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Federal Highway Administration, HY-8, V.7.1

LIST OF APPENDICES

Appendix A

Water Management Study Phase II Report Figures (Boyle, 2008)

(Note that figure numbers are those from the Water Management Study.)

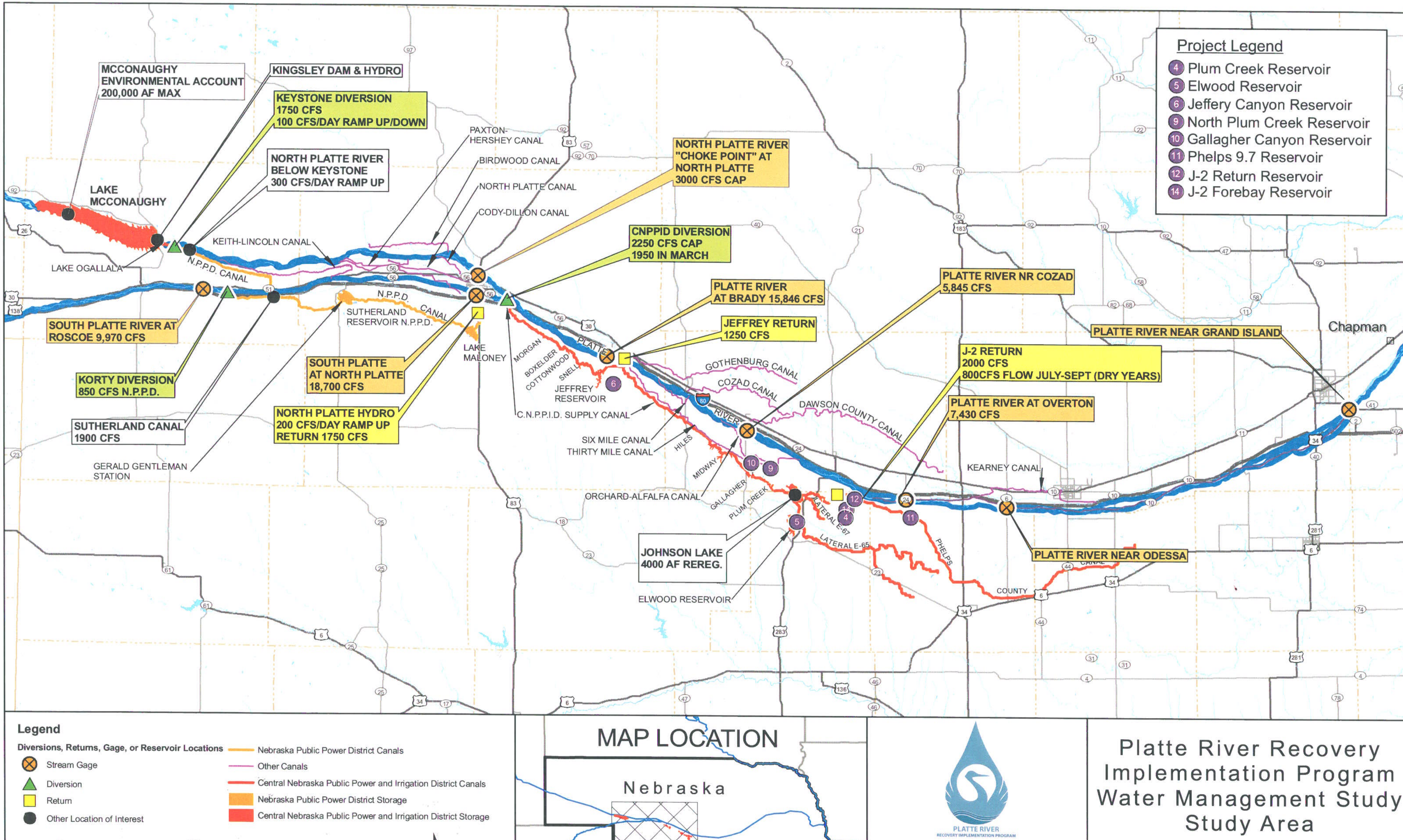
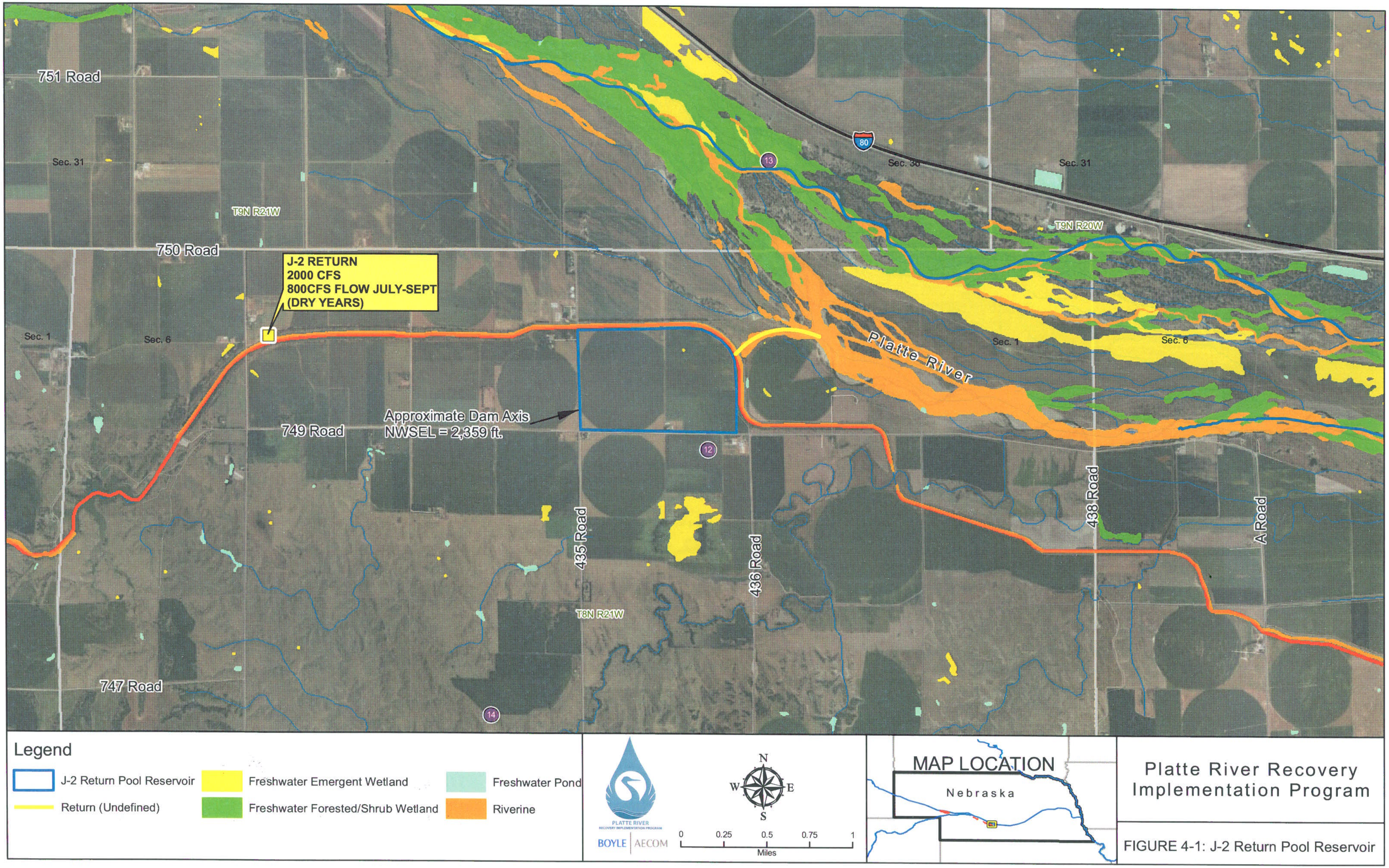


FIGURE 3-1: PROJECT LOCATIONS



BOYLE | AECOM

Platte River Recovery Implementation Program

FIGURE 4-1: J-2 Return Pool Reservoir

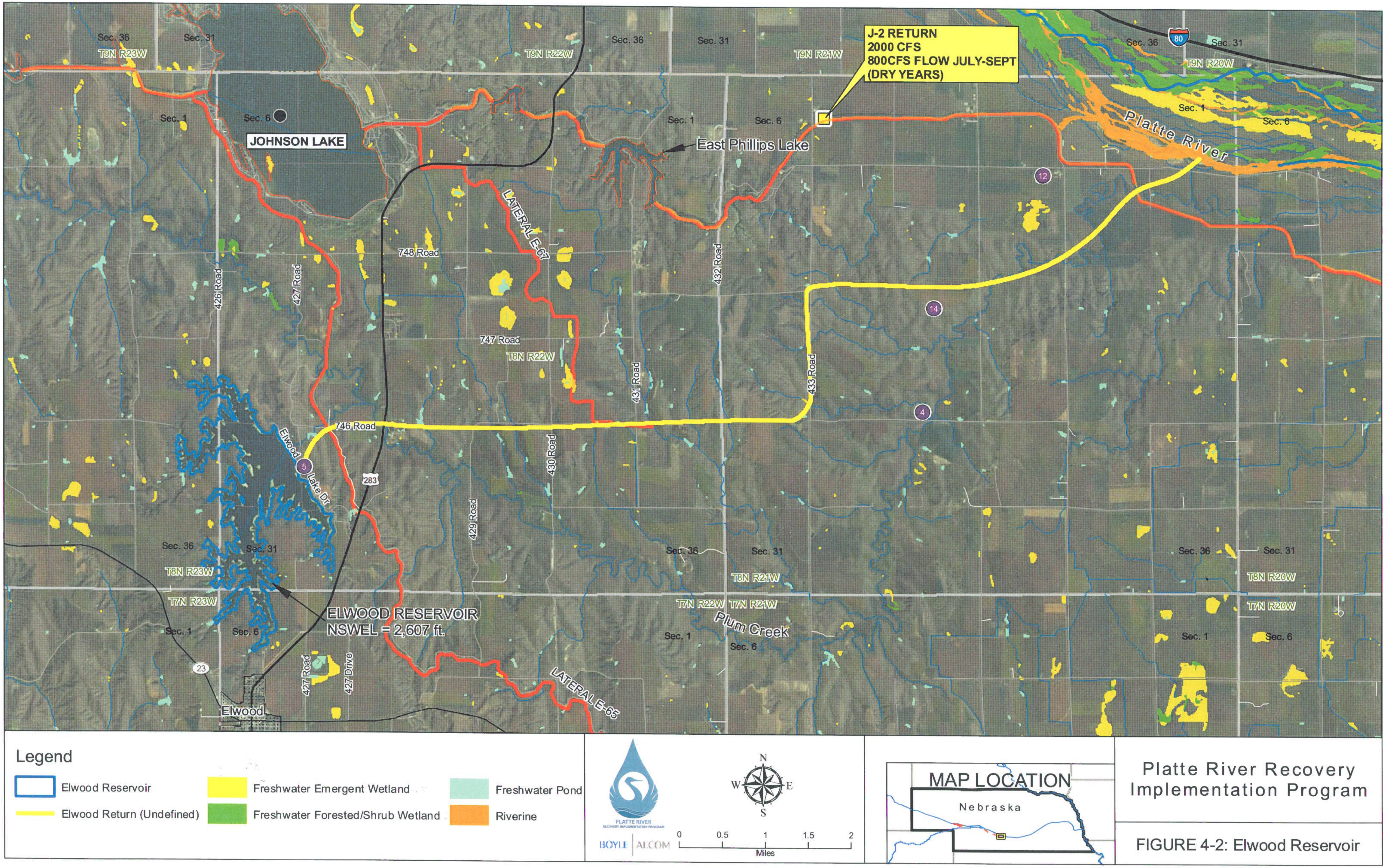
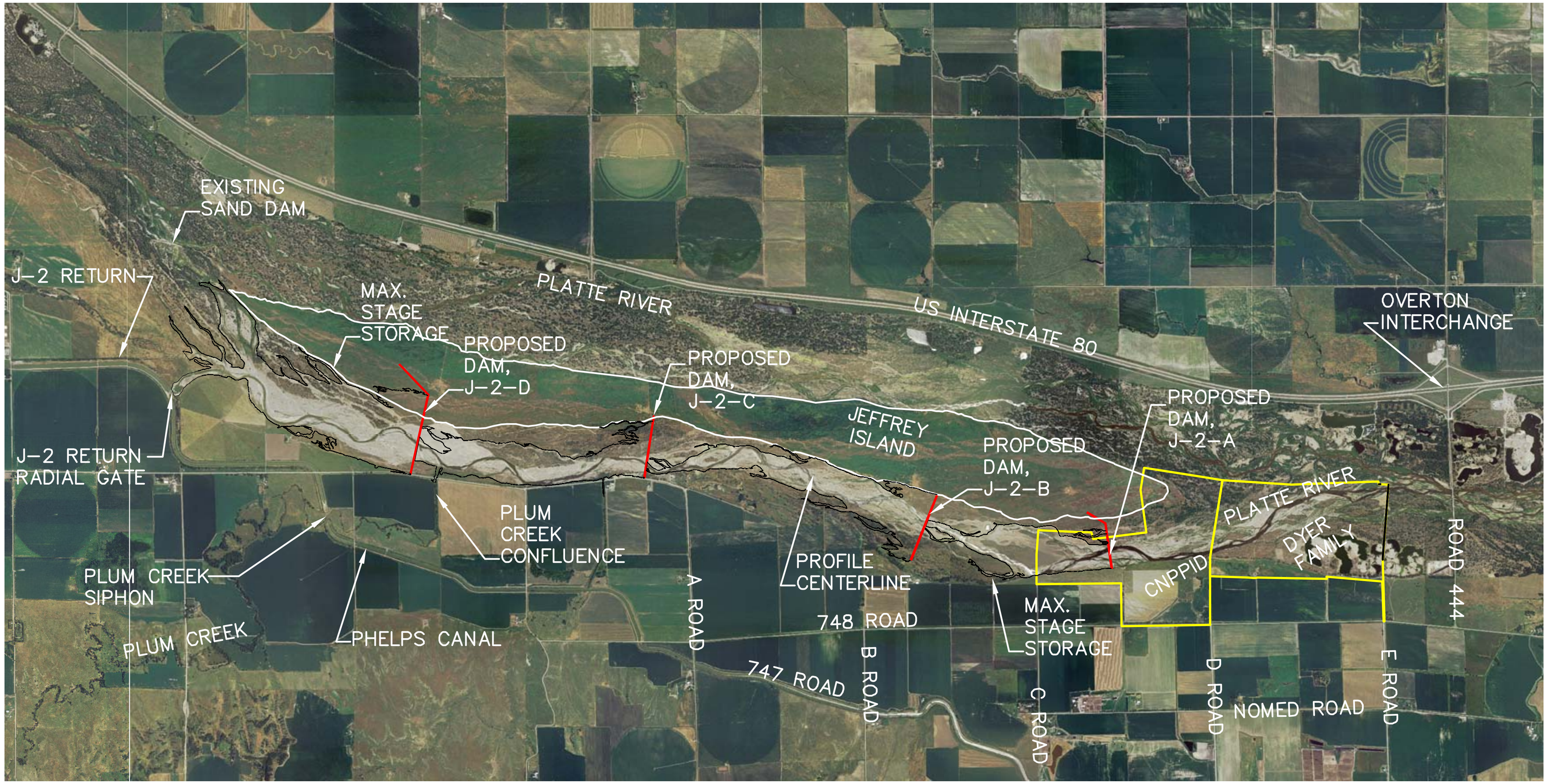


FIGURE 4-2: Elwood Reservoir

Appendix B

Elwood and J2 Alternatives Analysis Project
FIGURES

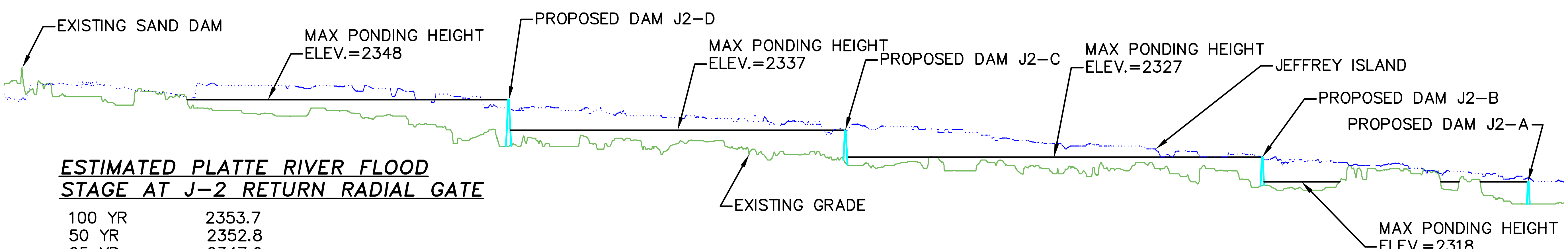


N

0' 2000' 4000'
SCALE IN FEET

LEGEND

- PROGRAM LAND BOUNDARY
- DAM CENTERLINE
- MAX STAGE STORAGE
- EXISTING GRADE
- PROPOSED DAM
- EXISTING JEFFREY ISLAND



ESTIMATED PLATTE RIVER FLOOD STAGE AT J-2 RETURN RADIAL GATE

100 YR	2353.7
50 YR	2352.8
25 YR	2347.6

CROSS SECTION
NOT TO SCALE

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 1 DAWSON, GOSPER, AND PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	PROPOSED DIKE LOCATIONS	FIGURE 1.1

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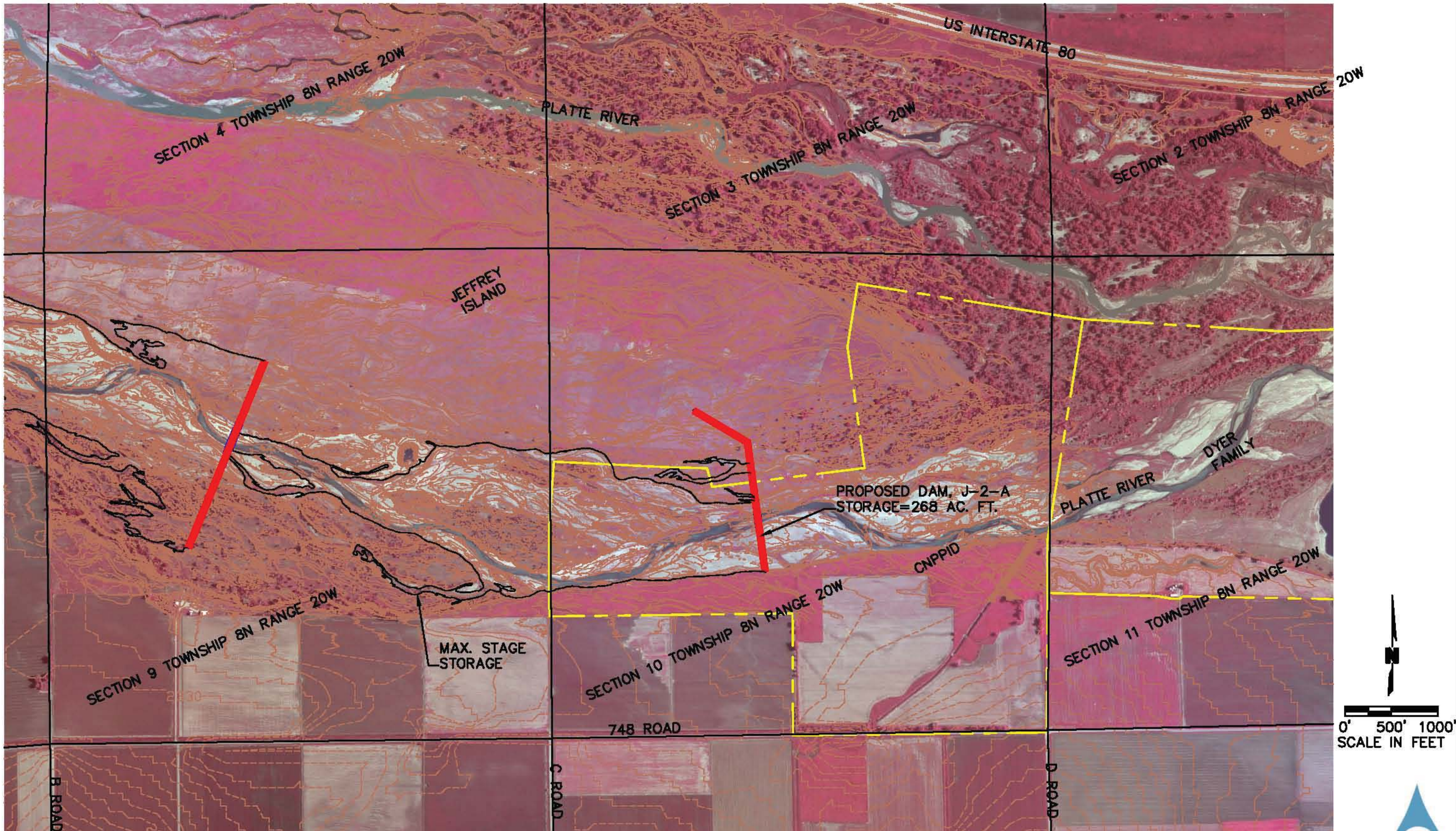

LEGEND
PROGRAM LAND BOUNDARY
DAM CENTERLINE
MAX STAGE STORAGE

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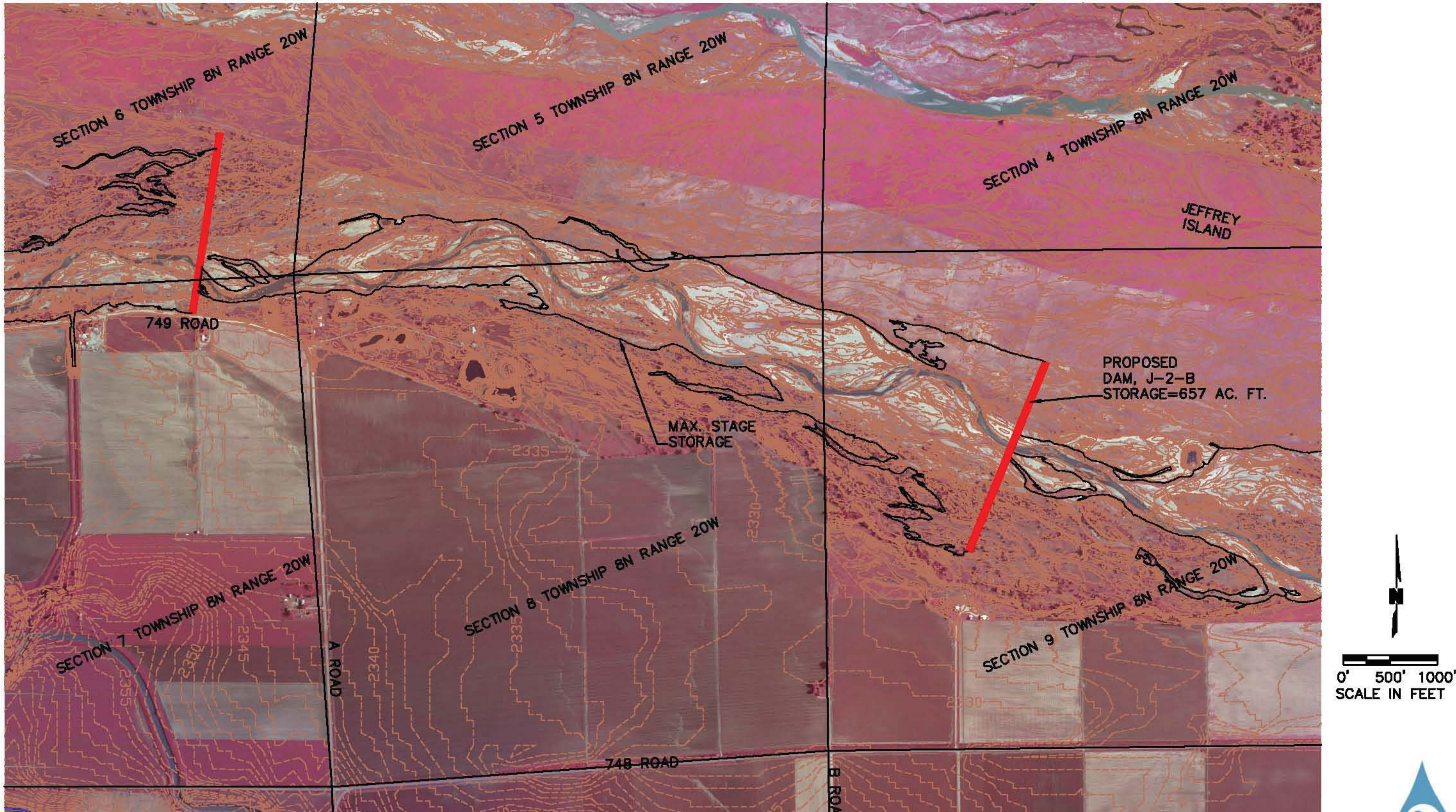

