81.5	730	55.6	910	42.4	1090	32.1
15	3.3	195	355.5	375	574.2	555	80.1	735	55.2	915	42.1	1095	31.9
20	8.0	200	361.5	380	538.7	560	78.7	740	54.8	920	41.7	1100	31.6
25	13.9	205	363.3	385	492.0	565	77.4	745	54.3	925	41.4	1105	31.4
30	20.0	210	363.8	390	443.9	570	76.0	750	53.9	930	41.1	1110	31.2
35	25.8	215	363.9	395	397.1	575	74.7	755	53.5	935	40.8	1115	30.9
40	31.2	220	363.6	400	352.6	580	73.4	760	53.1	940	40.5	1120	30.7
45	36.2	225	365.1	405	316.3	585	72.1	765	52.7	945	40.2	1125	30.5
50	41.2	230	372.5	410	287.5	590	70.9	770	52.3	950	39.9	1130	30.2
55	45.9	235	380.8	415	261.7	595	69.6	775	51.9	955	39.6	1135	30.0
60	50.3	240	390.3	420	237.9	600	68.7	780	51.5	960	39.3	1140	29.8
65	54.6	245	401.5	425	216.6	605	68.0	785	51.1	965	39.0	1145	29.5
70	58.9	250	414.0	430	198.4	610	67.5	790	50.7	970	38.7	1150	29.3
75	63.5	255	428.8	435	183.9	615	67.0	795	50.3	975	38.4	1155	29.1
80	68.6	260	447.8	440	172.0	620	66.4	800	49.9	980	38.1	1160	28.9
85	74.1	265	470.1	445	161.4	625	65.9	805	49.5	985	37.8	1165	28.6
90	79.8	270	490.2	450	152.7	630	65.3	810	49.2	990	37.5	1170	28.4
95	85.9	275	507.5	455	145.4	635	64.8	815	48.8	995	37.3	1175	28.2
100	92.3	280	523.5	460	138.6	640	64.3	820	48.4	1000	37.0	1180	28.0
105	99.4	285	537.7	465	132.2	645	63.8	825	48.1	1005	36.7	1185	27.8
110	107.3	290	551.1	470	126.2	650	63.3	830	47.7	1010	36.4	1190	27.5
115	115.8	295	564.3	475	120.7	655	62.8	835	47.4	1015	36.1	1195	27.3
120	124.6	300	574.7	480	115.9	660	62.2	840	47.0	1020	35.8	1200	27.1
125	133.7	305	583.3	485	111.8	665	61.7	845	46.7	1025	35.5	1205	26.9
130	143.2	310	594.4	490	108.3	670	61.2	850	46.3	1030	35.3	1210	26.7
135	153.7	315	609.7	495	105.0	675	60.7	855	46.0	1035	35.0	1215	26.5
140	165.2	320	627.0	500	101.9	680	60.3	860	45.7	1040	34.7	1220	26.3
145	177.6	325	641.8	505	99.0	685	59.8	865	45.3	1045	34.4	1225	26.0
150	190.6	330	649.7	510	96.2	690	59.3	870	45.0	1050	34.2	1230	25.8
155	203.7	335	650.4	515	93.6	695	58.8	875	44.7	1055	33.9	1235	25.6
160	216.6	340	646.5	520	91.3	700	58.4	880	44.3	1060	33.6	1240	25.4
165	229.1	345	640.1	525	89.2	705	57.9	885	44.0	1065	33.4	1245	25.2
170	245.5	350	632.7	530	87.5	710	57.4	890	43.7	1070	33.1		
175	276.5	355	625.0	535	85.9	715	57.0	895	43.3	1075	32.9		

Table 7: 100-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	149.1	360	173.5	540	64.6	720	44.2	900	33.4	1080	25.3
5	0.1	185	154.9	365	172.2	545	63.7	725	43.9	905	33.1	1085	25.1
10	0.5	190	160.2	370	169.6	550	62.8	730	43.5	910	32.9	1090	24.9
15	2.2	195	164.5	375	164.4	555	61.9	735	43.2	915	32.6	1095	24.7
20	5.4	200	167.6	380	156.9	560	61.1	740	42.8	920	32.4	1100	24.5
25	9.6	205	170.0	385	148.2	565	60.3	745	42.5	925	32.1	1105	24.3
30	13.9	210	172.2	390	139.5	570	59.5	750	42.1	930	31.9	1110	24.1
35	18.0	215	174.5	395	131.6	575	58.8	755	41.8	935	31.7	1115	23.9
40	21.8	220	176.4	400	124.8	580	58.1	760	41.4	940	31.4	1120	23.7
45	25.4	225	177.7	405	119.1	585	57.4	765	41.1	945	31.2	1125	23.5
50	28.9	230	178.3	410	114.3	590	56.8	770	40.8	950	30.9	1130	23.3
55	32.2	235	178.6	415	110.0	595	56.1	775	40.5	955	30.7	1135	23.1
60	35.4	240	179.0	420	106.3	600	55.5	780	40.1	960	30.5	1140	22.9
65	38.4	245	179.5	425	102.9	605	54.9	785	39.8	965	30.2	1145	22.8
70	41.4	250	180.2	430	99.9	610	54.3	790	39.5	970	30.0	1150	22.6
75	44.6	255	180.8	435	97.1	615	53.7	795	39.2	975	29.8	1155	22.4
80	48.1	260	181.2	440	94.5	620	53.2	800	38.9	980	29.5	1160	22.2
85	51.7	265	181.7	445	92.1	625	52.6	805	38.6	985	29.3	1165	22.0
90	55.3	270	182.2	450	89.9	630	52.1	810	38.3	990	29.1	1170	21.8
95	58.7	275	182.9	455	87.8	635	51.6	815	38.0	995	28.9	1175	21.6
100	62.2	280	183.4	460	85.8	640	51.1	820	37.7	1000	28.6	1180	21.5
105	65.8	285	183.7	465	83.9	645	50.6	825	37.4	1005	28.4	1185	21.3
110	69.8	290	183.7	470	82.2	650	50.1	830	37.1	1010	28.2	1190	21.1
115	74.1	295	183.5	475	80.5	655	49.6	835	36.9	1015	28.0	1195	20.9
120	78.6	300	183.4	480	79.0	660	49.2	840	36.6	1020	27.8	1200	20.8
125	83.2	305	183.4	485	77.5	665	48.7	845	36.3	1025	27.6	1205	20.6
130	88.2	310	183.2	490	76.0	670	48.3	850	36.0	1030	27.3	1210	20.4
135	93.6	315	182.5	495	74.6	675	47.8	855	35.7	1035	27.1	1215	20.2
140	99.6	320	181.5	500	73.3	680	47.4	860	35.5	1040	26.9	1220	20.1
145	106.0	325	180.2	505	72.1	685	47.0	865	35.2	1045	26.7	1225	19.9
150	112.5	330	179.1	510	70.9	690	46.6	870	34.9	1050	26.5	1230	19.7
155	119.0	335	178.0	515	69.7	695	46.2	875	34.7	1055	26.3	1235	19.6
160	125.3	340	177.2	520	68.6	700	45.8	880	34.4	1060	26.1	1240	19.4
165	131.3	345	176.2	525	67.5	705	45.4	885	34.2	1065	25.9	1245	19.3
170	137.2	350	175.3	530	66.5	710	45.0	890	33.9	1070	25.7		
175	143.1	355	174.3	535	65.5	715	44.6	895	33.6	1075	25.5		

