



APPENDIX A

ADDITIONAL BACKGROUND INFORMATION



AI DEPARTMENT OF FISH AI ME
DIVISION OF SPORT FISH
LAKE SURVEY SUMMARY

LAKE Knik (825)

MAP REF. Anch B-8 T 16N R 3W S 24 LAT. LONG.

LOC. Knik Road out of Wasilla SURF. ELEV. 50'

1. SURF. ACRES 50.4 MAX. DEPTH 37' AVG. DEPTH 19' ACRE FT. 963

SHOAL AREA WATER COLOR clear SECCHI READING

AQUATIC VEGETATION

2. FISH SPECIES: NATIVE SB INTRODUCED RB, SS

3. FISHING HISTORY Fair fishing after rehab 1957

4. INVERTEBRATES

5. INLETS None DISCHARGE cfs

DISCHARGE cfs

DISCHARGE cfs

BARRIERS

6. OUTLETS Intermittant-presently dry DISCHARGE cfs

DISCHARGE cfs

BARRIERS Structure placed in outlet to block fish passage into lake

7. SPAWNING AREAS None

8. WATERSHED TYPE Spruce and Birch DRAINAGE AREA Unknown ACRES

9. ACCESSIBILITY Adjacent ot Knik Road, 20 miles from Wasilla

10. ACCESS STATUS Right of way granted by private owner, access at Knik Lake Center

11. USE SITE Bible Camp, Roadhouse FACILITIES Boat launch

12. OTHER USE Residential, dog racing

13. POLLUTION None

14. REMARKS Reinfested with stickleback. Rehab in 1970 and will be planted with RB.
Rotenone 1.67 ppm.

Stickleback observed 5/30/79 by Engel & Watayell
Chemically treated w/ Rotenone in 10/1982

BY Rupert E. Andrews

DATE August 13, 1959

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

HABITAT AND RESTORATION DIVISION

FISH HABITAT PERMIT FG 97-II-0421

333 RASPBERRY ROAD
ANCHORAGE, ALASKA 99518-1599
PHONE: (907) 344-0541

ISSUED: June 5, 1997
EXPIRES: December 31, 1997

Mr. Ed Tompkins
HC 04, Box 9250
Palmer, Alaska 99645

Dear Mr. Tompkins:

Re: Outfall Structure
Wolverine Lake
Stream No. 247-50-10220-2080-3019-0010
Section 7, T. 18 N., R. 3 W., S.M.

Pursuant to AS 16.05.870(b), the Alaska Department of Fish and Game (ADF&G) has reviewed your proposal to repair the dam at the outlet of Wolverine Lake to raise the water level and improve fish passage. The work will consist of hand placing approximately 15 cubic yards of rock, root wads and logs to repair the dam and step pool for fish passage at the referenced location. No wheeled or tracked vehicles will be operated below the ordinary high water elevation of the lake.

Wolverine Lake has been specified as being important for the spawning, rearing, or migration of anadromous fish pursuant to AS 16.05.870(a). Sockeye salmon and resident Dolly Varden and rainbow trout use this portion of the water body.

In accordance with AS 16.05.870(d), project approval is hereby given subject to the following stipulations:

1. The outlet structure shall not block fish passage. The maximum drop from the lake to the seep pool shall not exceed 6 inches. If the single 6-inch drop is insufficient to maintain the desired lake level, a second outlet structure shall be constructed.
2. Any inadvertent bank cuts, slopes, fills, or other exposed earth work attributable to this project shall be immediately stabilized to prevent erosion which may occur both during and after the project.
3. The ADF&G, Habitat and Restoration Division shall be notified after construction is complete to arrange a site inspection of the project.

The permittee is responsible for the actions of contractors, agents, or other persons who perform work to accomplish the approved plan. For any activity that significantly deviates from the

June 5, 1997

approved plan, the permittee shall notify the ADF&G, Habitat and Restoration Division and obtain written approval in the form of a permit amendment before beginning the activity. Any action taken by the permittee, or an agent of the permittee, that increases the project's overall scope or that negates, alters, or minimizes the intent or effectiveness of any stipulation contained in this permit will be deemed a significant deviation from the approved plan. The final determination as to the significance of any deviation and the need for a permit amendment is the responsibility of the ADF&G, Habitat and Restoration Division. Therefore, it is recommended that the ADF&G, Habitat and Restoration Division be consulted immediately when a deviation from the approved plan is being considered.

This letter constitutes a permit issued under the authority of AS 16.05.870. This permit must be retained on site during construction. Please be advised that this approval does not relieve you of the responsibility for securing other permits: state, federal, or local.

Pursuant to 6 AAC 80.010 (b), the conditions of this permit are consistent with the Standards of the Alaska Coastal Management Program and the Matanuska Susitna Borough Coastal District Program.

In addition to the penalties provided by law, this permit may be terminated or revoked for failure to comply with its provisions or failure to comply with applicable statutes and regulations. The department reserves the right to require mitigation measures to correct disruption to fish and game created by the project and which were a direct result of the failure to comply with this permit or any applicable law.

The recipient of this permit (the permittee) shall indemnify, save harmless, and defend the department, its agents, and its employees from any and all claims, actions or liabilities for injuries or damages sustained by any person or property arising directly or indirectly from permitted activities or the permittee's performance under this permit. However, this provision has no effect if, and only if, the sole proximate cause of the injury is the department's negligence.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330--44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner

Donald O. McKay

By: Donald O. McKay
Habitat Biologist
Habitat and Restoration Division

FG 97-II-0421

-3-

June 5, 1997

cc: C. Whitmore, ADF&G
C. Yoder, FWP
R. Thompson, ADNR
K. Hudson, MSB

LAKE SURVEY

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
DIVISION OF SPORT FISH

LAKE SUMMARY

LAKE... KNIK LAKE.....T. 16N . R. 3W . Sec. 19...

Long. Lat.

1. Other names of lake None
2. Accessibility (how reached, condition of roads) Good gravel road from town of Wasilla about 8 miles. elevation 90'
3. Outlet (immediate and main drainage) Outlet directly into Knik Arm. permanency Permanent. size 5 cps. max.
4. Dam in outlet Yes distance from lake Immediate height 4 1/2'
effect on level Very little owner ADF&G
effect on fish movements Block to downstream movement of fish and upstream.
5. Inlets (name, size & permanency) None, spring fed and seepage. drainage area
6. Pollution (kind, source, severity) None
7. Immediate shore (topography, soil, cover) Gentle sloping banks, Spruce, Birch
8. Surrounding country (topography, soil, cover) Rolling, wooded hills, Spruce & birch.
9. Use (private, public, semi-private) Public public fishing site Yes
10. Approximate number of cottages 0 hotels 0 resorts 1 Bible boat liveries 1
Camp
11. Fishing: general reputation Fair fishing success.
history: Rehab 1957 by ADF&G, 7000 RB fry 1957- 24,000 RB & SS fry 1958.
reported by ADF&G annual report, 1957
intensity (heavy, medium, light) summer Light winter None
12. Other uses Bible Camp in summer
13. Area 67 3/4 AC. 50.19 shore development Average maximum depth 18
14. Area of vegetation (acres) percent shoal (less than 15 ft) Max. Depth-
15. Slope at drop-off (gradual, steep) Gradual 40'
16. Bottom soil: shoal deep water
17. Color Clear Secchi disk (range) turbidity
18. Depth range where temperature is below 70° F and O₂ above 4 PPM Dis. solids
19. Cover (kind, abundance)
20. Vegetation (type, abundance)
21. Food (abundance, dominant organisms): plankton
bottom: shoal depths
vegetation
22. Spawning grounds (summarize observations and reports) No spawning areas.
23. Predators (kind and abundance) Loons, Grebes
24. Severity of fish losses Unknown cause
25. Game fish RB abundance Fair dominant size in catch 10.0 in. growth rate Good
- other fish Stickleback-- Silver salmon planted but lost downstream before screen placed in outlet. 1958.
26. Continuations (use item numbers): 49.3 acres by planimeter photo # 5065
scale 8 miles to inch Van Helle
27. Prepared by Rupert E. Andrews date of survey 13 Aug. 1959

Date July Aug. 13, 1959

ALASKA DEPARTMENT OF FISH AND GAME

Sport Fish Division

Anchor B-8

Lake Survey Form

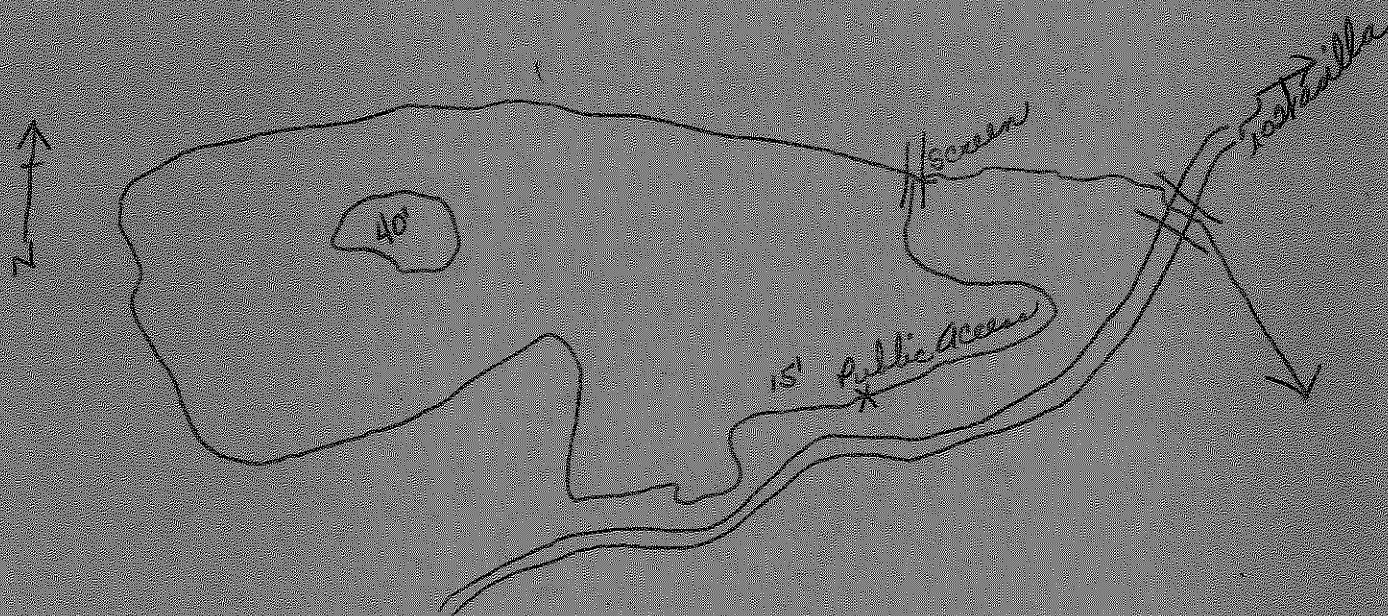
Lake Knik Lake Sec. 24, Twp 16 N, Rge. 3 W, Lat. 50° 19' 44" N., Long. 155° 19' 44" W.
Acreage 62 Max. Depth 40' Altitude 50'
Location Wasilla Water Color (clear, silty) Clear
Type of Bottom Mud
Inlets (name, size, permanency) None, permanent springs & seeps
Benchmark (Description) _____
Outlet (size, immediate and main drainage) Small outlet to Knik Arm about 3-5 fms. dry part of the time
Barriers Fish screen in outlet
Use (Private, public, semiprivate) Public
Public Access Site Yes
Facilities (Campground, roadhouse, etc.) Parking area and roadhouse.
Native Fish Species Stickleback.
Introduced Species Silver salmon and rainbow trout. Stickleback
Spawning Grounds No
Fishing History Fair to good fishing. 1960 spot checks indicated good rainbow fishing.
Other Uses Bible Camp.
Fish Losses Severe to silver salmon in 1958 when they left via outlet on freshet.
Character and size of watershed Terminal moraine country with spruce and birch.
Remarks Test netting in 1960 indicated abundant RB averaging 12" and ranging from 8 to 16 in.

*DT 1 p 29 SURVEY
DT 6 p 347 ACCRS OK*

(over)

Description of accessibility (how reached) About 20 miles west of Wasilla on Knik Road. Lake is adjacent to road.

Sketch: showing outline of lake, depth, prominent landmarks, inlets, outlet, weedbeds, public service site location, benchmark location, etc.





APPENDIX B

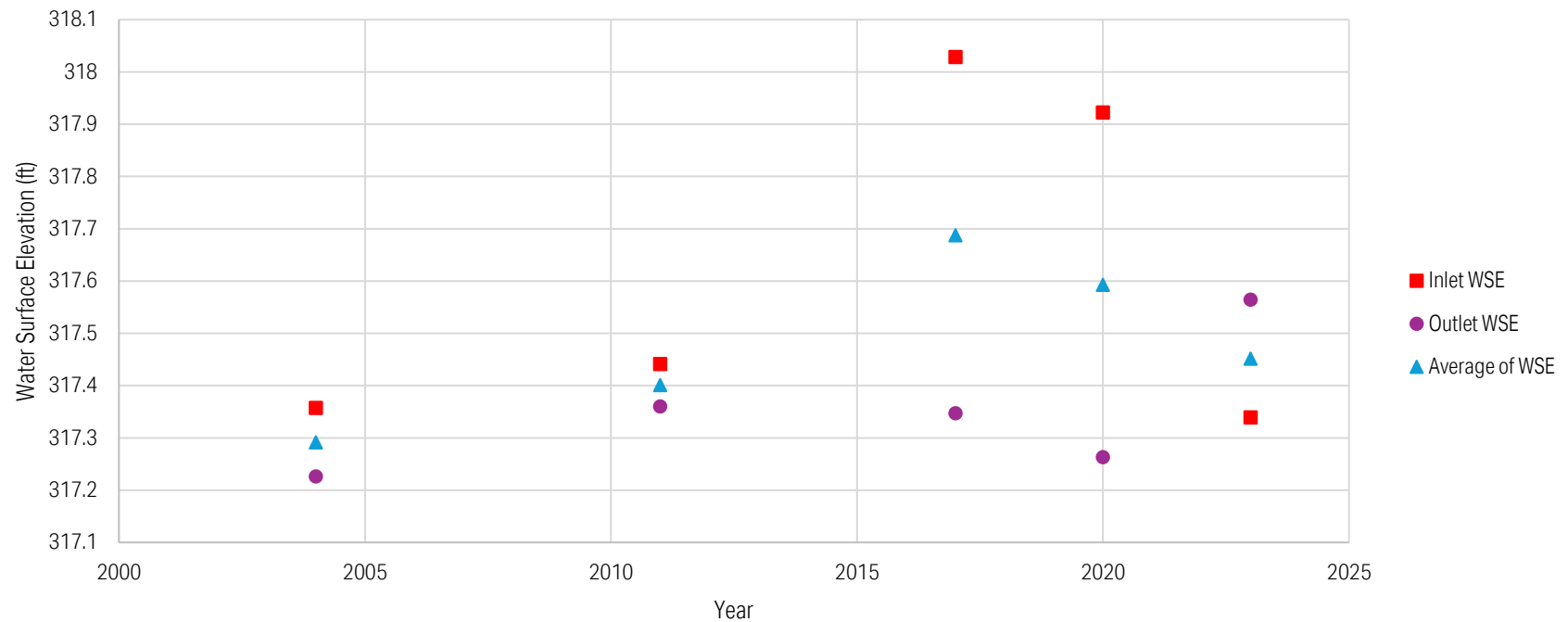
LAKE LEVEL DATA



Upper Caswell Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
2004	317.36	317.23	317.29
2011	317.44	317.36	317.40
2017	318.03	317.35	317.69
2020	317.92	317.26	317.59
2023	317.34	317.56	317.45

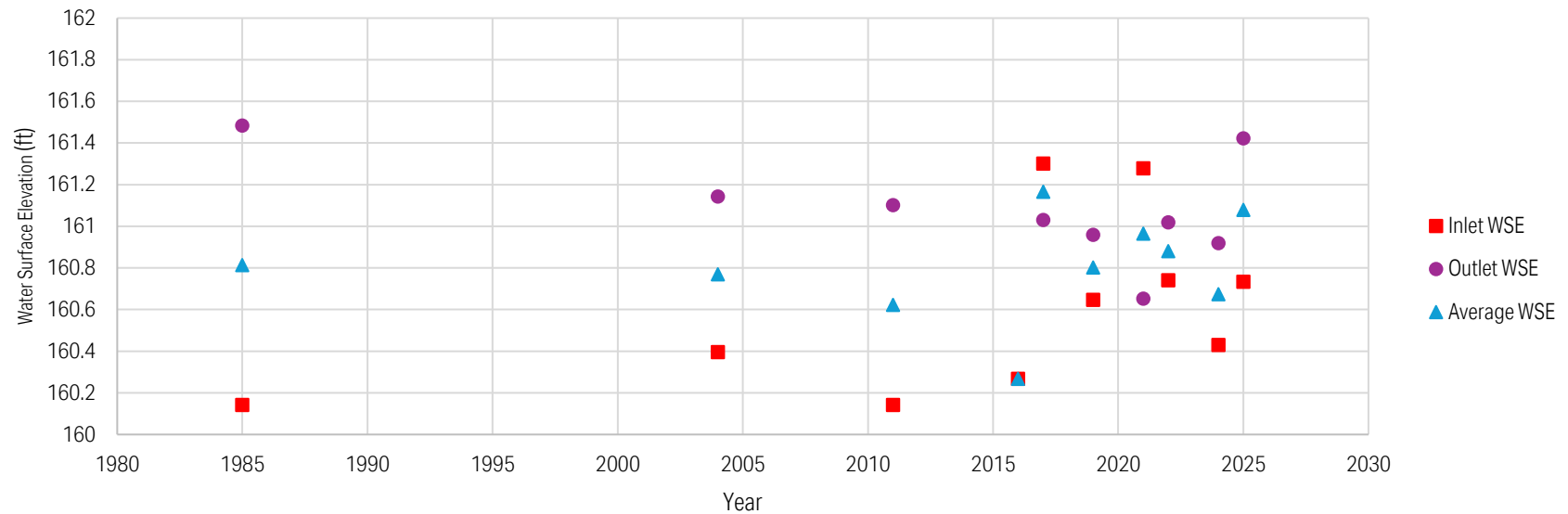
Upper Caswell Lake Water Surface Elevations vs Year