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DAM CENTERLINE

MAX STAGE STORAGE

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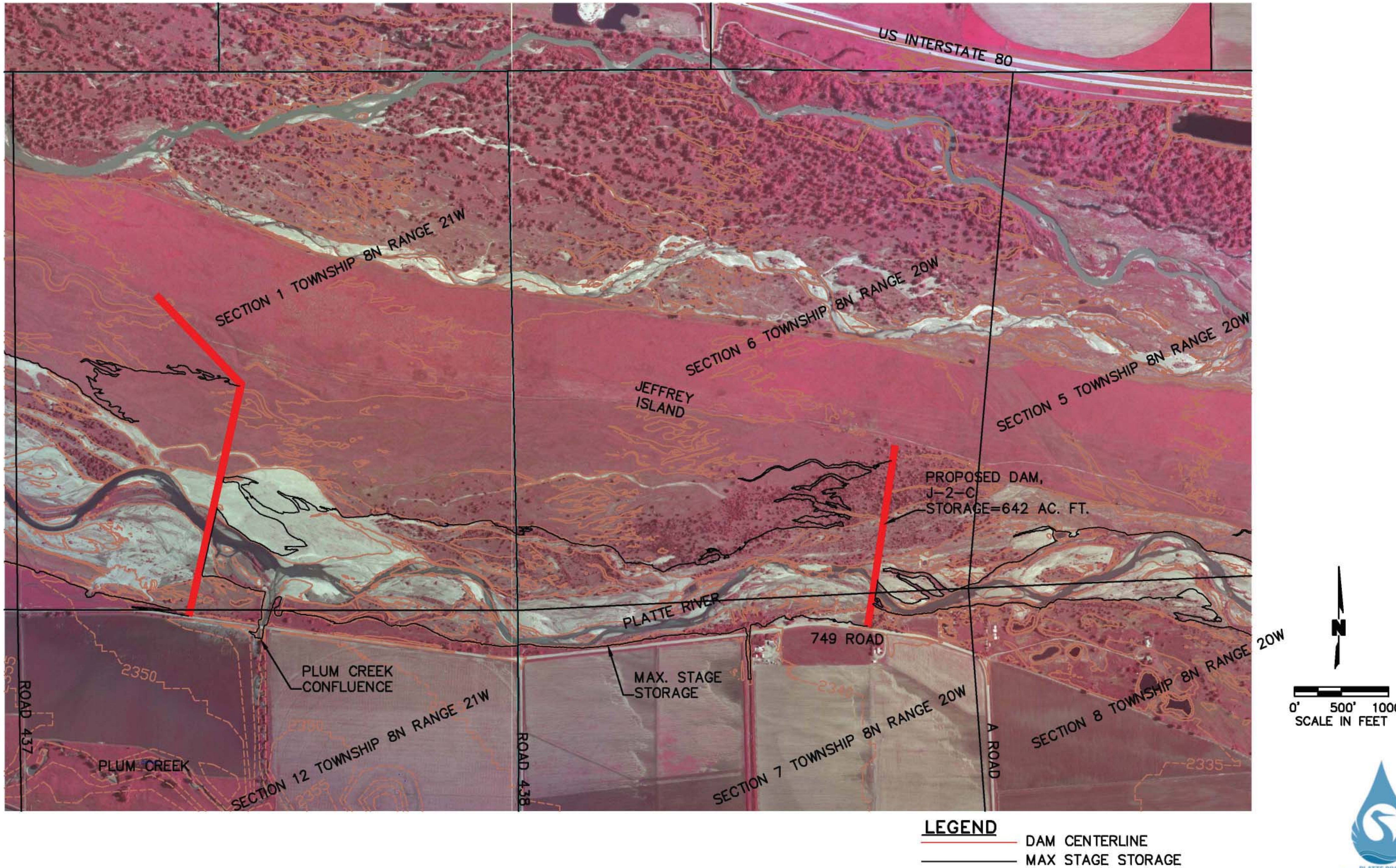
PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM



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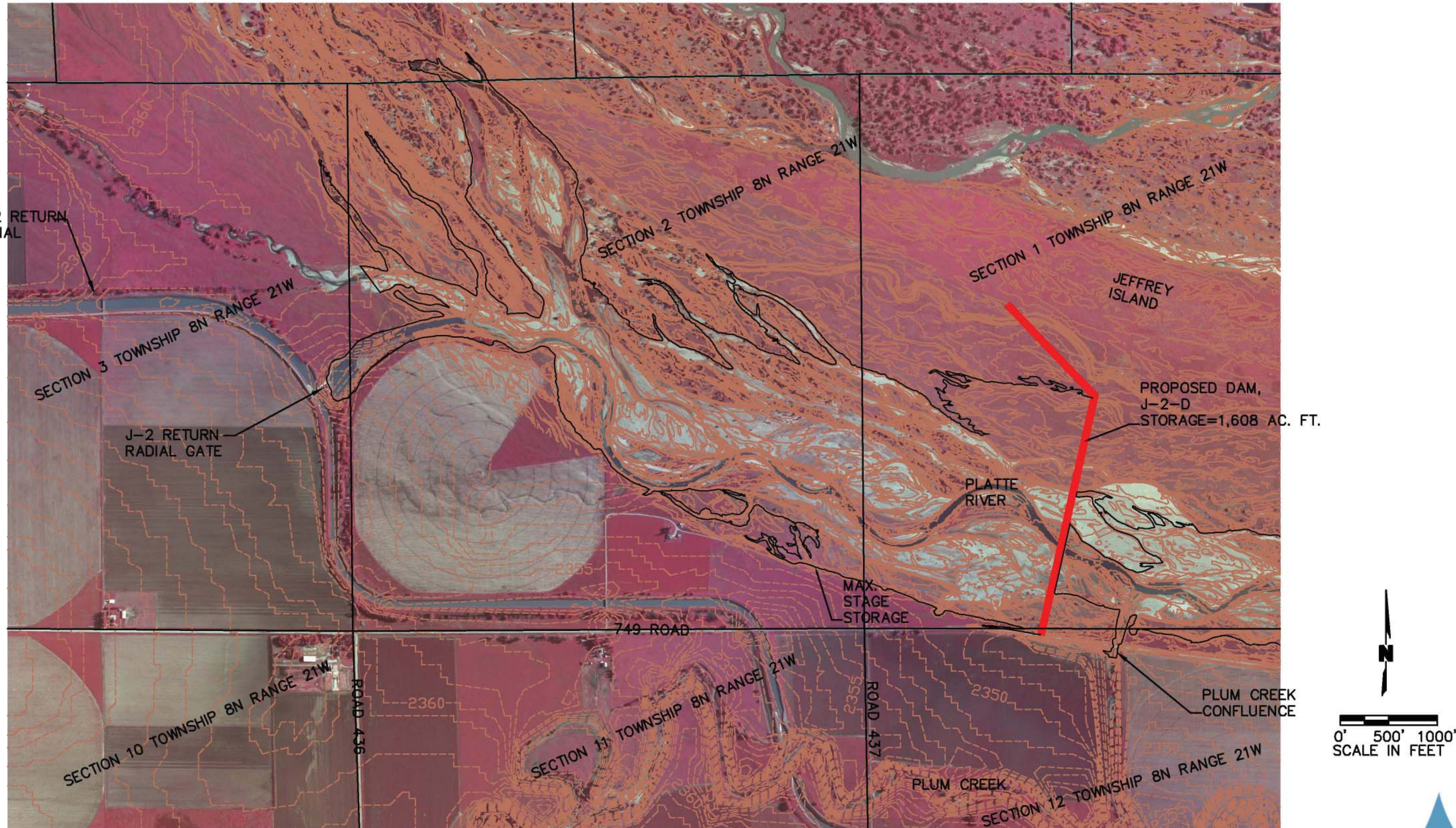

LEGEND

DAM CENTERLINE

MAX STAGE STORAGE

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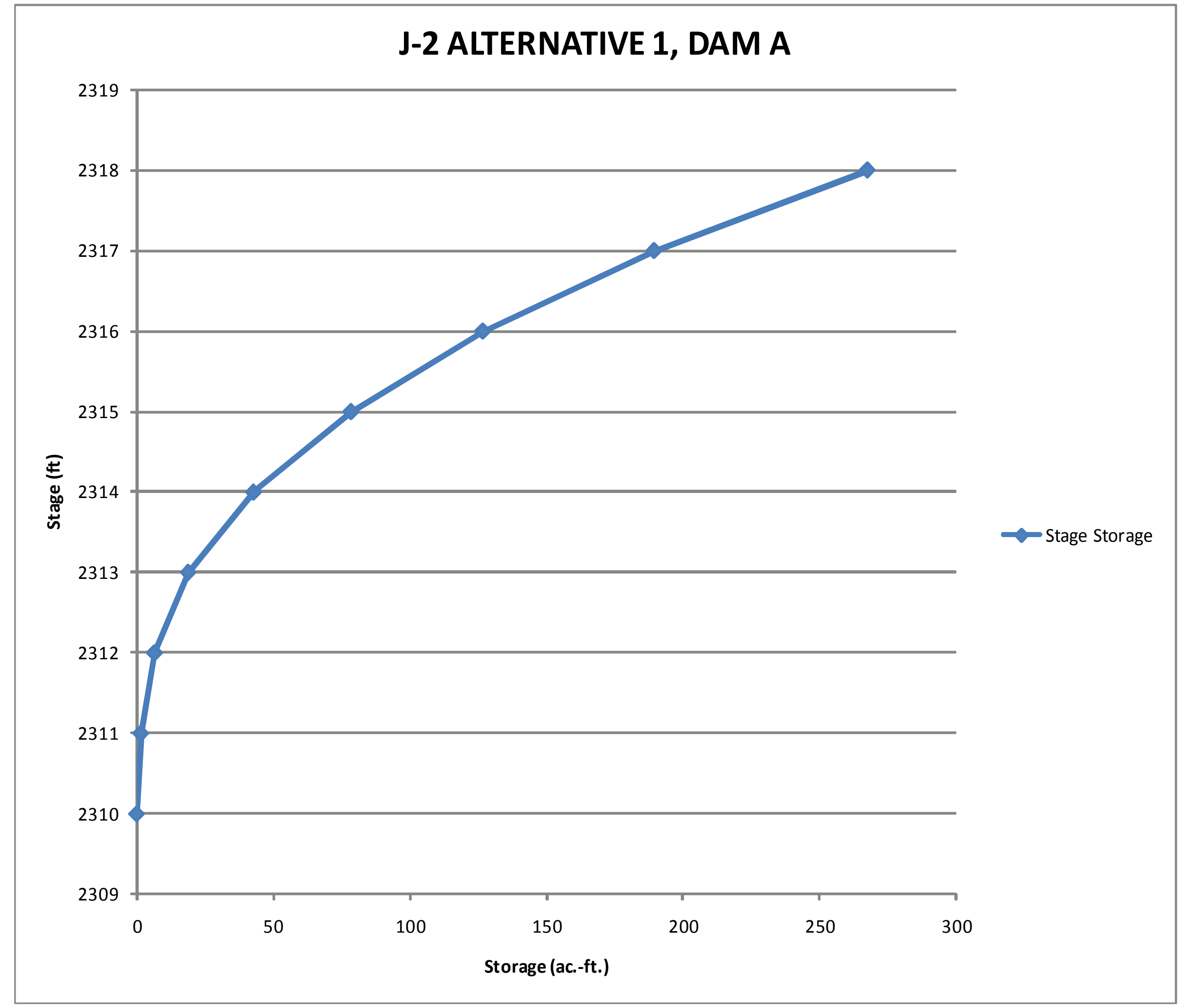
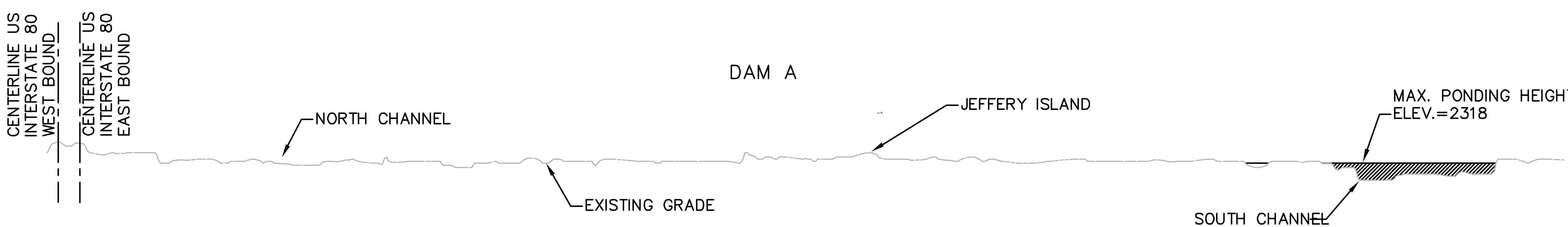
J-2 Return Alternative 1, Dam A Stage Storage - Top of Dam 2318				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2310	13,929	0	0	0
2311	119,765	3	2	2
2312	314,637	7	5	7
2313	764,451	18	12	19
2314	1,316,741	30	24	43
2315	1,795,032	41	36	79
2316	2,412,151	55	48	127
2317	3,057,058	70	63	190
2318	3,746,169	86	78	268





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NOT TO SCALE

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DATE: 1.27.10

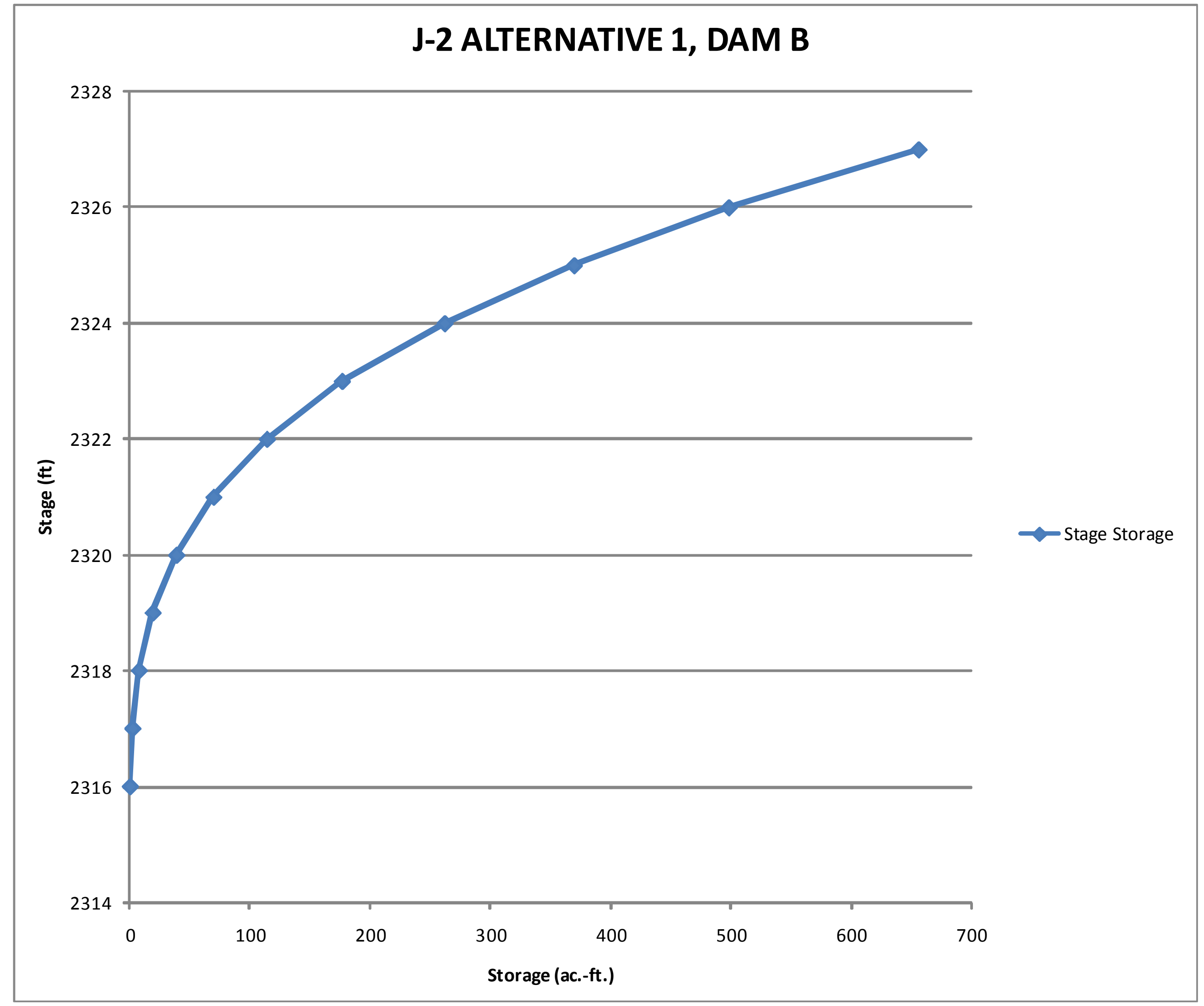
J-2 RETURN ALTERNATIVE 1
DAWSON AND PHELPS COUNTY, NEBRASKA

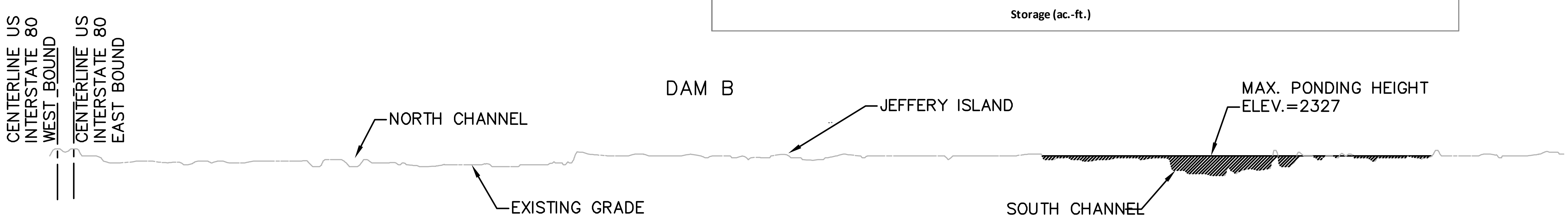
OLSSON ASSOCIATES

DAM "A"
STAGE STORAGE

FIGURE
1.6

J-2 Return Alternative 1, Dam B Stage Storage - Top of Dam 2327				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2316	41,744	1	0	0
2317	147,304	3	2	2
2318	330,390	8	5	8
2319	666,950	15	11	19
2320	1,047,142	24	20	39
2321	1,637,741	38	31	70
2322	2,235,086	51	44	114
2323	3,208,281	74	62	177
2324	4,246,446	97	86	262
2325	5,134,688	118	108	370
2326	6,102,434	140	129	499
2327	7,666,007	176	158	657





CROSS SECTION ALONG CENTERLINE OF DIKE

NOT TO SCALE

PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 1 DAWSON AND PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	DAM "B" STAGE STORAGE	FIGURE 1.7

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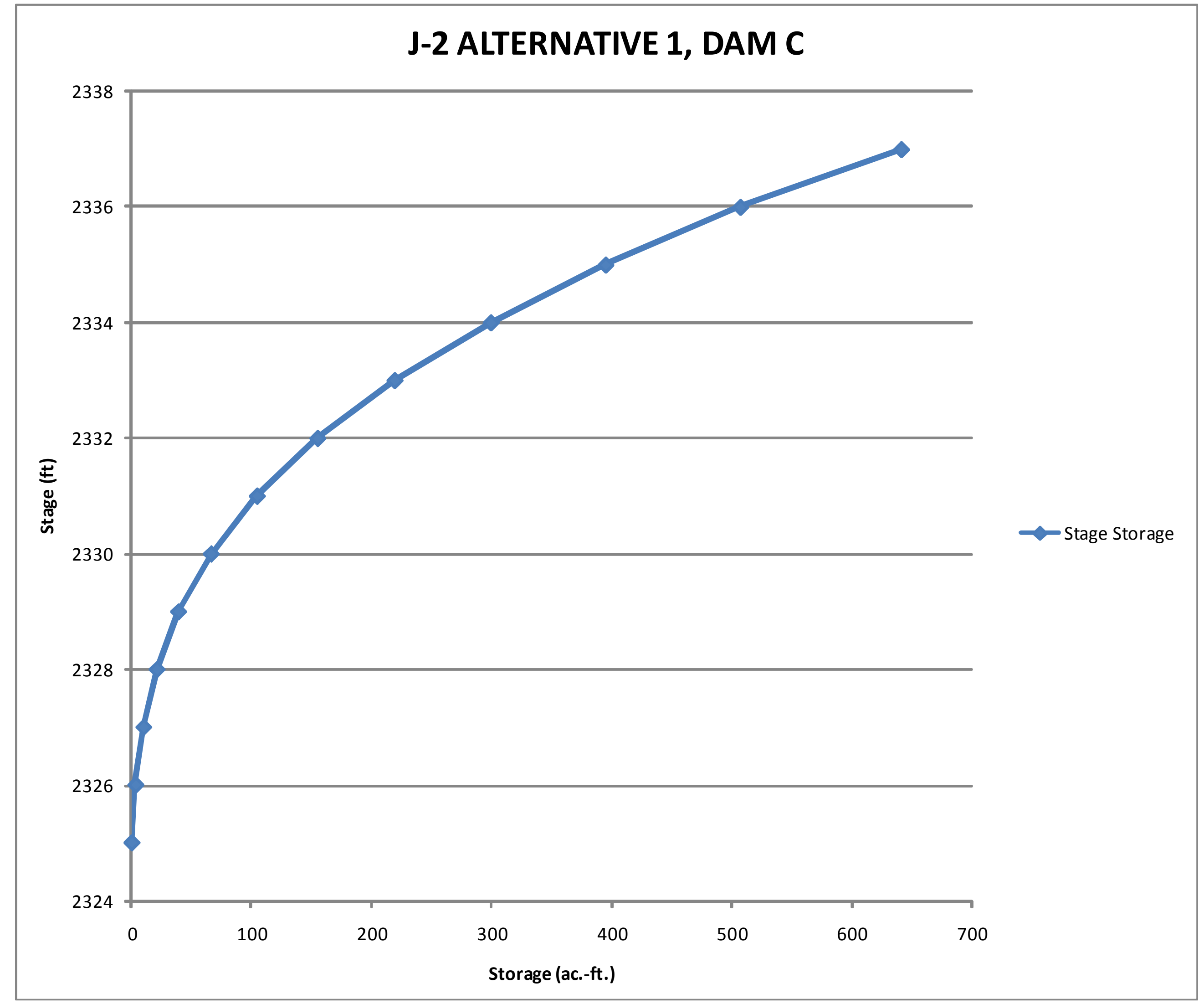
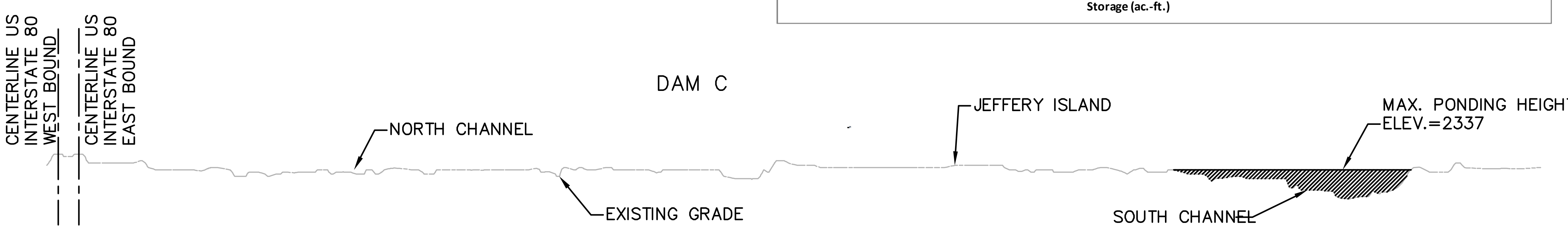
J-2 Return Alternative 1, Dam C Stage Storage - Top of Dam 2337

Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2325	49,190	1	0	0
2326	217,378	5	3	3
2327	368,262	8	7	10
2328	603,127	14	11	21
2329	962,924	22	18	39
2330	1,413,900	32	27	66
2331	1,929,543	44	38	105
2332	2,453,424	56	50	155
2333	3,169,640	73	65	219
2334	3,823,379	88	80	300
2335	4,512,649	104	96	395
2336	5,283,201	121	112	508
2337	6,401,085	147	134	642





CROSS SECTION ALONG CENTERLINE OF DIKE

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PROJECT: 09-1466	J-2 RETURN ALTERNATIVE 1 DAWSON, GOSPER, AND PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	DAM "C" STAGE STORAGE	FIGURE 1.8
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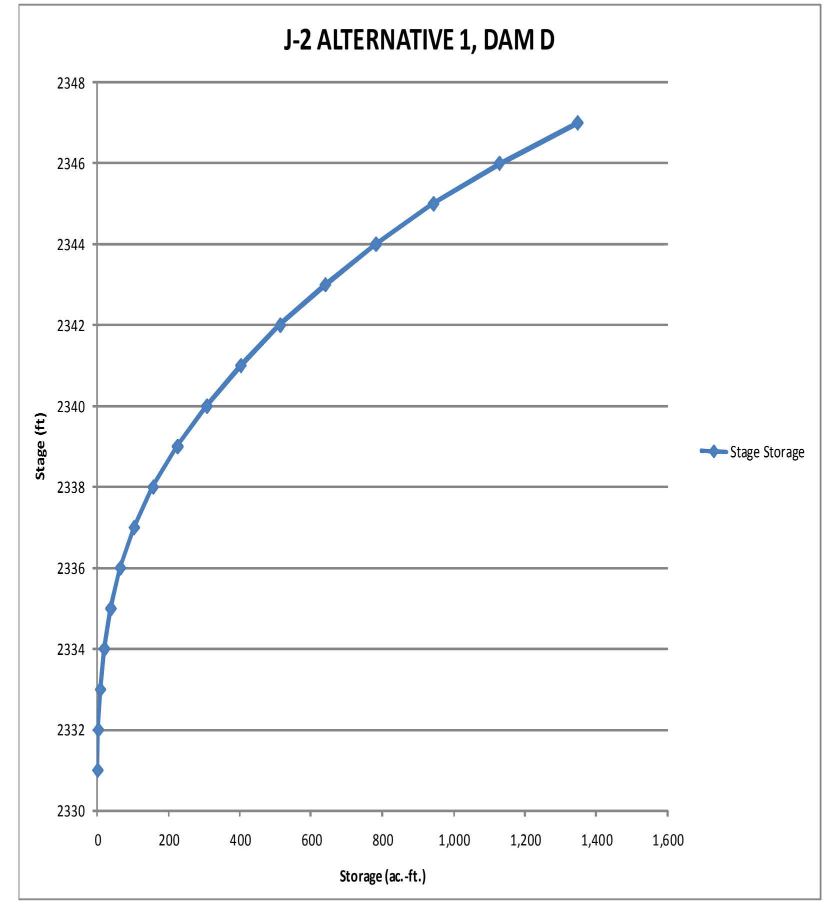
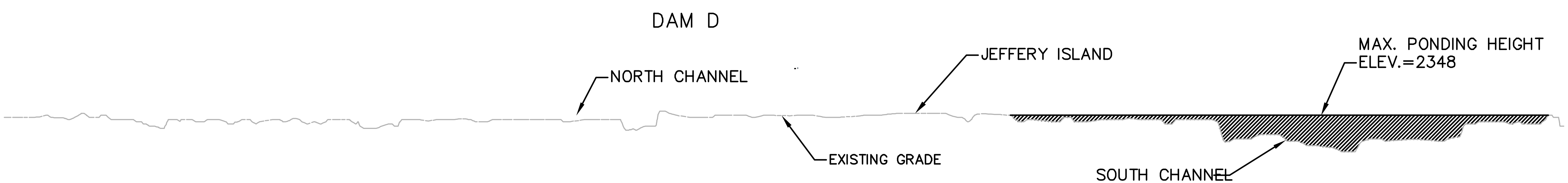
J-2 Return Alternative 1, Dam D Stage Storage - Top of Dam 2348				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2331	23,610	1	0	0
2332	154,615	4	2	2
2333	349,742	8	6	8
2334	617,852	14	11	19
2335	967,051	22	18	37
2336	1,373,159	32	27	64
2337	1,980,583	45	38	102
2338	2,666,961	61	53	156
2339	3,299,104	76	68	224
2340	3,850,264	88	82	306
2341	4,475,354	103	96	402
2342	5,163,564	119	111	513
2343	5,846,806	134	126	639
2344	6,541,284	150	142	781
2345	7,485,313	172	161	942
2346	8,666,703	199	185	1,128
2347	10,446,890	240	219	1,347
2348	12,266,452	282	261	1,608