Table 8: 50-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	122.4	360	141.3	540	52.1	720	34.2	900	24.9	1080	18.3
5	0.0	185	126.7	365	140.3	545	51.4	725	33.9	905	24.7	1085	18.2
10	0.4	190	130.6	370	138.1	550	50.6	730	33.6	910	24.5	1090	18.0
15	1.9	195	133.6	375	134.0	555	49.9	735	33.3	915	24.3	1095	17.9
20	4.7	200	135.8	380	127.9	560	49.2	740	32.9	920	24.1	1100	17.7
25	8.3	205	137.6	385	120.8	565	48.5	745	32.6	925	23.9	1105	17.5
30	12.1	210	139.4	390	113.8	570	47.8	750	32.3	930	23.7	1110	17.4
35	15.8	215	141.1	395	107.4	575	47.2	755	32.0	935	23.5	1115	17.3
40	19.1	220	142.7	400	101.9	580	46.6	760	31.8	940	23.3	1120	17.1
45	22.2	225	143.9	405	97.3	585	46.0	765	31.5	945	23.1	1125	17.0
50	25.3	230	144.5	410	93.4	590	45.4	770	31.2	950	22.9	1130	16.8
55	28.2	235	144.8	415	90.0	595	44.8	775	30.9	955	22.7	1135	16.7
60	31.0	240	145.1	420	86.9	600	44.3	780	30.6	960	22.5	1140	16.5
65	33.7	245	145.6	425	84.2	605	43.7	785	30.3	965	22.3	1145	16.4
70	36.3	250	146.2	430	81.7	610	43.2	790	30.1	970	22.1	1150	16.2
75	39.1	255	146.7	435	79.4	615	42.7	795	29.8	975	21.9	1155	16.1
80	42.2	260	147.1	440	77.2	620	42.2	800	29.5	980	21.7	1160	16.0
85	45.3	265	147.4	445	75.3	625	41.7	805	29.3	985	21.5	1165	15.8
90	48.5	270	147.9	450	73.4	630	41.2	810	29.0	990	21.4	1170	15.7
95	51.5	275	148.5	455	71.7	635	40.8	815	28.8	995	21.2	1175	15.6
100	54.5	280	148.9	460	70.1	640	40.3	820	28.5	1000	21.0	1180	15.4
105	57.5	285	149.2	465	68.6	645	39.9	825	28.3	1005	20.8	1185	15.3
110	60.7	290	149.2	470	67.1	650	39.4	830	28.0	1010	20.6	1190	15.2
115	64.1	295	149.1	475	65.7	655	39.0	835	27.8	1015	20.5	1195	15.0
120	67.5	300	149.0	480	64.4	660	38.6	840	27.6	1020	20.3	1200	14.9
125	71.1	305	149.0	485	63.1	665	38.2	845	27.3	1025	20.1	1205	14.8
130	74.9	310	148.9	490	61.9	670	37.8	850	27.1	1030	19.9	1210	14.7
135	79.2	315	148.4	495	60.7	675	37.4	855	26.9	1035	19.8	1215	14.5
140	83.9	320	147.5	500	59.6	680	37.0	860	26.6	1040	19.6	1220	14.4
145	88.8	325	146.6	505	58.6	685	36.6	865	26.4	1045	19.4	1225	14.3
150	94.0	330	145.6	510	57.5	690	36.3	870	26.2	1050	19.3	1230	14.2
155	99.1	335	144.8	515	56.6	695	35.9	875	26.0	1055	19.1	1235	14.0
160	104.1	340	144.1	520	55.6	700	35.6	880	25.8	1060	18.9	1240	13.9
165	108.9	345	143.4	525	54.7	705	35.2	885	25.6	1065	18.8	1245	13.8
170	113.5	350	142.7	530	53.8	710	34.9	890	25.3	1070	18.6		
175	118.0	355	141.9	535	53.0	715	34.5	895	25.1	1075	18.5		

Table 9: 25-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	101.2	360	114.4	540	42.8	720	27.5	900	19.5	1080	14.3
5	0.0	185	104.5	365	113.6	545	42.2	725	27.2	905	19.4	1085	14.2
10	0.3	190	107.4	370	112.0	550	41.5	730	26.9	910	19.2	1090	14.1
15	1.6	195	109.6	375	108.7	555	40.9	735	26.7	915	19.0	1095	13.9
20	4.1	200	111.0	380	103.8	560	40.3	740	26.4	920	18.9	1100	13.8
25	7.2	205	112.1	385	98.2	565	39.8	745	26.1	925	18.7	1105	13.7
30	10.5	210	113.2	390	92.7	570	39.2	750	25.9	930	18.5	1110	13.6
35	13.7	215	114.3	395	87.6	575	38.6	755	25.6	935	18.4	1115	13.5
40	16.7	220	115.4	400	83.2	580	38.1	760	25.4	940	18.2	1120	13.4
45	19.4	225	116.2	405	79.5	585	37.6	765	25.1	945	18.1	1125	13.2
50	22.1	230	116.6	410	76.3	590	37.1	770	24.9	950	17.9	1130	13.1
55	24.6	235	116.8	415	73.6	595	36.6	775	24.7	955	17.7	1135	13.0
60	27.1	240	117.1	420	71.1	600	36.1	780	24.4	960	17.6	1140	12.9
65	29.4	245	117.5	425	68.9	605	35.7	785	24.2	965	17.4	1145	12.8
70	31.7	250	117.9	430	66.9	610	35.2	790	24.0	970	17.3	1150	12.7
75	34.2	255	118.4	435	65.1	615	34.8	795	23.7	975	17.1	1155	12.6
80	36.9	260	118.7	440	63.5	620	34.4	800	23.5	980	17.0	1160	12.5
85	39.6	265	119.1	445	61.9	625	33.9	805	23.3	985	16.8	1165	12.4
90	42.3	270	119.5	450	60.4	630	33.5	810	23.1	990	16.7	1170	12.3
95	45.0	275	119.9	455	59.0	635	33.1	815	22.9	995	16.6	1175	12.2
100	47.5	280	120.4	460	57.7	640	32.7	820	22.6	1000	16.4	1180	12.1
105	50.2	285	120.6	465	56.5	645	32.3	825	22.4	1005	16.3	1185	12.0
110	52.9	290	120.6	470	55.3	650	32.0	830	22.2	1010	16.1	1190	11.9
115	55.7	295	120.5	475	54.1	655	31.6	835	22.0	1015	16.0	1195	11.8
120	58.5	300	120.5	480	53.0	660	31.2	840	21.8	1020	15.9	1200	11.7
125	61.3	305	120.5	485	52.0	665	30.9	845	21.6	1025	15.7	1205	11.6
130	64.2	310	120.4	490	51.0	670	30.5	850	21.4	1030	15.6	1210	11.5
135	67.4	315	120.0	495	50.0	675	30.2	855	21.2	1035	15.4	1215	11.4
140	71.0	320	119.4	500	49.1	680	29.9	860	21.0	1040	15.3	1220	11.3
145	74.9	325	118.6	505	48.2	685	29.5	865	20.8	1045	15.2	1225	11.2
150	78.8	330	117.9	510	47.3	690	29.2	870	20.6	1050	15.1	1230	11.1
155	82.9	335	117.2	515	46.5	695	28.9	875	20.4	1055	14.9	1235	11.0
160	86.8	340	116.7	520	45.7	700	28.6	880	20.3	1060	14.8	1240	10.9
165	90.5	345	116.1	525	44.9	705	28.3	885	20.1	1065	14.7	1245	10.8
170	94.2	350	115.5	530	44.2	710	28.0	890	19.9	1070	14.5		
175	97.7	355	115.0	535	43.5	715	27.7	895	19.7	1075	14.4		