Horseshoe Lake Water Level Data

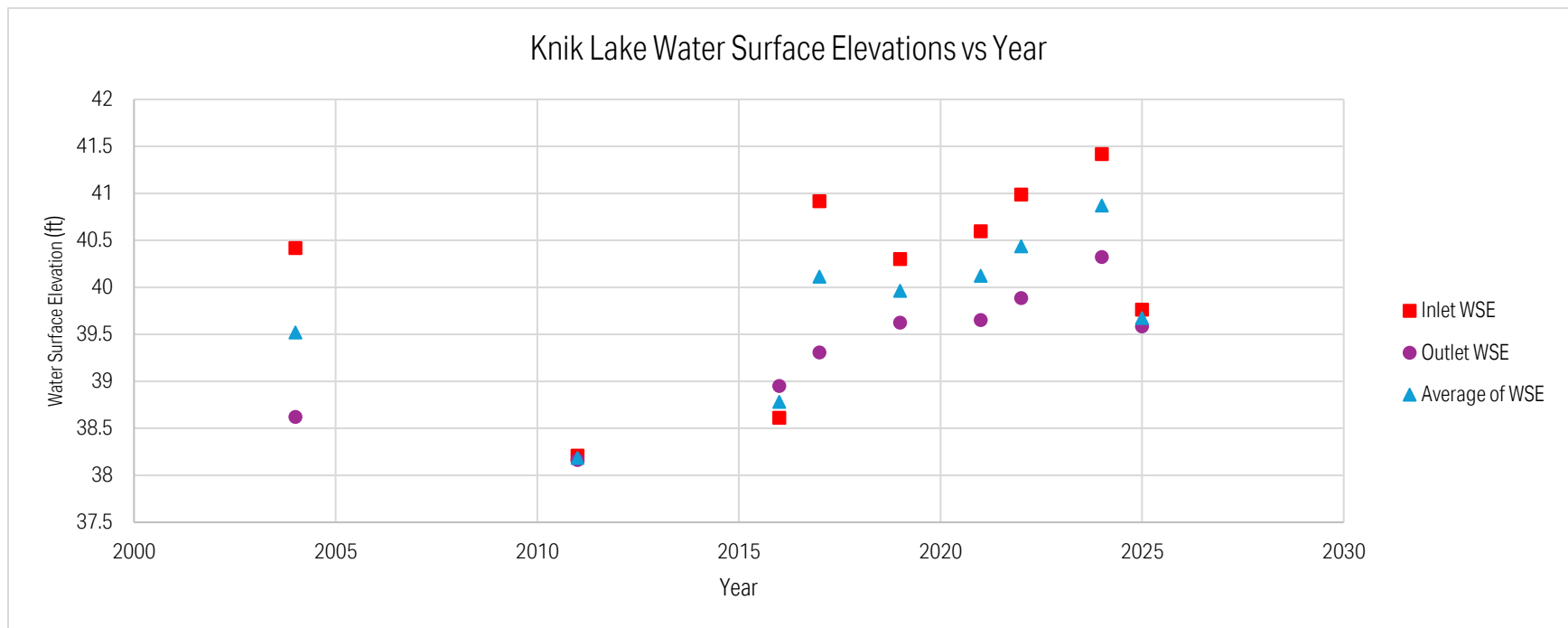
Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	160.14	161.48	160.81
2004	160.40	161.14	160.77
2011	160.14	161.10	160.62
2016	160.27	--	160.27
2017	161.30	161.03	161.17
2019	160.65	160.96	160.80
2021	161.28	160.65	160.96
2022	160.74	161.02	160.88
2024	160.43	160.92	160.67
2025	160.73	161.42	161.08

Horseshoe Lake Water Surface Elevations vs Year



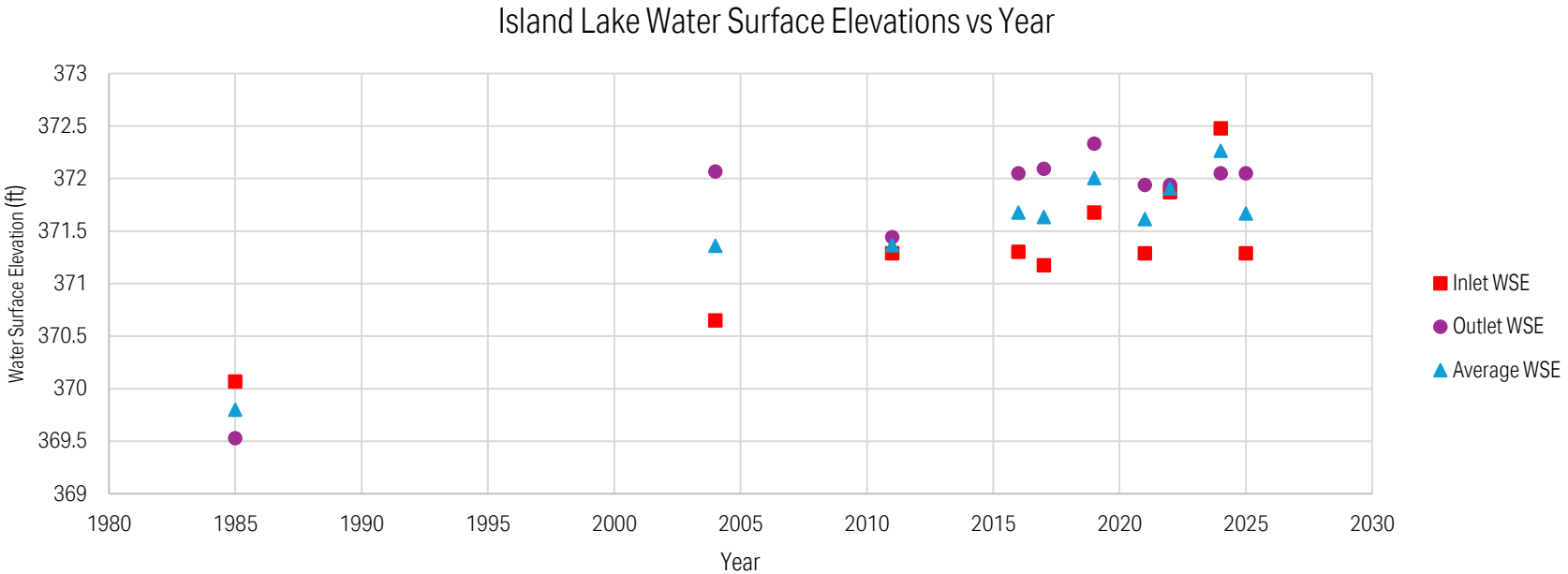
Knik Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
2004	40.42	38.62	39.52
2011	38.21	38.16	38.19
2016	38.61	38.95	38.78
2017	40.92	39.31	40.11
2019	40.30	39.63	39.96
2021	40.60	39.65	40.12
2022	40.99	39.88	40.44
2024	41.42	40.32	40.87
2025	39.76	39.59	39.67



Island Lake Water Level Data

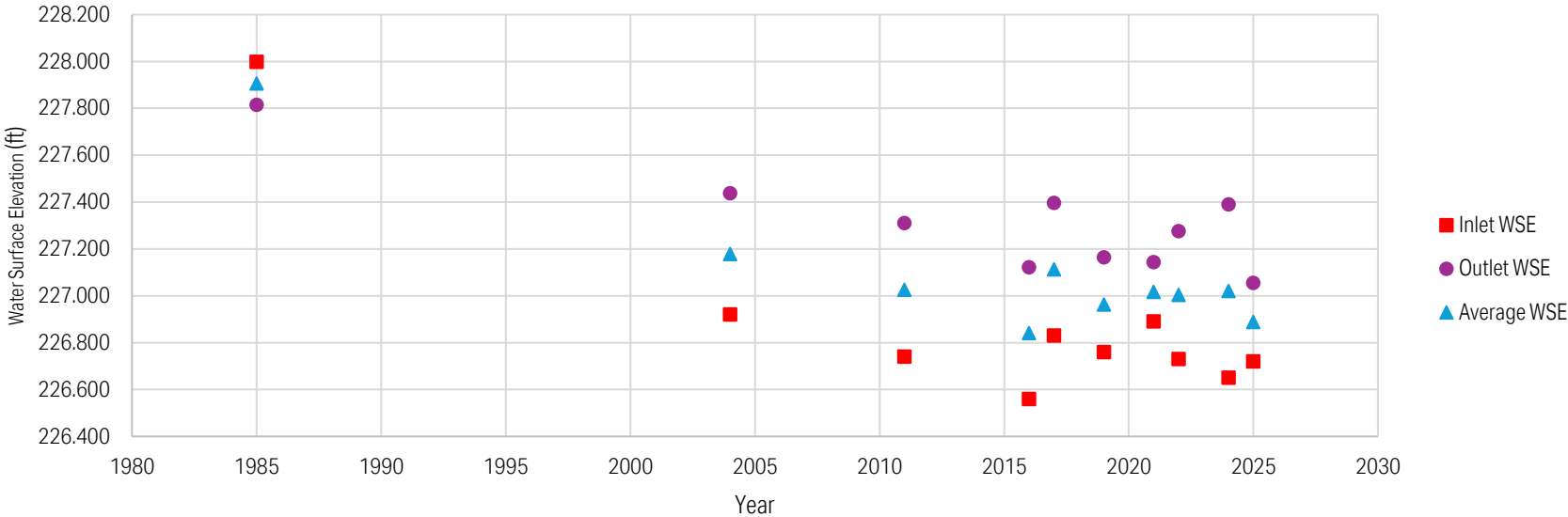
Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	370.07	369.53	369.80
2004	370.65	372.07	371.36
2011	671.29	371.44	371.37
2016	371.30	372.05	371.68
2017	371.17	372.09	371.63
2019	371.67	372.33	372.00
2021	371.29	371.94	371.61
2022	371.87	371.94	371.90
2024	372.48	372.05	372.26
2025	371.29	372.05	371.67



Blodgett Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	228.00	227.81	227.91
2004	226.92	227.44	227.18
2011	226.74	227.31	227.02
2016	226.56	221.12	226.84
2017	226.83	227.40	227.11
2019	226.76	227.16	226.96
2021	226.89	227.14	227.02
2022	226.73	222.28	227.00
2024	226.65	227.39	227.02
2025	226.72	227.05	226.89

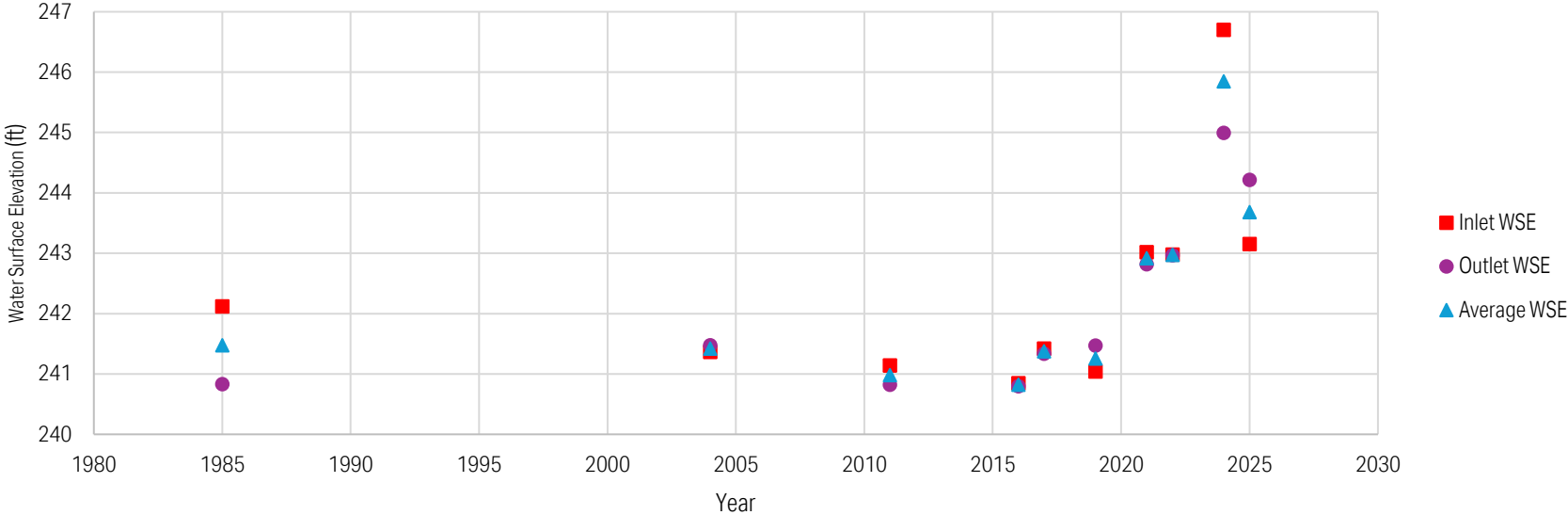
Blodgett Lake Water Surface Elevations vs Year



Swan Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	242.12	240.83	241.47
2004	241.37	241.47	241.42
2011	214.14	240.82	240.98
2016	240.84	240.79	240.82
2017	241.42	241.33	241.38
2019	241.04	241.47	241.25
2021	243.02	242.82	242.92
2022	242.98	242.97	242.97
2024	246.70	244.99	245.85
2025	243.15	244.21	243.68

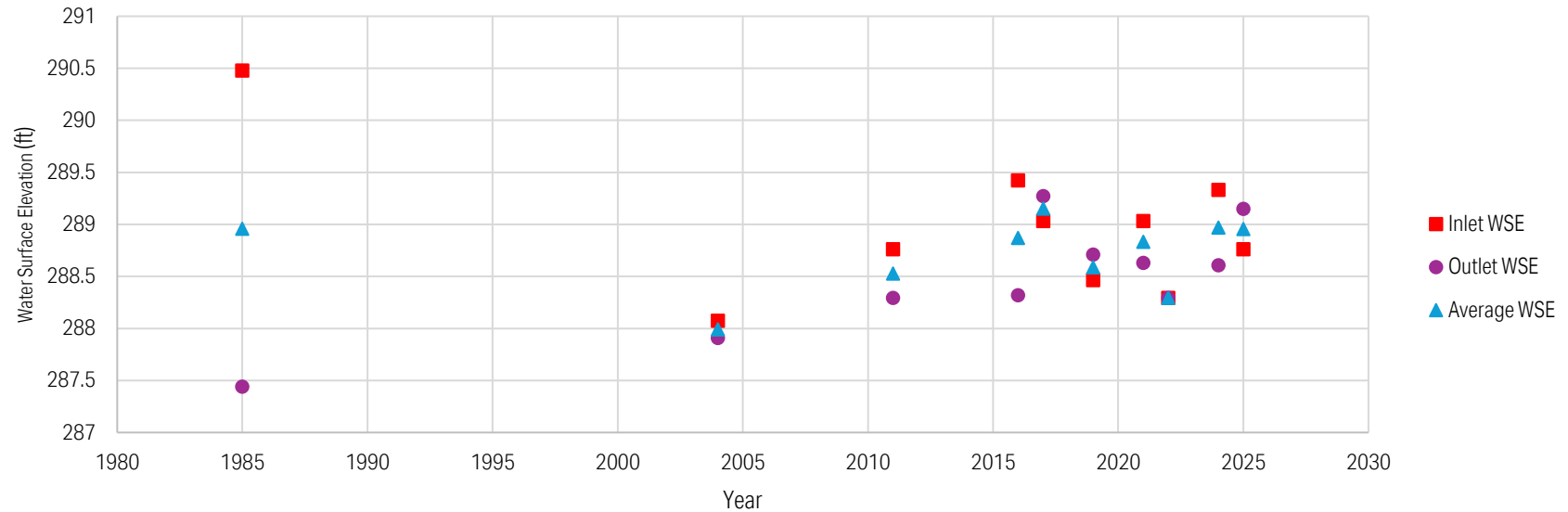
Swan Lake Water Surface Elevations vs Year



Golden Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	290.48	287.44	288.96
2004	288.07	287.91	287.99
2011	288.76	288.29	288.53
2016	289.42	288.32	288.87
2017	289.03	289.27	289.15
2019	288.47	288.71	288.59
2021	289.03	288.63	288.83
2022	288.29	288.29	288.29
2024	289.33	288.61	288.97
2025	288.76	289.15	288.95

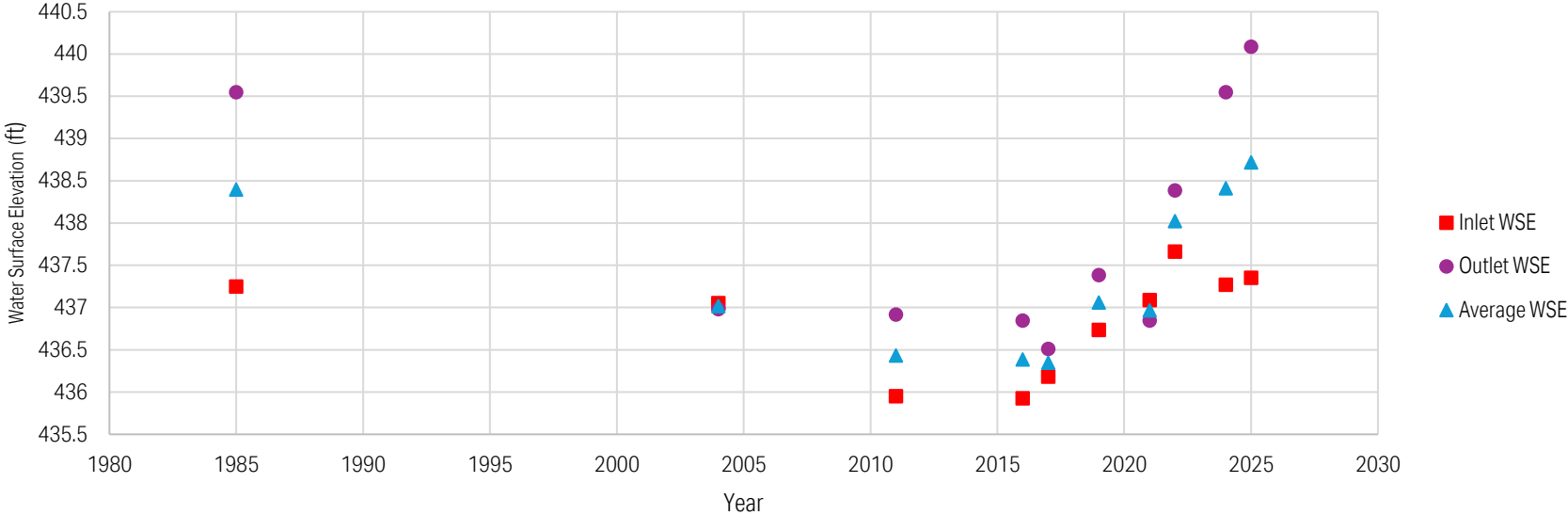
Golden Lake Water Surface Elevations vs Year



Kings Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	437.25	439.55	438.40
2004	437.05	436.98	437.02
2011	435.95	436.92	436.43
2016	435.93	436.85	436.39
2017	436.18	436.51	436.34
2019	436.73	437.38	437.06
2021	437.09	436.85	436.97
2022	437.66	438.39	438.02
2024	437.27	439.55	438.41
2025	437.35	440.08	438.72