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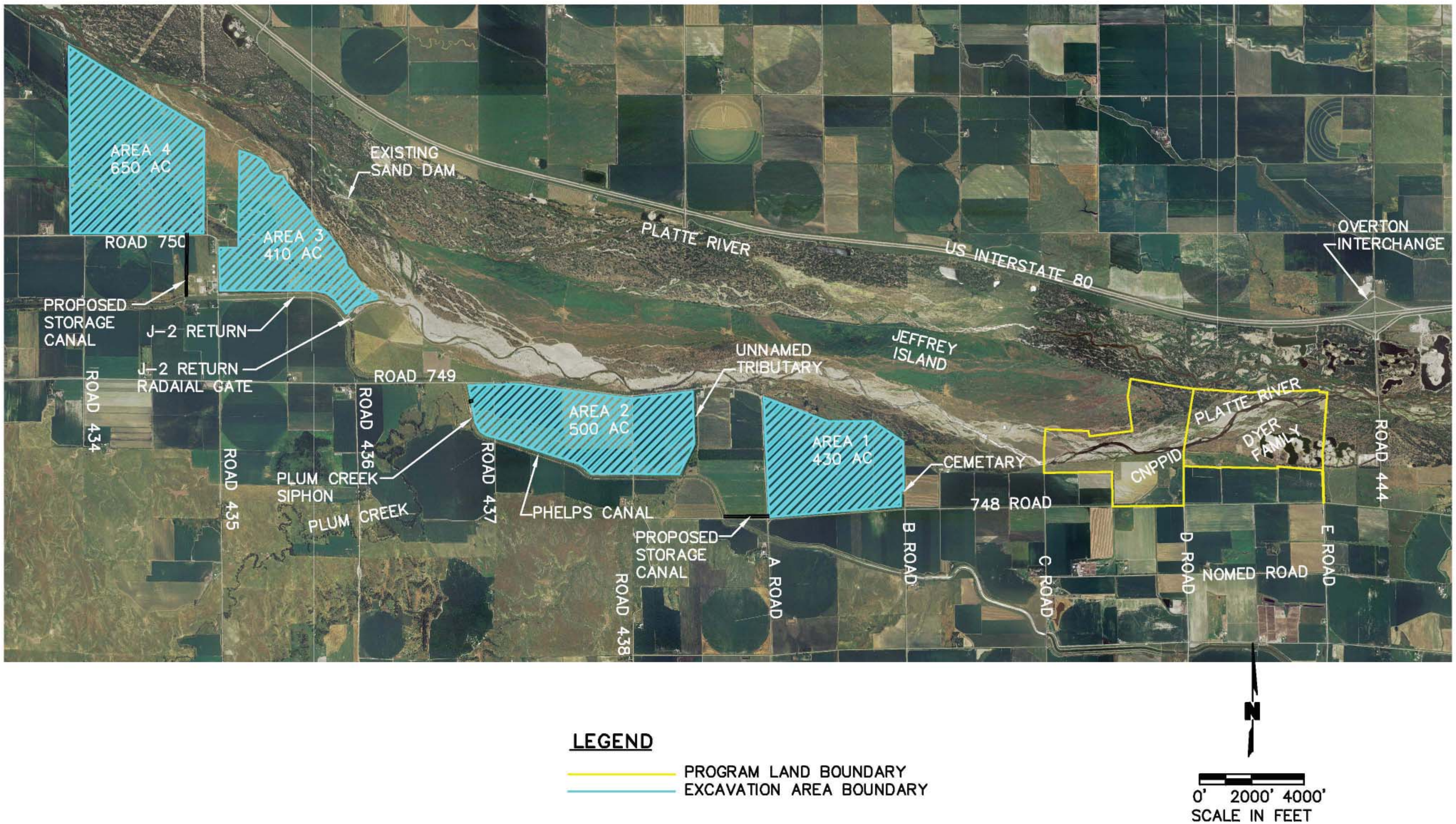

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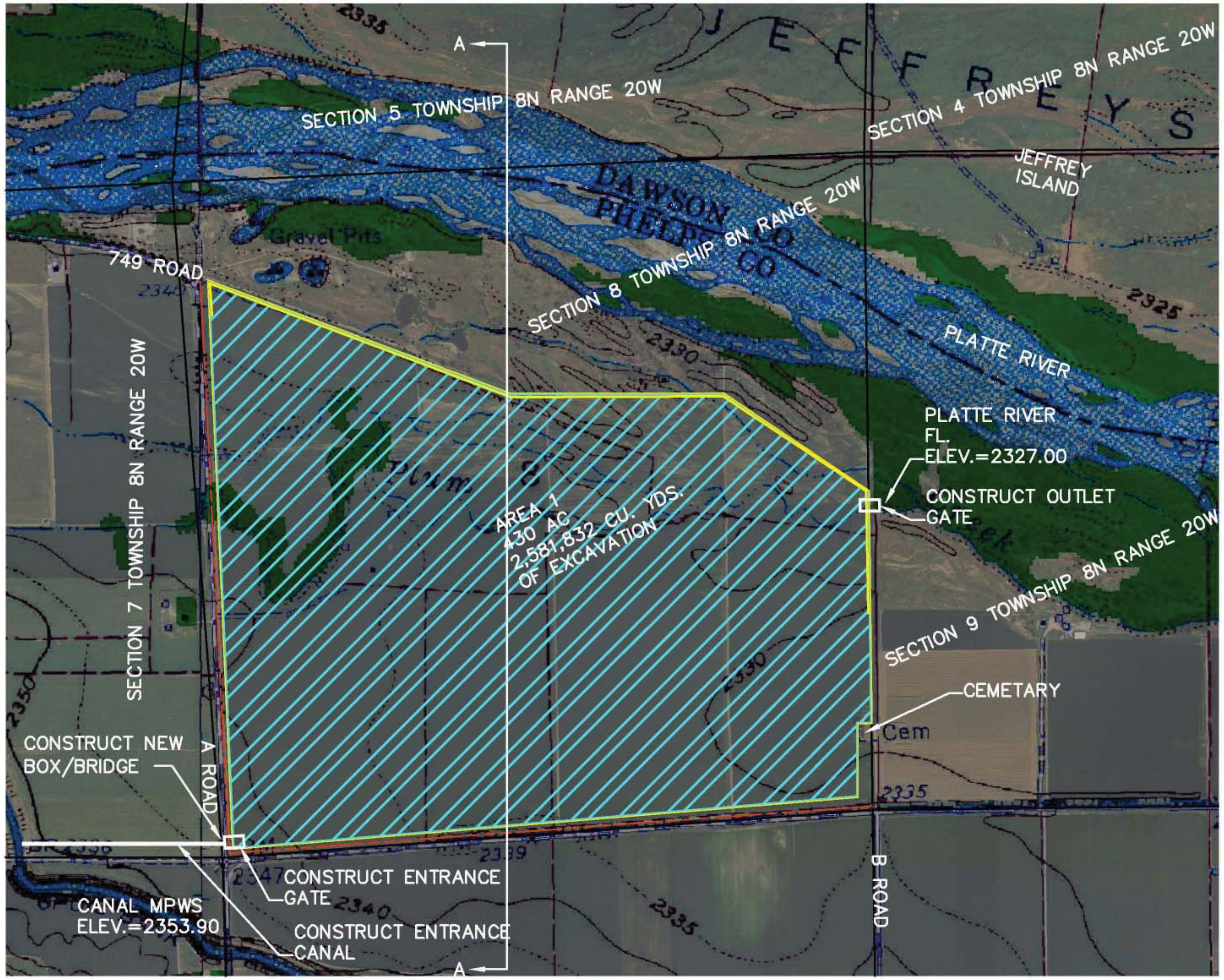
PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 2 GOSPER AND PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	PROPOSED EXCAVATION	FIGURE 2.1



J-2 Return Alternative 2 Stage Storage - Area 1				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2328	14,787	0	0	0
2329	148,867	3	2	2
2330	17,409,781	400	202	203
2331	17,461,971	401	400	604
2332	17,514,236	402	401	1,005
2333	17,566,575	403	403	1,408
2334	17,618,989	404	404	1,812
2335	17,671,477	406	405	2,217
2336	17,724,039	407	406	2,623
2337	17,776,676	408	407	3,031
2338	17,829,387	409	409	3,439
2339	17,882,172	411	410	3,849
2340	17,935,032	412	411	4,260
2341	17,987,966	413	412	4,673
2342	18,040,975	414	414	5,086
2343	18,094,058	415	415	5,501
2344	18,147,215	417	416	5,917
2345	18,200,446	418	417	6,334
2346	18,253,752	419	418	6,753
2347	18,307,132	420	420	7,172
2348	18,360,587	422	421	7,593
2349	18,414,116	423	422	8,015
2350	18,467,719	424	423	8,439
2351	18,521,397	425	425	8,863
2352	18,575,149	426	426	9,289
2353	18,596,671	427	427	9,716

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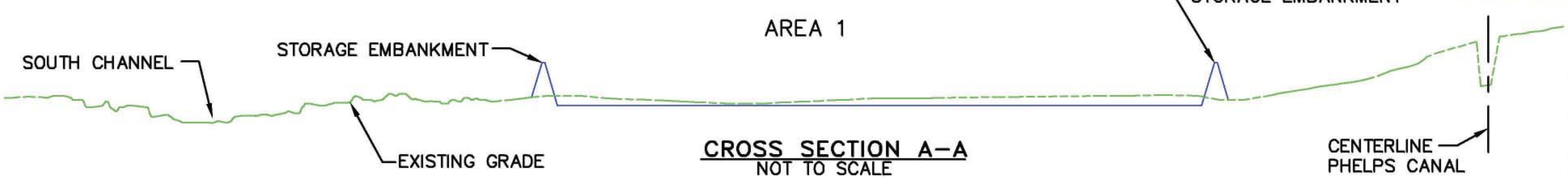
0' 500' 1000'
SCALE IN FEET

LEGEND

- STORAGE AREA BOUNDARY
- EXISTING GRADE
- PROPOSED STORAGE
- TOP OF EMBANKMENT
- EXISTING MAJOR CONTOUR



CROSS SECTION A–A
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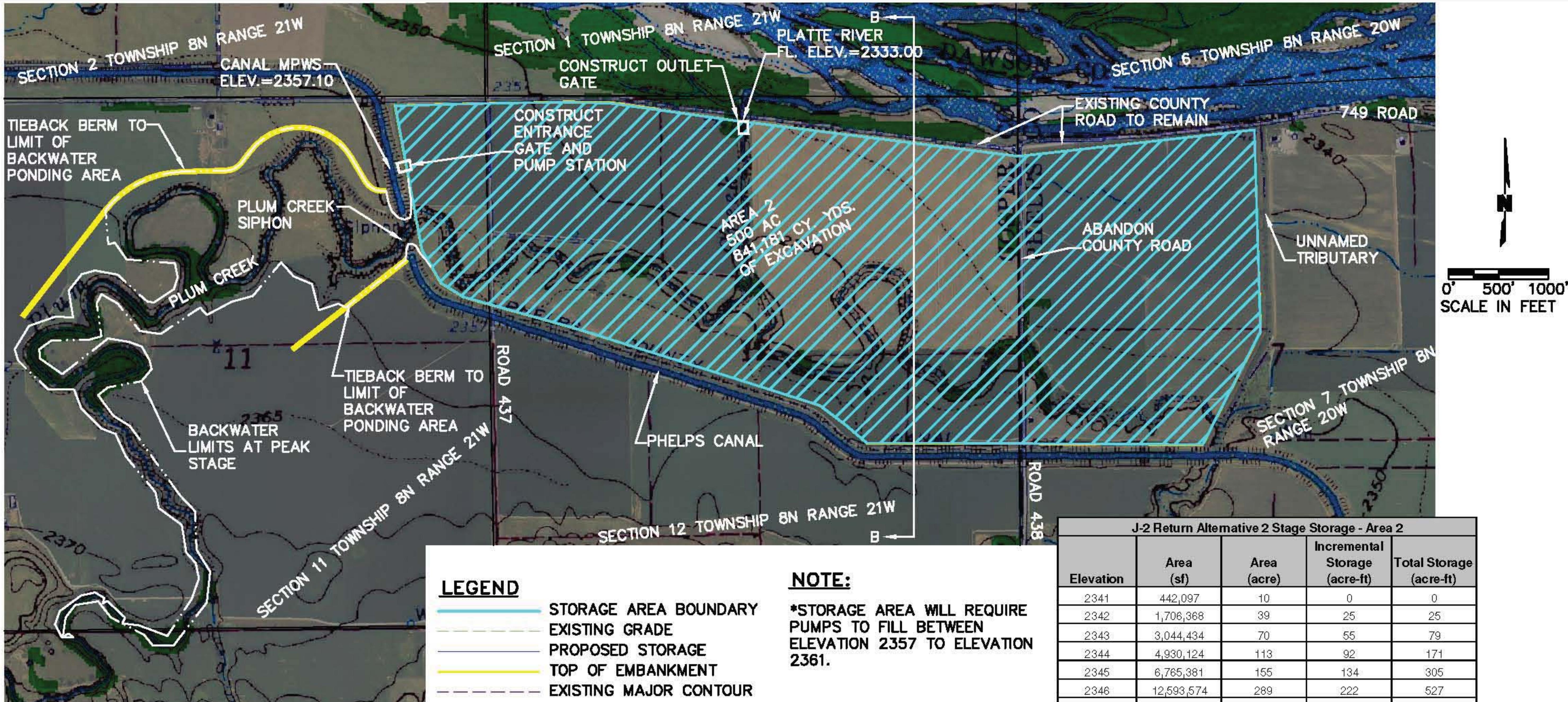
NOTE:
CONTOURS DEVELOPED FROM THE COMBINATION OF LIDAR POINTS WITHIN THE PLATTE RIVER AND NED POINTS SOUTH OF THE PLATTE RIVER.

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 2 PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	EXCAVATION AREA 1	FIGURE 2.2



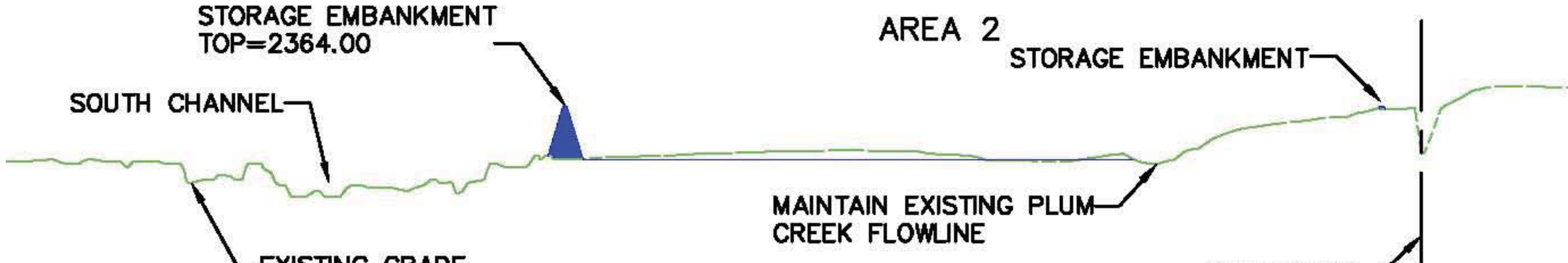
LEGEND

- STORAGE AREA BOUNDARY
- EXISTING GRADE
- PROPOSED STORAGE
- TOP OF EMBANKMENT
- EXISTING MAJOR CONTOUR
- BACKWATER LIMITS AT PEAK STAGE

NOTE:

*STORAGE AREA WILL REQUIRE PUMPS TO FILL BETWEEN ELEVATION 2357 TO ELEVATION 2361.

J-2 Return Alternative 2 Stage Storage - Area 2				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2341	442,097	10	0	0
2342	1,706,368	39	25	25
2343	3,044,434	70	55	79
2344	4,930,124	113	92	171
2345	6,765,381	155	134	305
2346	12,593,574	289	222	527
2347	12,854,484	295	292	819
2348	13,341,838	306	301	1,120
2349	13,959,225	320	313	1,433
2350	14,597,327	335	328	1,761
2351	15,450,584	355	345	2,106
2352	16,531,221	380	367	2,473
2353	17,471,798	401	390	2,863
2354	18,061,498	415	408	3,271
2355	18,743,860	430	422	3,694
2356	19,769,331	454	442	4,136
2357	20,972,974	481	468	4,604
2358*	21,253,566	488	485	5,088
2359*	21,519,828	494	491	5,579
2360*	21,795,508	500	497	6,076
2361*	22,061,056	506	503	6,580



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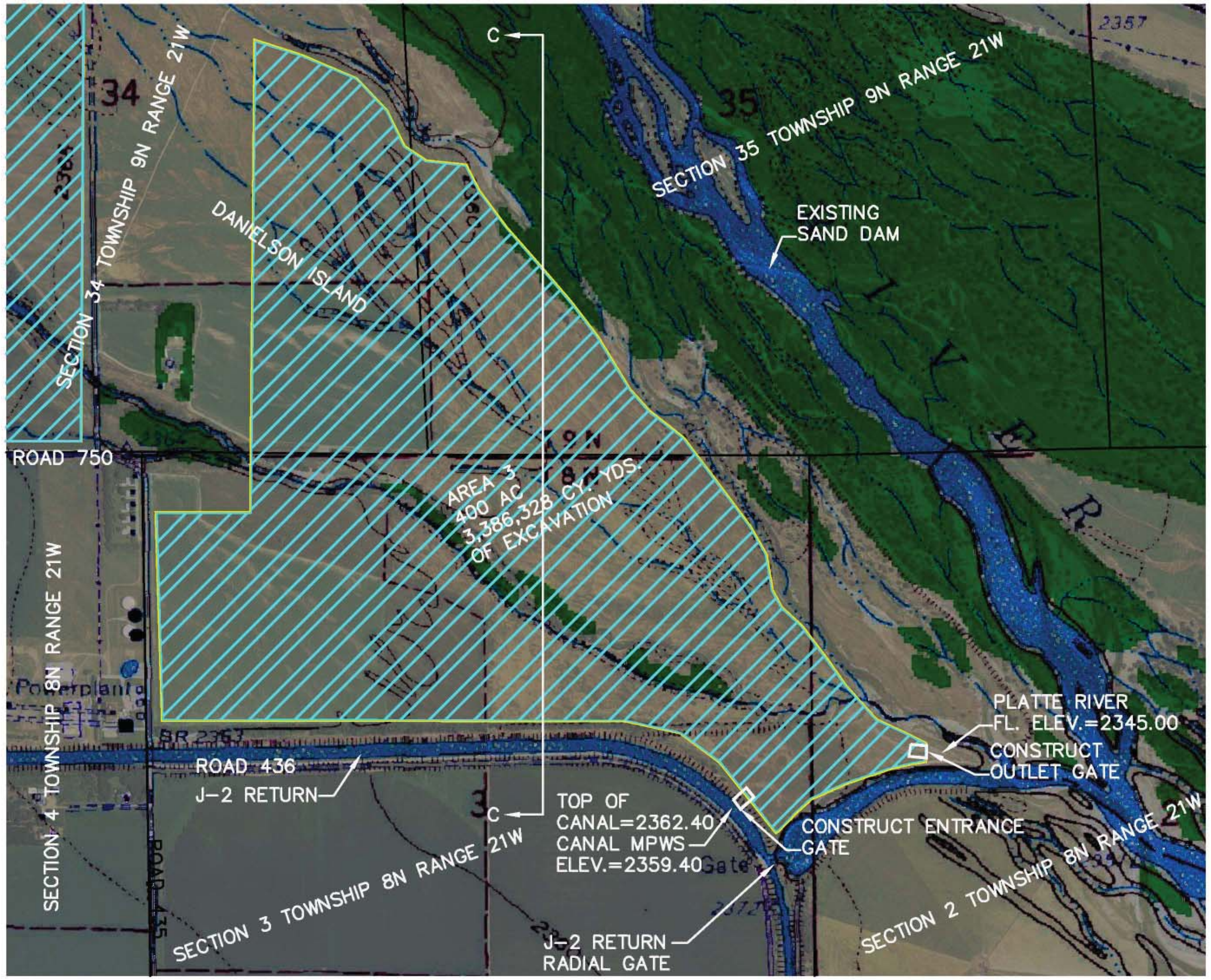
PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 2 GOSPER AND PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	EXCAVATION AREA 2	FIGURE 2.3



J-2 Return Alternative 2 Stage Storage - Area 3				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2346	4,016	0	0	0
2347	16,558	0	0	0
2348	28,845	1	1	1
2349	32,001	1	1	1
2350	34,814	1	1	2
2351	37,539	1	1	3
2352	40,343	1	1	4
2353	43,376	1	1	5
2354	47,320	1	1	6
2355	16,759,270	385	193	199
2356	16,820,489	386	385	584
2357	16,881,784	388	387	971
2358	16,943,155	389	388	1,359
2359 *	17,004,601	390	390	1,749
2360 *	17,066,122	392	391	2,140
2361 *	17,127,719	393	392	2,533
2362 *	17,189,390	395	394	2,927
2363 *	17,251,137	396	395	3,322
2364 *	17,312,959	397	397	3,719
2365 *	17,374,857	399	398	4,117
2366 *	17,436,830	400	400	4,516

N

0' 500' 1000'
SCALE IN FEET

LEGEND

- STORAGE AREA BOUNDARY
- EXISTING GRADE
- PROPOSED STORAGE
- TOP OF EMBANKMENT
- EXISTING MAJOR CONTOUR

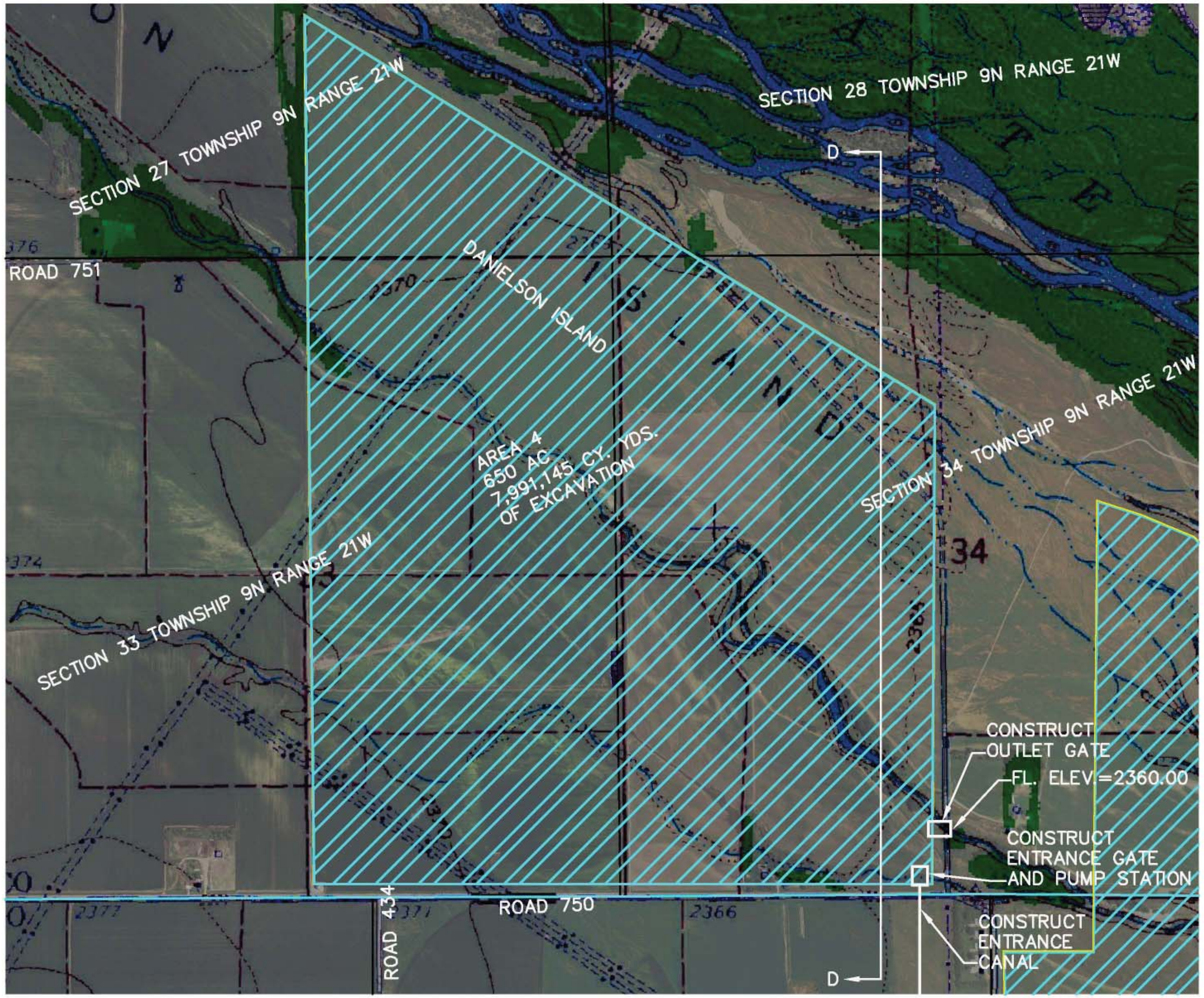
CROSS SECTION C–C
NOT TO SCALE

NOTE:

*STORAGE AREA WILL REQUIRE PUMPS TO FILL BETWEEN ELEVATION 2359 TO ELEVATION 2366.