Table 10: 10-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	78.8	360	86.0	540	33.5	720	21.4	900	15.2	1080	11.2
5	0.0	185	81.2	365	85.4	545	33.0	725	21.2	905	15.1	1085	11.1
10	0.3	190	83.3	370	84.2	550	32.5	730	21.0	910	14.9	1090	11.0
15	1.3	195	84.9	375	81.8	555	32.0	735	20.8	915	14.8	1095	10.9
20	3.3	200	85.9	380	78.3	560	31.5	740	20.6	920	14.7	1100	10.8
25	5.9	205	86.6	385	74.3	565	31.1	745	20.4	925	14.5	1105	10.7
30	8.7	210	87.3	390	70.2	570	30.6	750	20.2	930	14.4	1110	10.6
35	11.3	215	87.9	395	66.5	575	30.2	755	20.0	935	14.3	1115	10.5
40	13.8	220	88.5	400	63.4	580	29.8	760	19.8	940	14.2	1120	10.4
45	16.1	225	88.8	405	60.7	585	29.4	765	19.6	945	14.0	1125	10.3
50	18.3	230	88.8	410	58.4	590	29.0	770	19.4	950	13.9	1130	10.2
55	20.4	235	88.7	415	56.5	595	28.6	775	19.2	955	13.8	1135	10.2
60	22.4	240	88.6	420	54.7	600	28.2	780	19.0	960	13.7	1140	10.1
65	24.4	245	88.7	425	53.1	605	27.9	785	18.8	965	13.6	1145	10.0
70	26.3	250	88.8	430	51.7	610	27.5	790	18.6	970	13.4	1150	9.9
75	28.3	255	88.9	435	50.3	615	27.2	795	18.4	975	13.3	1155	9.8
80	30.6	260	89.1	440	49.1	620	26.8	800	18.3	980	13.2	1160	9.7
85	32.9	265	89.2	445	47.9	625	26.5	805	18.1	985	13.1	1165	9.7
90	35.1	270	89.5	450	46.8	630	26.2	810	17.9	990	13.0	1170	9.6
95	37.3	275	89.8	455	45.8	635	25.9	815	17.8	995	12.9	1175	9.5
100	39.4	280	90.0	460	44.8	640	25.6	820	17.6	1000	12.8	1180	9.4
105	41.6	285	90.2	465	43.8	645	25.3	825	17.4	1005	12.7	1185	9.3
110	43.9	290	90.2	470	42.9	650	25.0	830	17.3	1010	12.5	1190	9.3
115	46.2	295	90.2	475	42.0	655	24.7	835	17.1	1015	12.4	1195	9.2
120	48.4	300	90.2	480	41.2	660	24.4	840	16.9	1020	12.3	1200	9.1
125	50.6	305	90.2	485	40.4	665	24.1	845	16.8	1025	12.2	1205	9.0
130	52.8	310	90.2	490	39.6	670	23.9	850	16.6	1030	12.1	1210	8.9
135	55.1	315	89.9	495	38.9	675	23.6	855	16.5	1035	12.0	1215	8.9
140	57.6	320	89.5	500	38.2	680	23.3	860	16.3	1040	11.9	1220	8.8
145	60.3	325	89.0	505	37.5	685	23.1	865	16.2	1045	11.8	1225	8.7
150	63.0	330	88.4	510	36.9	690	22.8	870	16.0	1050	11.7	1230	8.6
155	65.8	335	88.0	515	36.3	695	22.6	875	15.9	1055	11.6	1235	8.5
160	68.6	340	87.6	520	35.7	700	22.4	880	15.7	1060	11.5	1240	8.5
165	71.2	345	87.2	525	35.1	705	22.1	885	15.6	1065	11.4	1245	8.4
170	73.8	350	86.8	530	34.5	710	21.9	890	15.5	1070	11.3		
175	76.3	355	86.4	535	34.0	715	21.7	895	15.3	1075	11.2		

Table 11: 5-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	66.1	360	69.6	540	28.3	720	18.1	900	12.9	1080	9.5
5	0.0	185	68.0	365	69.2	545	27.8	725	17.9	905	12.8	1085	9.4
10	0.2	190	69.6	370	68.3	550	27.4	730	17.8	910	12.7	1090	9.3
15	1.1	195	70.8	375	66.5	555	27.0	735	17.6	915	12.6	1095	9.2
20	2.8	200	71.6	380	63.8	560	26.7	740	17.4	920	12.5	1100	9.2
25	5.1	205	72.2	385	60.7	565	26.3	745	17.2	925	12.4	1105	9.1
30	7.5	210	72.7	390	57.6	570	25.9	750	17.1	930	12.2	1110	9.0
35	9.8	215	73.2	395	54.7	575	25.6	755	16.9	935	12.1	1115	8.9
40	11.9	220	73.6	400	52.2	580	25.2	760	16.7	940	12.0	1120	8.8
45	13.9	225	73.8	405	50.1	585	24.9	765	16.5	945	11.9	1125	8.8
50	15.9	230	73.7	410	48.3	590	24.5	770	16.4	950	11.8	1130	8.7
55	17.7	235	73.6	415	46.8	595	24.2	775	16.2	955	11.7	1135	8.6
60	19.5	240	73.5	420	45.4	600	23.9	780	16.1	960	11.6	1140	8.5
65	21.2	245	73.4	425	44.1	605	23.6	785	15.9	965	11.5	1145	8.5
70	22.8	250	73.4	430	42.9	610	23.3	790	15.8	970	11.4	1150	8.4
75	24.6	255	73.5	435	41.9	615	23.0	795	15.6	975	11.3	1155	8.3
80	26.6	260	73.4	440	40.9	620	22.8	800	15.5	980	11.2	1160	8.3
85	28.6	265	73.4	445	39.9	625	22.5	805	15.3	985	11.1	1165	8.2
90	30.5	270	73.5	450	39.0	630	22.2	810	15.2	990	11.1	1170	8.1
95	32.5	275	73.5	455	38.2	635	21.9	815	15.0	995	11.0	1175	8.0
100	34.3	280	73.6	460	37.4	640	21.7	820	14.9	1000	10.9	1180	8.0
105	36.2	285	73.6	465	36.6	645	21.4	825	14.8	1005	10.8	1185	7.9
110	38.2	290	73.5	470	35.9	650	21.2	830	14.6	1010	10.7	1190	7.8
115	40.1	295	73.3	475	35.2	655	20.9	835	14.5	1015	10.6	1195	7.8
120	42.1	300	73.2	480	34.5	660	20.7	840	14.4	1020	10.5	1200	7.7
125	44.0	305	73.1	485	33.9	665	20.5	845	14.2	1025	10.4	1205	7.6
130	45.9	310	73.0	490	33.3	670	20.2	850	14.1	1030	10.3	1210	7.6
135	47.8	315	72.8	495	32.7	675	20.0	855	14.0	1035	10.2	1215	7.5
140	49.9	320	72.4	500	32.1	680	19.8	860	13.9	1040	10.2	1220	7.4
145	52.1	325	72.0	505	31.6	685	19.6	865	13.7	1045	10.1	1225	7.4
150	54.2	330	71.5	510	31.1	690	19.3	870	13.6	1050	10.0	1230	7.3
155	56.3	335	71.2	515	30.6	695	19.1	875	13.5	1055	9.9	1235	7.2
160	58.3	340	70.9	520	30.1	700	18.9	880	13.4	1060	9.8	1240	7.2
165	60.3	345	70.6	525	29.6	705	18.7	885	13.2	1065	9.7	1245	7.1
170	62.3	350	70.2	530	29.1	710	18.5	890	13.1	1070	9.7		
175	64.2	355	69.9	535	28.7	715	18.3	895	13.0	1075	9.6		