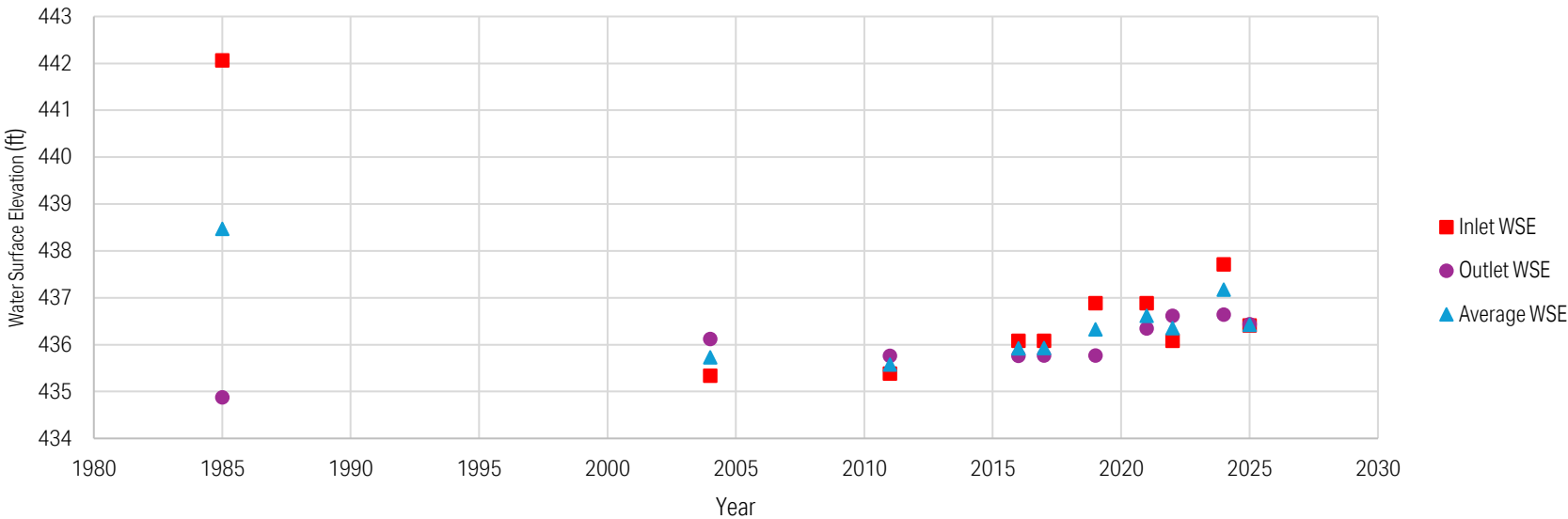
Kings Lake Water Surface Elevations vs Year



Anderson Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	442.06	434.87	438.47
2004	435.34	436.12	435.73
2011	435.38	435.76	435.57
2016	436.08	435.76	435.92
2017	436.08	435.77	435.92
2019	436.88	435.77	436.32
2021	436.88	436.34	436.61
2022	436.08	436.61	436.35
2024	437.71	436.64	437.17
2025	436.41	436.43	436.42

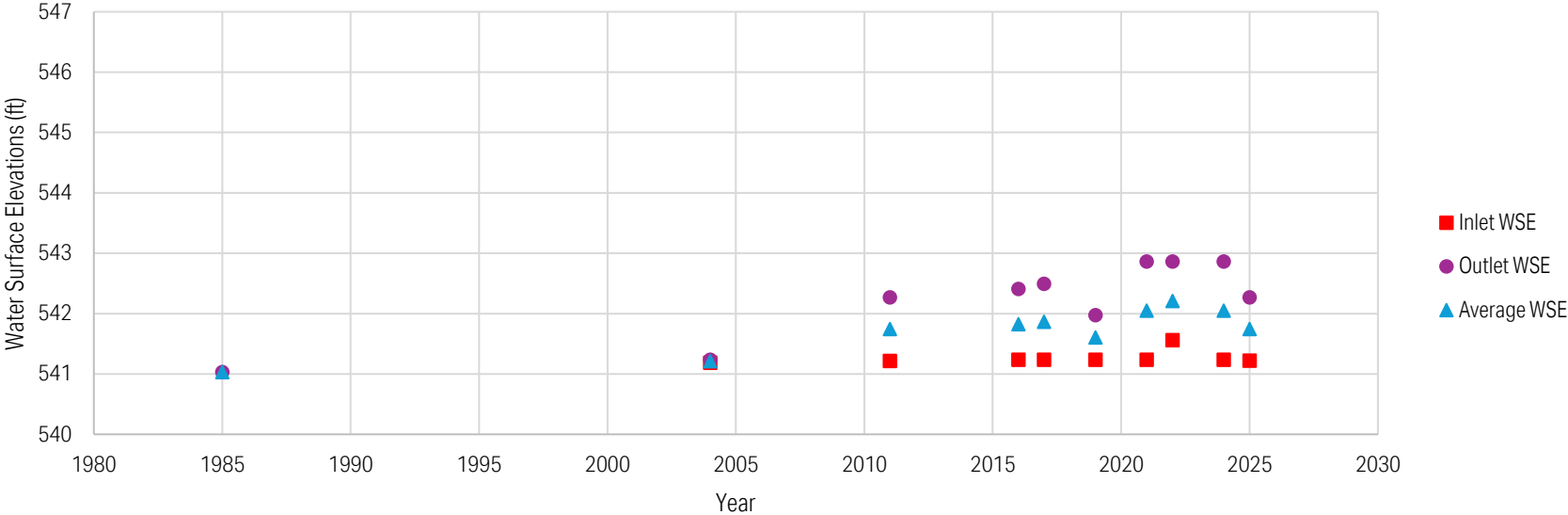
Anderson Lake Water Surface Elevations vs Year



Wolf Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
1985	--	541.03	541.03
2004	541.19	541.24	541.21
2011	541.22	542.27	541.74
2016	541.24	542.41	541.82
2017	541.24	542.49	541.87
2019	541.24	541.97	541.60
2021	541.24	542.86	542.05
2022	541.56	542.86	542.21
2024	541.24	542.86	542.05
2025	541.22	542.27	541.74

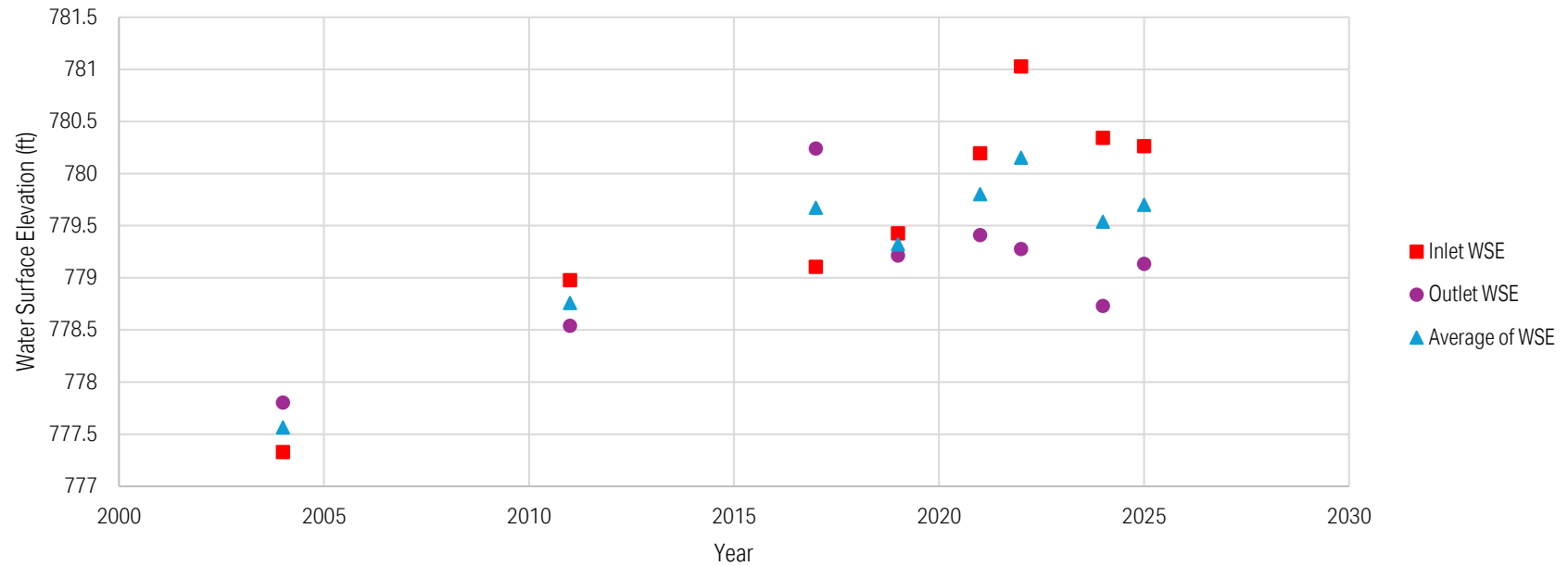
Wolf Lake Water Surface Elevations vs Year



Wolverine Lake Water Level Data

Year	Water Surface Elevations (ft)		
	Near inlet	Near outlet	Average
2004	777.33	777.80	777.57
2011	778.98	778.54	778.76
2017	779.11	780.24	779.67
2019	779.43	779.22	779.32
2021	780.20	779.41	779.80
2022	781.03	779.28	780.15
2024	780.34	778.73	779.54
2025	780.26	779.13	779.70

Wolverine Lake Water Surface Elevations vs Year

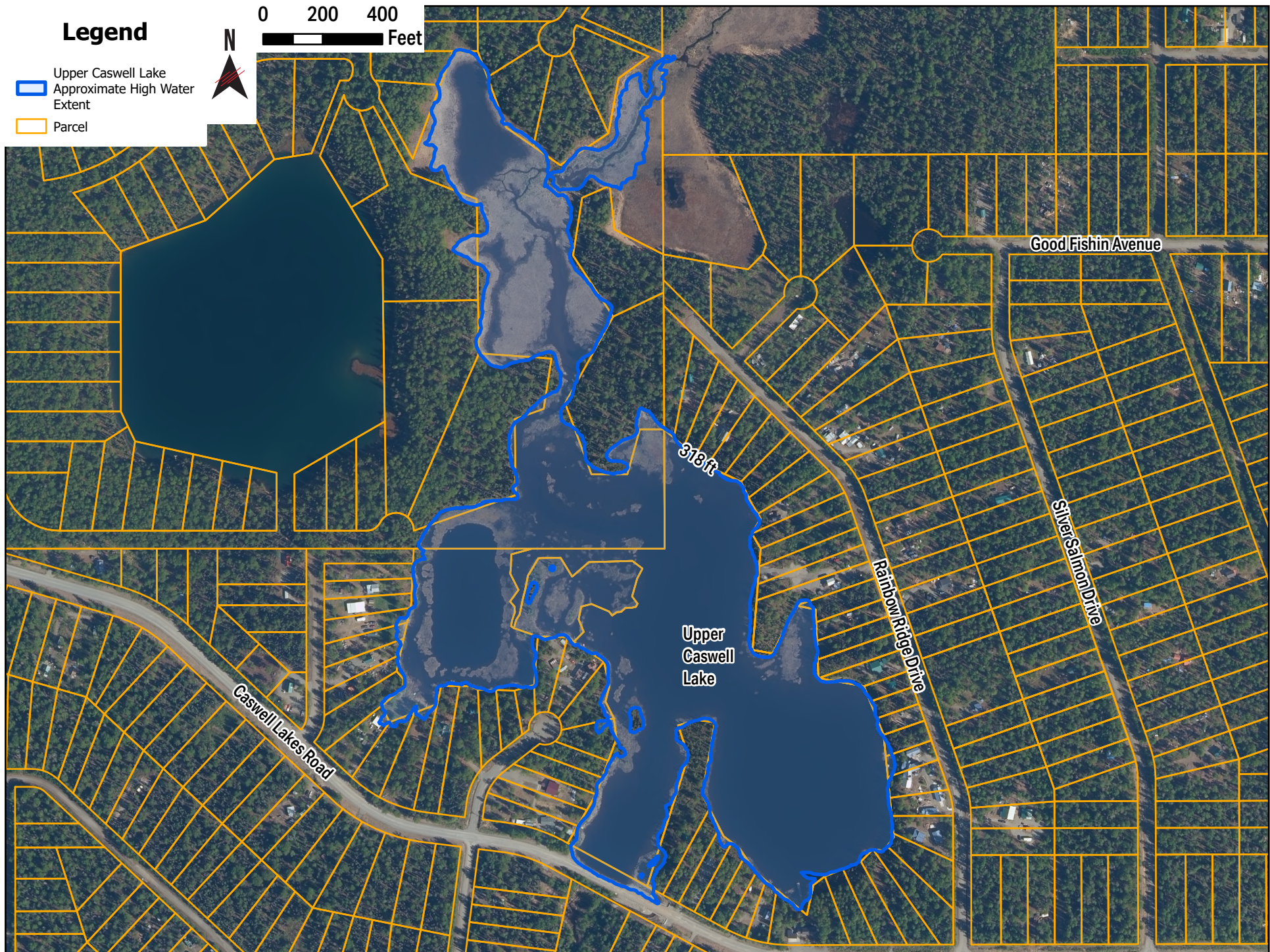




APPENDIX C

HIGH WATER LEVEL FIGURES





Legend

- Upper Caswell Lake
- Approximate High Water Extent
- Parcel

0 200 400 Feet





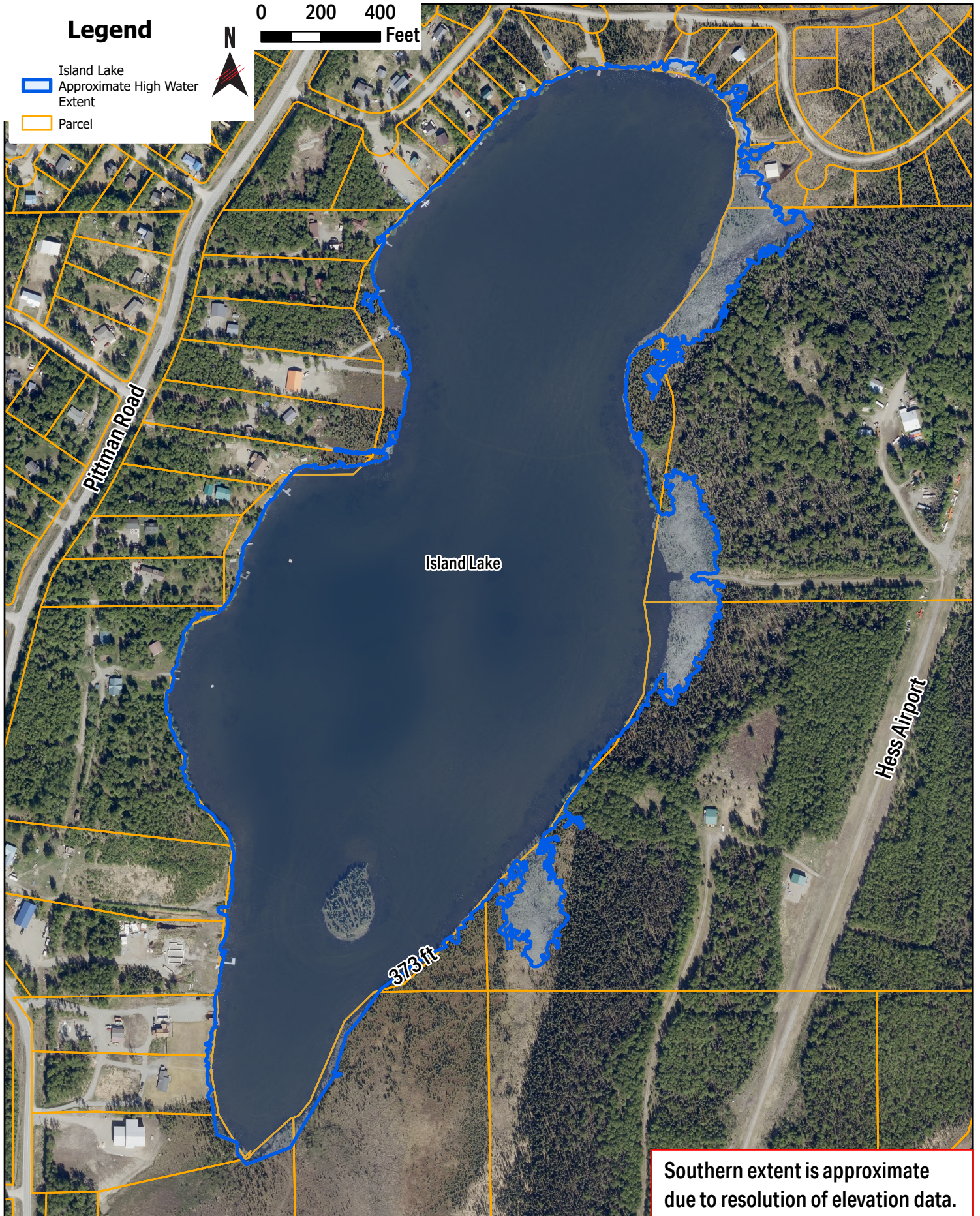
Year of Imagery: 2025



Legend

- Island Lake
- Approximate High Water Extent
- Parcel

0 200 400 Feet



Southern extent is approximate due to resolution of elevation data.