DWG: F:\Projects\009-1466\Alternative 2\009-1466_StageStorageArea3.dwg USER: cluttrell
DATE: Jan 27, 2010 1:39pm XREFS: 09_1466_Pbase J2_TOPO 009-1466_SectionTownship TitleBlock

PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 2 GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	EXCAVATION AREA 3	FIGURE 2.4



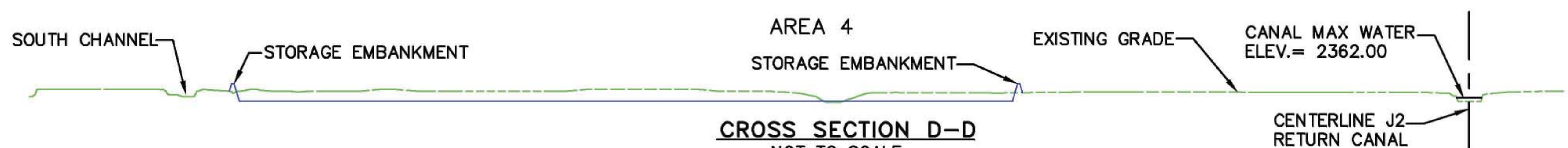
J-2 Return Alternative 2 Stage Storage - Area 4				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2360.5	27,826,729	639	0	0
2361	27,859,787	640	320	320
2362*	27,925,961	641	640	960
2363*	27,992,213	643	642	1,602
2364*	28,058,544	644	643	2,245
2365*	28,124,954	646	645	2,890
2366*	28,191,442	647	646	3,536
2367*	28,258,008	649	648	4,184
2368*	28,324,653	650	649	4,834
2369*	28,391,376	652	651	5,485
2370*	28,458,178	653	653	6,137

NOTE:

*STORAGE AREA WILL REQUIRE PUMPS TO FILL BETWEEN ELEVATION 2362 TO ELEVATION 2370.

LEGEND

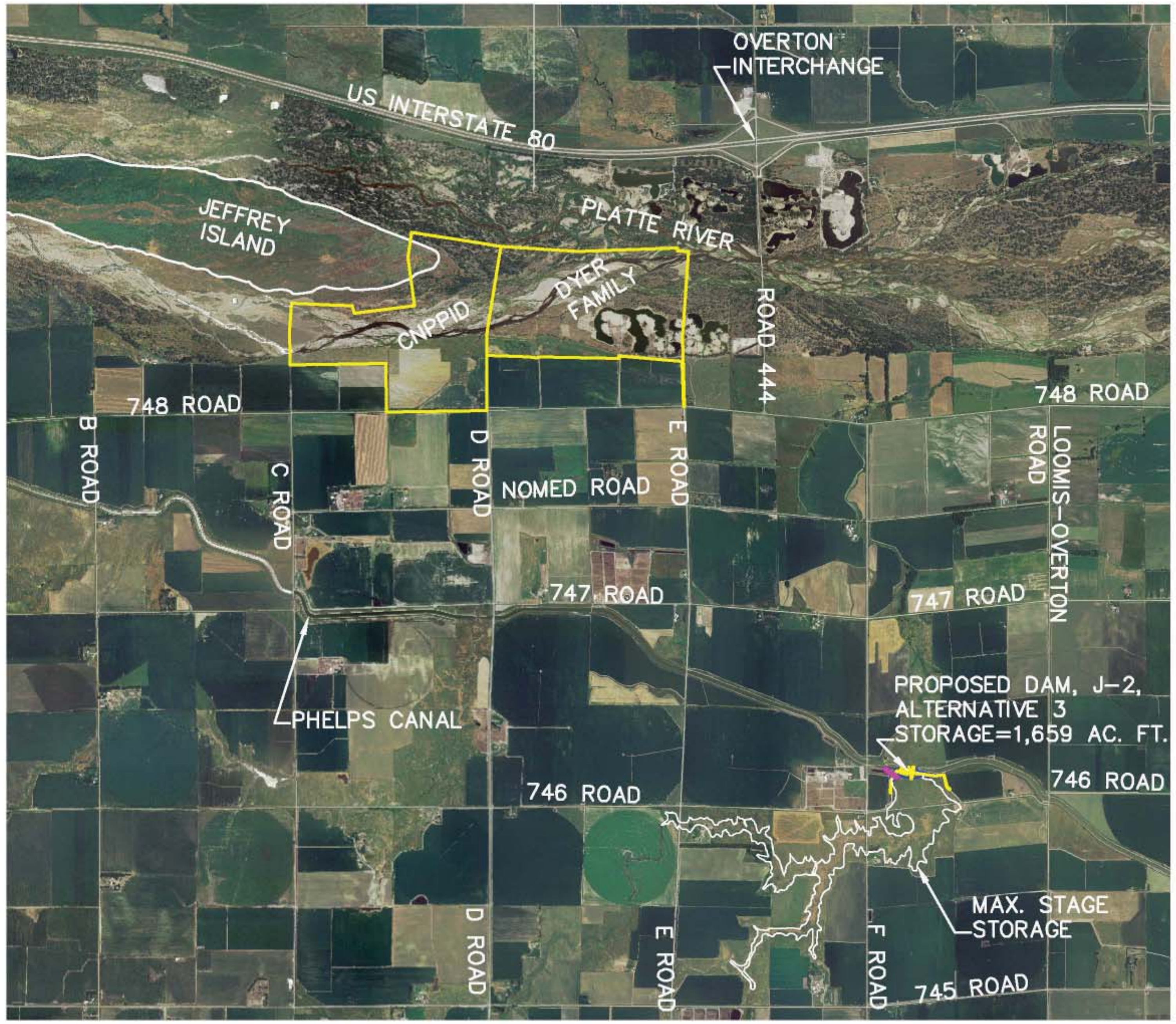
- STORAGE AREA BOUNDARY
- EXISTING GRADE
- PROPOSED STORAGE
- TOP OF EMBANKMENT
- EXISTING MAJOR CONTOUR



CROSS SECTION D–D
NOT TO SCALE

DWG: F:\Projects\009-1466\Alternative 2\009-1466_StageStorageArea4.dwg USER: cluttrell
DATE: Jan 27, 2010 1:40pm XREFS: 09_1466_Pbase J2_TOPO 009-1466_SectionTownship TitleBlock

PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 2 GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	EXCAVATION AREA 4	FIGURE 2.5



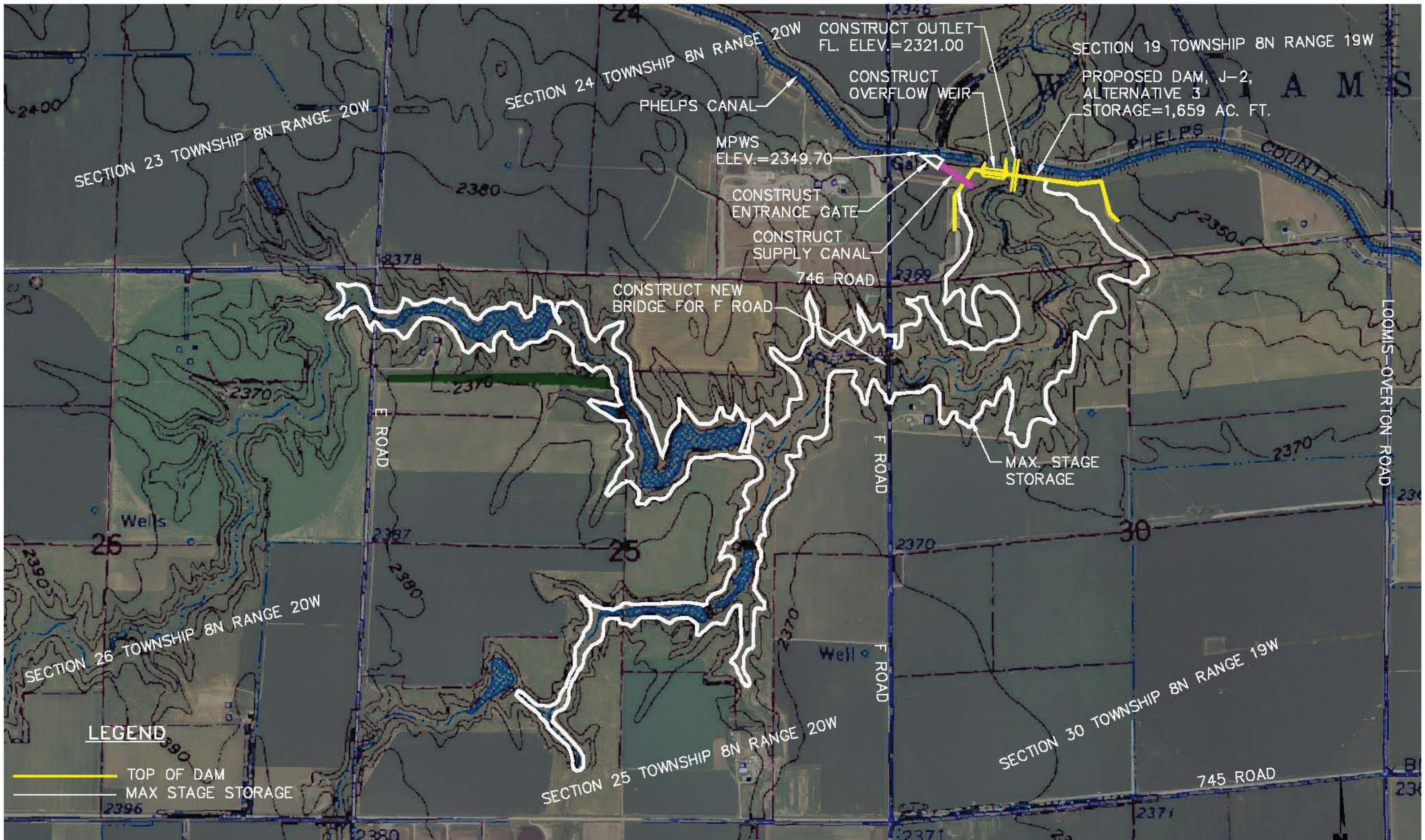
0' 2000' 4000'
SCALE IN FEET

LEGEND

- PROGRAM LAND BOUNDARY
- DAM CENTERLINE
- MAX STAGE STORAGE

DWG: F:\Projects\009-1466\Alternative 3\009-1466_StageStorageExhibit.dwg USER: cluttrell
DATE: Jan 27, 2010 1:35pm XREFS: 09_1466_LowResolutionAerials 009-1466_SectionTownship 09_1466_Pbase J2_TOPO TitleBlock

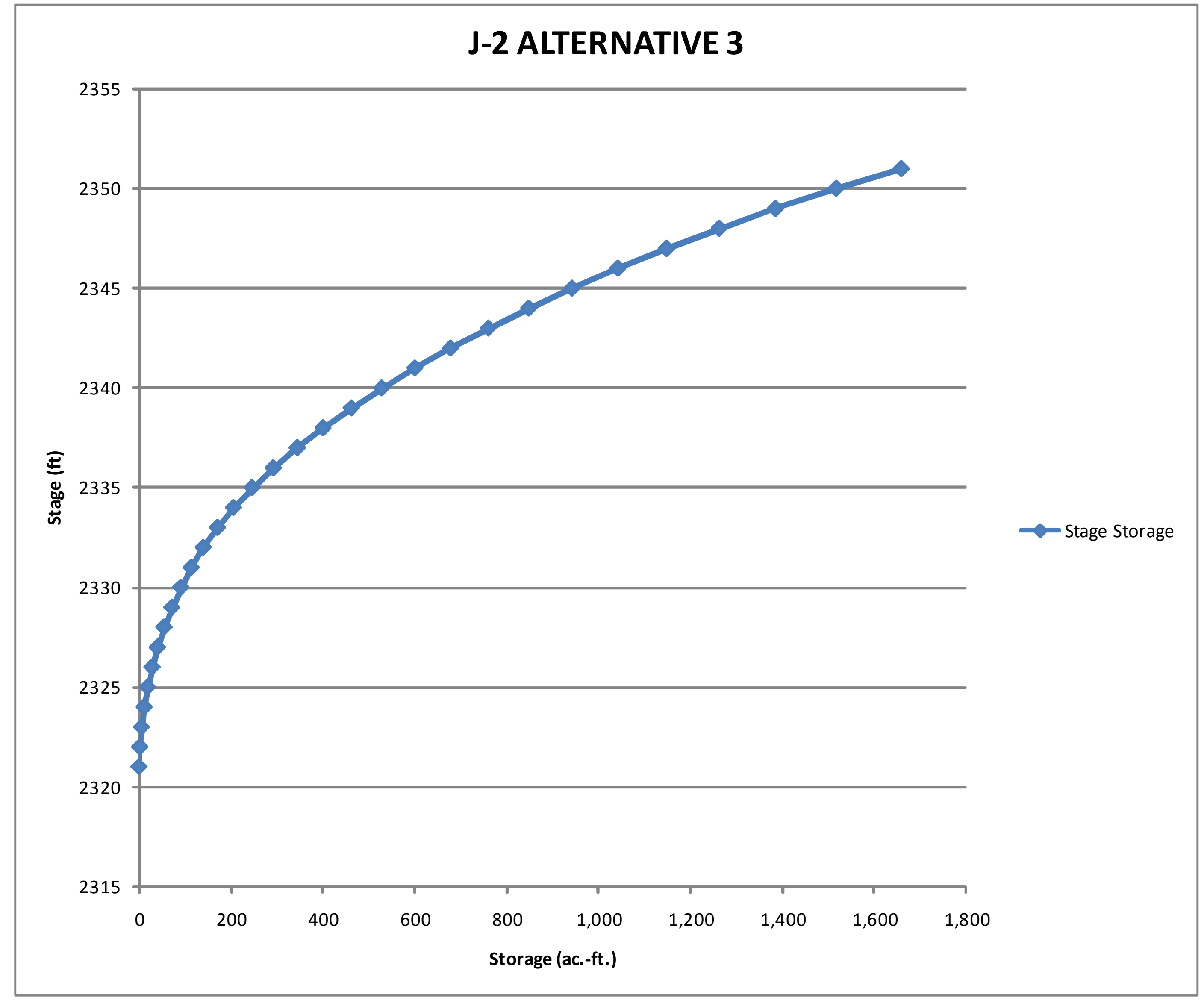
PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 3 PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	SITE LOCATION	FIGURE 3.1



DWG: F:\Projects\009-1466\Alternative 3\009-1466_StageStorageExhibit.dwg USER: cluttrell
DATE: Jan 27, 2010 1:34pm XREFS: 09_1466_LowResolutionAerials 009-1466_SectionTownship 09_1466_Pbase J2_TOPO TitleBlock

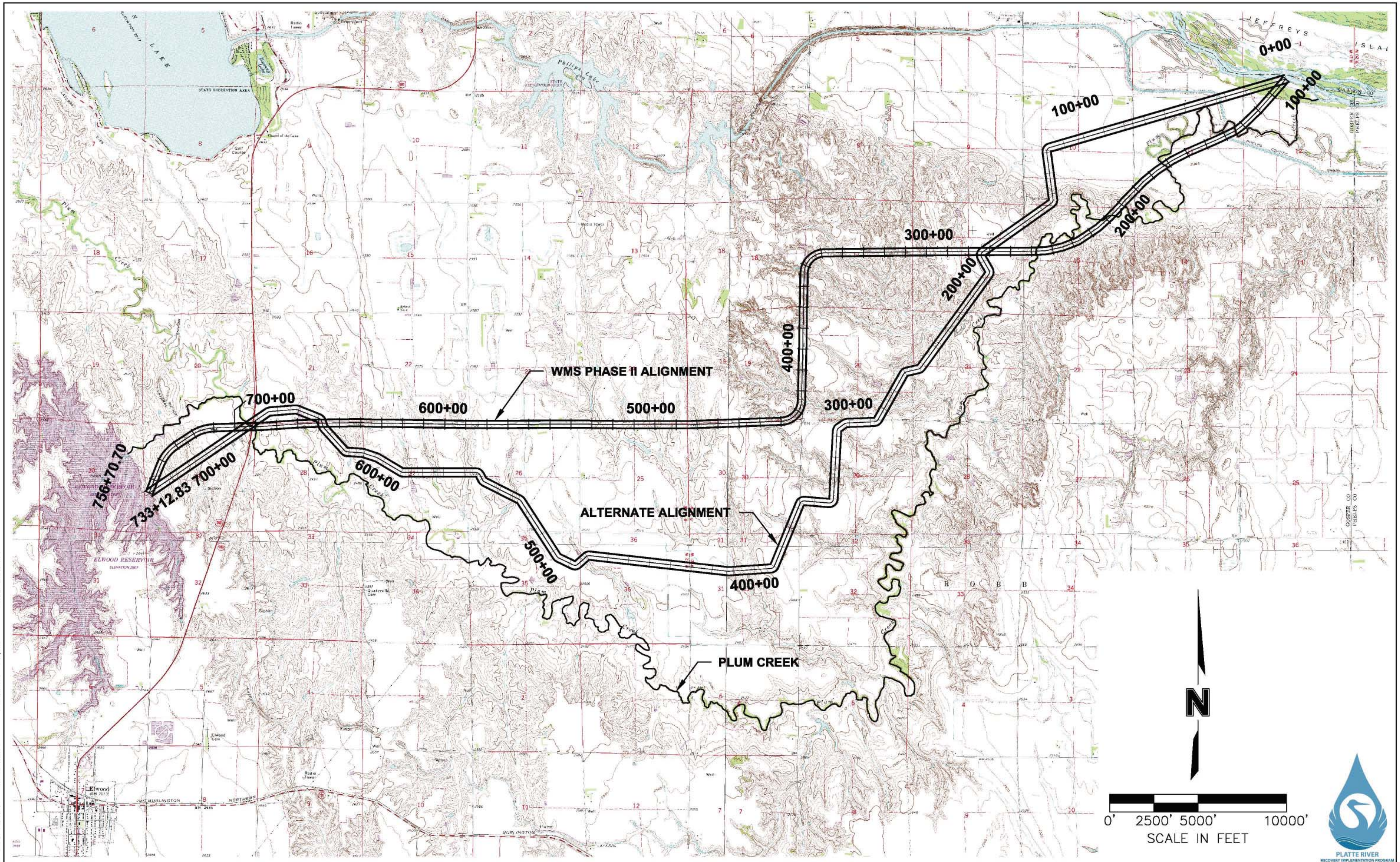
PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 3 PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	PLAN VIEW	FIGURE 3.2

J-2 Return Alternative 3 Stage Storage				
Elevation	Area (sf)	Area (acre)	Incremental Storage (acre-ft)	Total Storage (acre-ft)
2321	20,661	0	0	0
2322	109,688	3	1	1
2323	219,481	5	4	5
2324	297,966	7	6	11
2325	373,489	9	8	19
2326	466,945	11	10	29
2327	564,618	13	12	40
2328	678,891	16	14	55
2329	782,507	18	17	71
2330	909,688	21	19	91
2331	1,070,703	25	23	114
2332	1,235,602	28	26	140
2333	1,417,541	33	30	171
2334	1,642,770	38	35	206
2335	1,899,481	44	41	246
2336	2,136,071	49	46	293
2337	2,349,470	54	51	344
2338	2,562,213	59	56	401
2339	2,785,721	64	61	462
2340	3,013,934	69	67	528
2341	3,244,954	74	72	600
2342	3,473,378	80	77	677
2343	3,734,216	86	83	760
2344	3,964,885	91	88	849
2345	4,198,629	96	94	942
2346	4,447,319	102	99	1,041
2347	4,792,244	110	106	1,148
2348	5,173,118	119	114	1,262
2349	5,535,109	127	123	1,385
2350	5,982,798	137	132	1,517
2351	6,354,399	146	142	1,659



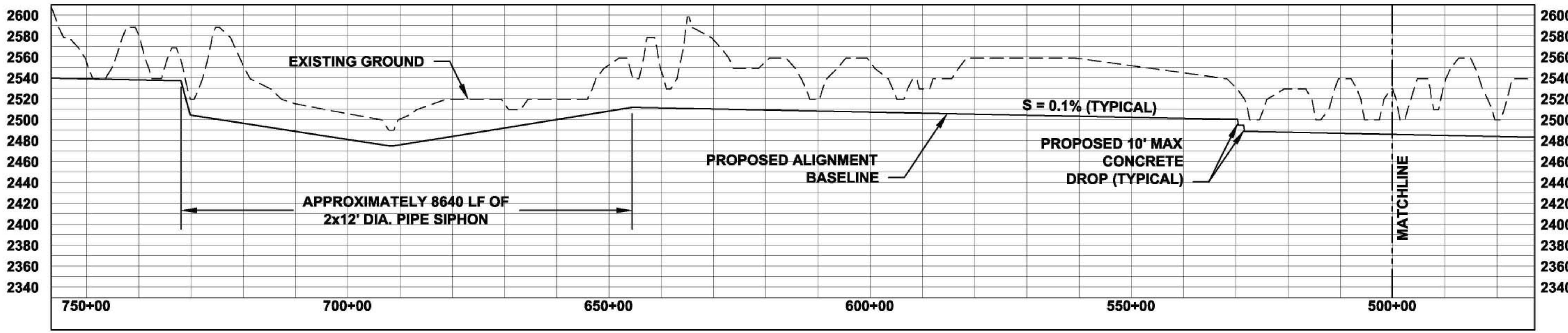
DWG: F:\Projects\009-1466\Alternative 3\009-1466_StageStorageExhibit.dwg USER: cluttrell
DATE: Jan 27, 2010 1:34pm XREFS: 09_1466_LowResolutionAerials 009-1466_SectionTownship 09_1466_Pbase J2_TOPO TitleBlock

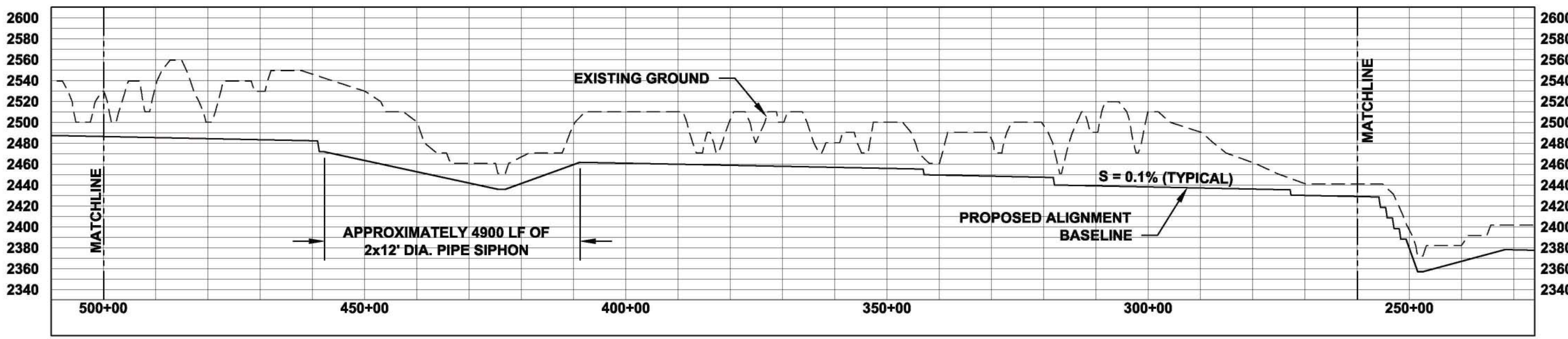
PROJECT: 09-1466 DRAWN BY: CRL DATE: 1.27.10	J-2 RETURN ALTERNATIVE 3 PHELPS COUNTY, NEBRASKA	OLSSON ASSOCIATES	STAGE STORAGE	FIGURE 3.3

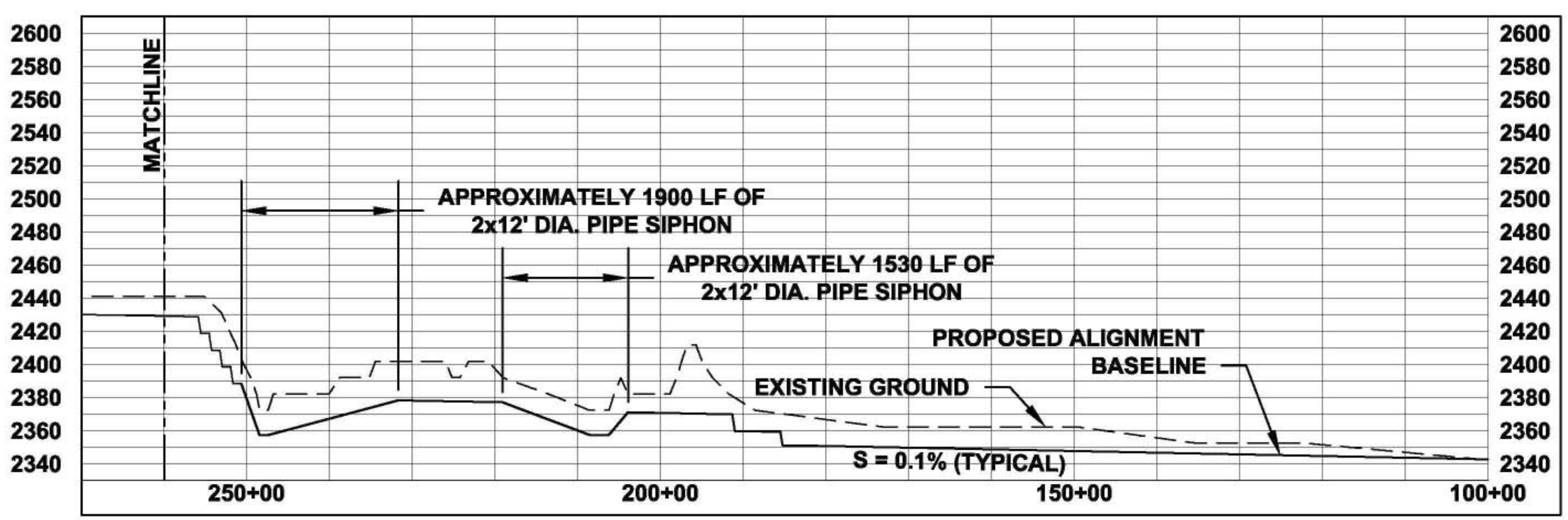


DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:36am XREFS: Topo Title Block

PROJECT: 09-1466 DRAWN BY: CAU DATE: 10.01.09	ELWOOD RESERVOIR SCREENING ALTERNATIVES GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	CANAL ALIGNMENT ALTERNATIVES	FIGURE 4.1