Table12: 2-Year WMS Inflow Hydrograph

Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)	Time (min)	InFlow (cfs)
0	0.0	180	53.2	360	53.5	540	23.0	720	14.9	900	10.6	1080	7.8
5	0.0	185	54.4	365	53.1	545	22.6	725	14.7	905	10.5	1085	7.7
10	0.2	190	55.5	370	52.4	550	22.3	730	14.6	910	10.4	1090	7.6
15	0.8	195	56.3	375	51.0	555	22.0	735	14.4	915	10.4	1095	7.6
20	2.3	200	56.9	380	49.1	560	21.7	740	14.3	920	10.3	1100	7.5
25	4.2	205	57.3	385	46.9	565	21.4	745	14.1	925	10.2	1105	7.4
30	6.2	210	57.6	390	44.6	570	21.1	750	14.0	930	10.1	1110	7.4
35	8.1	215	57.9	395	42.6	575	20.8	755	13.9	935	10.0	1115	7.3
40	9.9	220	58.2	400	40.8	580	20.5	760	13.7	940	9.9	1120	7.3
45	11.5	225	58.3	405	39.3	585	20.3	765	13.6	945	9.8	1125	7.2
50	13.1	230	58.3	410	38.0	590	20.0	770	13.5	950	9.7	1130	7.1
55	14.7	235	58.2	415	36.8	595	19.7	775	13.3	955	9.7	1135	7.1
60	16.1	240	58.1	420	35.8	600	19.5	780	13.2	960	9.6	1140	7.0
65	17.5	245	58.0	425	34.9	605	19.2	785	13.1	965	9.5	1145	6.9
70	18.9	250	57.9	430	34.0	610	19.0	790	13.0	970	9.4	1150	6.9
75	20.4	255	57.9	435	33.2	615	18.8	795	12.8	975	9.3	1155	6.8
80	22.0	260	57.8	440	32.5	620	18.5	800	12.7	980	9.3	1160	6.8
85	23.7	265	57.8	445	31.8	625	18.3	805	12.6	985	9.2	1165	6.7
90	25.3	270	57.7	450	31.1	630	18.1	810	12.5	990	9.1	1170	6.6
95	26.9	275	57.7	455	30.5	635	17.9	815	12.4	995	9.0	1175	6.6
100	28.4	280	57.7	460	29.9	640	17.7	820	12.3	1000	8.9	1180	6.5
105	30.0	285	57.6	465	29.3	645	17.5	825	12.1	1005	8.9	1185	6.5
110	31.6	290	57.4	470	28.8	650	17.3	830	12.0	1010	8.8	1190	6.4
115	33.3	295	57.3	475	28.3	655	17.1	835	11.9	1015	8.7	1195	6.4
120	34.9	300	57.1	480	27.8	660	16.9	840	11.8	1020	8.6	1200	6.3
125	36.4	305	56.9	485	27.3	665	16.7	845	11.7	1025	8.6	1205	6.2
130	38.0	310	56.8	490	26.9	670	16.5	850	11.6	1030	8.5	1210	6.2
135	39.6	315	56.5	495	26.4	675	16.3	855	11.5	1035	8.4	1215	6.1
140	41.3	320	56.1	500	26.0	680	16.2	860	11.4	1040	8.3	1220	6.1
145	43.1	325	55.7	505	25.6	685	16.0	865	11.3	1045	8.3	1225	6.0
150	44.8	330	55.3	510	25.1	690	15.8	870	11.2	1050	8.2	1230	6.0
155	46.4	335	55.0	515	24.8	695	15.7	875	11.1	1055	8.1	1235	5.9
160	48.0	340	54.7	520	24.4	700	15.5	880	11.0	1060	8.1	1240	5.9
165	49.4	345	54.4	525	24.0	705	15.3	885	10.9	1065	8.0	1245	5.8
170	50.7	350	54.1	530	23.6	710	15.2	890	10.8	1070	7.9		
175	51.9	355	53.7	535	23.3	715	15.0	895	10.7	1075	7.8		

Technical Memorandum No.2

J·U·B ENGINEERS, INC.

TECHNICAL MEMORANDUM 002	
Date:	November 5, 2021
To:	NRCS - Utah
Cc:	
From:	Bryce Wilcox, PE J-U-B Engineers, Inc.
Project:	North Ogden Project Plan-EA
Subject:	Technical Memorandum No. 002 - Flooding and Risk Analysis

2	2/14/2020	Revisions for NRCS and Utah Division of Dam Safety Review
4	5/3/2021	Revised and Resubmitted to NRCS

1.0 Introduction

The Weber-Box Elder Conservation District (District) contracted with J-U-B Engineers, Inc. (J-U-B) to complete a Supplemental Watershed Plan-Environmental Assessment (Plan-EA) of the North Pine Reservoir. Part of the Scope of Work included a breach flooding and risk analysis for the project site.

The flood inundation analysis consists of modeling a breach of North Ogden Irrigation and Detention Pond embankment under sunny day conditions per Technical Release 60 (TR-60) NRCS, 2005 and Utah Dam Safety criteria. The analysis also includes the development of a map delineating the extents of inundation. Results of the inundation analysis are then used to (1) assess the hazard classification of the dam, (2) determine the population at risk (PAR) downstream of the structure, and (3) assess the risks due to the potential failure of the dam over the projected life of the dam.

1.1 Purpose

The purpose of Technical Memorandum (TM) No. 002 is to present the methodology and results of the flooding and risk analysis conducted for North Ogden Detention Pond in support of the Plan-EA. The information presented in the TM will be used to determine the PAR in the event of a breach, total loss-of-life (LOL) expected, and the NRCS and Utah Division of Dam Safety hazard classification for the pond.

1.2 Data Sources

The structural information for the embankment and reservoir is shown in Table 1. For additional hydraulic information on the reservoir see TM No. 001 and Appendix D. Table 2 presents the data sources used in the breach and inundation analysis.

Table 1. Dam and Reservoir Summary Data.

Feature	Dimension
Maximum Dam Height	5.5 ft
Dam Crest Elevation	4346.6
Auxiliary Spillway Crest Elevation	4344.6
Principle Spillway Crest Elevation	4343.6
Lowest Natural Ground Elevation at Dam	4341.1
Max Depth of Water Above Natural Ground (Auxiliary Spillway – Natural Ground Elevation)	3.5 ft
Reservoir Capacity at Auxiliary Spillway	42.5 ac-ft
Reservoir Capacity above Lowest Natural Ground Elevation	9.1 ac-ft
Reservoir Capacity Below Natural Ground Elevation	33.4 ac-ft
Dam Crest Length	1,090 ft
Dam Crest Width	8 ft
Upstream Slope of Dam	3H : 1V
Downstream Slope of Dam	2.5H : 1V

Table 2. Model Development Data Sources

Data	Source	Description
LiDAR	Utah Automated Geographic Reference Center, (AGRC) 2017&2011	1-meter resolution bare earth surface data set of Ogden and downstream of channel used for development of the SRH-2D model.
Aerial Imagery	ESRI Imagery Service: DigitalGlobe, Vivid, September 2016	Aerial imagery was used in model development and inundation mapping.

LiDAR = Light Detection and Ranging

2.0 Dam Breach Analysis

The dam breach analysis was conducted in support of the risk assessment and hazard classification process for North Pine Reservoir. The purpose of the breach analysis is to develop the breach hydrograph to be used as the upstream condition for the SRH-2D inundation model. NRCS TR-210-60 requires the breach analysis assumes that the water surface of the reservoir is ath the crest of the dam, with no concurrent flooding, and the low-level outlet is discharging at capacity. The Utah Division of Dam Safety per Administrative Rule R655-10-5 uses the water surface at the auxiliary spillway. This analysis is done with the water surface at the crest of the dam.