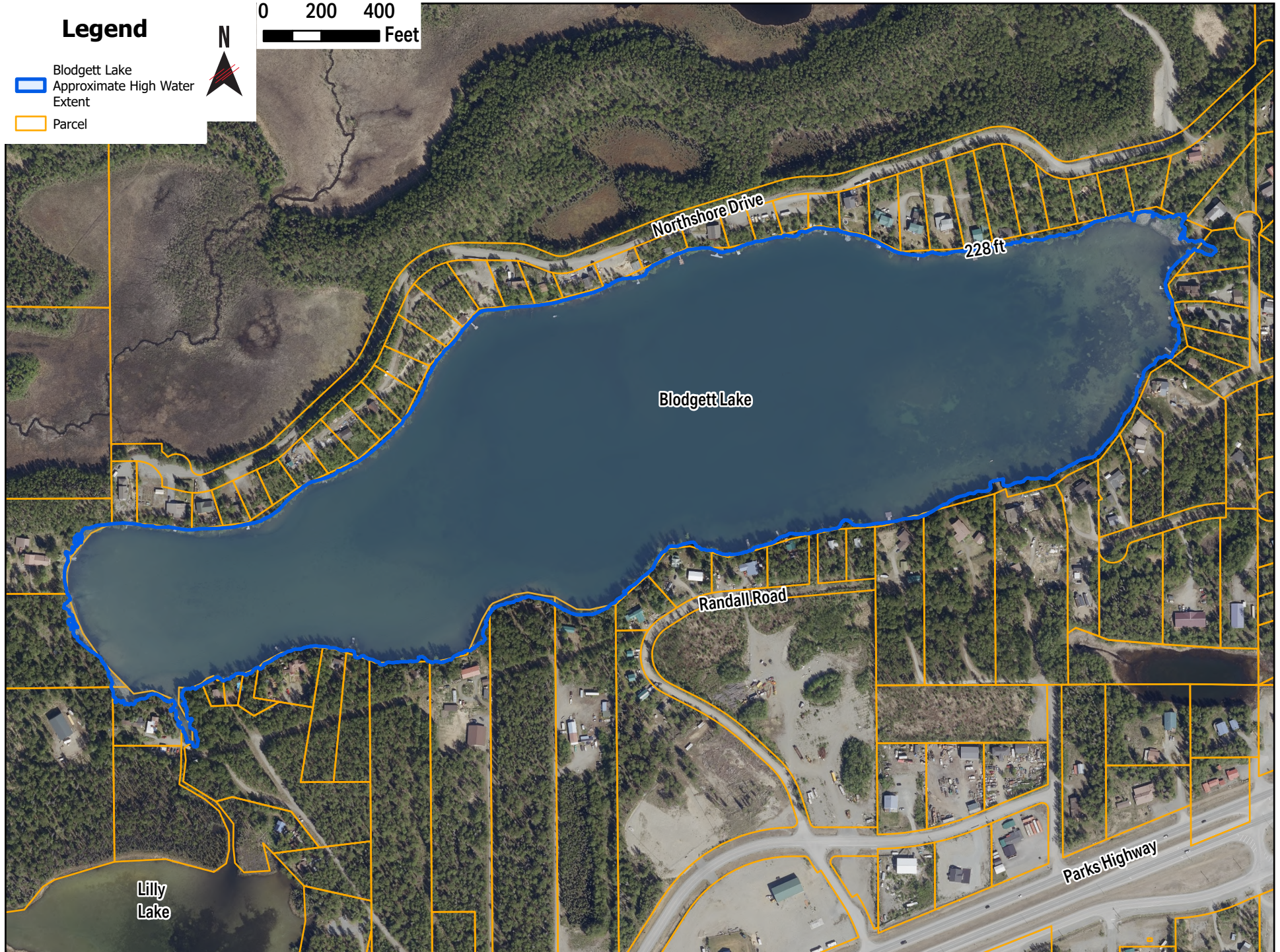
Year of Imagery: 2025

Legend

- Blodgett Lake
- Approximate High Water Extent
- Parcel



0 200 400 Feet



Year of Imagery: 2025

Legend

- Swan Lake Approximate High Water Extent
- Parcel



0 50 100 Feet

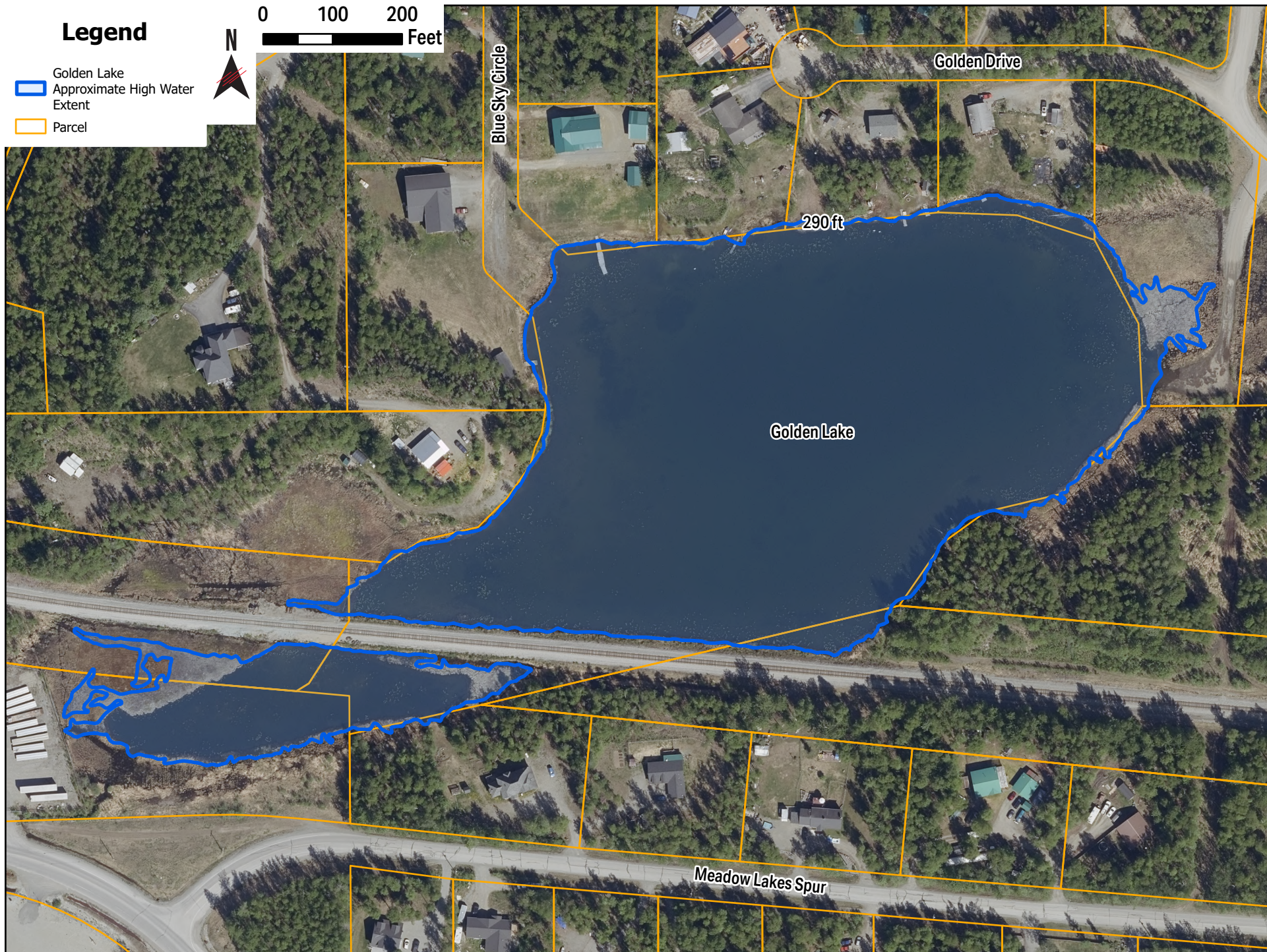


Year of Imagery: 2025

Legend

- Golden Lake
- Approximate High Water Extent
- Parcel

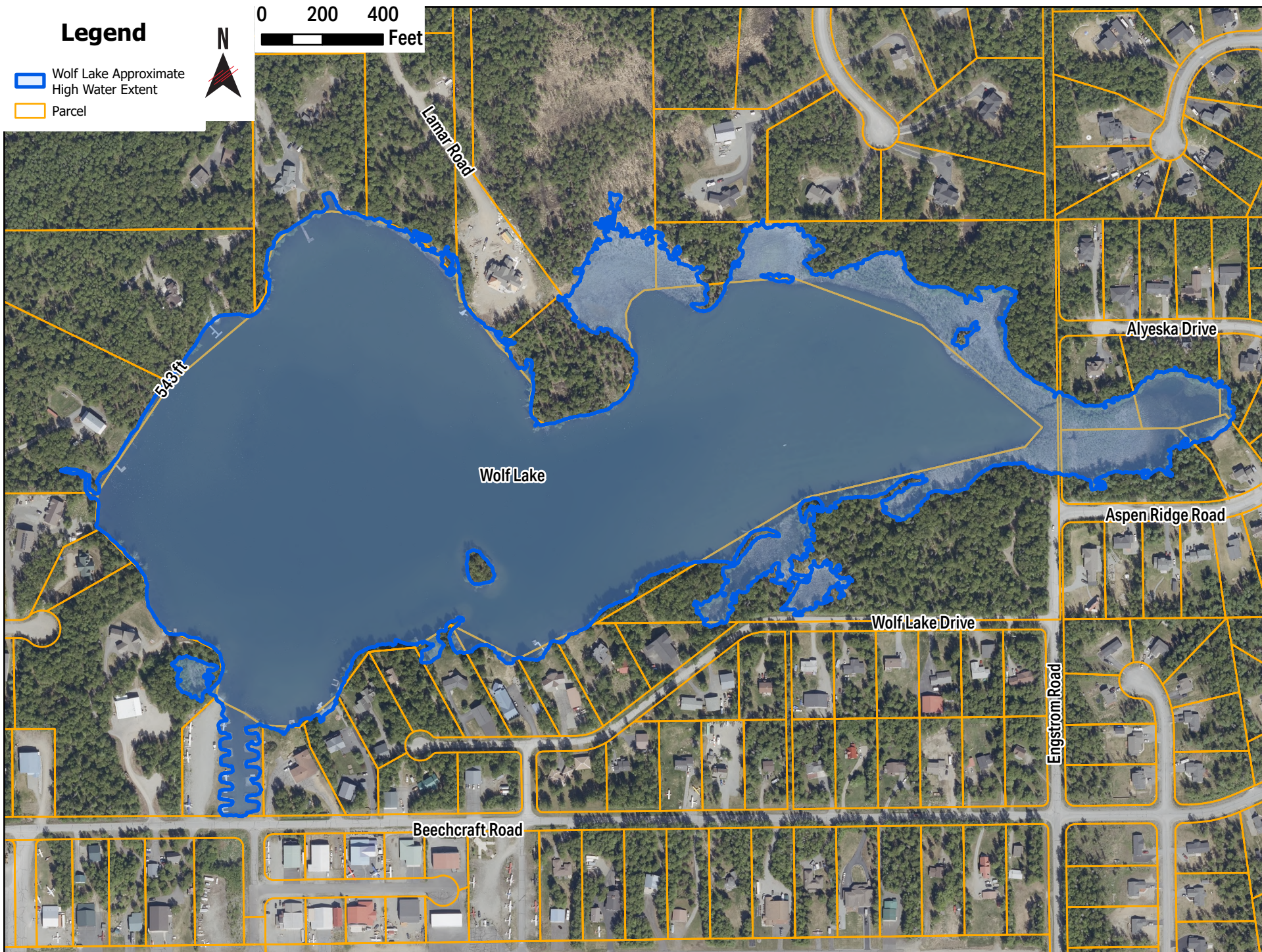
0 100 200 Feet



Year of Imagery: 2025



Year of Imagery: 2025



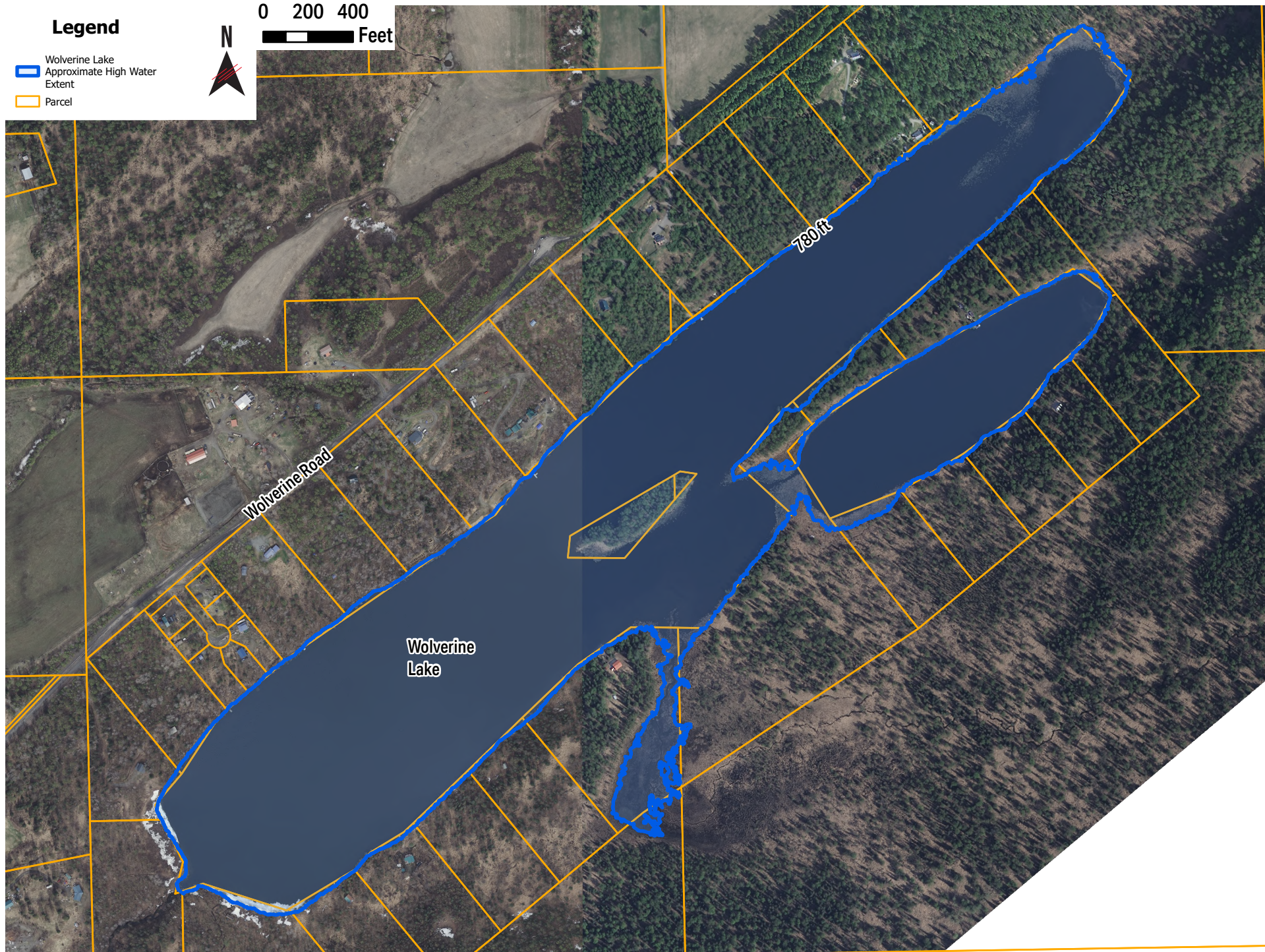
Year of Imagery: 2025

Legend

- Wolverine Lake
- Approximate High Water Extent
- Parcel



0 200 400
Feet



Year of Imagery: 2019

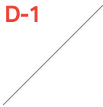


APPENDIX D

DRAINAGE BASINS

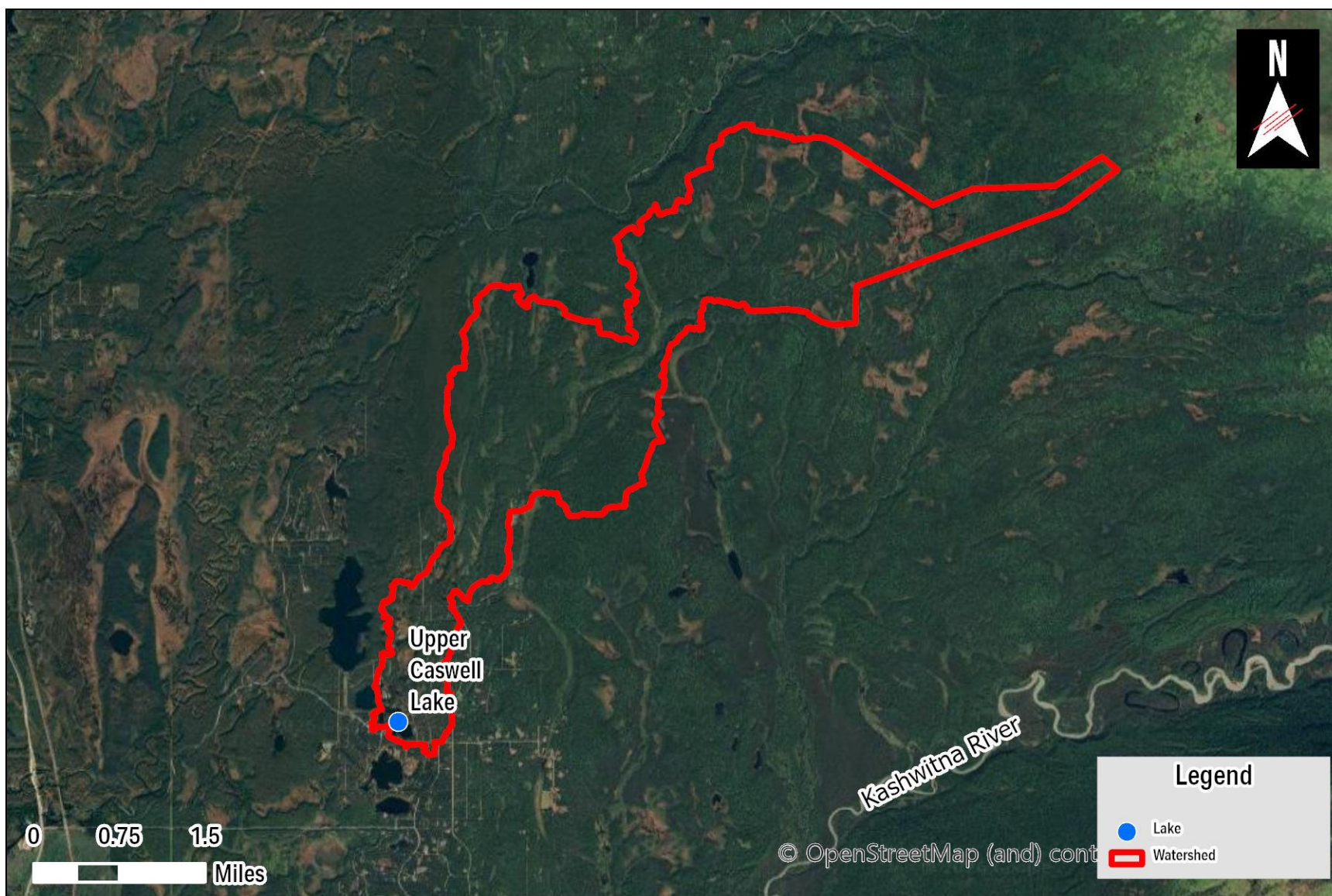


D-1

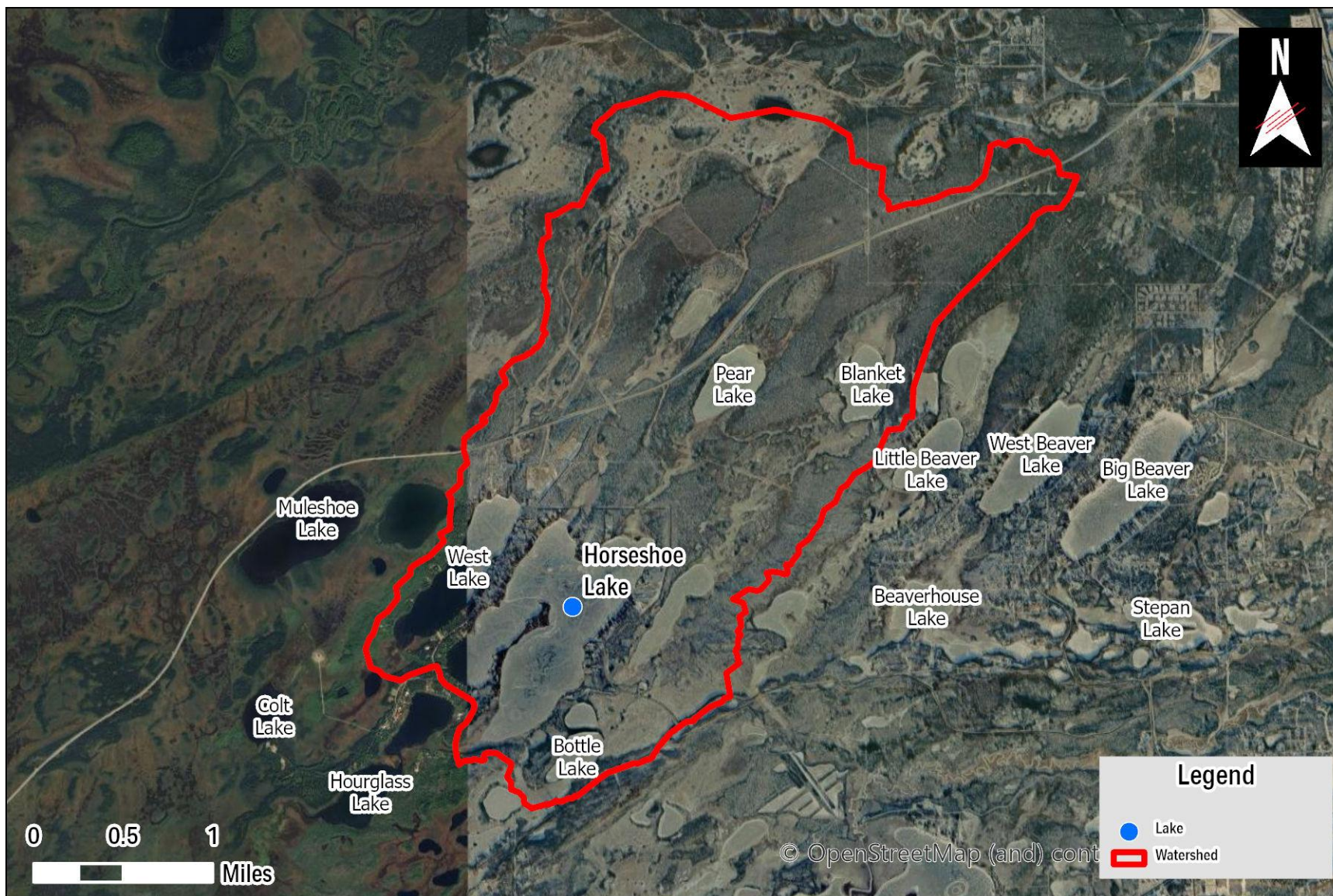


2026 LAKE LEVEL ANALYSIS





Upper Caswell Lake Watershed



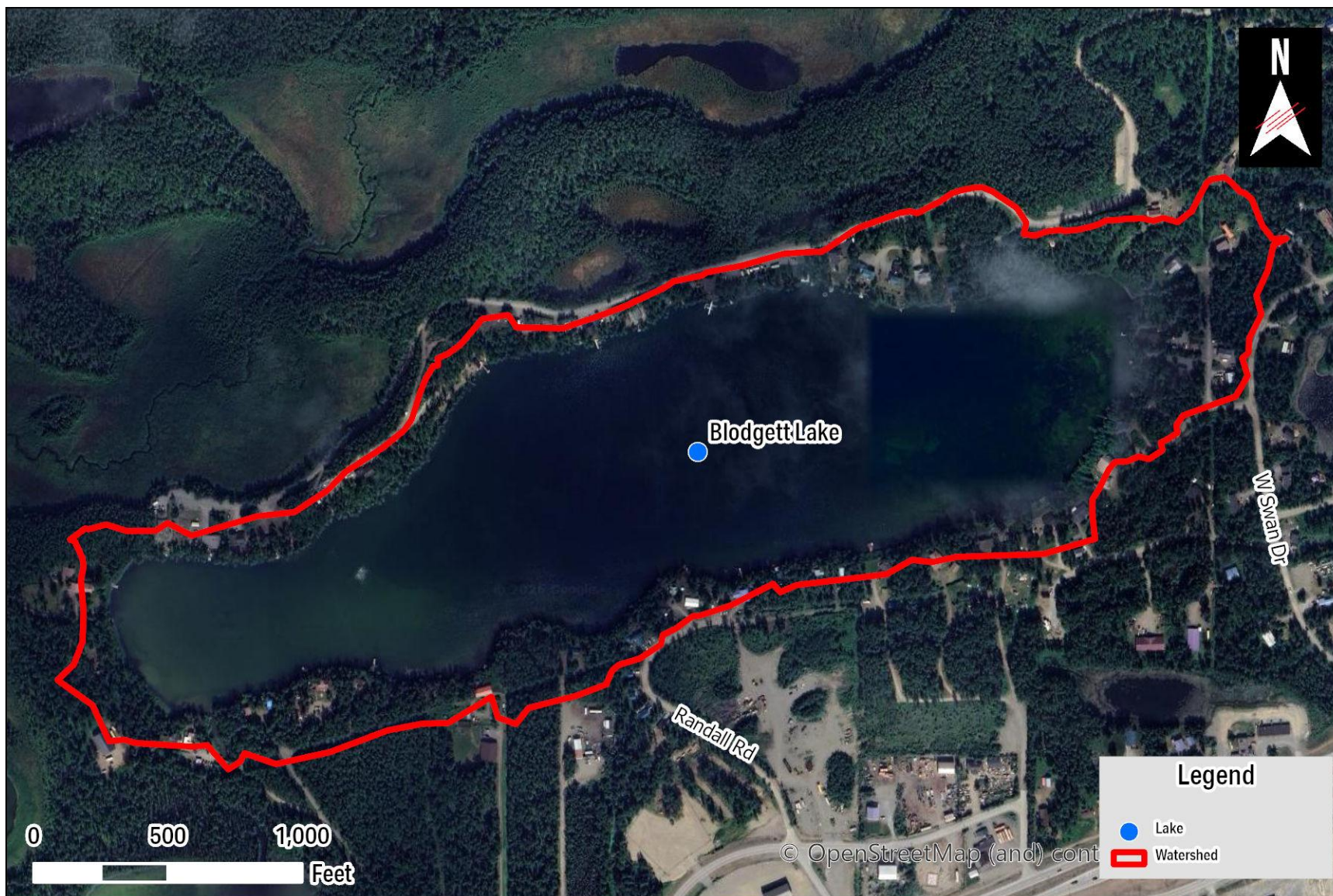
Horseshoe Lake Watershed



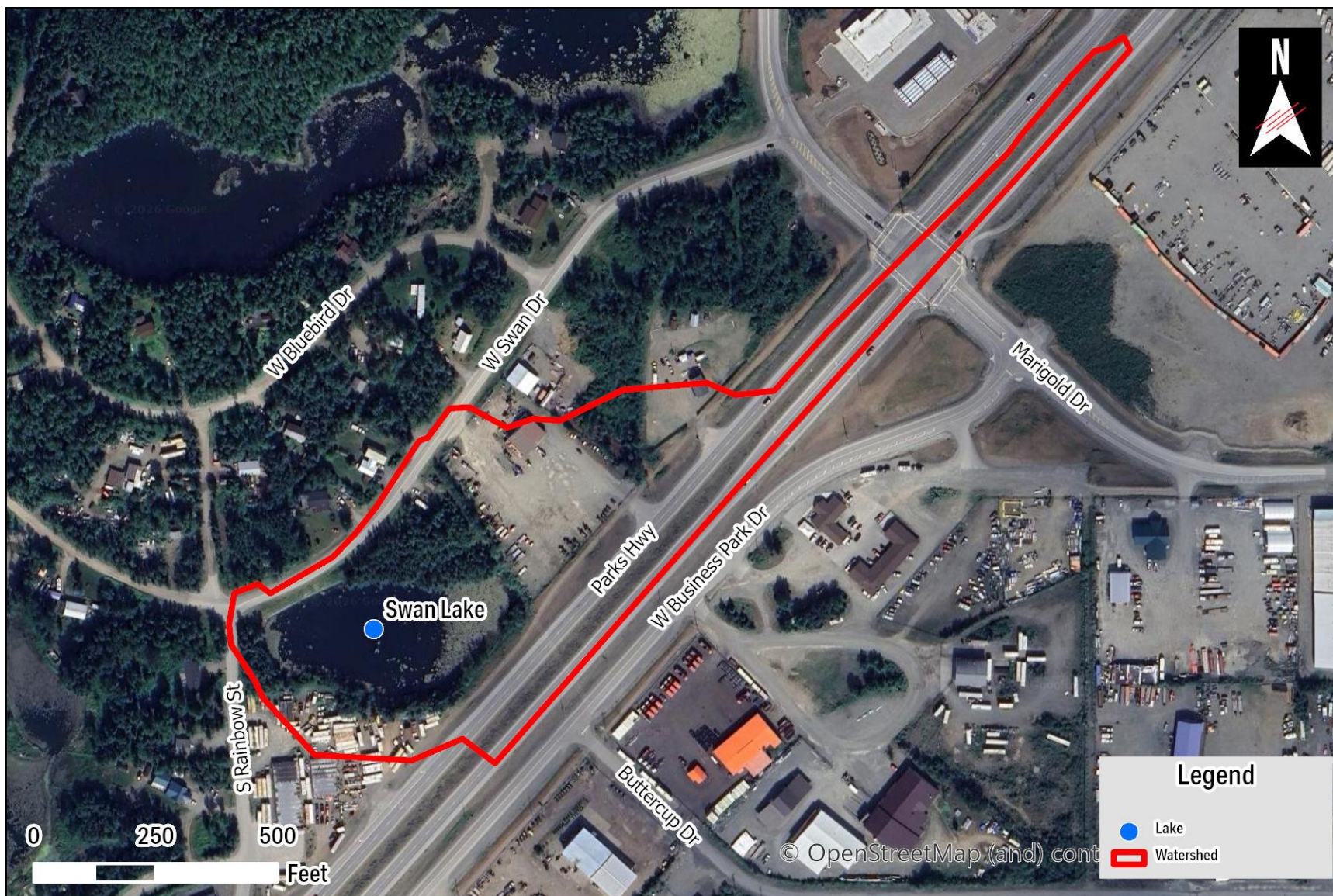
Knik Lake Watershed



Island Lake Watershed



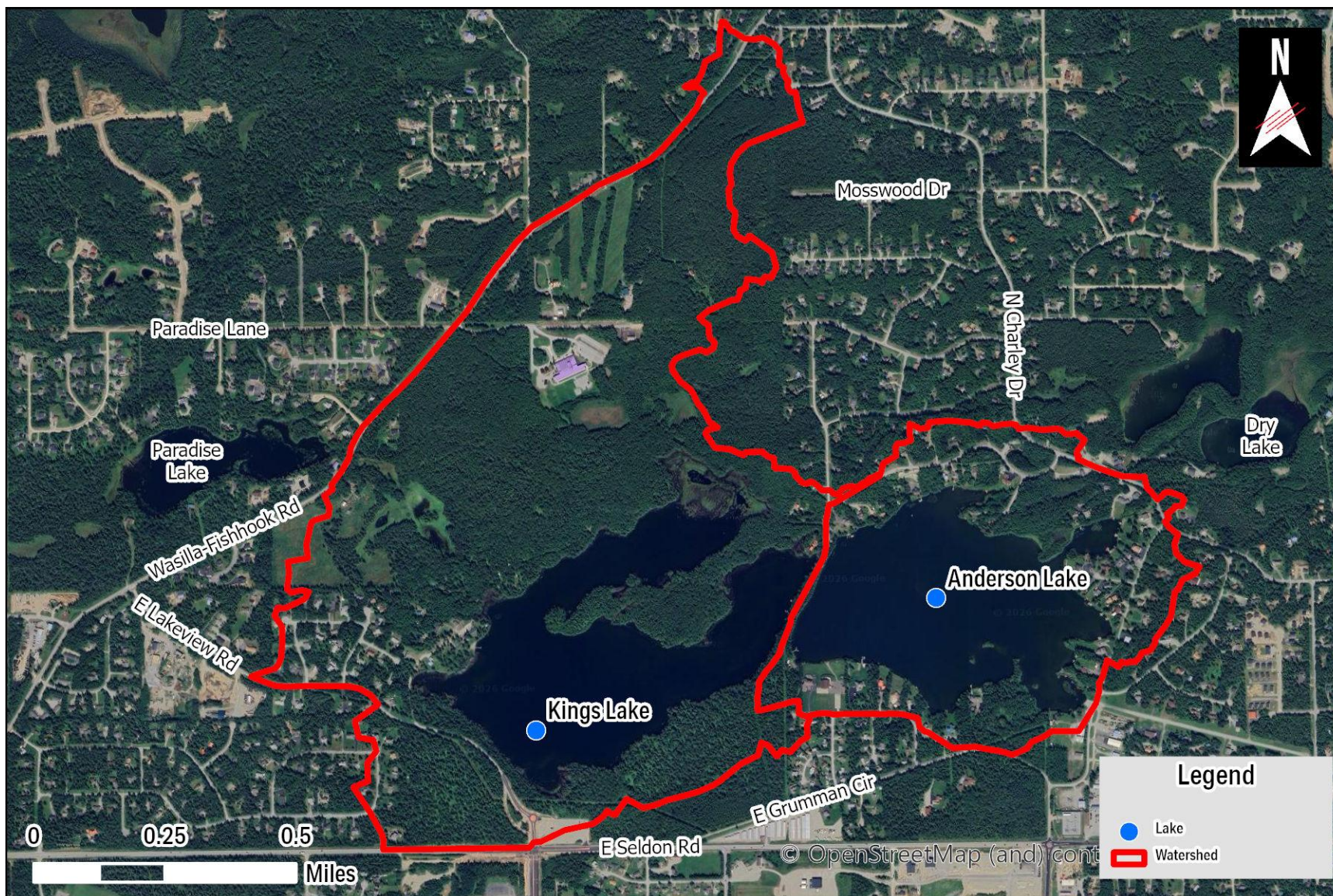
Blodgett Lake Watershed



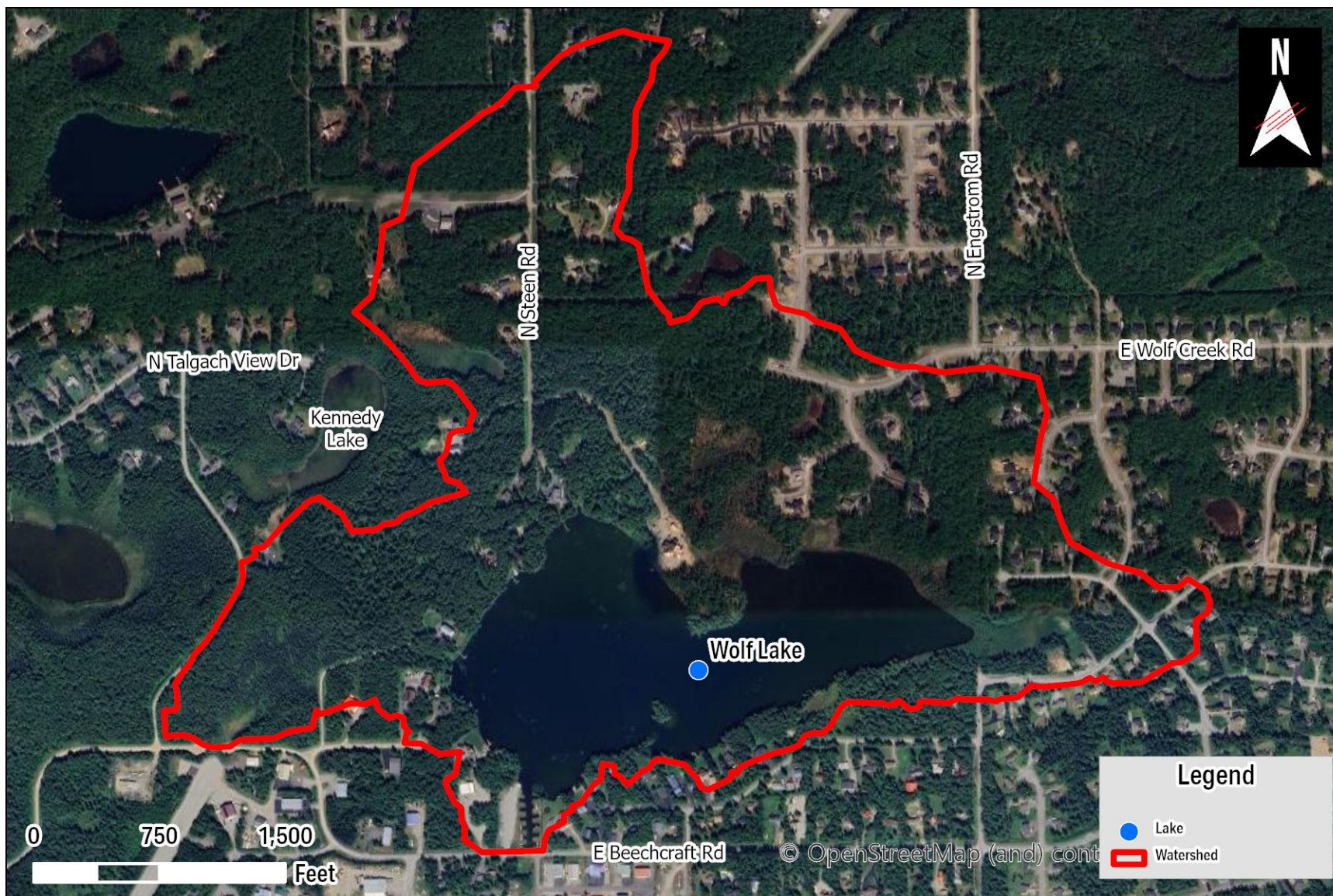
Swan Lake Watershed



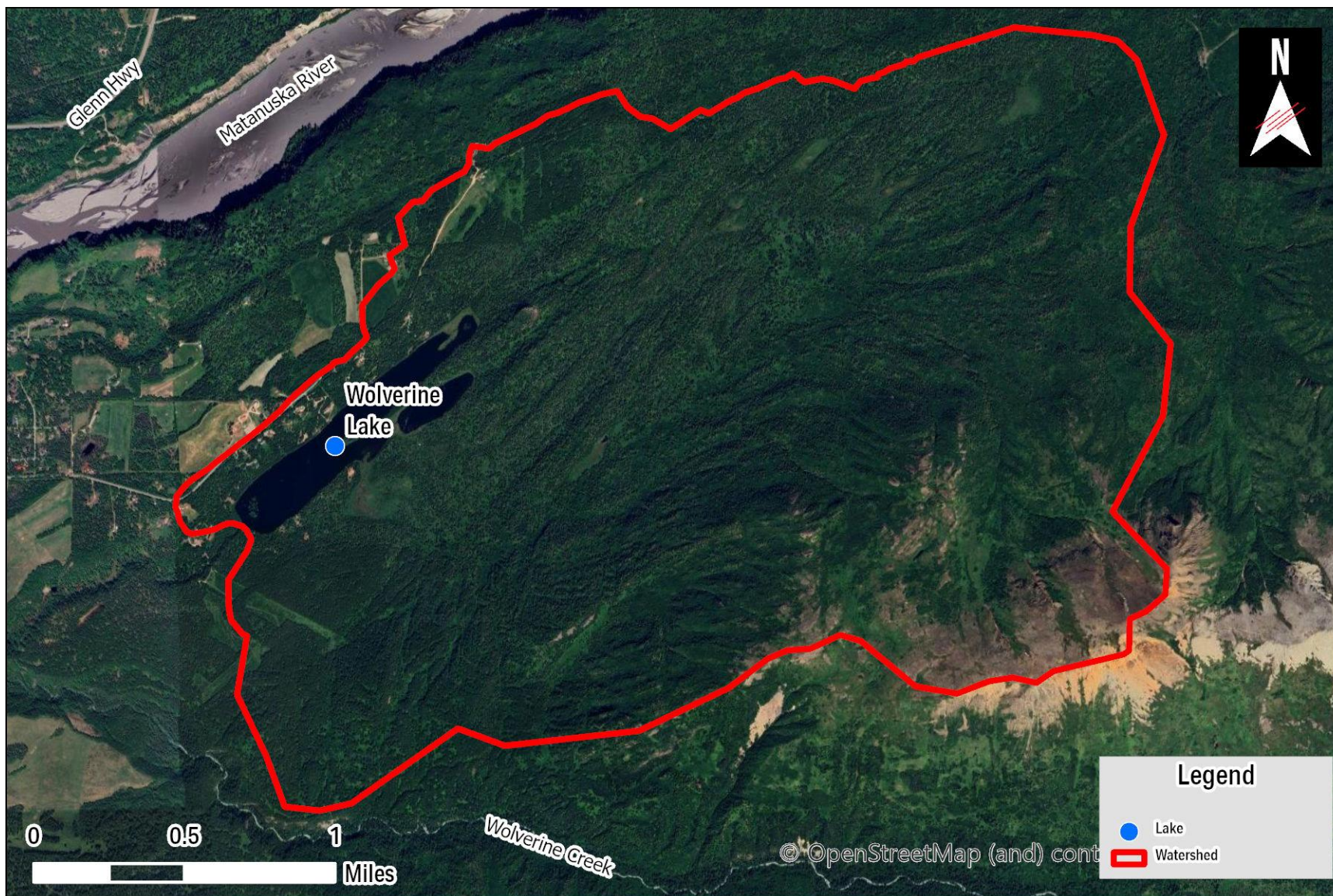
Golden Lake Watershed



Kings Lake and Anderson Lake Watersheds



Wolf Lake Watershed



Wolverine Lake Watershed

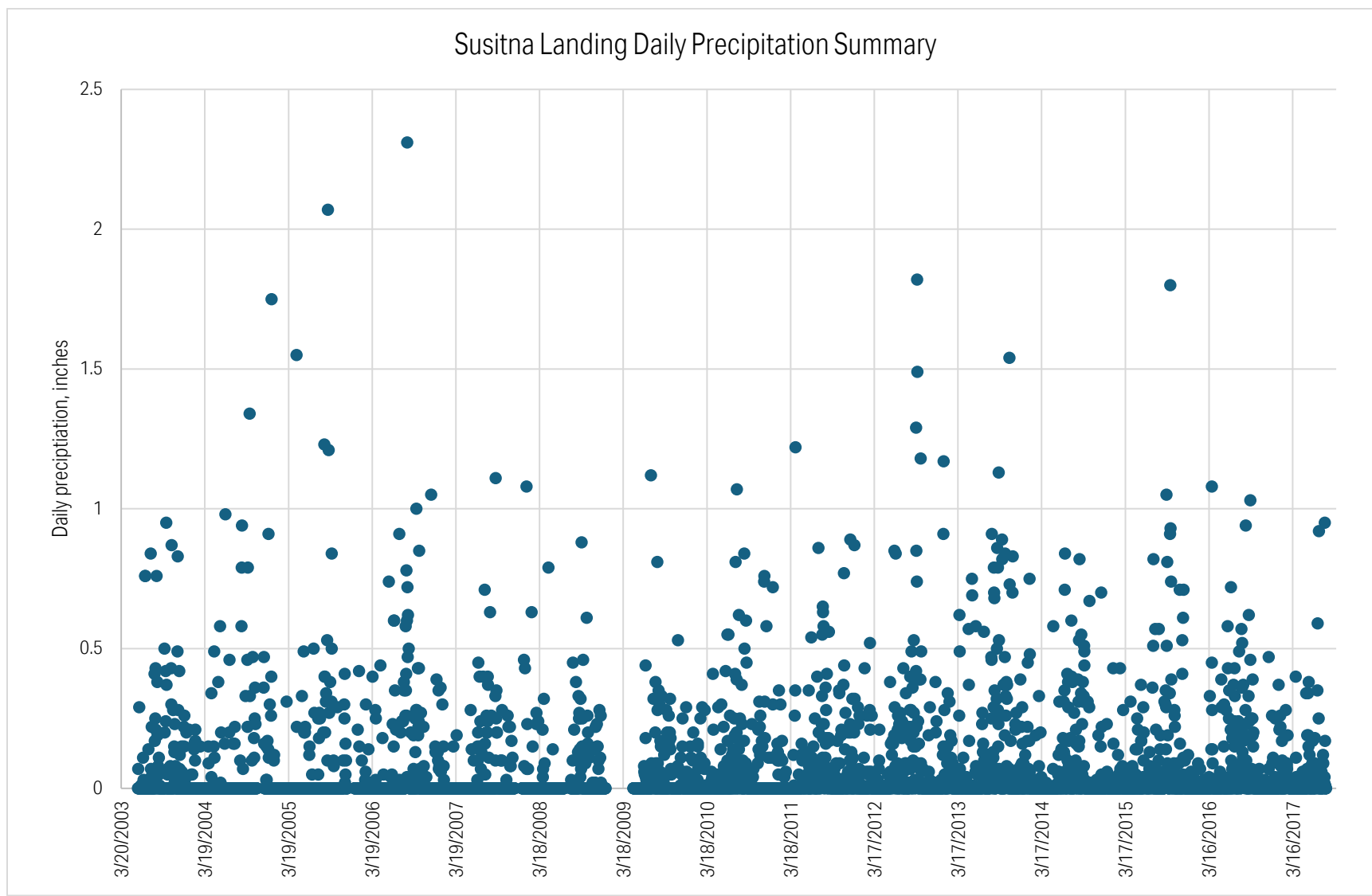


APPENDIX E

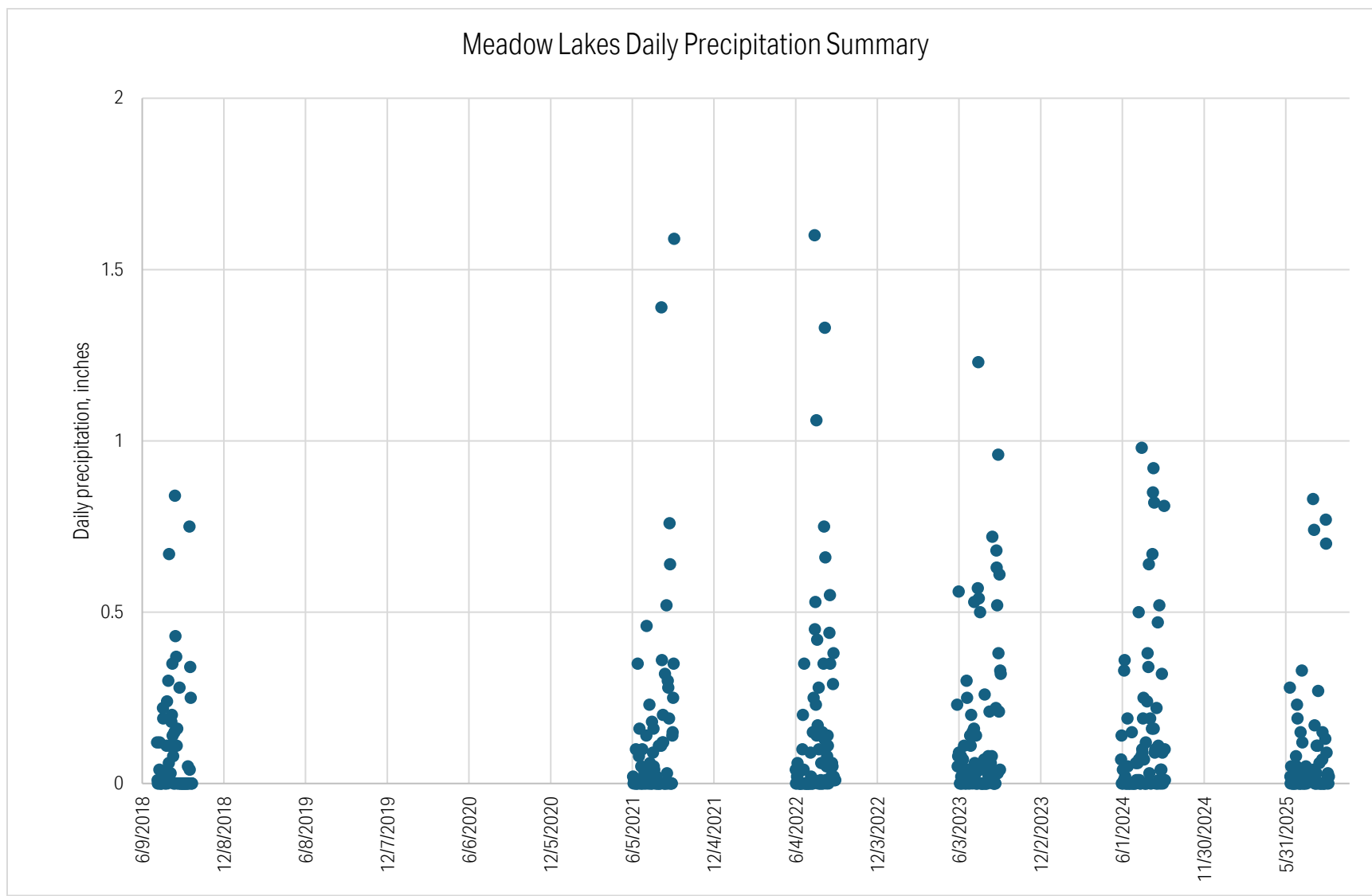
PRECIPITATION DATA



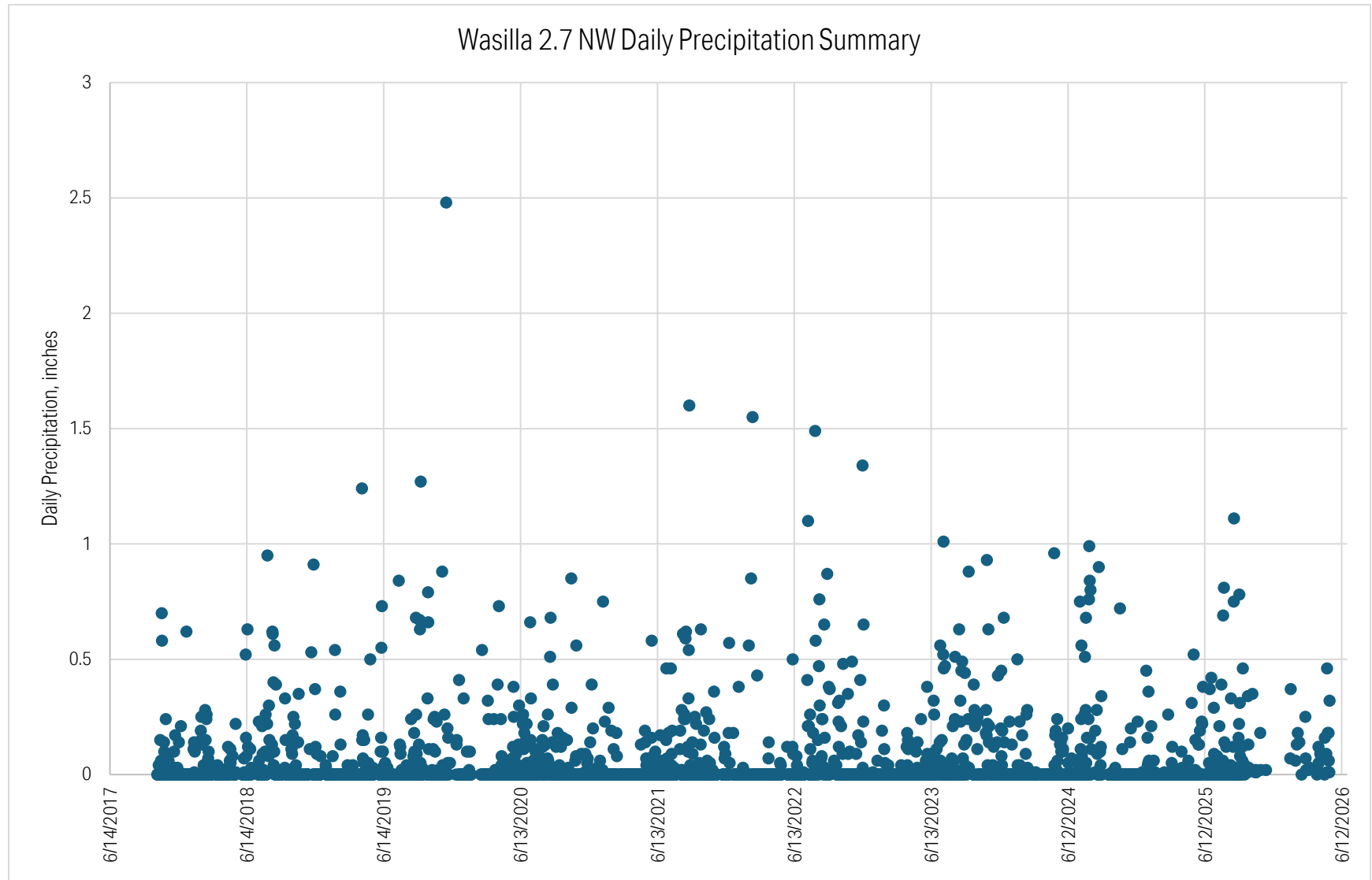
Susitna Landing, AK US
USC00508884



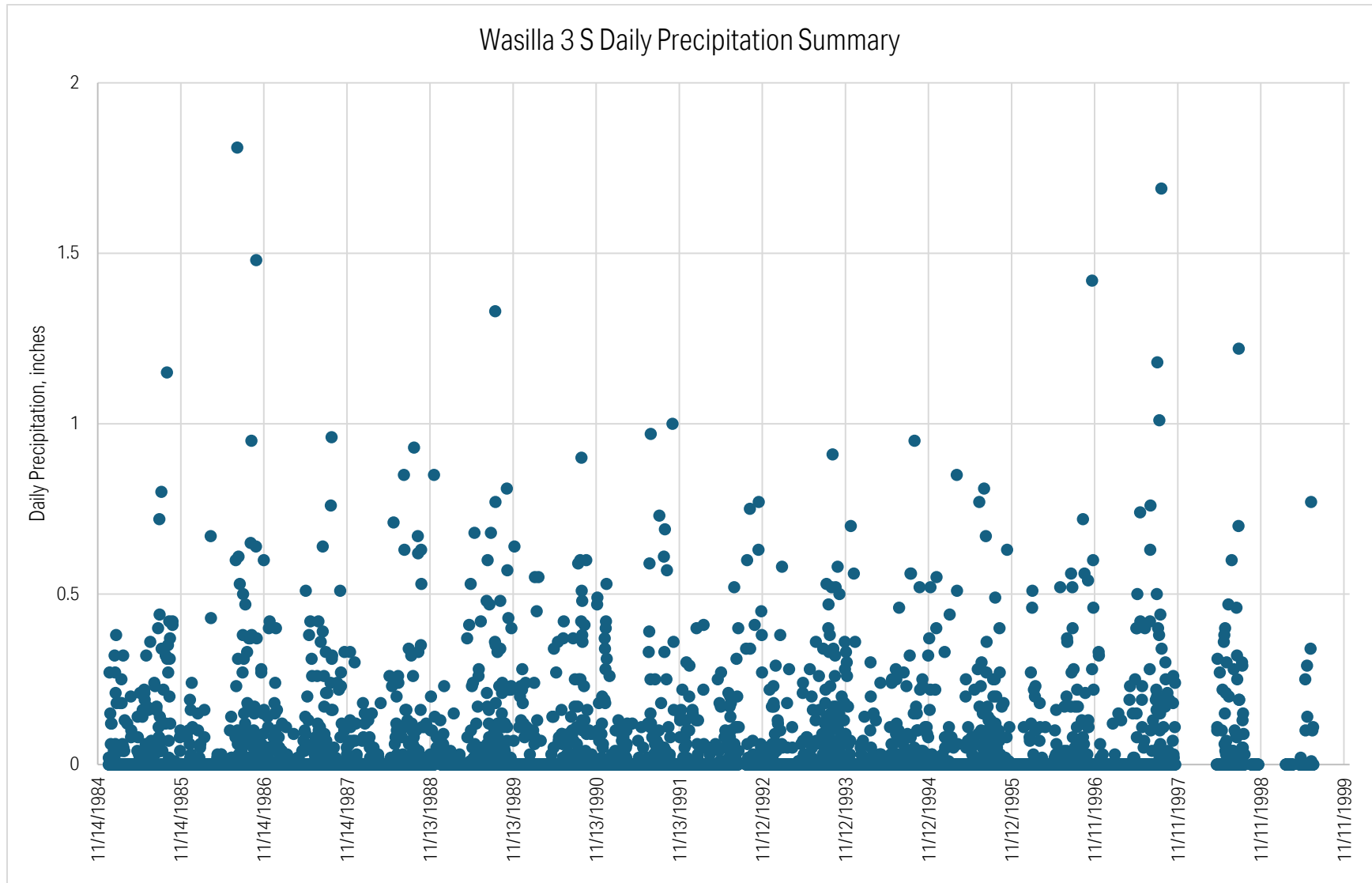
Meadow Lakes 1.0 WSW, AK US
US1AKMS0015



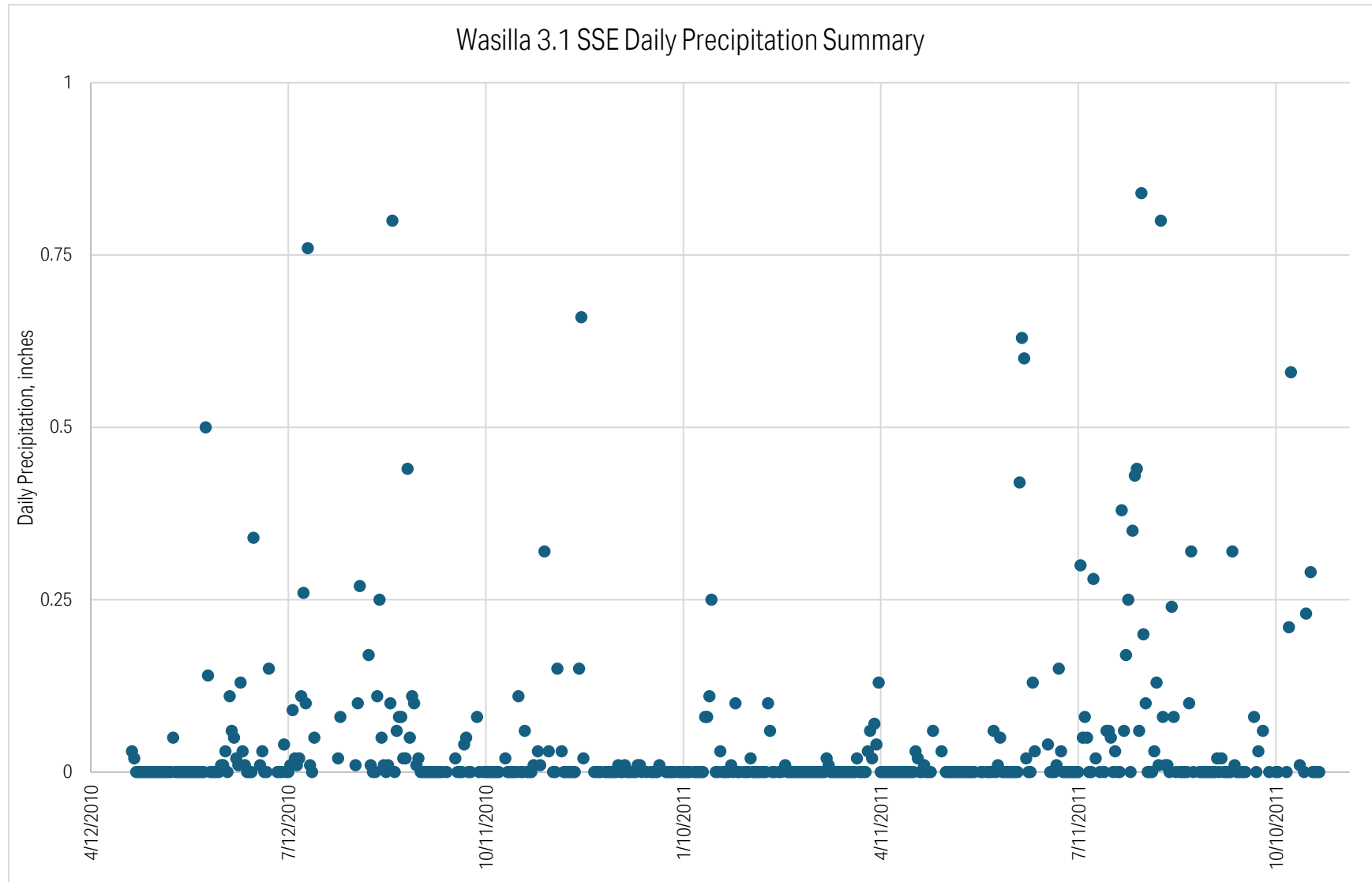
Wasilla 2.7 NW, AK US
US1AKMS0014



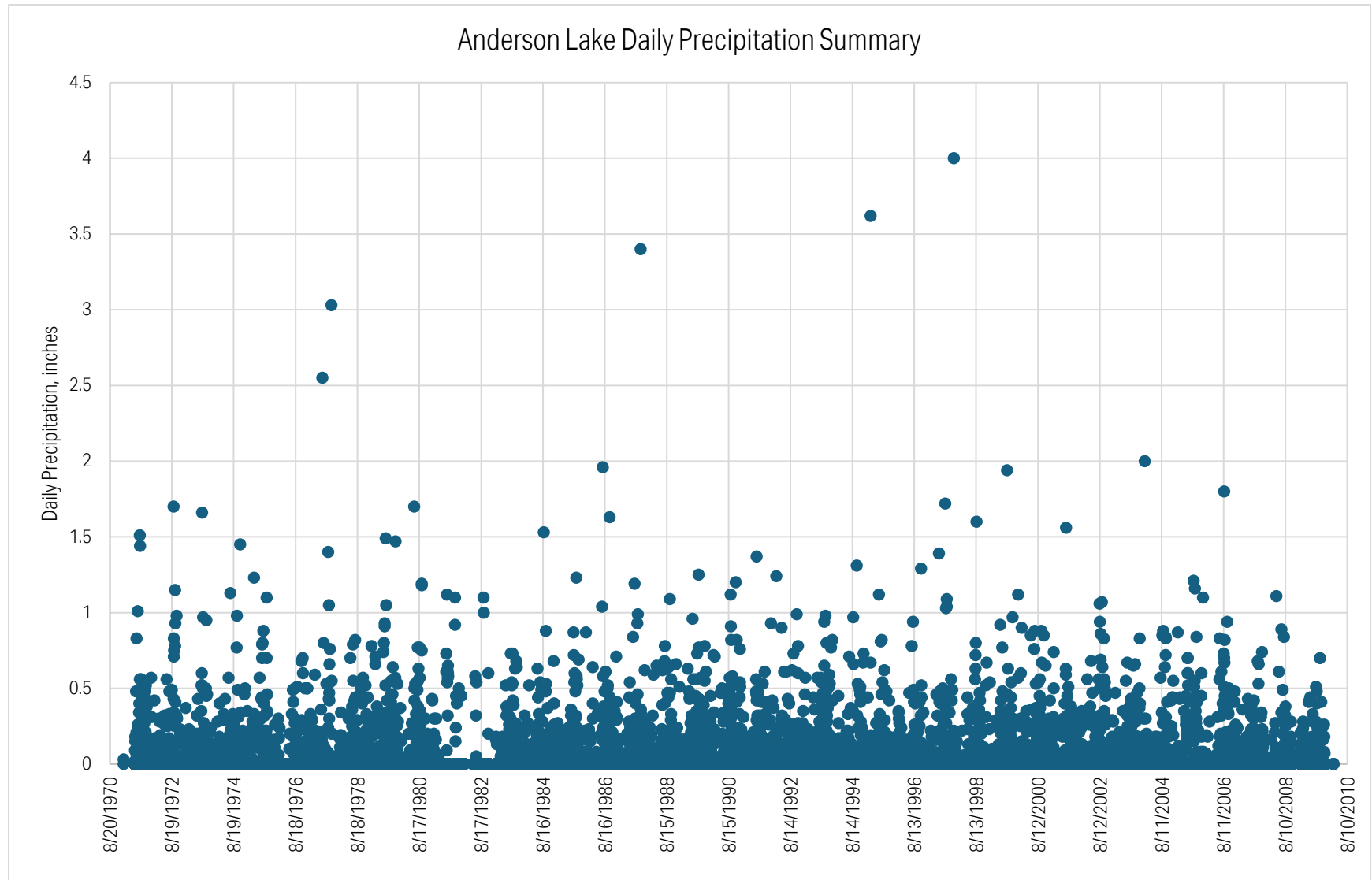
Wasilla 3 S, AK US
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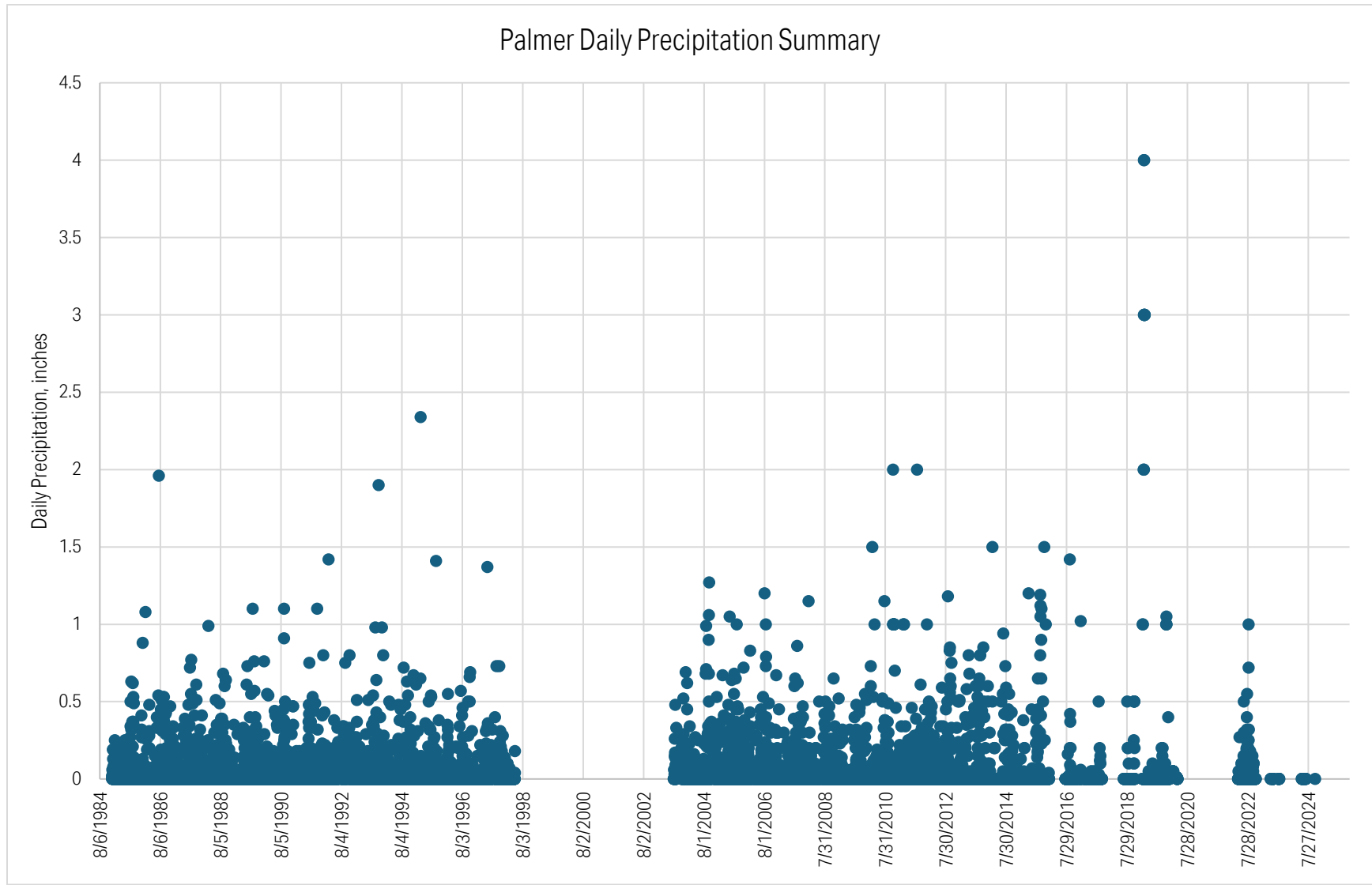
Wasilla 3.1 SSE, AK US
US1AKMS0010



Anderson Lake, AK US