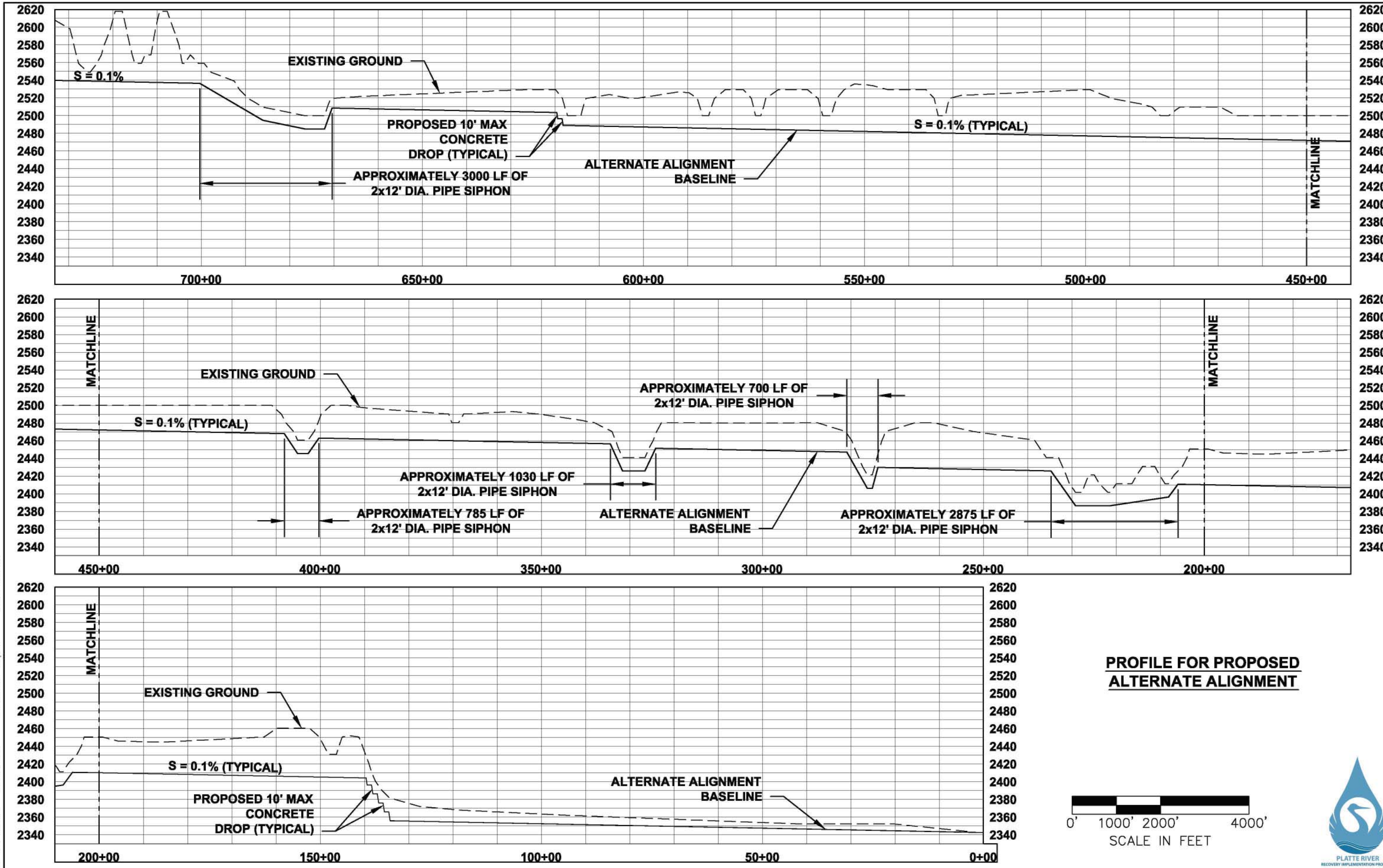
WMS PHASE II ALIGNMENT

0' 1000' 2000' 4000'
SCALE IN FEET

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

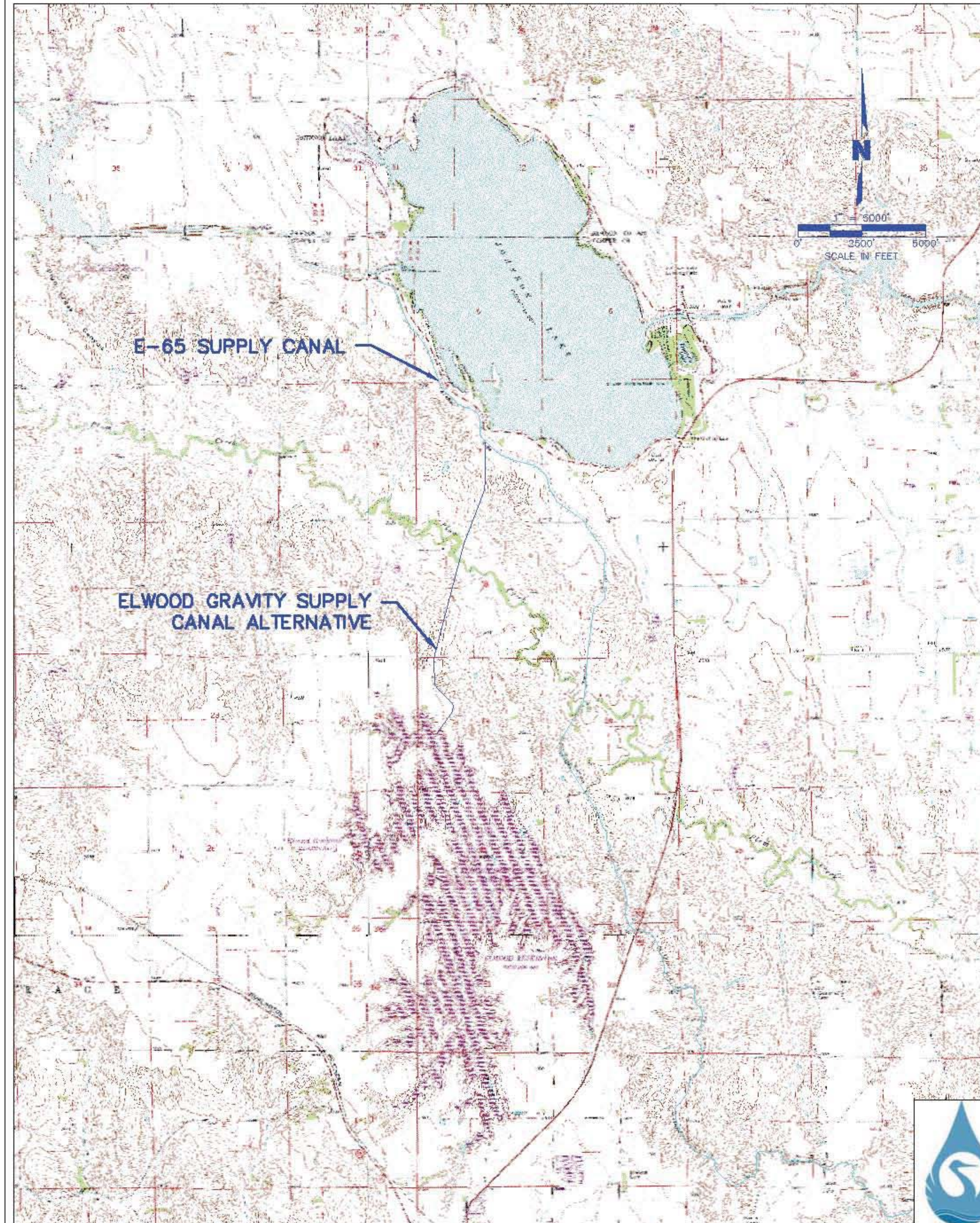
PROJECT: 09-1466 DRAWN BY: CAU DATE: 10.01.09	ELWOOD RESERVOIR SCREENING ALTERNATIVES GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	WMS PHASE II CANAL PROFILE	FIGURE 4.2

DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:48am XREFS: Topo Title Block



DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:55am XREFS: Topo Title Block

PROJECT: 09-1466 DRAWN BY: CAU DATE: 10.01.09	ELWOOD RESERVOIR SCREENING ALTERNATIVES GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	ALT. ALIGN. CANAL PROFILE	FIGURE 4.3

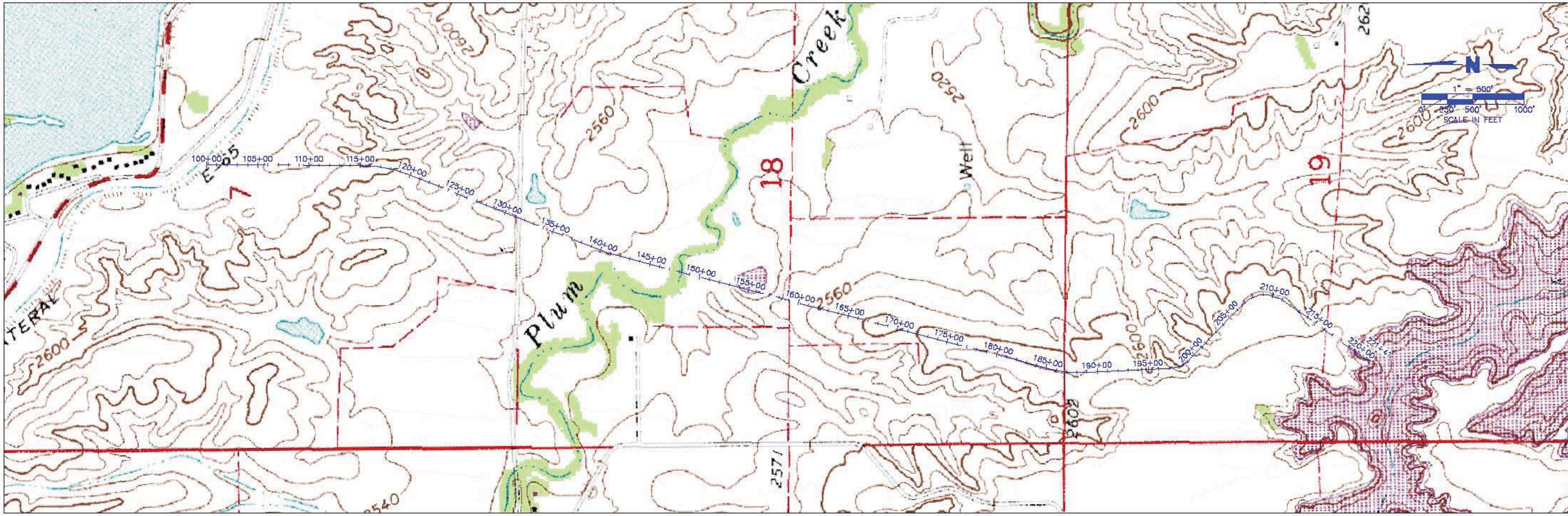


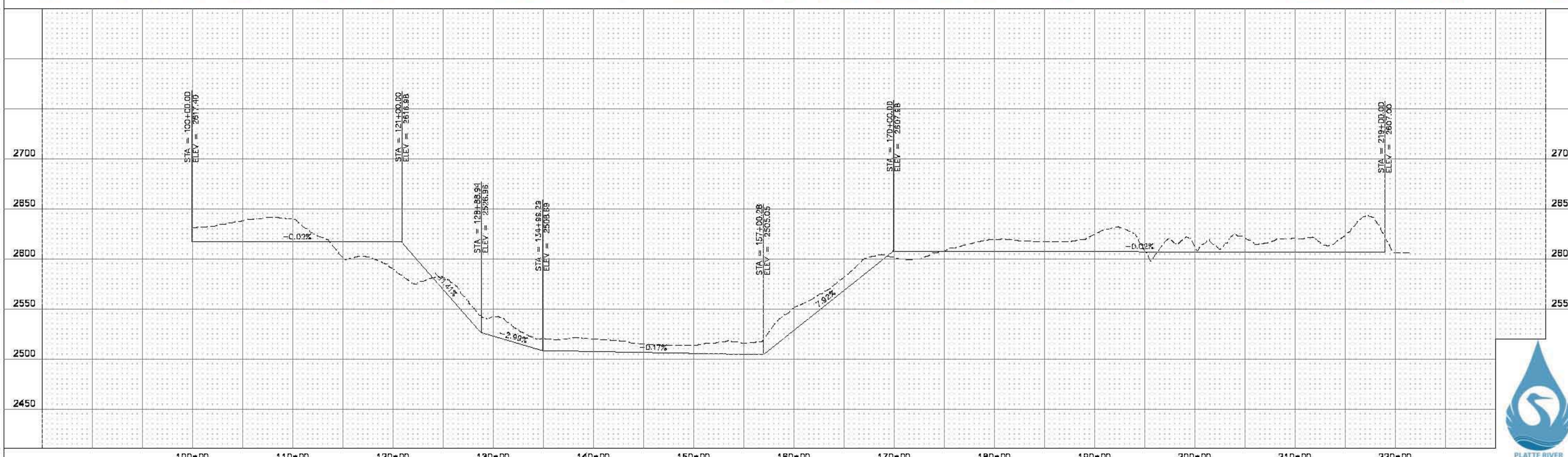
PROJECT NO:	009-1466
DRAWN BY:	TG
DATE:	10/01/09

ELWOOD GRAVITY SUPPLY &
E-65 CANAL ALIGNMENT

OLSSON ASSOCIATES

FIGURE 4.4

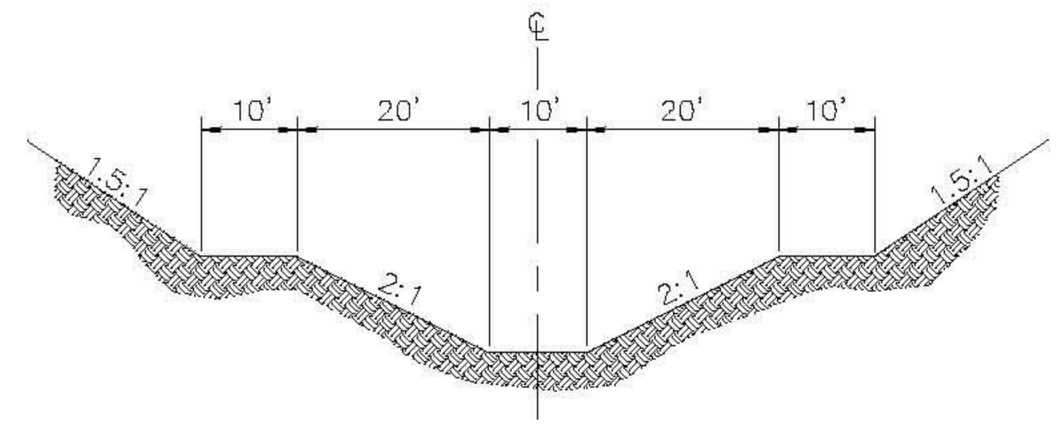




DWG: F:\Projects\009-1466_MUNI\Exhibits\PRRIP-Elwood-Canal.dwg USER: tgolka
DATE: Dec 21, 2009 9:56am XREFS: Johnson_Lake_QUAD TTLBLK-Elwood-22x34

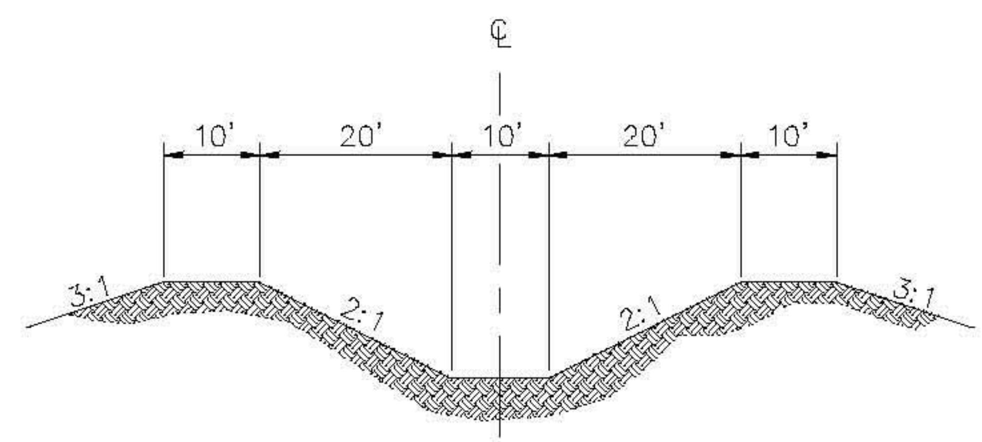
PROJECT: 09-1466 DRAWN BY: TAG DATE: 10/01/09	ELWOOD GRAVITY SUPPLY CANAL PLAN AND PROFILE	OLSSON ASSOCIATES	FIGURE 4.5

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM



ELWOOD SUPPLY CANAL
CUT SECTION

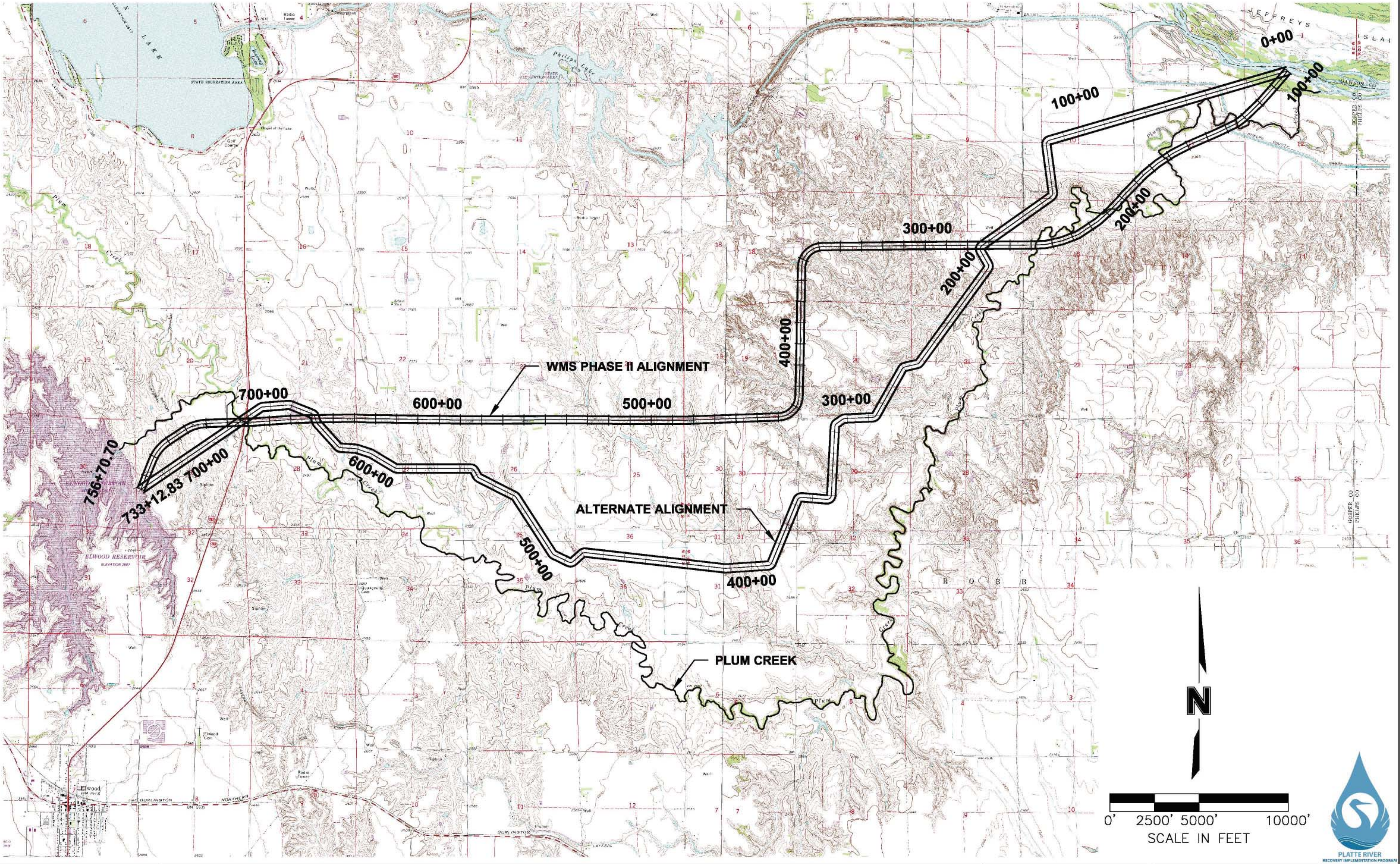
DEPTH OF CANAL 10'
NOT TO SCALE



ELWOOD SUPPLY CANAL
FILL SECTION

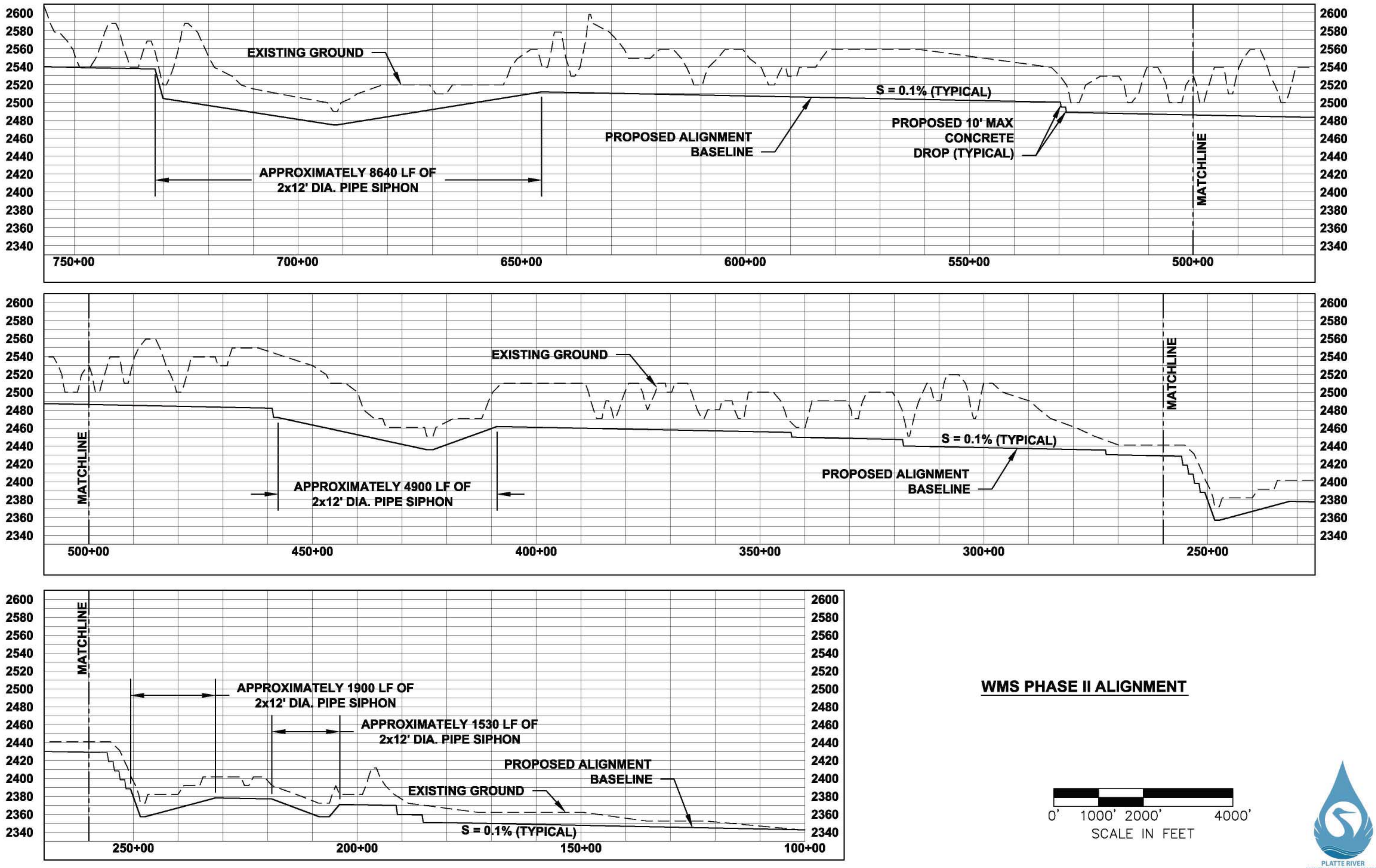
DEPTH OF CANAL 10'
NOT TO SCALE

PROJECT NO: 009-1466	ELWOOD SUPPLY CANAL TYPICAL SECTIONS	OLSSON ASSOCIATES	FIGURE
DRAWN BY: TG			4.6
DATE: 10/01/09			



PROJECT: 09-1466 DRAWN BY: CAU DATE: 10.01.09	ELWOOD RESERVOIR SCREENING ALTERNATIVES GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	CANAL ALIGNMENT ALTERNATIVES	FIGURE 4.7

DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:36am XREFS: Topo Title Block