Based on the above assumptions, the breach scenario will consist of a piping failure in which the breach initiates at the elevation of the natural ground and extends to the crest of the

embankment. The breach analysis was conducted using methods outlined in TR-60 for a depth of water (H_W) less than 103 feet to obtain a Q_{max} value.2.1 Peak Discharge Criteria – TR-60

TR-60 provides a methodology and equations to determine a minimum peak discharge that is used to generate the breach hydrograph. These equations are based on the depth of water at the time of failure and the theoretical breach width at the water surface elevation corresponding to the depth of water. A flow chart was provided by NRCS that demonstrates the steps followed and is provided in Figure 1.

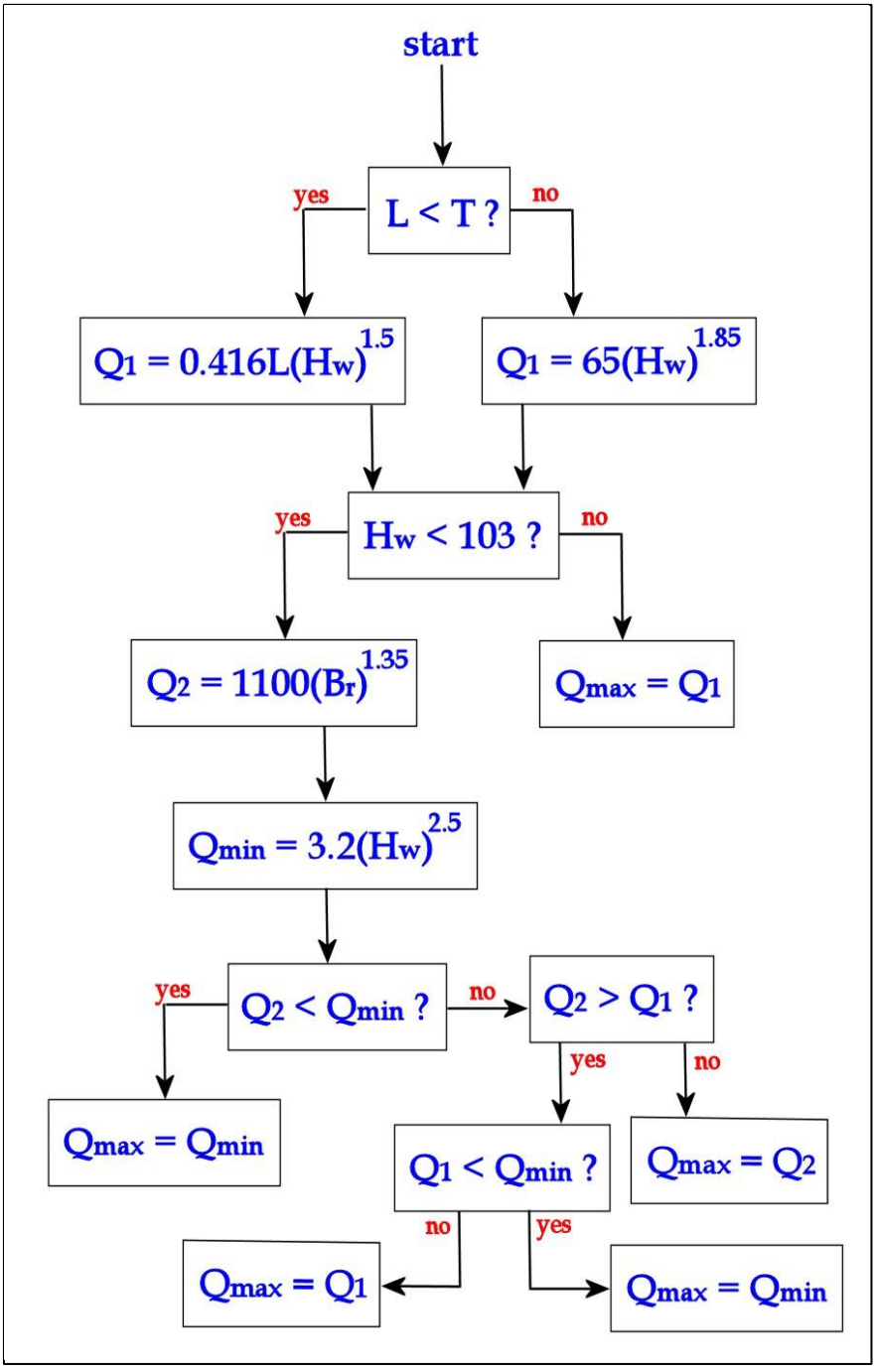


Figure 1. TR-60 Peak Discharge Flow Chart

For the North Pine Reservoir, the H*w* will be less than 103 feet. The following equations, from TR-60, define "the minimum peak discharge of the breach hydrograph, regardless of the technique used to analyze the downstream inundation area":

$$Q_{max} = (1{,}100)B_r^{1.35} \quad (1)$$

Where $B_r = (V_s)(H_w)/A$

B_r = breach factor (acre)
V_s = reservoir storage at time of failure (acre-ft)
H_W = depth of water at the dam at the time of failure (ft)
A = cross-sectional area of embankment at the assumed location of the breach (ft^2)

But, not less than $Q_{max} = (3.2)H_w^{2.5}$ (2)

Or more than $Q_{max} = (65)H_w^{1.8}$ (3)

The TR-60 definition for H*w* is the "depth of water at the dam at the time of failure". TR-60 and TR-66 are acceptable methods by the NRCS for peak breach flow and flow hydrograph and they were used in the development of the peak breach flow and flow hydrograph for the North Pine Reservoir.

2.1.1 Breach Q_{max}

The TR-60 minimum peak breach discharge (Q_{max}) was calculated for the height of water above the existing natural grade. The breach analysis evaluated the dam failure with the water at the dam crest elevation of 4346.6 and the existing ground elevation is approximately 4341.1 feet, for a depth of water (H_w) of 5.5 feet. See Figure 2 for North Pine Reservoir cross-section view. Q_{max} at a breach water height of 5.5 feet is 850 cubic feet per second (cfs).

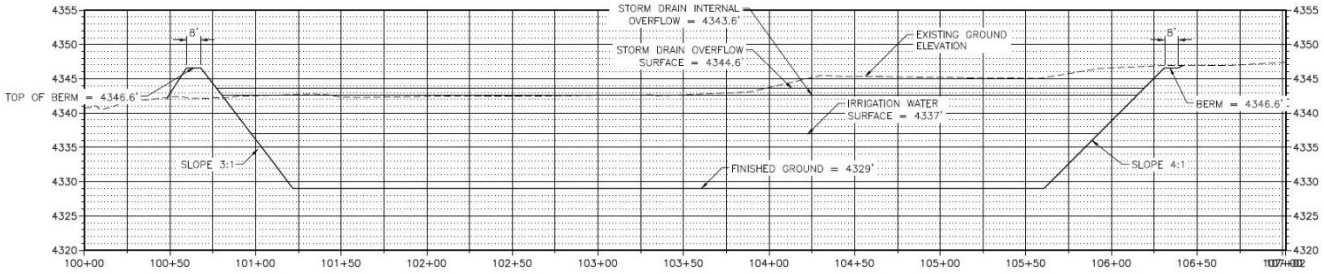


Figure 2. North Pine Reservoir Cross-section

Equation (1) was used to determine the Qmax for the Hw of 5.5 feet. The other equations were checked but did not govern the flow rate. The results of the analysis are shown in the Peak Breach Discharge spreadsheet provided by NRCS-Utah (see Table 3 with a Qmax of 850 cfs calculated flow rate).