USC00500302



Palmer Job Corps, AK US
USC00506870





APPENDIX F

SITE VISIT PHOTOS





Upper Caswell Lake



Upper Caswell Lake Outlet



Horseshoe Lake



Horseshoe Lake Outlet



Knik Lake



Knik Lake



Knik Lake Outlet



Knik Lake Outlet Channel



Knik Lake Outlet Culvert



Island Lake



Island Lake Outlet Wetland



Kings Lake Outlet



Looking at Anderson Lake from Kings Lake



Anderson Lake Outlet



Wolf Lake



Wolf Lake



Wolf Lake



Wolf Lake Outlet



Wolf Lake Outlet



Wolf Lake Outlet Path



Wolf Lake Outlet Path



Wolf Lake Outlet Path



Wolverine Lake



Wolverine Lake Outlet Channel



Wolverine Lake Outlet Structure



Wolverine Lake Outlet Structure



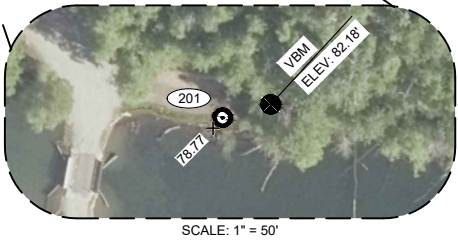
APPENDIX G

SURVEY BENCHMARKS AND LAKE LEVEL MONITORING PLAN





KEPLER LAKE
SCALE: 1" = 200'



LEGEND

POINT NUMBER
○ FOUND 2" ALUMINUM CAP ON REBAR
● SET 2" ALUMINUM CAP ON 5/8" REBAR
⊗ VERTICAL BENCH MARK
+ + + + SPOT ELEVATION AT EDGE OF WATER

CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
201	N61°33'07.97"	W149°11'55.3"	2760133.93'	1780168.90'	80.86'	FOUND 2" ALUMINUM CAP MONUMENT

NOTES:

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- THE ELEVATIONS AND HORIZONTAL POSITIONS OF RECOVERED MONUMENTS WERE ESTABLISHED USING STATIC GNSS SURVEYING METHODS.
- VERIFY ALL HORIZONTAL AND VERTICAL CONTROL PRIOR TO USE.



NAME OF SURVEYOR:
RESPEC
125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

**SURVEY BENCHMARKS
AND LEVELING PLAN**

MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

KEPLER LAKE

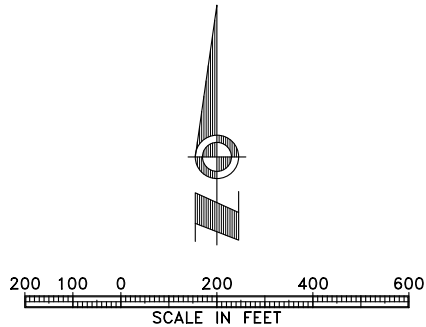
OWNER:
Matanuska-Susitna Borough - Public Works
350 E. Dahlia Ave.
Palmer, AK 99645

MATANUSKA-SUSITNA BOROUGH

SCALE	SEE PLAN
SURVEYOR	TCK
DRAWN	CES
CHECKED	TCK
DATE	JUNE 30, 2026
PROJECT NO.	10946.26003
SHEET NUMBER	1 OF 7



FINGER LAKE
SCALE: 1" = 200'



LEGEND	