PROJECT: 09-1466
DRAWN BY: CAU
DATE: 10.01.09

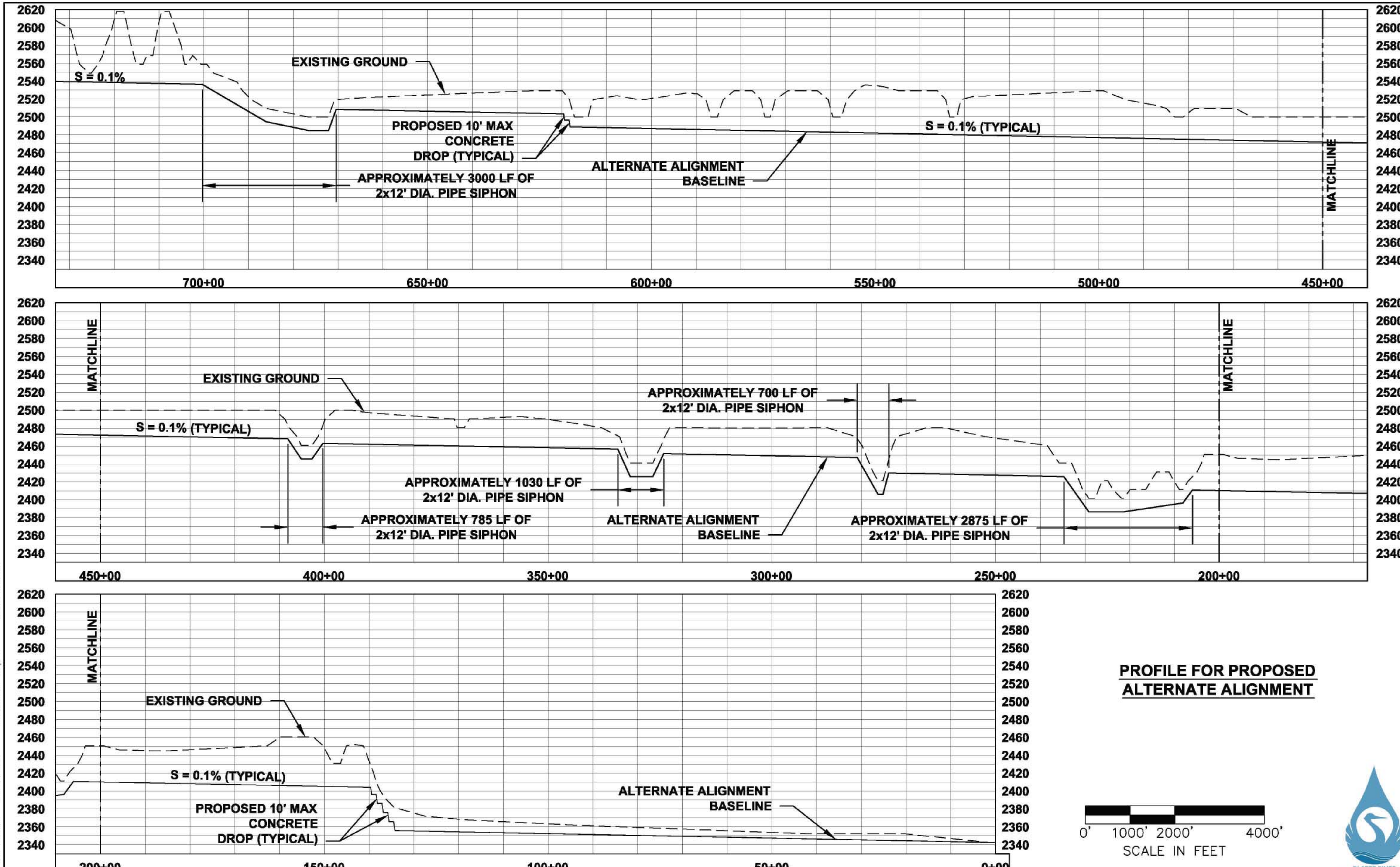
ELWOOD RESERVOIR SCREENING ALTERNATIVES
GOSPER COUNTY, NEBRASKA

OLSSON ASSOCIATES

WMS PHASE II CANAL PROFILE

FIGURE 4.8

DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:48am XREFS: Topo Title Block



PROFILE FOR PROPOSED ALTERNATE ALIGNMENT

0' 1000' 2000' 4000'
SCALE IN FEET

DWG: F:\Projects\009-1466_WTRS\091466-DB\dwg\Exhibits\Ditch Alignment Exhibit.DWG USER: cuhrich
DATE: Dec 21, 2009 10:55am XREFS: Topo Title Block

PROJECT: 09-1466	ELWOOD RESERVOIR SCREENING ALTERNATIVES GOSPER COUNTY, NEBRASKA	OLSSON ASSOCIATES	ALT. ALIGN. CANAL PROFILE	FIGURE 4.9
DRAWN BY: CAU				
DATE: 10.01.09				

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Appendix C

Scoring Matrix, Capital Costs and Operating Costs

Elwood and J-2 Alternatives Analysis Scoring

Alternative	Reservoir	Inlet	Outlet	Transmission	Criteria #	1	2	3	4	5	6	7	8	9	10	Weighted Total
					Criteria	Life Cycle Costs for 50-year life span	SDHF Augmentation	Ability to Reduce Shortages to Target Flows	Flexibility and Multiple Benefits	Ability to Permit (NEPA)	Impacts to Landowners / Other Facilities and Installations	Portion of the Reach Positively Impacted by Water Delivery	Opportunities for Partnering	Implementation time	Hydropower Flow Cycling Mitigation	
					Weight	10	10	8	5	10	8	10	5	10	6	
J -2 Alt 1	J-2 south channel option	J-2 Canal	Radial Gates	n/a	Description	Life cycle costs will be on the order of $34 per ac-ft	This alternative can only deliver an average of 350 cfs	Target flow shortage reduction will amount to 14,660 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Impoundment of the south channel of the Platte River could be most difficult to permit. Likely individual permit.	No impacts to landowners, completely contained in south channel	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 99%	
					Score	4	0	3	3	1	5	5	5	3	5	264
J -2 Alt 2, Area 1	J-2 Excavation Area 1	Phelps Canal	Radial Gates	n/a	Description	Life cycle costs will be on the order of $16 per ac-ft	This alternative can only deliver 1,667 cfs	Target flow shortage reduction will amount to 33,668 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Off-line excavation should be relatively easy to permit, likely to require 404 nationwide permit.	One landowner affected	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 59%	
					Score	5	3	5	3	5	5	5	5	3	1	336
J -2 Alt 2, Area 2	J-2 Excavation Area 2	Phelps Canal+ pumps	Radial Gates	n/a	Description	Life cycle costs will be on the order of $16 per ac-ft	This alternative can only deliver 1,333 cfs	Reduction of shortages to target flows of 24,974 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Impacts to Plum Creek make this location more difficult to permit, likely require 404 individual permit.	Three landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 59%	
					Score	5	3	5	3	2	4	5	5	3	1	298
J -2 Alt 2, Area 3	J-2 Excavation Area 3	J-2 Return	Radial Gates	n/a	Description	Life cycle costs will be on the order of $46 per ac-ft	This alternative can only deliver 667 cfs	Reduction of shortages to target flows of 20,341 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Apparent impacts to smaller streams. May need 404 nationwide or individual permit.	Four landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 99%	
					Score	3	0	5	3	4	4	5	5	3	5	292
J -2 Alt 2, Area 4	J-2 excavation Area 4	J-2 Return	Radial Gates	n/a	Description	Life cycle costs will be on the order of $80 per ac-ft	This alternative can only deliver 667 cfs	Reduction of shortages to target flows of 24,268 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Apparent impacts to smaller streams. May need 404 nationwide or individual permit.	Four landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 59%	
					Score	2	0	5	3	4	4	5	5	3	1	258
J -2 Alt 2, Area 1 & 2	J-2 excavation Areas 1&2	Phelps Canal	Radial Gates	n/a	Description	Life cycle costs will be on the order of $19 per ac-ft	This alternative can deliver 2,000 cfs	Reduction of shortages to target flows of 47,480 acre-feet per year	Sediment delivery will not be extensive, fisheries are a possibility, and there are benefits to CNPPID	Impacts to Plum Creek make this location more difficult to permit, likely will need 404 individual permit.	Four landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 99%	
					Score	4	5	5	3	2	4	5	5	3	5	332
J -2, Alt 3	9.7 Canal Reservoir	9.7 Canal	Radial Gates	n/a	Description	Life cycle costs will be on the order of $23 per ac-ft	This alternative can only deliver 279 cfs	Reduction of shortages to target flows of 8,298 acre-feet per year	Sediment delivery will be minimal, fisheries are a possibility, and there are benefits to CNPPID	Impoundment of a drainage would require 404 individual permit, may make permitting difficult.	Two landowners affected	Water will be delivered to 80% of the reach.	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 83%	
					Score	4	0	2	3	2	4	4	5	3	4	242

Elwood and J-2 Alternatives Analysis Scoring

Alternative	Reservoir	Inlet	Outlet	Transmission	Criteria #	1	2	3	4	5	6	7	8	9	10	Weighted Total
					Criteria	Life Cycle Costs for 50-year life span	SDHF Augmentation	Ability to Reduce Shortages to Target Flows	Flexibility and Multiple Benefits	Ability to Permit (NEPA)	Impacts to Landowners / Other Facilities and Installations	Portion of the Reach Positively Impacted by Water Delivery	Opportunities for Partnering	Implementation time	Hydropower Flow Cycling Mitigation	
					Weight	10	10	8	5	10	8	10	5	10	6	
E-1	Elwood buttress	Gravity Canal	Tunnels	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $80 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 19,408 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	Three landowners impacted for gravity canal	Water will be delivered to the entire reach	CNPPID, and perhaps Fish and Wildlife, will likely be interested in partnering	Construction could be finished by as early as 2012	No hydropower flow cycling mitigation	
					Score	2	5	4	5	3	4	5	5	3	0	294
E-2	Elwood remove & replace embankment	Gravity Canal	Open cut 2 pipes	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $84 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 19,408 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	Three landowners impacted for gravity canal	Water will be delivered to the entire reach	CNPPID, and perhaps USFWS, will likely be interested in partnering	Construction could be finished by as early as 2012	No hydropower flow cycling mitigation	
					Score	1	5	4	5	3	4	5	5	3	0	284
E-3	Elwood remove & replace upstream shell	Gravity Canal	2-8' Tunnels	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $84 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 19,408 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	3 landowners impacted for gravity canal	Water will be delivered to the entire reach	CNPPID, and perhaps USFWS, will likely be interested in partnering	Construction could be finished by as early as 2012	No hydropower flow cycling mitigation	
					Score	1	5	4	5	3	4	5	5	3	0	284
E-4	Elwood buttress	Existing E-65 Canal	2-8' Tunnels	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $67 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 17,788 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	No landowner impacts	Water will be delivered to the entire reach	USFWS will likely be interested in partnering	Construction could be finished by as early as 2012	No hydropower flow cycling mitigation	
					Score	2	5	4	5	3	5	5	3	3	0	292
E-5	Elwood remove & replace embankment	Existing E-65 Canal	Open cut 2 pipes	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $70 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 17,788 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	No landowner impacts	Water will be delivered to the entire reach	USFWS will likely be interested in partnering	Construction could be finished by as early as 2012	No hydropower flow cycling mitigation	
					Score	2	5	4	5	3	5	5	3	3	0	292
E-6	Elwood remove & replace upstream shell	Existing E-65 Canal	2-8' Tunnels	Plum Creek, 2,400 cfs	Description	Life cycle costs will be on the order of $70 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 17,788 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Some impacts to Plum Creek. Depending on impacts, may need 404 individual permit.	No landowner impacts	Water will be delivered to the entire reach	USFWS will likely be interested in partnering	Construction could be finished by as early as 2012	No Hydropower flow cycling mitigation	
					Score	2	5	4	5	3	5	5	3	3	0	292
E/J-2 Alt 2, Area 1	Elwood buttress, J-2 excavation, Area 1 modified	Gravity Canal	Tunnels (1 only)	Plum Creek, 1,200 cfs	Description	Life cycle costs will be on the order of $33 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 33,668 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Less impacts to Plum Creek. May need either 404 nationwide or individual permit.	One landowner in J2 area 1, three landowners for Elwood gravity canal; total of four landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps USFWS, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 83%	
					Score	4	5	5	4	4	4	5	5	3	4	351
E/J-2 Alt 2, Area 2	Elwood buttress, J-2 excavation, Area 2	Gravity Canal	Tunnels (1 only)	Plum Creek, 1,200 cfs	Description	Life cycle costs will be on the order of $37 per ac-ft	This alternative will deliver 2,000 cfs to Overton	Reduction of shortages to target flows of 24,974 acre-feet per year	Sediment delivery will be good, fisheries will be supported, and there are benefits to CNPPID	Less impacts to Plum Creek. May need either 404 nationwide or individual permit.	Three landowners in J2 area 2,three landowners for Elwood gravity canal; total of six landowners affected	Water will be delivered to the entire reach	CNPPID, and perhaps USFWS, will likely be interested in partnering	Construction could be finished by as early as 2012	Hydropower flow cycling can be mitigated effectively to 83%	
					Score	4	5	5	3	4	2	5	5	3	4	330

Elwood and J-2 Alternatives Analysis Capital and Operating Costs

Alternative	Reservoir[1]	Inlet Costs ($000)	Outlet Costs ($000)	Conveyance Costs ($000)	Capital Costs[2] ($000)	Operating Costs (50-yr $000)	Total Costs ($000)	SDHF Augmentation cfs	SDHF Augmentation ac-ft/yr[3]	Reductions to Shortages to Target Flows, Normal Year, ac-ft/yr[4]	Delivered Total, ac-ft/yr	Delivered Total, ac-ft (50 yr)[5]	Life Cycle Cost per ac-ft	Capital Cost per ac-ft SDHF	Capital Cost per ac-ft Target	Capital Cost per ac-ft Total
J -2 Alt 1	J-2 south channel option $11,452	J-2 Canal $0	Radial Gates $6,008	n/a	$17,460	$10,913	$28,373	350	1,825	14,660	16,485	824,250	$34	$9,567	$1,191	$1,059
J -2 Alt 2, Area 1	Area 1 $23,208	Phelps Canal $310	Radial Gates $688	n/a	$24,206	$9,077	$33,283	1,489	8,860	33,668	42,528	2,126,408	$16	$2,732	$719	$569
J -2 Alt 2, Area 2	Area 2 $15,043	Phelps Canal+ pumps $2,115	Radial Gates $325	n/a	$17,483	$7,606	$25,089	1,129	6,580	24,974	31,554	1,577,700	$16	$2,657	$700	$554
J -2 Alt 2, Area 3	Area 3 $39,719	J-2 Return $465	Radial Gates $340	n/a	$40,541	$16,550	$57,091	774	4,516	20,341	24,857	1,242,850	$46	$8,977	$1,993	$1,631
J -2 Alt 2, Area 4	Area 4 $83,102	J-2 Return $465	Radial Gates $310	n/a	$83,877	$34,040	$117,917	905	5,387	24,268	29,655	1,482,750	$80	$15,570	$3,456	$2,828
J -2 Alt 2, Area 1 & 2	Areas 1&2 $38,251	Phelps Canal $775	Radial Gates $1,013	n/a	$40,039	$16,064	$56,103	2,000	11,901	47,480	59,381	2,969,041	$19	$3,364	$843	$674
J -2, Alt 3	9.7 Canal Reservoir $5,392	9.7 Canal $310	Radial Gates $357	n/a	$6,059	$5,302	$11,361	279	1,659	8,298	9,957	497,850	$23	$3,652	$730	$609
E-1	Elwood buttress $2,797	Gravity Canal $6,265	Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$42,942	$34,495	$77,437	2,000	11,901	19,408	19,408	970,400	$80	$3,608	$2,213	$2,213
E-2	Elwood remove & replace embankment $9,453	Gravity Canal $6,265	Open cut 2 pipes $8,353	Plum Creek, 2,400 cfs $21,373	$45,444	$36,059	$81,503	2,000	11,901	19,408	19,408	970,400	$84	$3,819	$2,342	$2,342
E-3	Elwood remove & replace upstream shell $5,377	Gravity Canal $6,265	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$45,522	$36,108	$81,630	2,000	11,901	19,408	19,408	970,400	$84	$3,825	$2,346	$2,346
E-4	Elwood buttress $2,797	Existing E-65 Canal $0	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$36,677	$22,471	$59,148	2,000	11,901	17,788	17,788	889,400	$67	$3,082	$2,062	$2,062
E-5	Elwood remove & replace embankment $9,453	Existing E-65 Canal $0	Open cut 2 pipes $8,353	Plum Creek, 2,400 cfs $21,373	$39,179	$23,409	$62,588	2,000	11,901	17,788	17,788	889,400	$70	$3,292	$2,203	$2,203
E-6	Elwood remove & replace upstream shell $5,377	Existing E-65 Canal $0	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$39,257	$22,939	$62,196	2,000	11,901	17,788	17,788	889,400	$70	$3,299	$2,207	$2,207
E/J-2 Alt 2, Area 1	Elwood buttress, J-2 excavation, Area 1 modified $22,605	Gravity Canal $6,265	Tunnels (1 only) $7,504	Plum Creek, 1,200 cfs $15,252	$51,626	$22,869	$74,495	2,000	11,901	33,668	45,569	2,278,441	$33	$4,338	$1,533	$1,133
E/J-2 Alt 2, Area 2	Elwood buttress, J-2 excavation, Area 2 $17,840	Gravity Canal $6,265	Tunnels (1 only) $7,504	Plum Creek, 1,200 cfs $15,252	$46,861	$21,082	$67,943	2,000	11,901	24,974	36,875	1,843,741	$37	$3,938	$1,876	$1,271

Notes: [1]Base cost of reservoir (total estimated project cost without inlet, outlet, and conveyance costs). For Elwood, the cost represents improvements to the embankment.

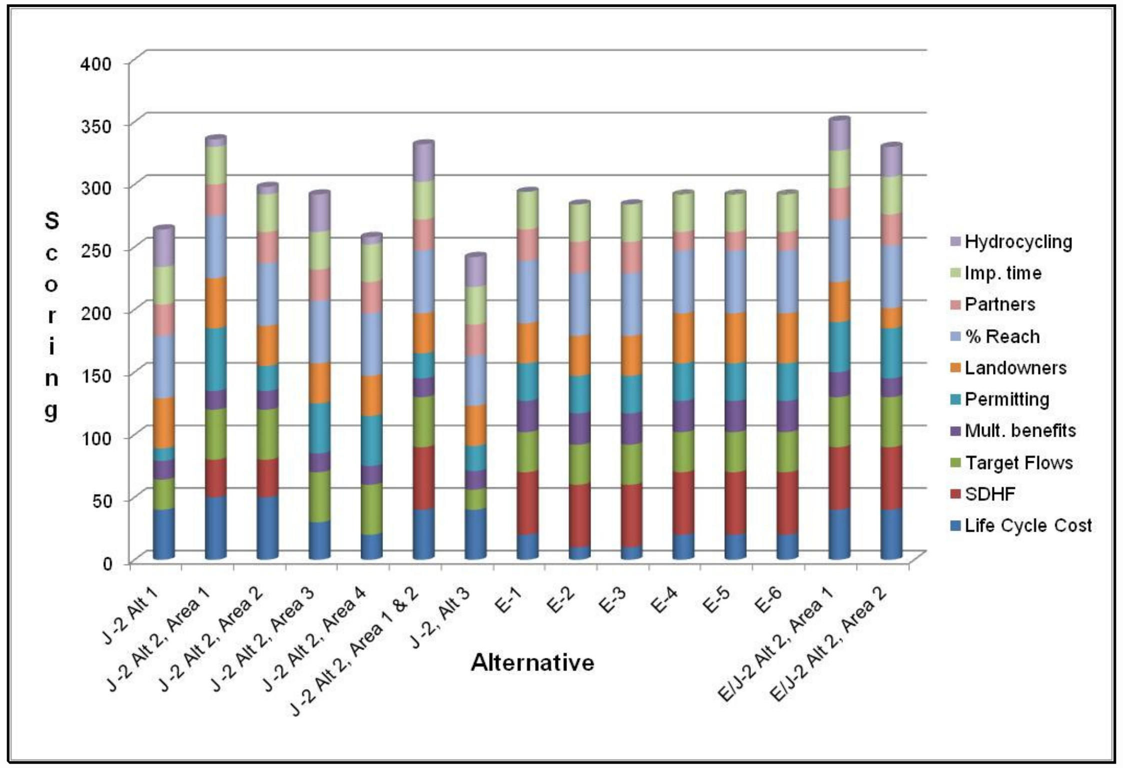
[2]Total estimated project cost including base reservoir cost, inlet, outlet, and conveyance costs (sum of preceding columns)

[3]Water to augment SDHF can be either environmental account (EA) water routed down Lake McConaughy and staged in the reservoir or excess flows captured and stored in reservoirs immediately before a SDHF if available. Though the units are ac-ft per year, the values presented are the total volume of SDHF augmentation flows provided by the alternative over three days.

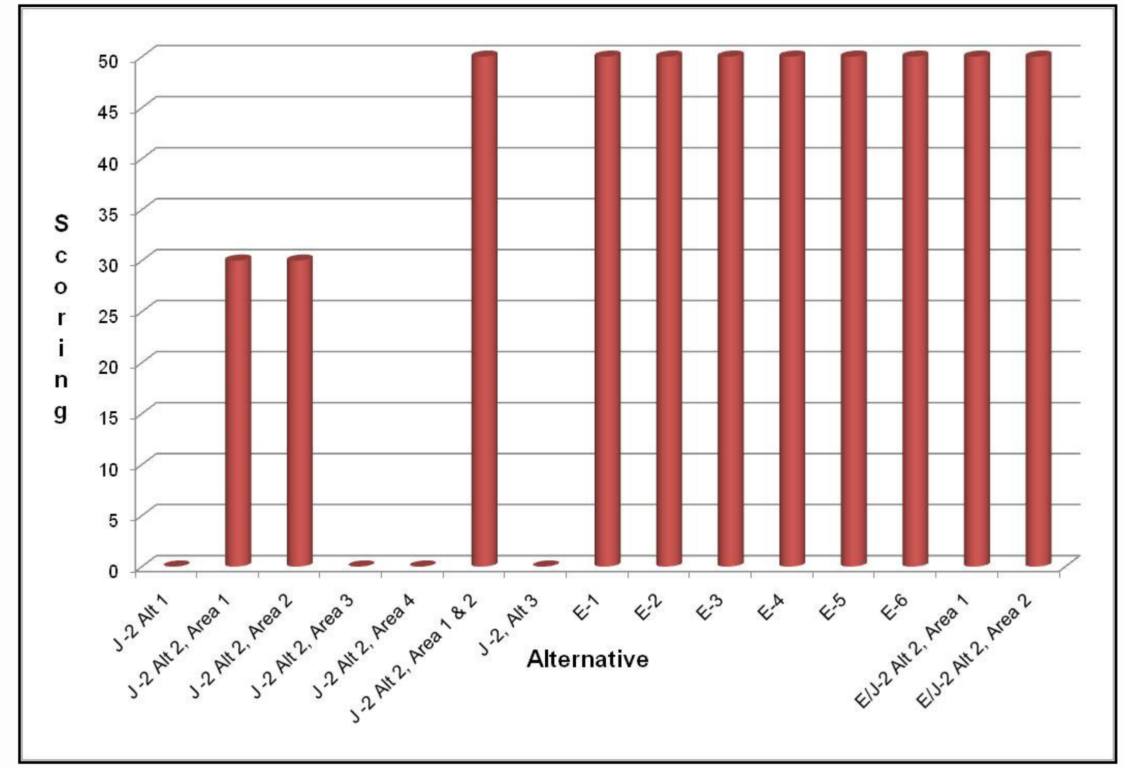
[4]Water to reduce shortages to target flows is excess flows in CNPPID's system that could between stored during times of excess, and released during periods of shortage. Elwood Reservoir use is outside of the time period when CNPPID requires use and is above the target operating curve.