Table 3. TR 60 and TR 66 Breach Hydrograph Calculations

Input data required:			**Outputs**	
data	**variable**		**variable**	**results**
4346.6	crestEL		T	284
4346.6	wsEL		(L < T)?	N
8	TW		H_w	5.5
3	SSup		Q_1	1523
2.5	SSdn		(H_w < 103)?	Y
4341.1	floorEL		Awave	0
19.1	Vs		Astab	0
305	L		A	127
	ELwave		Br	0
	Wwave		Q_2	850
	SSwave		Qmin	227
	ELstab		(Q_2 < Q_{min})?	N
	Wstab		(Q_2 > Q_1)?	N
	SSstab		(Q_1 < Q_{min})?	N
5	ts		**Qmax**	**850**

(Dambreach Hydrographs via TRs 60 & 66 NRCS guidance, version 3, July 2018)

2.2 Breach Analysis Results

North Pine Reservoir was assumed to fail due to piping with water at the level of the overflow crest and a volume in the pond of 19.1 acre-feet. TR-66, Simplified Dam-Breach Routing Procedure, was used to develop the Breach Hydrograph. Figure 3 presents the breach hydrograph resulting from the NRCS-Utah supplied breach hydrograph development spreadsheet. The breach hydrograph utilizes the NRCS Qmax discharge of 850 cfs.

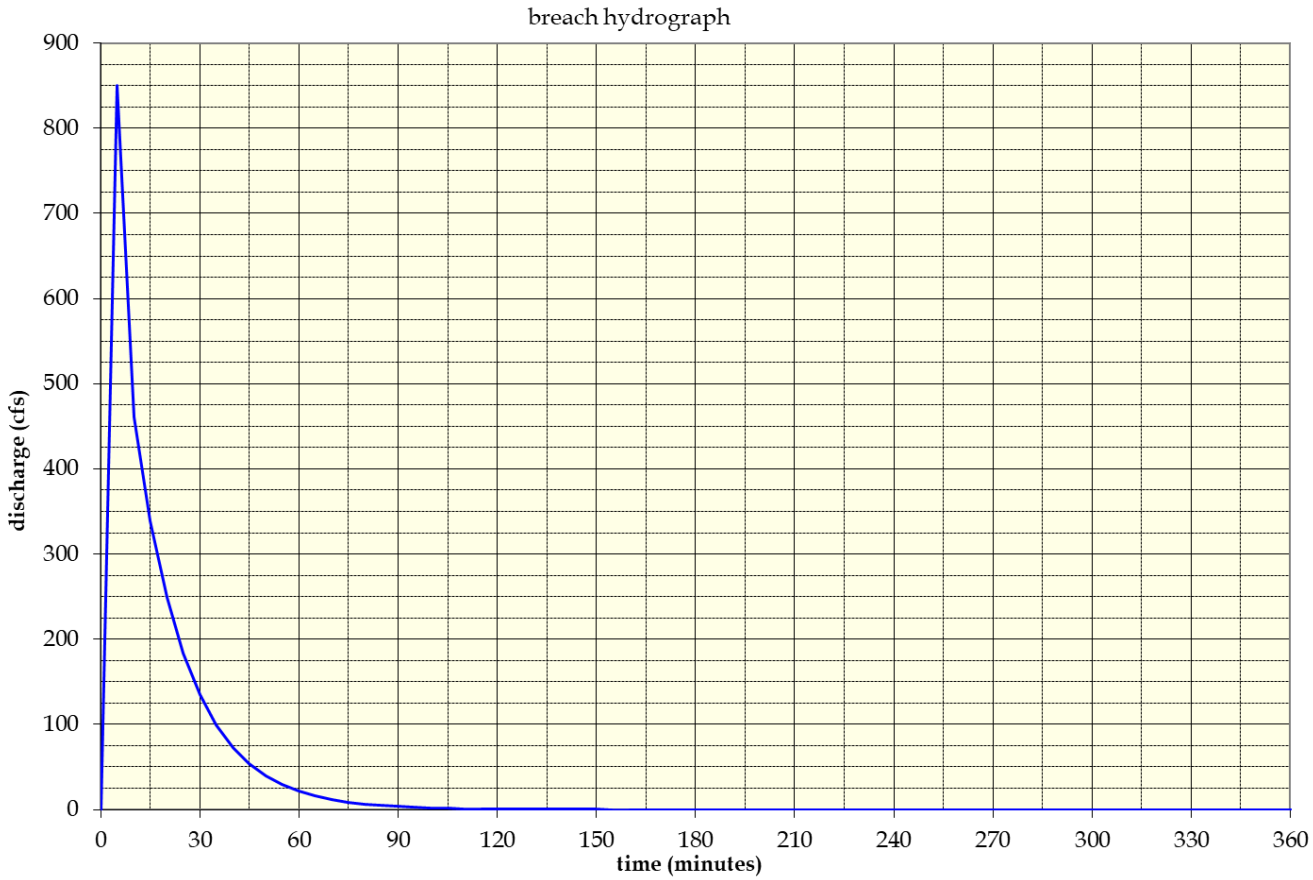


Figure 3. North Pine Reservoir Breach Hydrograph

3.0 Inundation Analysis

The purpose of the inundation analysis is to simulate the breach wave from the failure of North Pine Reservoir as it travels through the cities of North Ogden, Harrisville and Pleasant View. This section shows the SRH-2D model development, the inundation model results, and inundation maps.

3.1 Breach Model Development

SRH-2D is a two-dimensional hydrodynamic model capable of simulating unsteady free surface flow through open-channel systems. Aquaveo's software package, Surface-water Modeling System (SMS), was used to set up the modeling domain and parameters for the SRH-2D engine. The continuity and momentum equations are solved by the model using a central, finite difference scheme applied to a grid. The grid is constructed using a high-resolution array of elevation points and is populated with initial and boundary conditions as necessary. The computational grid can incorporate floodplain features and characteristics such as Manning's roughness, flow blockage due to buildings, hydraulic structures, etc. Upstream boundary conditions can accept user-specified hydrographs like the dam breach outflow hydrograph provided in Figure 3. Table 4 presents the parameters and data used to develop the North Pine Reservoir SRH-2D model.

Table 4. SRH-2D Model Parameter

Grid Input	
Parameter	Input
Upstream Boundary Condition	Breach Hydrograph
Downstream Boundary Condition	Normal Depth (No Hydrograph)
Number of Elements	166,186
Grid Elevation	2011 FEMA LiDAR

Major assumptions of the SRH-2D model include the following:

- Roughness Coefficients, see Table 5;
- No infiltration or evaporation losses;
- Flow is steady for a given time step;
- Pressure distribution is hydrostatic;
- Hydraulic roughness based on steady, uniform, fully turbulent flow; and
- Channel element represented by uniform channel geometry and roughness.

Table 5. Roughness Coefficients

Roughness	
Land Use	Manning's n
Roadway	0.016
Residential	0.08
Agriculture	0.04
Mixed	0.06
Open Space	0.04

Arc boundaries were placed along the features such as road and ditches. Grid spacing was densified to approximately 20 feet along the arc boundaries. The model domain extends from approximately the North Pine Reservoir to Highway 89, and 2150 North in Harrisville on the south to 2825 North in Pleasant View on the north (see Figure 4). The model domain was expanded for modeling needs for other portions of the project. For this reason, the modeling domain extends beyond the point at which the breach wave is fully attenuated.