#	POINT NUMBER
⊙	FOUND 2" ALUMINUM CAP ON REBAR
⊗	SET 2" ALUMINUM CAP ON 5/8" REBAR
⊕	VERTICAL BENCH MARK
+	SPOT ELEVATION AT EDGE OF WATER

CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
202	N61°36'33.69"	W149°15'49.0"	2780890.07'	1768612.07'	343.44'	SET 2" ALUMINUM CAP MONUMENT

NOTES:

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PHONE: 907.707.1215
AECC163270

**SURVEY BENCHMARKS
AND LEVELING PLAN**
MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

FINGER LAKE

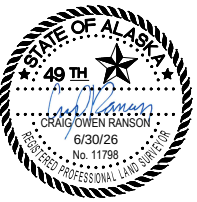
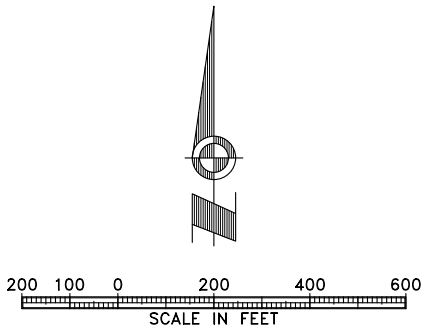
OWNER:
Matanuska-Susitna Borough - Public Works
350 E. Dahlia Ave.
Palmer, AK 99645

MATANUSKA-SUSITNA BOROUGH

SCALE	SEE PLAN
SURVEYOR	TCK
DRAWN	CES
CHECKED	TCK
DATE	JUNE 30, 2026
PROJECT NO.	10946.26003
SHEET NUMBER	2 OF 7



ANDERSON LAKE
SCALE: 1" = 200'



NAME OF SURVEYOR:
RESPEC
125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

SURVEY BENCHMARKS AND LEVELING PLAN

MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

ANDERSON LAKE

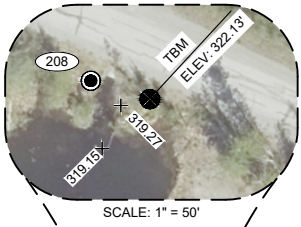
OWNER: Matanuska-Susitna Borough - Public Works 350 E. Dahlia Ave. Palmer, AK 99645	SCALE SURVEYOR DRAWN CHECKED DATE PROJECT NO. SHEET NUMBER	SEE PLAN TCK CES TCK JUNE 30, 2026 10946.26003 3 OF 7
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LEGEND	
#	POINT NUMBER
⊙	FOUND 2" ALUMINUM CAP ON REBAR
⊙	SET 2" ALUMINUM CAP ON 5/8" REBAR
⊙	VERTICAL BENCH MARK
+	SPOT ELEVATION AT EDGE OF WATER

CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
203	N61°37'17.55"	W149°20'35.8"	2785195.87'	1754700.31'	443.57'	SET 2" ALUMINUM CAP MONUMENT

NOTES:

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- VERIFY ALL HORIZONTAL AND VERTICAL CONTROL PRIOR TO USE.



RAINBOW LAKE
SCALE: 1" = 200'

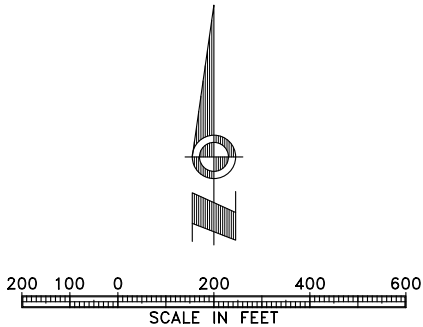
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6. VERIFY ALL HORIZONTAL AND VERTICAL CONTROL PRIOR TO USE.

CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
208	N61°35'56.24"	W149°37'20.2"	2776553.00'	1706198.22'	319.99'	SET 2" ALUMINUM CAP MONUMENT

LEGEND

- # POINT NUMBER
- SET 2" ALUMINUM CAP ON 5/8" REBAR
- ⊗ VERTICAL BENCH MARK
- + + + + SPOT ELEVATION AT EDGE OF WATER

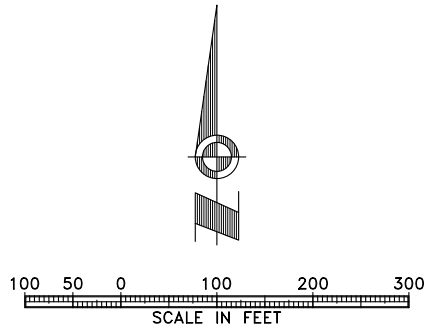
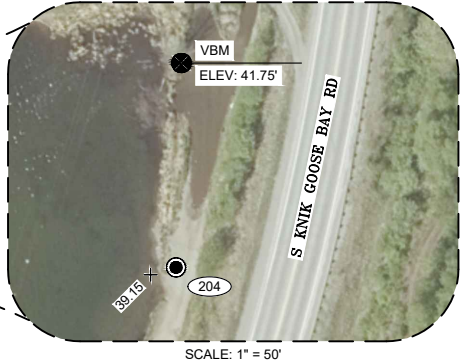


NAME OF SURVEYOR:
RESPEC
125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

**SURVEY BENCHMARKS
AND LEVELING PLAN**
MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

RAINBOW LAKE

OWNER: Matanuska-Susitna Borough - Public Works 350 E. Dahlia Ave. Palmer, AK 99645	SCALE	SEE PLAN
	SURVEYOR	TCK
	DRAWN	CES
	CHECKED	TCK
	DATE	JUNE 30, 2026
MATANUSKA-SUSITNA BOROUGH	PROJECT NO.	10946.26003
	SHEET NUMBER	4 OF 7



KNIK LAKE
SCALE: 1" = 100'

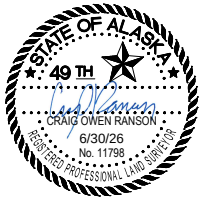
LEGEND

POINT NUMBER
FOUND 2" ALUMINUM CAP ON REBAR
SET 2" ALUMINUM CAP ON 5/8" REBAR
VERTICAL BENCH MARK
SPOT ELEVATION AT EDGE OF WATER

CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
204	N61°27'40.09"	W149°43'23.4"	2726082.14'	1688838.75'	40.94'	SET 2" ALUMINUM CAP MONUMENT

NOTES:

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NAME OF SURVEYOR:
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125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

**SURVEY BENCHMARKS
AND LEVELING PLAN**
MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

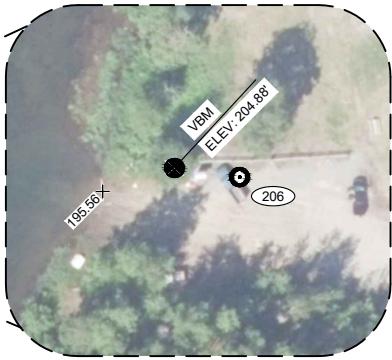
KNIK LAKE

OWNER: Matanuska-Susitna Borough - Public Works 350 E. Dahlia Ave. Palmer, AK 99645	SCALE	SEE PLAN
	SURVEYOR	TCK
	DRAWN	CES
	CHECKED	TCK
	DATE	JUNE 30, 2026
MATANUSKA-SUSITNA BOROUGH	PROJECT NO.	10946.26003
	SHEET NUMBER	5 OF 7

Printed: 6/30/2026 3:17 PM File: N:\Projects\2026\2026\BANKS - Lake Level Analysis\2026\BANKS - Lake Level Analysis.dwg User: CARSTENWEL SETTLER



WILLOW LAKE
SCALE: 1" = 200'