[5]SDHF Augmentation plus Reductions to Shortages to Target Flows, Normal Year

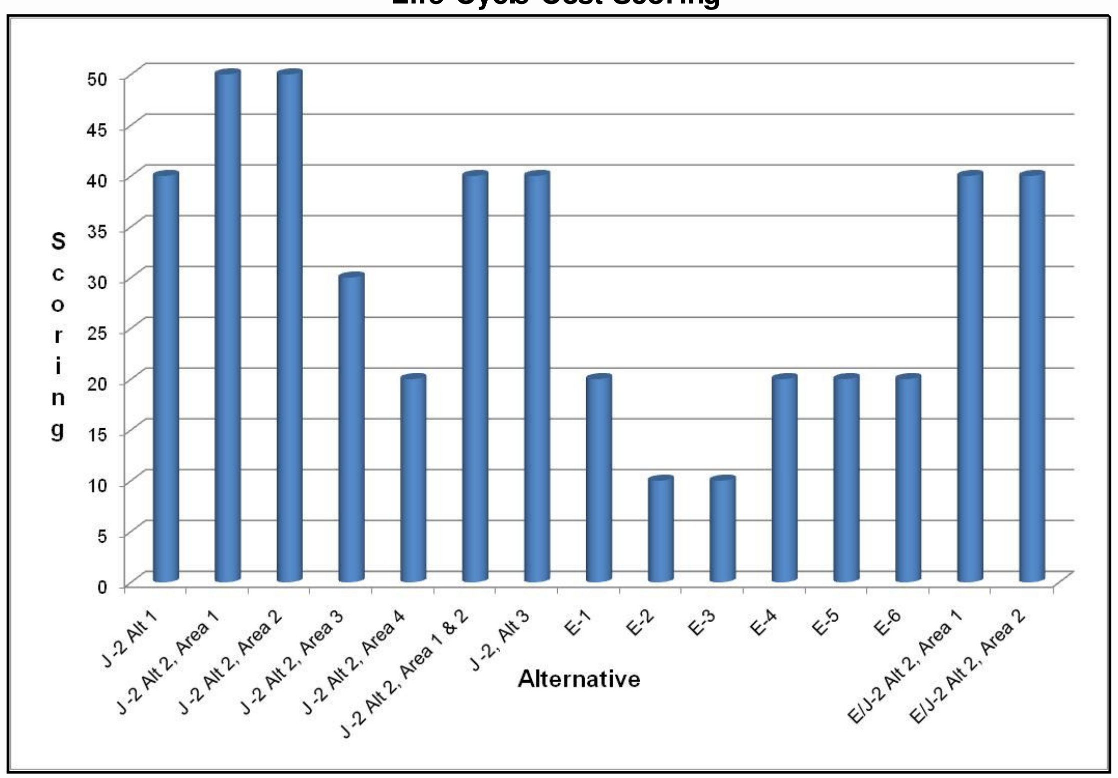
Total Scoring



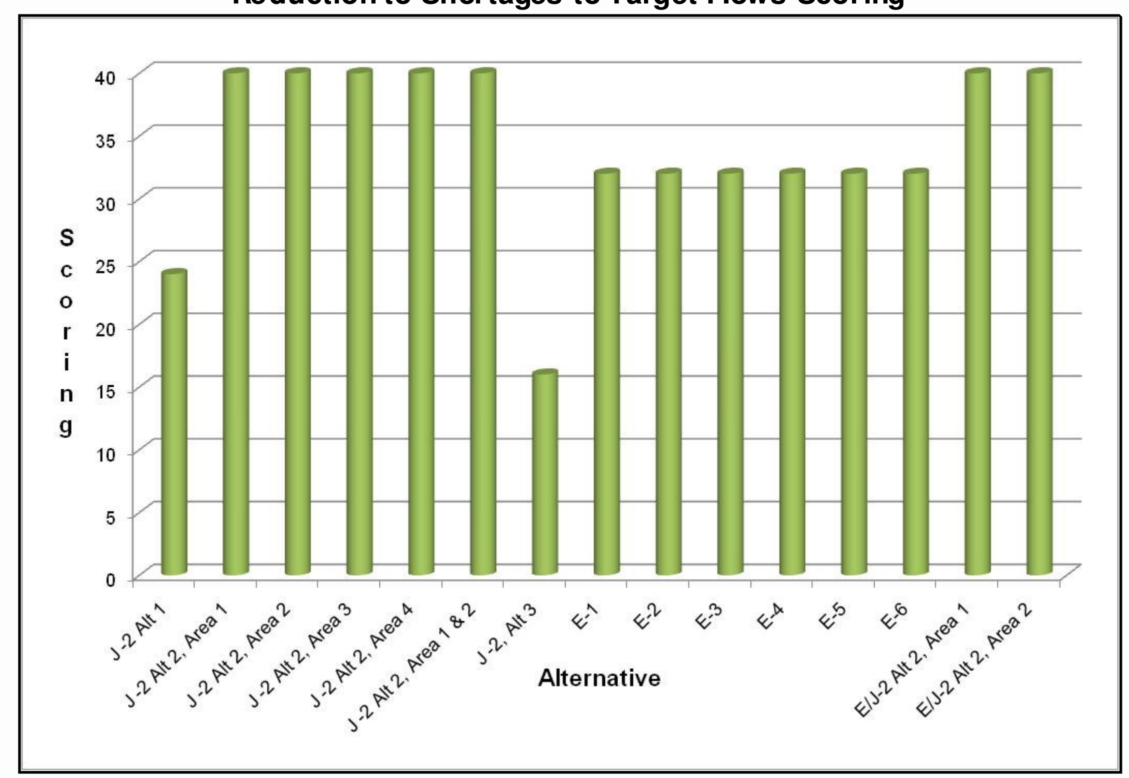
SDHF Augmentation Scoring



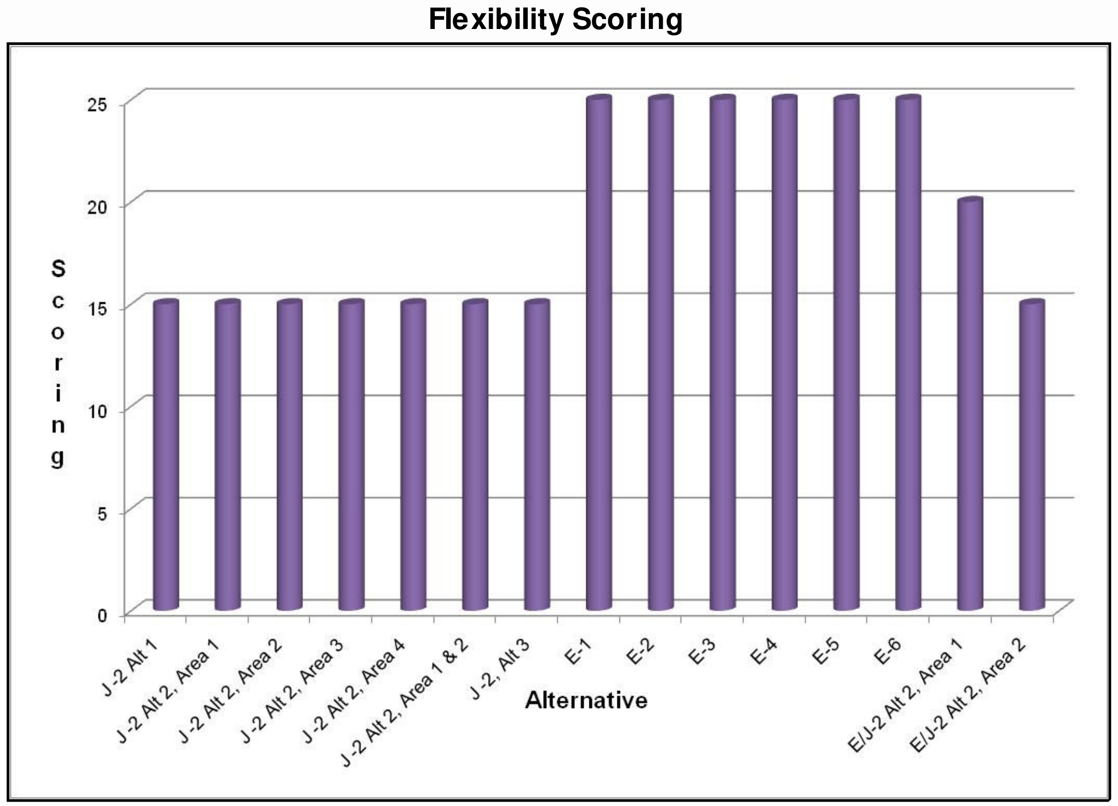
Life Cycle Cost Scoring

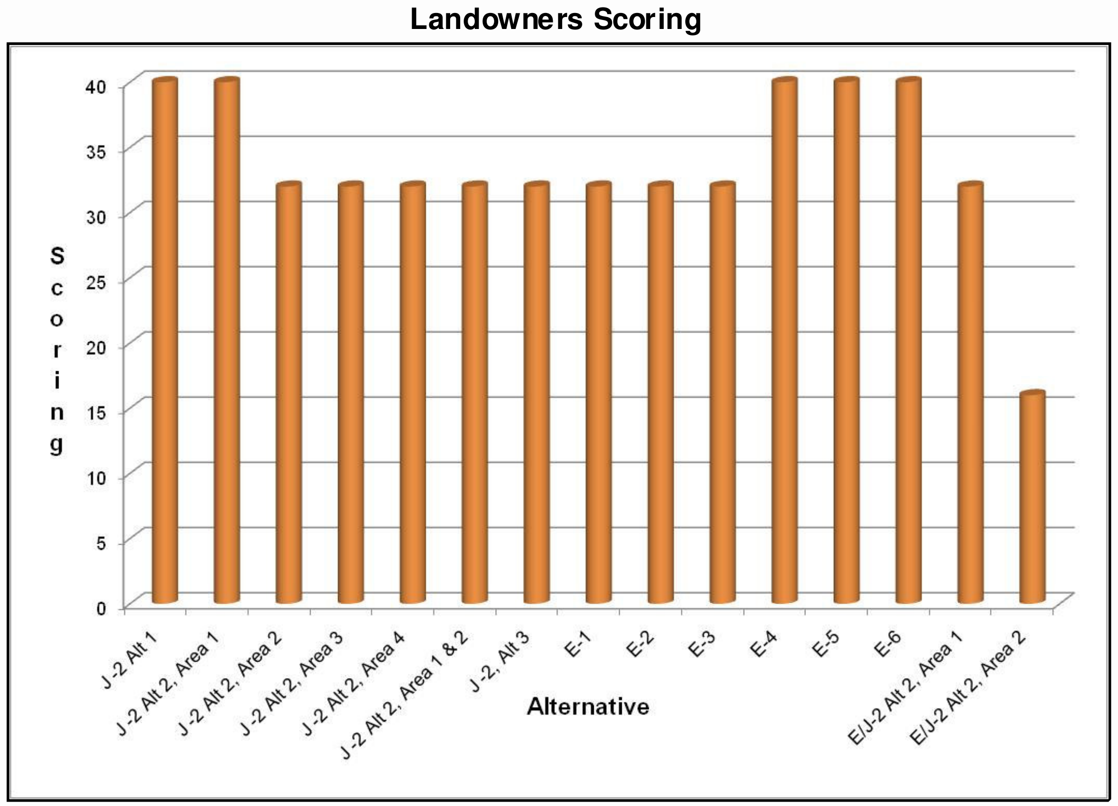


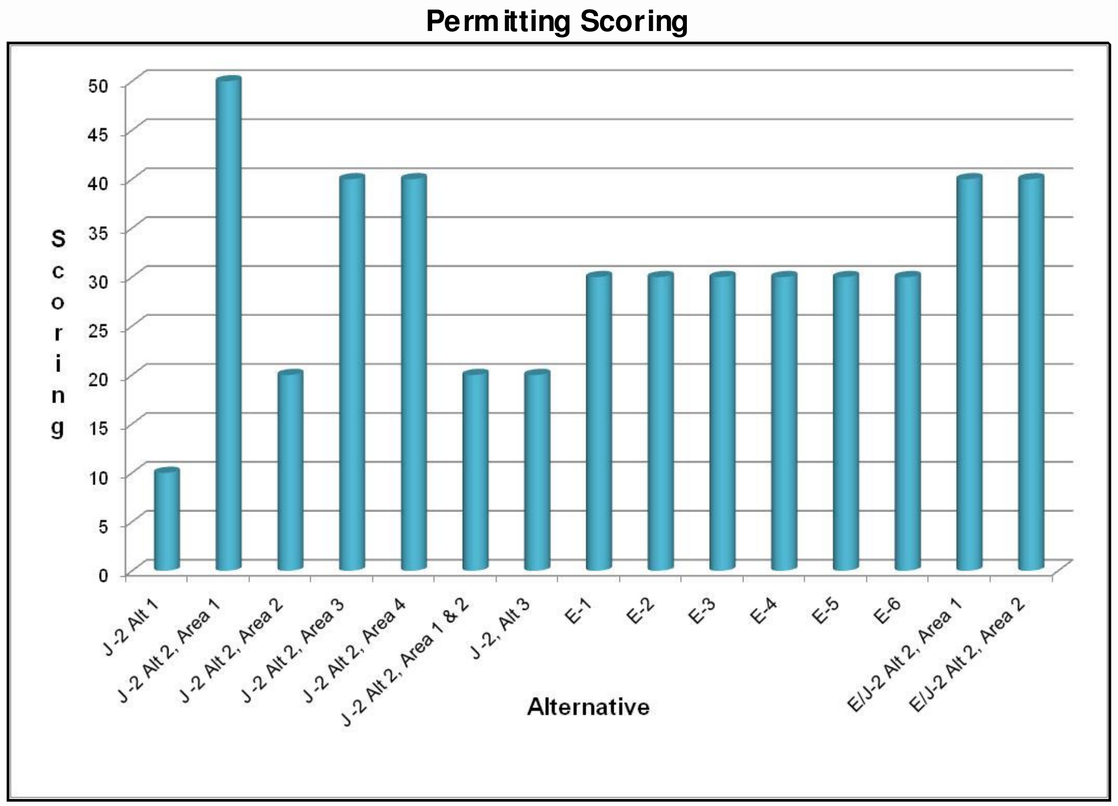
Reduction to Shortages to Target Flows Scoring

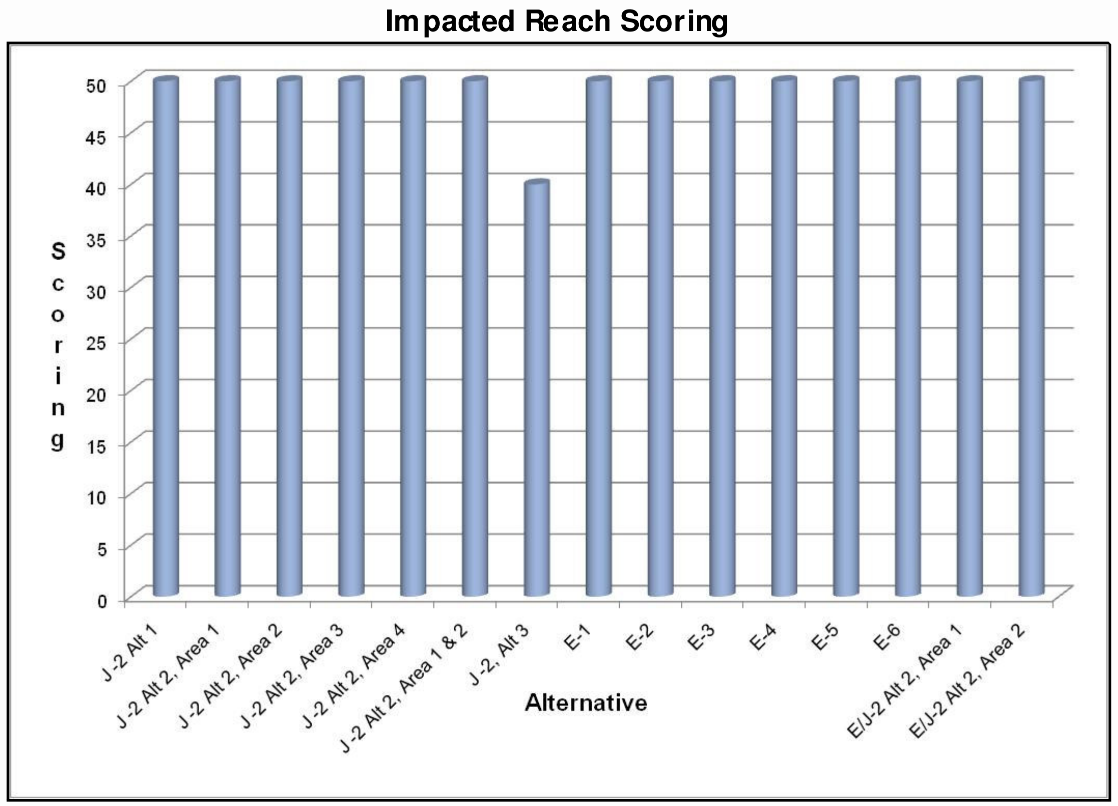


BLACK & VEATCH
OLSSON ASSOCIATES

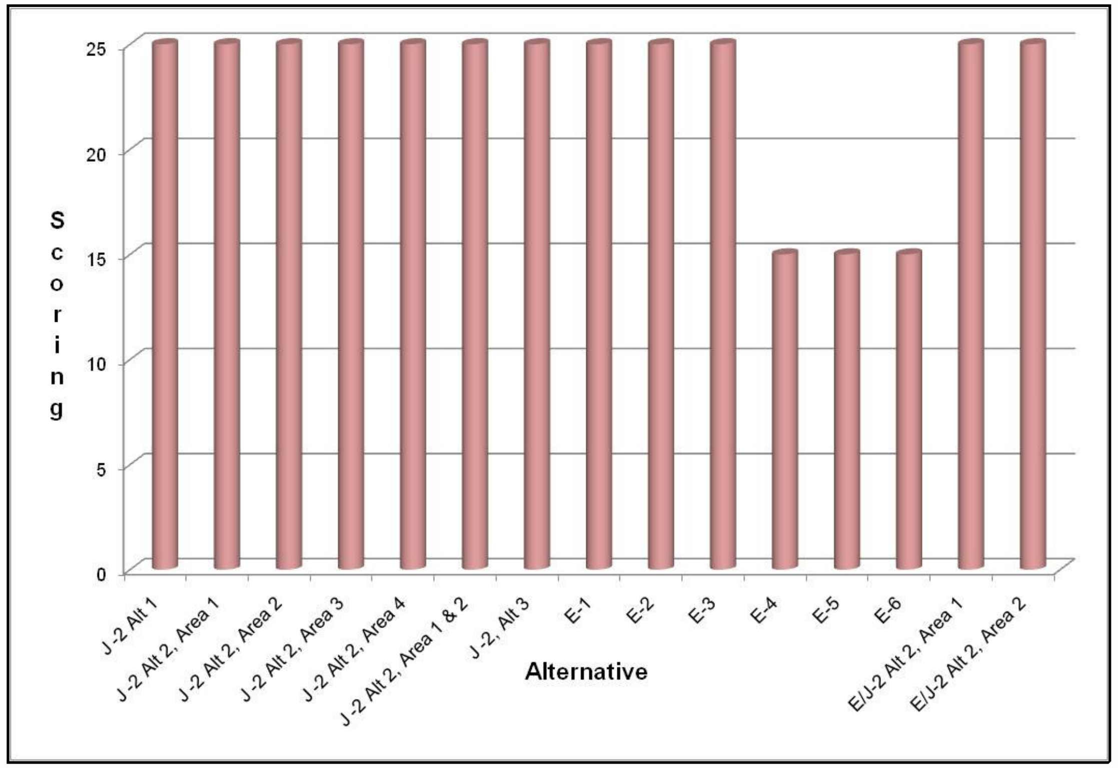

Flexibility Scoring
Scoring
Alternative
J-2 Alt 1
J-2 Alt 2, Area 1
J-2 Alt 2, Area 2
J-2 Alt 2, Area 3
J-2 Alt 2, Area 4
J-2 Alt 2, Area 1 & 2
J-2, Alt 3
E-1
E-2
E-3
E-4
E-5
E-6
E/J-2 Alt 2, Area 1
E/J-2 Alt 2, Area 2


Landowners Scoring
Scoring
Alternative
J-2 Alt 1
J-2 Alt 2, Area 1
J-2 Alt 2, Area 2
J-2 Alt 2, Area 3
J-2 Alt 2, Area 4
J-2 Alt 2, Area 1 & 2
J-2, Alt 3
E-1
E-2
E-3
E-4
E-5
E-6
E/J-2 Alt 2, Area 1
E/J-2 Alt 2, Area 2

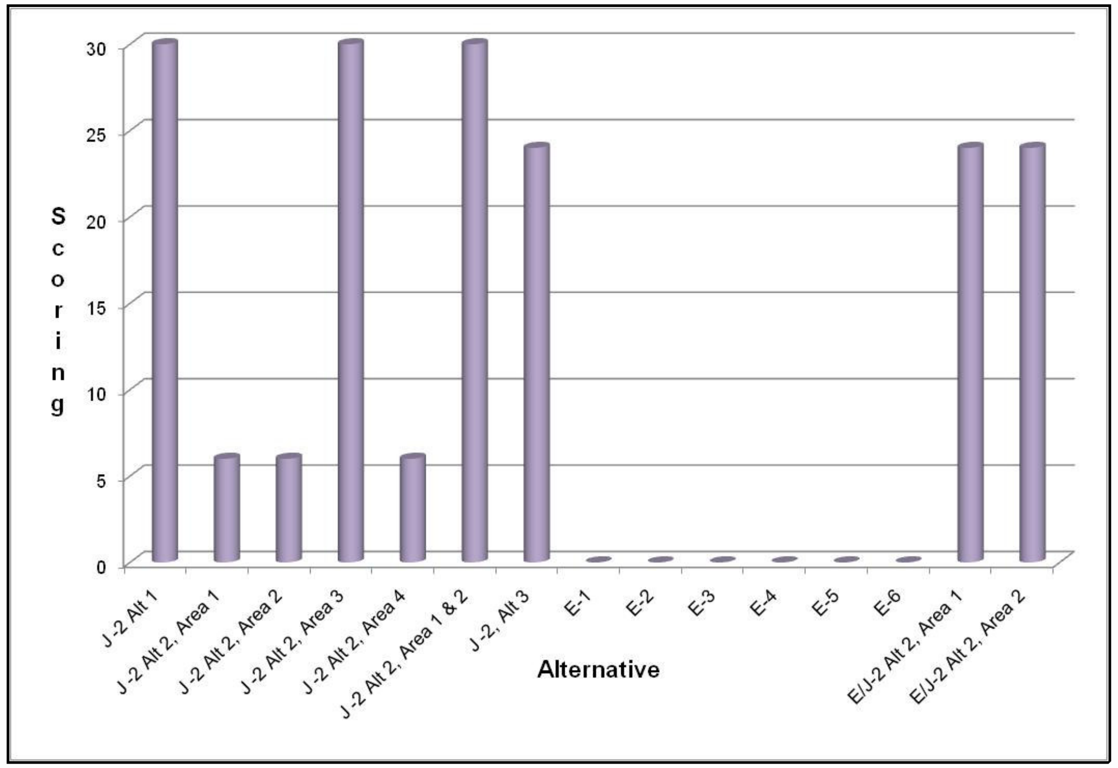

Permitting Scoring
Scoring
Alternative
J-2 Alt 1
J-2 Alt 2, Area 1
J-2 Alt 2, Area 2
J-2 Alt 2, Area 3
J-2 Alt 2, Area 4
J-2 Alt 2, Area 1 & 2
J-2, Alt 3
E-1
E-2
E-3
E-4
E-5
E-6
E/J-2 Alt 2, Area 1
E/J-2 Alt 2, Area 2


Impacted Reach Scoring
Scoring
Alternative
J-2 Alt 1
J-2 Alt 2, Area 1
J-2 Alt 2, Area 2
J-2 Alt 2, Area 3
J-2 Alt 2, Area 4
J-2 Alt 2, Area 1 & 2
J-2, Alt 3
E-1
E-2
E-3
E-4
E-5
E-6
E/J-2 Alt 2, Area 1
E/J-2 Alt 2, Area 2

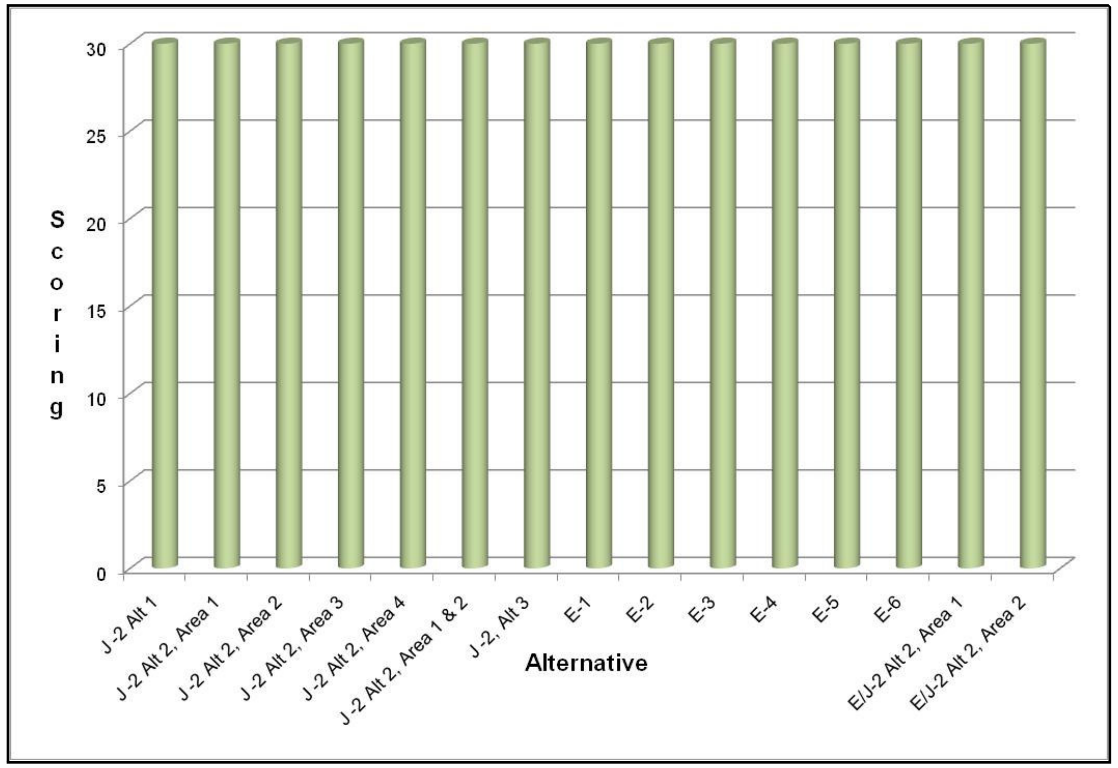
Partnering Opportunity Scoring



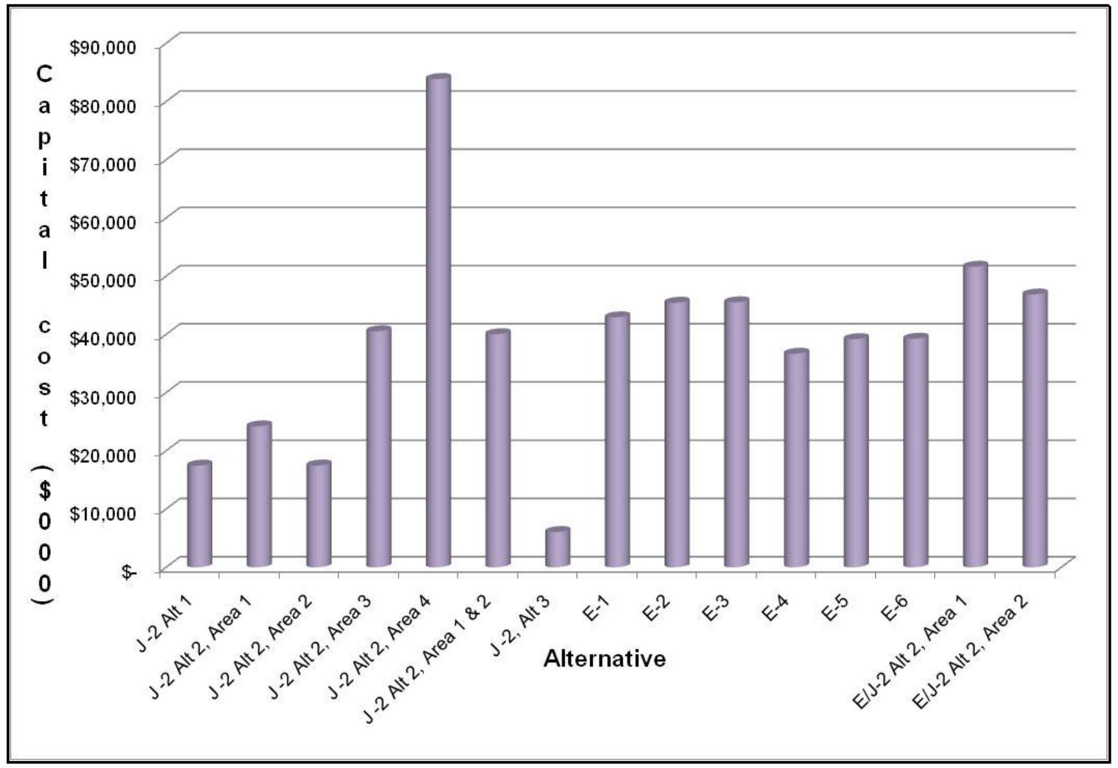
Hydropower Flow Cycling Mitigation Scoring