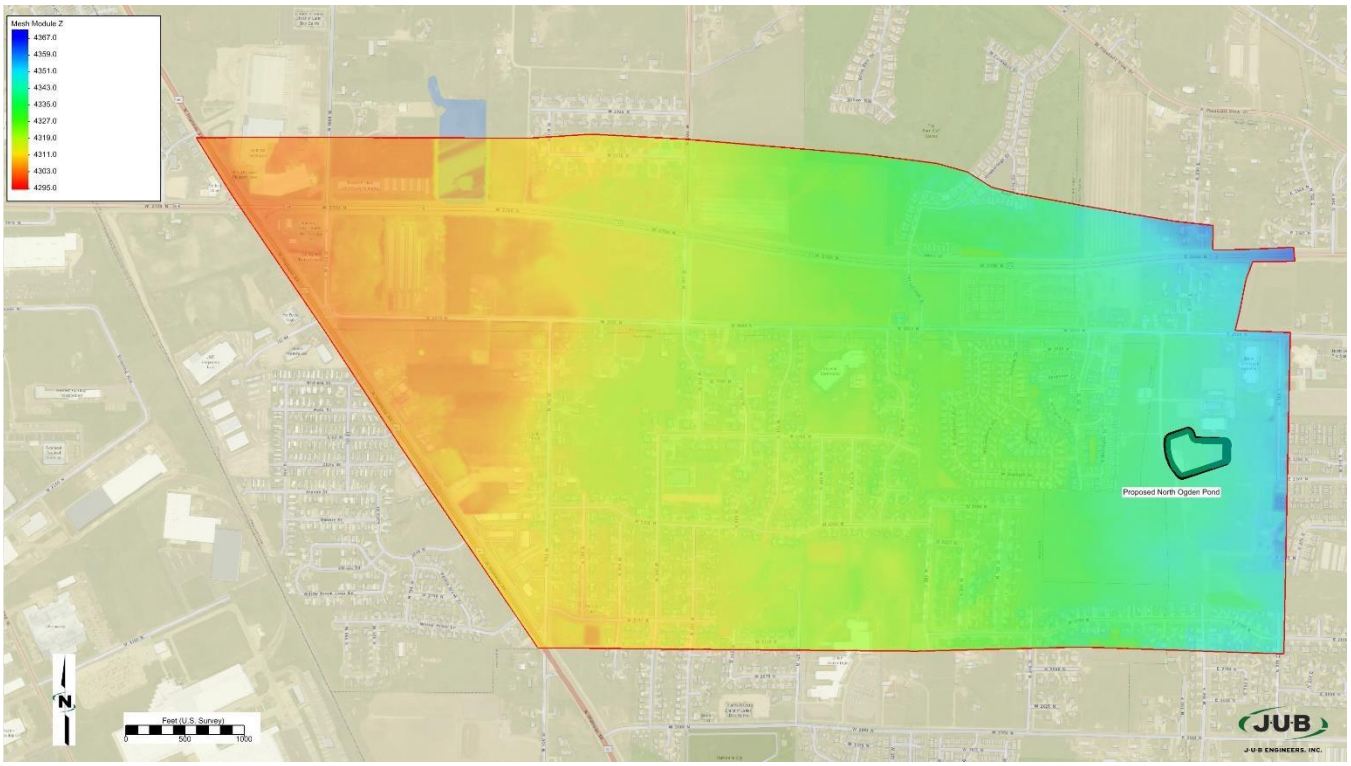


Figure 4: SRH-2D Model Domain, Grid Extents and Elevation

3.2 Breach Model Results

The results of the inundation analysis show an area of approximately 83 acres that would be inundated by the breach of North Pine Reservoir. The North Pine Reservoir will breach into an existing field to the west of the pond, that dissipates the breach wave rather quickly. The breach wave is dissipated before it reaches a residential neighbor of homes and town homes, approximately 400 feet to the west of the pond. The wave peak velocity is approximate 4 ft/s and with a maximum wave depth of approximately 2 foot. A map of the inundation is provided in Figure 5. The results of this inundation model were used to assess the population at risk (PAR) and damage to structures, vehicles, agriculture, and so forth, and to estimate the loss of life due to such an event. Future development was taken into account for the modeled break analysis.

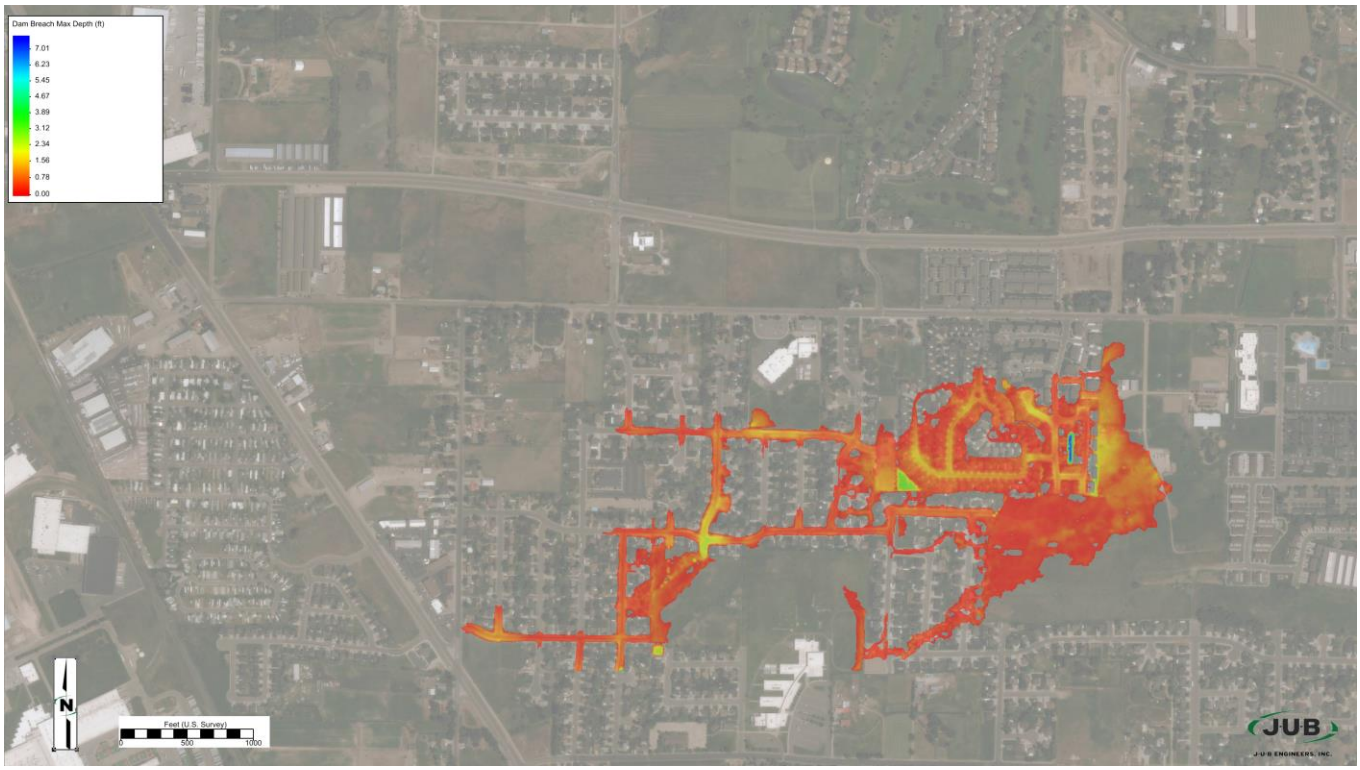


Figure 5. North Pine Reservoir Breach Flood Inundation.