SCALE: 1" = 50'

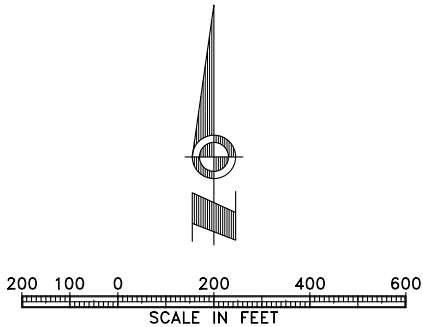
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CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
206	N61°44'41.05"	W150°03'11.2"	2829660.46'	1631211.59'	205.62'	

LEGEND

- # POINT NUMBER
- SET 2" ALUMINUM CAP ON 5/8" REBAR
- ⊗ VERTICAL BENCH MARK
- +xxx+ SPOT ELEVATION AT EDGE OF WATER



NAME OF SURVEYOR:
RESPEC
125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

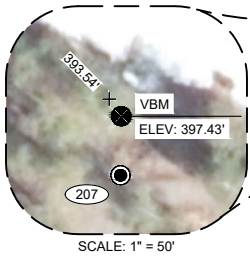
**SURVEY BENCHMARKS
AND LEVELING PLAN**
MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

WILLOW LAKE

OWNER:
Matanuska-Susitna Borough - Public Works
350 E. Dahlia Ave.
Palmer, AK 99645

MATANUSKA-SUSITNA BOROUGH

SCALE	SEE PLAN
SURVEYOR	TCK
DRAWN	CES
CHECKED	TCK
DATE	JUNE 30, 2026
PROJECT NO.	10946.26003
SHEET NUMBER	6 OF 7



CHRISTIANSEN LAKE
SCALE: 1" = 200'

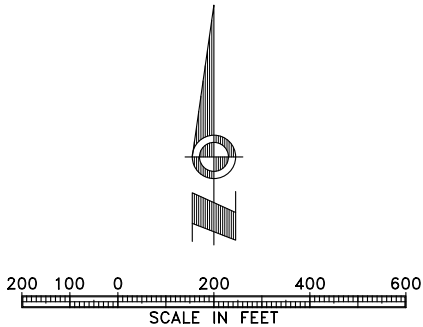
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CONTROL TABLE						
POINT	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	DESCRIPTION
207	N62°18'55.42"	W150°04'15.7"	3038295.76'	1628335.02'	401.06'	SET 2" ALUMINUM CAP MONUMENT

LEGEND

- # POINT NUMBER
- SET 2" ALUMINUM CAP ON 5/8" REBAR
- ⊗ VERTICAL BENCH MARK
- + + + + SPOT ELEVATION AT EDGE OF WATER



NAME OF SURVEYOR:
RESPEC
125 W. EVERGREEN AVE. STE. 102
PALMER, AK 99645
PHONE: 907.707.1215
AECC163270

**SURVEY BENCHMARKS
AND LEVELING PLAN**
MATANUSKA-SUSITNA BOROUGH LAKE LEVEL ANALYSIS

CHRISTIANSEN LAKE

OWNER: Matanuska-Susitna Borough - Public Works 350 E. Dahlia Ave. Palmer, AK 99645	SCALE	SEE PLAN
	SURVEYOR	TCK
	DRAWN	CES
	CHECKED	TCK
	DATE	JUNE 30, 2026
MATANUSKA-SUSITNA BOROUGH	PROJECT NO.	10946.26003
	SHEET NUMBER	7 OF 7

1.0 OBJECTIVES AND DATA NEEDS

- / Tracking seasonal and long-term water level trends
- / Supporting infrastructure design (culvert, docks, roads)
- / Flood risk assessment
- / Evaluating impacts of climate or watershed changes

2.0 MONITORING LOCATIONS

Select locations that capture representative conditions.

- / Primary gage site: typically, near the lake outlet or a stable shoreline with minimal wave action
- / Supplemental sites (if needed): for large or irregular lakes to capture spatial variability
- / Ensure sites have the following:
 - » Stable bank conditions
 - » Minimal risk of disturbance (ice, debris, vandalism)
 - » Safe and repeatable access

Tie all measurements to a consistent vertical datum using surveyed benchmarks.

3.0 EQUIPMENT AND INSTRUMENTATION

- / Crest-stage gage
 - » One-time measurement of maximum water level
 - » Simple, low-cost
 - » <https://www.usgs.gov/water-science-school/science/crest-gage-a-quick-way-measure-river-stage>
- / Staff gage
 - » Simple, low-cost, visual readings
 - » Good for periodic/manual monitoring
- / Pressure transducer (vented or non-vented)
 - » Continuous water level recording
 - » Often paired with a data logger
- / Radar or ultrasonic sensors

- » Non-contact option (useful in icy or debris-prone conditions)
- / Telemetry systems (options)
 - » Real-time data access via cellular/satellite

Include barometric pressure compensation if using non-vented sensors.

4.0 MONITORING FREQUENCY

Match frequency to project needs:

- / Continuous (15-60 minute intervals): Best for capturing fluctuations and peak events
- / Manual readings (weekly/monthly): Suitable for long-term trends or supplementing automated data
 - » Increase frequency (e.g. daily) during:
 - Spring snowmelt
 - Storm events
 - Known high-variability periods

5.0 SURVEY CONTROL AND CALIBRATION

- / Establish permanent benchmarks near each site
- / Survey gage elevations to a known datum
- / Periodically verify:
 - » Staff gage alignment
 - » Sensor drift or offset
- / Conduct **routine calibration checks** (e.g. compare sensor readings to staff gage)

6.0 DATA MANAGEMENT AND QA/QC

- / Store data in a centralized database (e.g. Excel or cloud-based systems)
- / Apply QA/QC procedures:
 - » Check for sensor drift or data gaps
 - » Flag outliers and anomalies
 - » Correct for barometric pressure (if needed)
- / Maintain metadata:

- » Equipment type
- » Calibration records
- » Site notes and photos

7.0 MAINTENANCE AND INSPECTION

- / Routine site visits (e.g. monthly or quarterly) to:
 - » Inspect equipment condition
 - » Remove debris or ice impacts
 - » Download data (if not telemetered)
- / Seasonal considerations:
 - » Ice cover impacts
 - » Low water accessibility

8.0 REPORTING AND USE OF DATA

- / Develop clear deliverables:
 - » Hydrographs (lake level vs time)
 - » Seasonal summaries
 - » Trend analyses
- / Compare against:
 - » Historical data
 - » Design thresholds (e.g. peak elevations)
- / Use results to inform:
 - » Engineering design
 - » Permitting
 - » Adaptive management decisions

9.0 DURATION OF MONITORING

- / Short-term (1-2 years): Baseline characterization
- / Long-term (10+ years): Trend detection and climate variability
- / Ideally capture multiple seasonal cycles before making major decisions



10.0 CONTINGENCIES

Plan for:

- / Equipment failure (spare sensors)
- / Data gaps (manual backup readings)
- / Site access issues



APPENDIX H

PLANNING-LEVEL COST ESTIMATES



Upper Caswell Lake

Pay Item	Description	Unit	QTY	Unit Cost	Cost
201.0003.0000	Clearing and Grubbing	AC	0.4	\$ 30,000.00	\$ 12,000.00
202.0002.0000	Removal of Pavement	SY	2200	\$ 7.00	\$ 15,400.00
202.0004.0000	Removal of Culvert Pipe	LF	60.0	\$ 100.00	\$ 6,000.00
203.0003.0000	Unclassified Excavation	CY	4100.0	\$ 50.00	\$ 205,000.00
203.0005.000A	Borrow, Type A	CY	1800	\$ 100.00	\$ 180,000.00
203.2057.0000	Dewatering	LS	1	\$ 20,000.00	\$ 20,000.00
204.0001.0000	Structure Excavation	CY	2100	\$ 40.00	\$ 84,000.00
301.0002.00D1	Aggregate Base Course, Grading D-1	CY	580.0	\$ 150.00	\$ 87,000.00
401.0001.002B	HMA, Type II; Class B	TON	370.0	\$ 230.00	\$ 85,100.00
602.2001.1205	Aluminum Box Culvert, 12'-5" Span	LF	60.0	\$ 3,500.00	\$ 210,000.00
602.2001.1509	Aluminum Box Culvert, 15'9" Span	LF	55.0	\$ 4,000.00	\$ 220,000.00
606.0001.0000	W-Beam Guardrail	LF	590.0	\$ 50.00	\$ 29,500.00
606.0006.0000	Removing and Disposing of Guardrail	LF	590.0	\$ 4.00	\$ 2,360.00
611.0001.0003	Riprap, Class III	CY	550.0	\$ 150.00	\$ 82,500.00
618.0004.0000	Seeding	SY	650	\$ 15.00	\$ 9,750.00
620.0001.0000	Topsoil	SY	650	\$ 20.00	\$ 13,000.00
639.0001.0000	Driveway	EA	4	\$ 5,000.00	\$ 20,000.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 95,000.00	\$ 95,000.00
641.0007.0000	SWPPP Manager	LS	1	\$ 36,000.00	\$ 36,000.00
642.0001.0000	Construction Surveying	LS	1	\$ 55,000.00	\$ 55,000.00
660.XXXX.XXXX	Traffic Control	LS	1	\$ 80,000.00	\$ 80,000.00
690.2002.0000	Waterway Bank Fill	LF	202	\$ 200.00	\$ 40,400.00
690.2012.0000	Waterway - Regrade Stream	LF	100	\$ 300.00	\$ 30,000.00

Subtotal \$ 1,618,010.00

Design Contingency \$ 323,602.00

Total \$ 1,941,612.00

Rounded Total \$ 1,941,700.00

Design & Permitting \$ 330,074.04

Construction Inspection/Testing \$ 194,161.20

Contingency \$ 16,503.70

Total \$ 540,738.94

Rounded Total \$ 540,800.00

Subtotal \$ 2,482,500.00

Contingency \$ 248,250.00

Project Cost \$ 2,730,750.00

Knik Lake - Alternative 1, Recommended					
Pay Item	Description	Unit	QTY	Unit Cost	Cost
201.0003.0000	Clearing and Grubbing	AC	0.3	\$ 30,000.00	\$ 9,000.00
203.0003.0000	Unclassified Excavation	CY	610.0	\$ 40.00	\$ 24,400.00
203.0005.000A	Borrow, Type A	CY	115	\$ 100.00	\$ 11,500.00
203.2057.0000	Dewatering	LS	1	\$ 5,000.00	\$ 5,000.00
301.0002.00D1	Aggregate Base Course, Grading D-1	CY	35.0	\$ 100.00	\$ 3,500.00
603.0009.0036	Corrugated Aluminum Pipe 36 Inch	LF	72.0	\$ 485.00	\$ 34,920.00
610.0001.0000	Ditch Lining	CY	270	\$ 100.00	\$ 27,000.00
618.0004.0000	Seeding	SY	640	\$ 15.00	\$ 9,600.00
620.0001.0000	Topsoil	SY	640	\$ 20.00	\$ 12,800.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 2,500.00	\$ 2,500.00
641.0007.0000	SWPPP Manager	LS	1	\$ 4,500.00	\$ 4,500.00
642.0001.0000	Construction Surveying	LS	1	\$ 2,900.00	\$ 2,900.00

Subtotal	\$ 147,620.00
Design Contingency	\$ 29,524.00
Total	\$ 177,144.00
Rounded Total	\$ 177,200.00

Design & Permitting	\$ 31,000.20
Construction Inspection/Testing	\$ 17,714.40
Contingency	\$ 1,550.01
Total	\$ 50,264.61
Rounded Total	\$ 50,300.00

Subtotal	\$ 227,500.00
Contingency	\$ 22,750.00
Project Cost	\$ 250,250.00

Knik Lake - Alternative 2					
Pay Item	Description	Unit	QTY	Unit Cost	Cost
203.0003.0000	Unclassified Excavation	CY	60.0	\$ 100.00	\$ 6,000.00
203.2057.0000	Dewatering	LS	1	\$ 2,500.00	\$ 2,500.00
606.0001.0000	W-Beam Guardrail	LF	300.0	\$ 50.00	\$ 15,000.00
606.0009.0000	Short Radius Guardrail	EA	1.0	\$ 5,500.00	\$ 5,500.00
606.0013.0000	Parallel Guardrail Terminal	EA	1.0	\$ 4,000.00	\$ 4,000.00
610.0001.0000	Ditch Lining	CY	60	\$ 150.00	\$ 9,000.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 2,500.00	\$ 2,500.00
641.0007.0000	SWPPP Manager	LS	1	\$ 1,500.00	\$ 1,500.00
642.0001.0000	Construction Surveying	LS	1	\$ 1,400.00	\$ 1,400.00
Subtotal					\$ 47,400.00
Design Contingency					\$ 14,220.00
Total					\$ 61,620.00
Rounded Total					\$ 61,700.00
Design & Permitting					\$ 11,707.80
Construction Inspection/Testing					\$ 6,162.00
Contingency					\$ 893.49
Total					\$ 18,763.29
Rounded Total					\$ 18,800.00
Subtotal					\$ 80,500.00
Contingency					\$ 8,050.00
Project Cost					\$ 88,550.00

Anderson Lake					
Pay Item	Description	Unit	QTY	Unit Cost	Cost
201.0003.0000	Clearing and Grubbing	AC	0.2	\$ 30,000.00	\$ 6,000.00
203.0003.0000	Unclassified Excavation	CY	1880.0	\$ 50.00	\$ 94,000.00
203.0005.000A	Borrow, Type A	CY	1560	\$ 100.00	\$ 156,000.00
203.2057.0000	Dewatering	LS	1	\$ 10,000.00	\$ 10,000.00
301.0002.00D1	Aggregate Base Course, Grading D-1	CY	30.0	\$ 100.00	\$ 3,000.00
602.0001.0162	Structural Plate Pipe 162" Diameter	LF	84.0	\$ 4,000.00	\$ 336,000.00
611.0001.0002	Ripap, Class II	CY	280	\$ 200.00	\$ 56,000.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 15,000.00	\$ 15,000.00
641.0007.0000	SWPPP Manager	LS	1	\$ 9,000.00	\$ 9,000.00
690.2003.0000	Waterway Bank Revegetation & Protection	LF	55	\$ 175.00	\$ 9,625.00
690.2007.0000	Waterway - Live Willow Staking	SY	60	\$ 75.00	\$ 4,500.00
690.2009.0000	Waterway Bed Fill	CY	30	\$ 200.00	\$ 6,000.00
642.0001.0000	Construction Surveying	LS	1	\$ 13,200.00	\$ 13,200.00

Subtotal \$ 718,325.00

Design Contingency \$ 143,665.00

Total \$ 861,990.00

Rounded Total \$ 862,000.00

Design & Permitting \$ 172,398.00

Construction Inspection/Testing \$ 86,199.00

Contingency \$ 12,929.85

Total \$ 271,526.85

Rounded Total \$ 271,600.00

Subtotal \$ 1,133,600.00

Contingency \$ 56,680.00

Project Cost \$ 1,190,280.00

Wolf Lake					
Pay Item	Description	Unit	QTY	Unit Cost	Cost
201.0003.0000	Clearing and Grubbing	AC	7.3	\$ 15,000.00	\$ 109,500.00
202.0004.0000	Removal of Culvert Pipe	LF	90	\$ 100.00	\$ 9,000.00
203.0003.0000	Unclassified Excavation	CY	1540	\$ 60.00	\$ 115,200.00
203.0005.000A	Borrow, Type A	CY	1530	\$ 85.00	\$ 130,050.00
203.2057.0000	Dewatering	LS	1	\$ 23,800.00	\$ 23,800.00
203.2058.0000	Ditch Linear Grading	LF	750	\$ 50.00	\$ 37,500.00
204.0001.0000	Structure Excavation	CY	1920.0	\$ 75.00	\$ 144,000.00
301.0002.00D1	Aggregate Base Course, Grading D-1	CY	25.0	\$ 100.00	\$ 2,500.00
401.0001.002B	HMA, Type II; Class B	TON	30.0	\$ 350.00	\$ 10,500.00
603.0003.0048	End Section for CSP 48 Inch	EA	2.0	\$ 2,750.00	\$ 5,500.00
603.0021.0048	Corrugated Polyethylene Pipe 48 Inch	LF	444.0	\$ 540.00	\$ 239,760.00
604.0001.0003	Storm Sewer Manhole, Type III	EA	3.0	\$ 35,000.00	\$ 105,000.00
618.0004.0000	Seeding	SY	34890	\$ 3.00	\$ 104,670.00
620.0001.0000	Topsoil	SY	34890	\$ 5.00	\$ 174,450.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 17,900.00	\$ 17,900.00
641.0007.0000	SWPPP Manager	LS	1	\$ 30,000.00	\$ 30,000.00
642.0001.0000	Construction Surveying	LS	1	\$ 47,600.00	\$ 47,600.00

Subtotal \$ 1,306,930.00

Design Contingency \$ 326,732.50

Total \$ 1,633,700.00

Design & Permitting \$ 175,622.75

Construction Inspection/Testing \$ 81,685.00

Contingency \$ 12,865.39

Total \$ 270,173.14

Rounded Total \$ 270,200.00

Subtotal \$ 1,903,900.00

Contingency \$ 95,195.00

Project Cost \$ 1,999,095.00

Wolverine Lake					
Pay Item	Description	Unit	QTY	Unit Cost	Cost
201.0003.0000	Clearing and Grubbing	AC	0.3	\$ 30,000.00	\$ 9,000.00
203.0003.0000	Unclassified Excavation	CY	380.0	\$ 100.00	\$ 38,000.00
203.0005.000C	Borrow, Type C	CY	180	\$ 200.00	\$ 36,000.00
203.2057.0000	Dewatering	LS	1	\$ 40,000.00	\$ 40,000.00
205.0004.0000	Porous Backfill Material	CY	180	\$ 150.00	\$ 27,000.00
611.0001.0002	Ripap, Class II	CY	90	\$ 200.00	\$ 18,000.00
618.0004.0000	Seeding	SY	1390	\$ 20.00	\$ 27,800.00
620.0001.0000	Topsoil	SY	1390	\$ 30.00	\$ 41,700.00
641.0001.0000	Erosion, Sediment and Pollution Control Administration	LS	1	\$ 25,000.00	\$ 25,000.00
641.0007.0000	SWPPP Manager	LS	1	\$ 15,000.00	\$ 15,000.00
642.0001.0000	Construction Surveying	LS	1	\$ 8,000.00	\$ 8,000.00
671.2003.0000	Stream Substrate	TON	350	\$ 145.00	\$ 50,750.00
690.2004.0000	Waterway Restoration	LF	80	\$ 300.00	\$ 24,000.00
690.2007.0000	Waterway - Live Willow Staking	SY	180	\$ 40.00	\$ 7,200.00

Subtotal \$ 367,450.00

Design Contingency \$ 91,862.50

Total \$ 459,312.50

Rounded Total \$ 459,400.00

Design & Permitting \$ 98,752.19

Construction Inspection/Testing \$ 45,931.25

Contingency \$ 7,234.17

Total \$ 151,917.61

Rounded Total \$ 152,000.00

Subtotal \$ 611,400.00

Contingency \$ 30,570.00

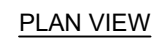
Project Cost \$ 641,970.00



APPENDIX I

WOLVERINE LAKE WEIR - CONCEPT DESIGN





NOT TO SCALE

1