4.0 Risk Analysis

This section describes the consequences that would result from a sunny day failure of the North Pine Reservoir. Although a failure of the North Pine Reservoir is not expected, there is always a risk of failure. If a failure were to occur, damage could be sustained downstream.

Dam failure consequences were estimated using a Population at Risk (PAR) Computation Worksheet developed by NRCS in 2013 (NRCS, 2013). The worksheet determines the total estimated PAR due to a flood event by multiplying a prescribed PAR per exposure by the total number of exposures during the event, broken up by exposure type and depth. The PAR and Loss of Life (LOL) worksheet results are provided in Table 6 and Table 7. The total PAR due to a sunny day breach of North Pine Reservoir is 27 people. The calculated Fatality Rate at 0.007 (0.7%) and the Failure Index at 2 which, when multiplied by the PAR, gives a total LOL (Risk Index) of 0 person (rounded).

Table 6. Computation of Population at Risk (PAR) during Dam Failure

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE						
STATE	UT		**BY**	CFS	**DATE**	5/3/21
DAM	North Pine Reservoir		**CHECKED BY**	BKW	**DATE**	5/3/21
YEAR BUILT	Proposed 2022	**DESIGN HAZARD CLASS**	L	**DRAINAGE AREA**	7.55	mi^2
WORK PLAN DATE		**CURRENT HAZARD CLASS**		**DAM HEIGHT**	5	ft
sht 2 of 3	**HYDROLOGIC FAILURE SCENARIO (ver. 2013-01)**				**NID ID**	

Structures (Elevated) Impacted by Potential Breach	**Number of Structures**			**PAR per Exposure with Inundation Depths >=2.0 Ft.**	**PAR**
	Inundation Depth Above Natural Ground		**Total**		
	<2.0 Ft	**>=2.0 Ft.**			
Mobile Homes	0	0		3	
Seasonal Use RV's	0	0		2	
Other	0	0			

Structures (With Foundations) Impacted by Potential Breach	**Number of Structures**			**PAR per Exposure with Inundation Depths >=1.0 Ft.**	**PAR**
	Inundation Depth Above Natural Ground		**Total**		
	<1.0 Ft	**>=1.0 Ft.**			
Homes	210	9	219	3	27
Seasonal Use Homes and Cabins	0	0		1.5	
Duplexes	0	0		5	
Apartments	0	0			
Commercial Buildings	0	0			
Schools (In Use)	0	0			
Schools (Not in Use)	0	0			
Hospitals	0	0			
Other	0	0			

Highways and Railroads	**Number of Roads, Highways and Railways**			**PAR per Exposure with Inundation Depths >=1.0 Ft.**	**PAR**
	Road Overflow Depth		**Total**		
	<1.0 Ft	**>=1.0 Ft.**			
Main Local Roads and Minor State Highways					
Name(s) (if applicable)	29	0	29	2	0
Name(s) (if applicable)	0			2	
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)	0	0		4	
Highway Name(s) or Number(s)	0	0		4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)	0	0		8	
Highway Name(s) or Number(s)	0	0		8	
Railroads					
UPSF Freight Traffic Only	0	0		3	
Passenger Traffic	0	0		20	
				TOTAL NUMBER OF PEOPLE AT RISK (PAR)	**27**

Table 7. Computation of Loss of Life (LOL) during Dam Failure

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	UT	**DAM**	North Pine Reservoir	**BY**	BKW	**DATE**	5/3/2021
sht 2 of 5	**FAILURE & RISK INDEXES**						ver 2013-01
Adopted from Bureau of Reclamation "Risk Based Profile System"							
see: http://www.usbr.gov/dsis/risk/rbpsdocumentation.pdf							

LIFE LOSS:

Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)

Estimate PAR for static loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway		A
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	27	B
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)		C

Fatality Rates [FR] from dam breach

Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06

see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf

Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)

DV= (breach discharge - bank full discharge) / breach floodplain width

Warning Time [T] between failure warning and flood wave at population (minutes)

Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude

Scenario	Breach Discharge	Bankfull Discharge	Breach Floodplain Width	DV	Warning Time, T	Understanding, U
	(cfs)	(cfs)	(ft)	(ft2/sec)	(minutes)	(N/A or Vague)
Static						
Hydrologic	850	100	50	15	5	Vague
Seismic						

For DV≥50	T≤60	U=vague	FR=0.04
	T>60		FR=0.03
For DV<50	T≤60	U=vague	FR=0.007
	T>60		FR=0.0003

Estimate FR for static loading failure scenario		D
Estimate FR for hydrologic loading failure scenario	0.007	E
Estimate FR for seismic loading failure scenario		F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1					
Hydrologic	*	*	2	0.007	24	0
Seismic						
		TOTAL=	2		TOTAL=	0

5.0 Hazard Classification

The North Pine Reservoir is located in the North Ogden city limits and is near the city of Harrisville. The PAR for the site is 27. With a water depth of 3.5 feet only occurring during 100-year storm events and a dam height of 5.5 feet, the downstream risks are minimal. NRCS-UT has preliminarily classified the structure as a low hazard dam. The Utah Division of Dam safety has preliminarily classified the dam a low hazard dam. The dam will follow the Application Procedure for approval through the Division of Dam Safety. An emergency action plan will be developed for the North Pine Reservoir as part of the design process.

The following are some of the characteristics of a dam that are considered when classifying its hazard potential:

- **Location:** Fourmile Creek Watershed, North Ogden City, Weber County, Utah, Latitude: 41°18'5.00"N, Longitude: 111°58'33.00"W
- **Description:** The North Pine Reservoir is a combined agricultural water storage pond and a flood control pond. The pond has 20.5 acre-feet of agricultural water storage below the elevation of the natural ground. The agricultural water storage area is lined with a concrete liner. The 22 acre-feet of flood control storage is located on top of the agricultural water. The flood control storage is earthen structure with principle and auxiliary spillways. The top auxiliary spillway is 3.5 feet above the natural ground at its highest point. The spillways discharge into the North Ogden and Harrisville city storm drain systems and streets. All systems drain to the west.
- **Existing development:** The pond is located inside the North Ogden City limits. A breach of the dam would flood within the city.
- **Potential for Future Developments:** With the pond inside the city limits and vacant ground downstream of the dam, there will be future development in the flood path. This ground was assumed to be developed into residential housing in the model.

6.0 Conclusions

The purpose of this report is to present the methodology and results of the flooding and risk analysis conducted for North Pine Reservoir Project as part of the Plan-EA. Key results of the flooding and risk analyses include the following:

- The peak breach flow from the North Pine Reservoir was 850 cfs.
- The height of the water impounded (below ground) is 3.5feet with a volume of 20.5 acre-feet.
- The maximum wave velocity in the model is approximately 4 ft/s below the pond.
- The maximum wave height is approximately 2 foot. • The total inundated area is approximately 115 acres;
- Total number of homes inundated is 219 (210 homes < 1 foot, 9 homes > 1 foot).
- Estimated PAR is 27 people.
- Estimated Loss of Life is 0 people.

7.0 Statement of Limitations

This document represents J-U-B Engineers, Inc.’s professional judgement based on the information available at the time of its completion and as appropriate for the project Scope of Work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. No warranty, express or implied, is made. It is recommended that further coordination with Utah Dam Safety be conducted throughout the design and construction phase of the project.

8.0 References

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Dam Safety Guidelines. Washington State Department of Ecology (Washington Ecology), 2007.

Technical Note 1: Dam Break Inundation Analysis and Downstream Hazard Classification. Dated July 1992, Revised October 2007.