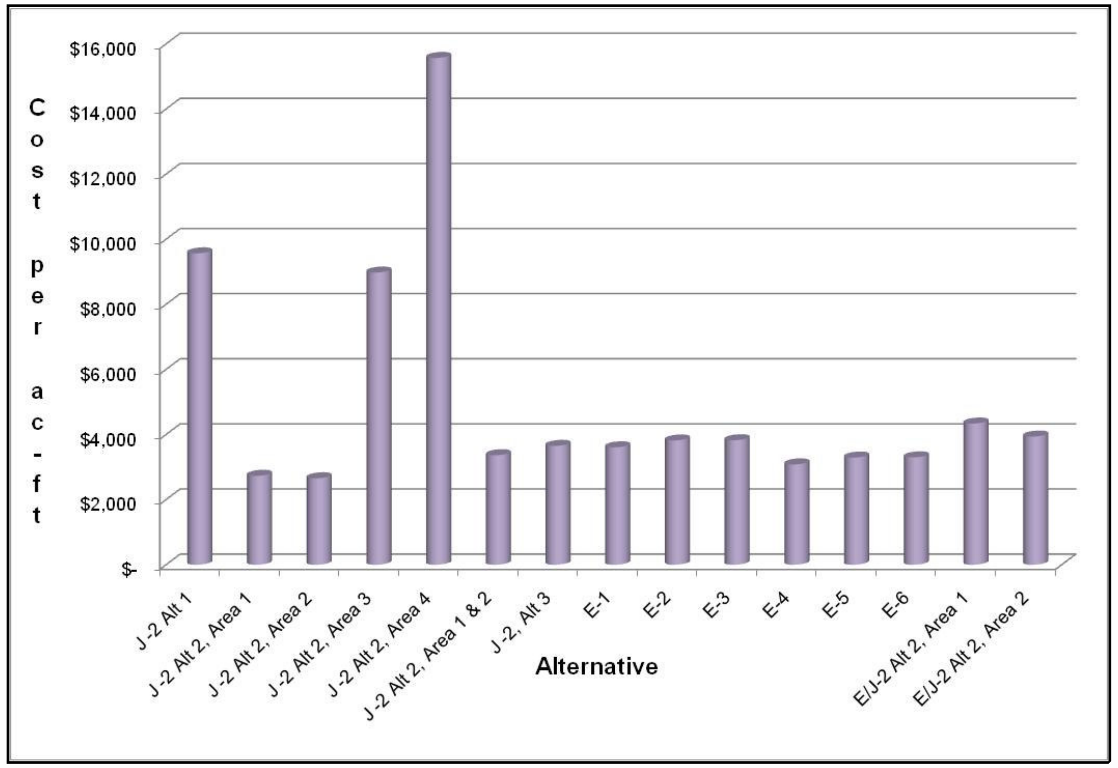
Implementation Time Scoring



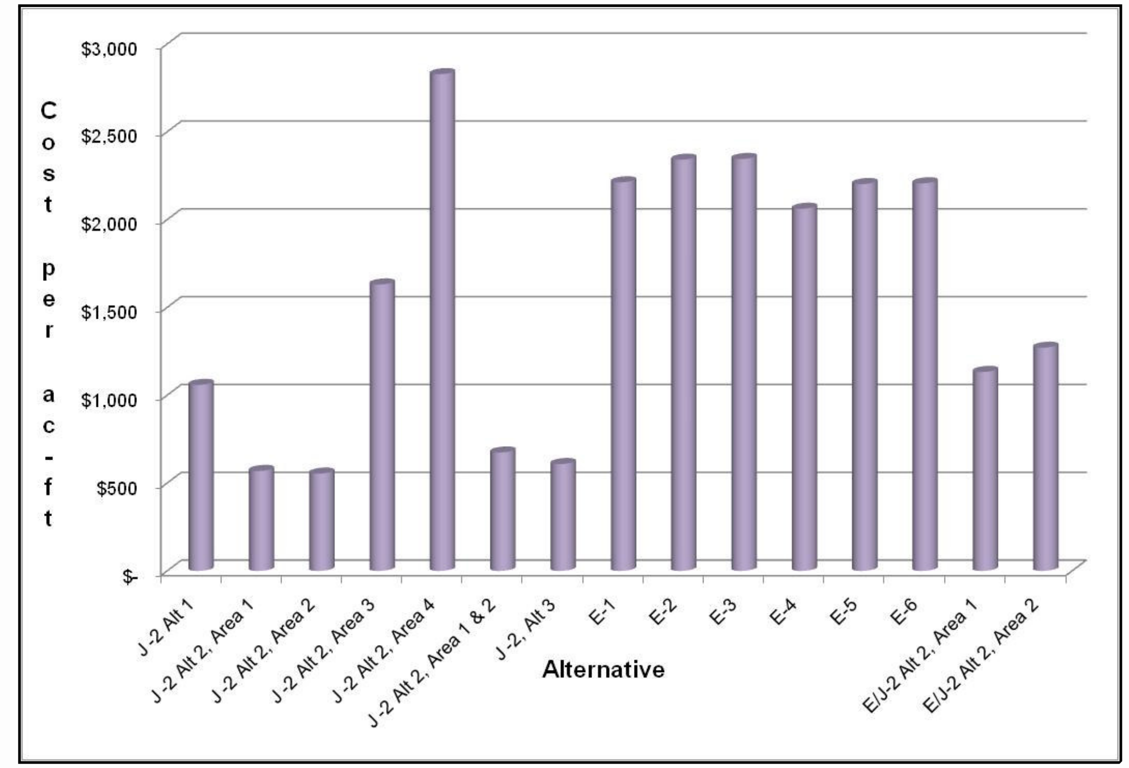
Total Capital Costs



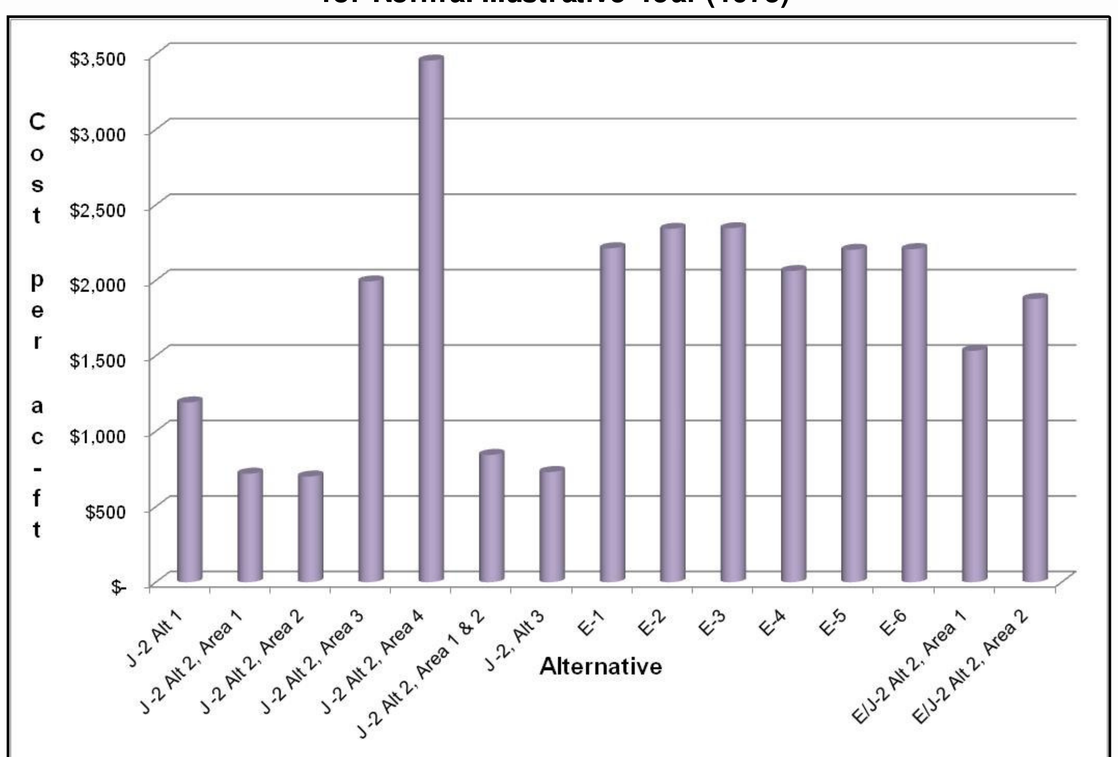
Capital Costs per SDHF Augmentation Acre-feet



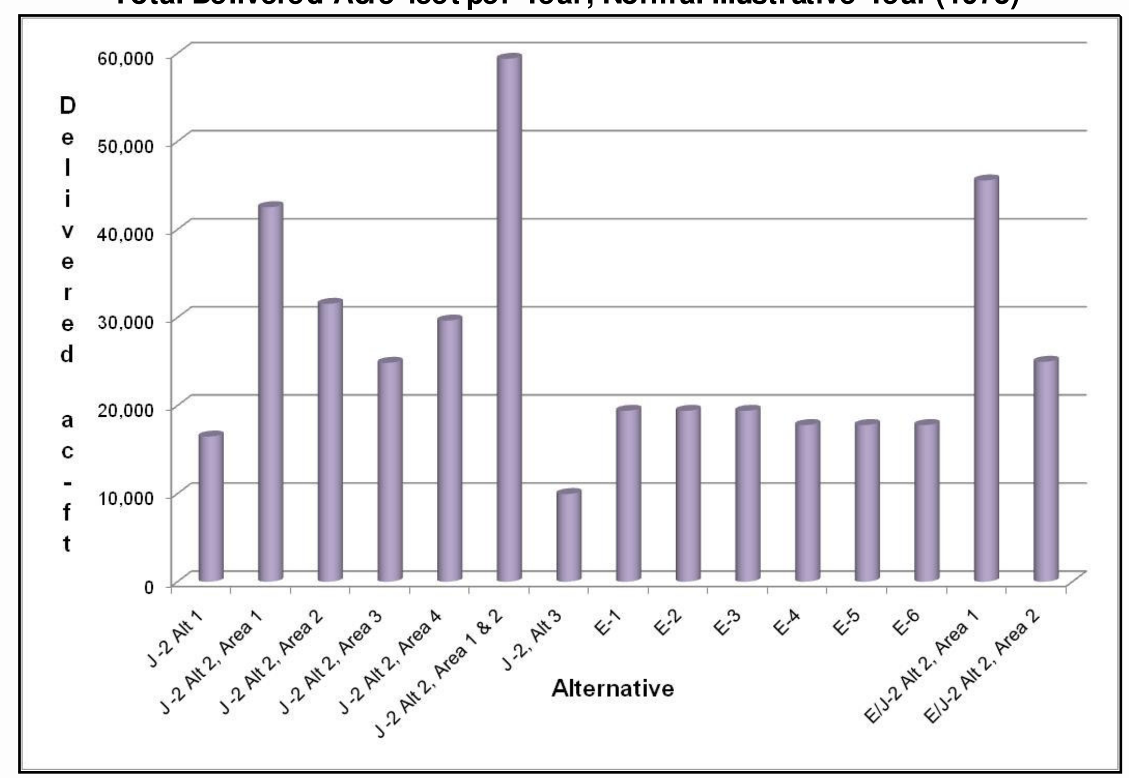
Capital Costs per Total Delivered Acre-feet, Normal Illustrative Year (1975)



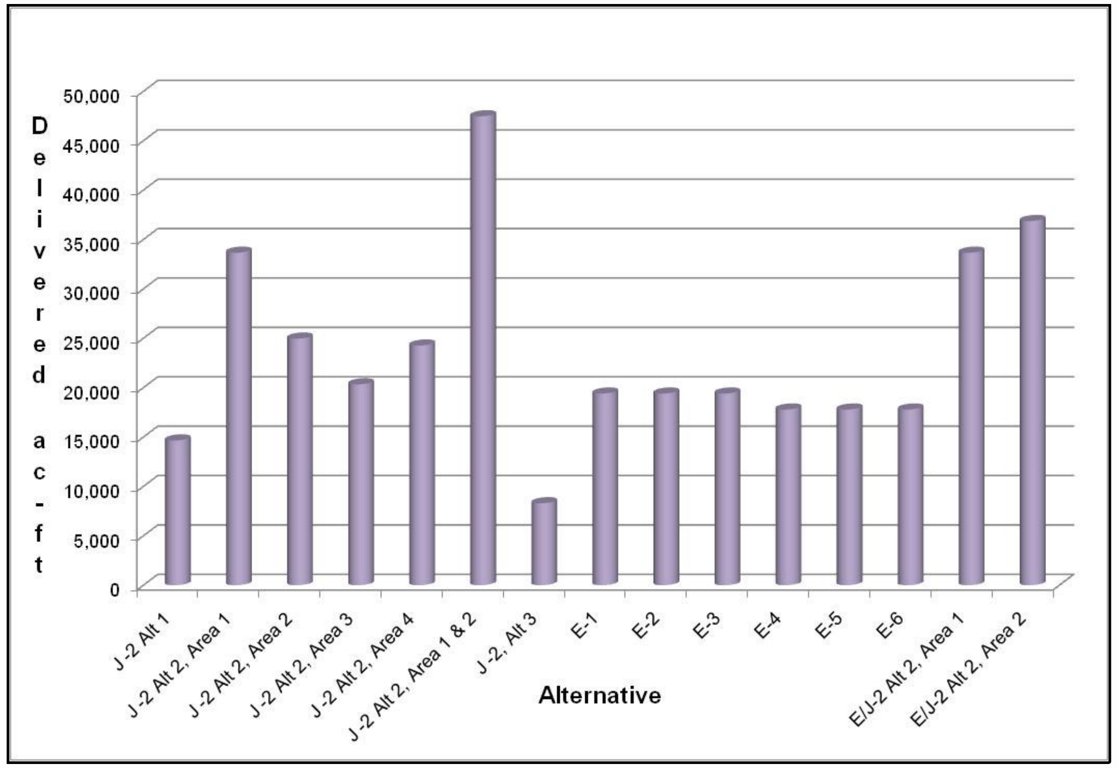
Capital Costs per Reduction to Shortages to Target Flows for Normal Illustrative Year (1975)



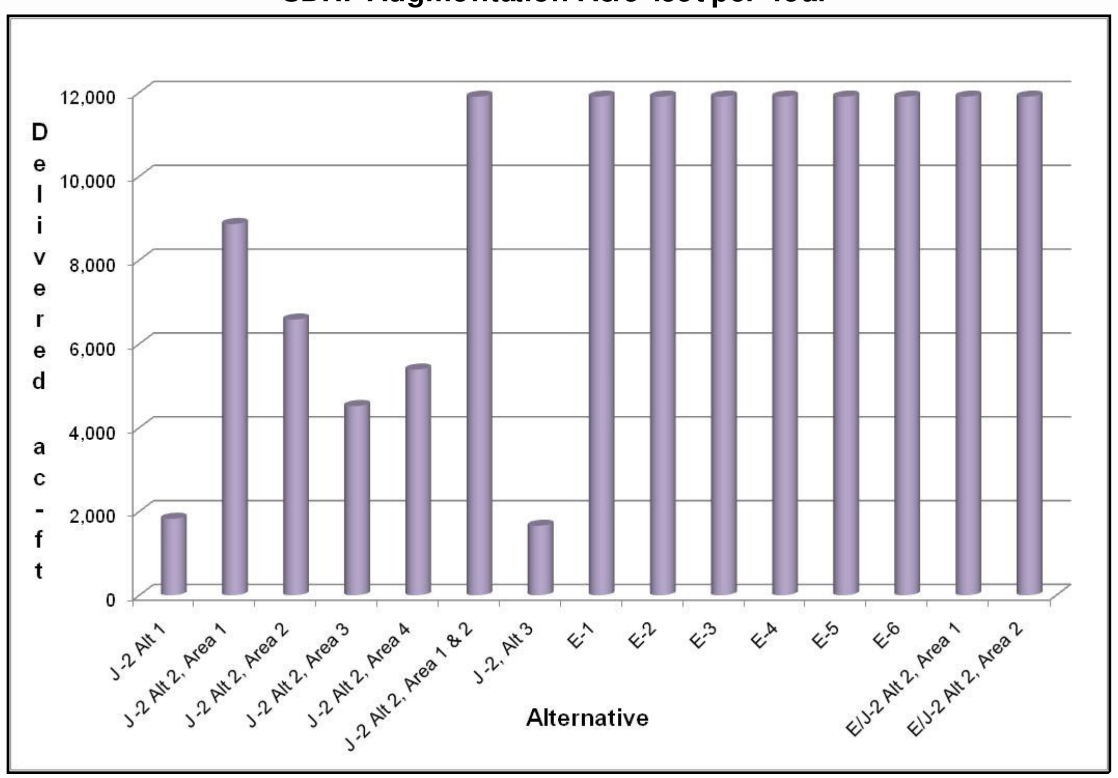
Total Delivered Acre-feet per Year, Normal Illustrative Year (1975)



Reduction to Shortages to Target Flows Acre-feet per Year for the Normal Illustrative Year (1975)



SDHF Augmentation Acre-feet per Year



OPERATION AND MAINTENANCE COSTS
NRCS SUGGESTED RATE FOR AVERAGE ANNUAL COSTS

Control Measure
Percentage of Engineers Estimates Of Construction Costs (Excluding Land Prices)

Waterflow Control Measures
a. Floodwater retarding structures 0.75%
b. Concrete and asphalt lined channels, reinforced concrete chutes 1.25%
c. Levees and dikes, major desilting basins 1.25%
d. Channel improvements – floodways 1.50%
e. Other 1.75%

Drainage Measures
a. Covered drains and appurtenances 0.75%
b. Open drains and appurtenances 1.25%

Irrigation measures
a. Water supply reservoirs 0.75%
b. Canal laterals 1.25%
c. Diversion dams and canal headworks 1.75%

Non-Agricultural Water Management Measures
a. Water supply reservoirs 0.75%
Operation and maintenance costs required on special items such as pumping plants, pipelines, etc. will vary so greatly no attempt is made to provide a rate. Applicants should work closely with persons who are familiar with these special items in developing suitable rates for such facilities.

Recreation Projects (from Nebraska Game and Parks Commission)
For recreation projects, use $1.35 per recreation day.

Elwood and J-2 Alternatives Operation and Maintenance Costs

Alternative	Reservoir[1]	Inlet	Outlet	Conveyance	Capital Costs[2] ($000)	Operating Cost rate	Pumped acre-feet	Pumping Costs @ $1.60/ac-ft ($000)	Pump Replacement ($000)	Power Generation Offset $7.89	Annual Operating Cost ($000)
J -2 Alt 1	J-2 south channel option $11,452	J-2 Canal $ -	Radial Gates $6,008	n/a $ -	$17,460	1.25%					$218.25
J -2 Alt 2, Area 1	Area 1 $23,208	Phelps Canal $310	Radial Gates $688	n/a $ -	$24,206	0.75%					$181.55
J -2 Alt 2, Area 2	Area 2 $15,043	pumps $2,115	Radial Gates $325	n/a $ -	$17,483	0.75%	6,868	$11	$10		$152.11
J -2 Alt 2, Area 3	Area 3 $39,719	J-2 Return $465	Radial Gates $340	n/a $ -	$40,541	0.75%	10,592	$17	$10		$331.00
J -2 Alt 2, Area 4	Area 4 $83,102	J-2 Return $465	Radial Gates $310	n/a $ -	$83,877	0.75%	26,076	$42	$10		$680.80
J -2 Alt 2, Area 1 & 2	Areas 1&2 $38,251	Phelps Canal $775	Radial Gates $1,013	n/a $ -	$40,039	0.75%	6,868	$11	$10		$321.28
J -2, Alt 3	9.7 Canal Reservoir $5,392	9.7 Canal $310	Radial Gates $357	n/a $ -	$6,059	1.75%					$106.03
E-1	Elwood buttress $2,797	Gravity Canal $6,265	Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$42,942	1.25%				$153.13	$689.90
E-2	Elwood remove & replace embankment $9,453	Gravity Canal $6,265	Open cut 2 pipes $8,353	Plum Creek, 2,400 cfs $21,373	$45,444	1.25%				$153.13	$721.18
E-3	Elwood remove & replace upstream shell $5,377	Gravity Canal $6,265	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$45,522	1.25%				$153.13	$722.15
E-4	Elwood buttress $2,797	Existing E-65 Canal $ -	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$36,677	0.75%	15,000	$24	$10	$140.35	$449.42
E-5	Elwood remove & replace embankment $9,453	Existing E-65 Canal $ -	Open cut 2 pipes $8,353	Plum Creek, 2,400 cfs $21,373	$39,179	0.75%	15,000	$24	$10	$140.35	$468.19
E-6	Elwood remove & replace upstream shell $5,377	Existing E-65 Canal $ -	2-8' Tunnels $12,507	Plum Creek, 2,400 cfs $21,373	$39,257	0.75%	15,000	$24		$140.35	$458.77
E/J-2 Alt 2, Area 1	Elwood buttress, J-2 excavation, Area 1 modified $22,605	Gravity Canal $6,265	Tunnels (1 only) $7,504	Plum Creek, 1,200 cfs $15,252	$51,626	0.75%				$70.17	$457.37
E/J-2 Alt 2, Area 2	Elwood buttress, J-2 excavation, Area 2 $17,840	Gravity Canal $6,265	Tunnels (1 only) $7,504	Plum Creek, 1,200 cfs $15,252	$46,861	0.75%				$70.17	$421.63

Notes: [1]Base cost of reservoir (total estimated project cost without inlet, outlet, and conveyance costs). For Elwood, the cost represents improvements to the embankment.
[2]Total estimated project cost including base reservoir cost, inlet, outlet, and conveyance costs (sum of preceding columns)

Elwood Reservoir Gravity Inlet Canal Alternative

Table C-1 – Gravity Canal Opinion of Probable Cost, included in Alternatives E-1, E-2, E-3, E/J-2 Alt 2, Area 1, and E/J-2 Alt 2, Area 2

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
Gravity Canal					
1	Mobilization / Demobilization	1	LS	$ 100,675.00	$ 100,675.00
2	Clearing and Grubbing	35	AC	$ 1,000.00	$ 35,000.00
3	Earth Fill, Class A Compaction	300,000	CY	$ 4.00	$ 1,200,000.00
4	Salvaging and Spreading Topsoil	170,000	SY	$ 1.00	$ 170,000.00
5	8" Welded Steel Pipe	4,850	LF	$ 500.00	$ 2,425,000.00
6	Siphon Anchorage	12	EA	$ 1,000.00	$ 12,000.00
7	Inlet transition	1	EA	$ 15,000.00	$ 15,000.00
8	Outlet transition	1	EA	$ 15,000.00	$ 15,000.00
9	Manhole	10	EA	$ 5,000.00	$ 50,000.00
10	Valve and Drain Pipe	1	EA	$ 5,000.00	$ 5,000.00
11	Supply Canal Intake Gate Structure	1	EA	$ 50,000.00	$ 50,000.00
12	Local Drainage Structure	5	EA	$ 10,000.00	$ 50,000.00
				Subtotal =	**$ 4,127,675**
				20% Mapping Uncertaintity =	**$ 825,535**
				20% Construction Contingency =	**$ 825,535**
				Probabale Construction Costs =	**$ 5,778,745**
				Permitting and Design (8%) =	**$ 462,300**
				Land Acquisition Costs (35 ac @ $700 per ac) =	**$ 24,500**
				Total Estimated Project Cost =	**$ 6,265,545**

Elwood Reservoir Embankment Upgrade Alternatives

Table C-2 – Dam Replacement Opinion of Probable Cost, included in Alternatives E-2 and E-5

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
Remove and Replace Existing Dam					
1	Mobilization / Demobilization	1	LS	$ 152,500.00	$ 152,500.00
2	Clearing and Grubbing	25	AC	$ 1,000.00	$ 25,000.00
3	Embankment Excavation	1,000,000	CY	$ 1.50	$ 1,500,000.00
4	Foundation Preparation	25	AC	$ 2,000.00	$ 50,000.00
5	Embankmnet Placement	1,000,000	CY	$ 3.00	$ 3,000,000.00
6	New Soil Cement	35,000	SY	$ 25.00	$ 875,000.00
7	Instummantation Installation	1	LS	$ 150,000.00	$ 150,000.00
8	Site Restoration	25	AC	$ 20,000.00	$ 500,000.00
				Subtotal =	**$ 6,252,500**
				20% Mapping Uncertaintity =	**$ 1,250,500**
				20% Construction Contingency =	**$ 1,250,500**
				Probabale Construction Costs =	**$ 8,753,500**
				Permitting and Design (8%) =	**$ 700,280**
				Total Estimated Project Cost =	**$ 9,453,780**

Table C-3 – Embankment Buttress Opinion of Probable Cost, included in Alternatives E-1, E-4, E/J-2 Alt 2, Area 1, and E/J-2 Alt 2, Area 2

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
Flatten Upstream Slope					
1	Mobilization / Demobilization	1	LS	$ 45,125.00	$ 45,125.00
2	Clearing and Grubbing	15	AC	$ 1,000.00	$ 15,000.00
3	Embankment Excavation	130,000	CY	$ 1.50	$ 195,000.00
4	Foundation Preparation	15	AC	$ 2,000.00	$ 30,000.00
5	Embankmnet Placement	130,000	CY	$ 3.00	$ 390,000.00
6	New Soil Cement	35,000	SY	$ 25.00	$ 875,000.00
7	Site Resortation	15	AC	$ 20,000.00	$ 300,000.00
				Subtotal =	**$ 1,850,125**
				20% Mapping Uncertaintity =	**$ 370,025**
				20% Construction Contingency =	**$ 370,025**
				Probabale Construction Costs =	**$ 2,590,175**
				Permitting and Design (8%) =	**$ 207,214**
				Total Estimated Project Cost =	**$ 2,797,389**

Table C-4 – Remove and Replace Upstream Embankment Shell Opinion of Probable Cost, included in Alternatives E-3 and E-6

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
Remove and Replace Upstream Shell					
1	Mobilization / Demobilization	1	LS	$ 86,750.00	$ 86,750.00
2	Clearing and Grubbing	15	AC	$ 1,000.00	$ 15,000.00
3	Embankment Excavation	500,000	CY	$ 1.50	$ 750,000.00
4	Foundation Preparation	15	AC	$ 2,000.00	$ 30,000.00
5	Embankmnet Placement	500,000	CY	$ 3.00	$ 1,500,000.00
6	New Soil Cement	35,000	SY	$ 25.00	$ 875,000.00
7	Site Restoration	15	AC	$ 20,000.00	$ 300,000.00
				Subtotal =	**$ 3,556,750**
				20% Mapping Uncertaintity =	**$ 711,350**
				20% Construction Contingency =	**$ 711,350**
				Probabale Construction Costs =	**$ 4,979,450**
				Permitting and Design (8%) =	**$ 398,356**
				Total Estimated Project Cost =	**$ 5,377,806**

Elwood Reservoir Outlet Works Alternatives

Table C-5 – New Outlet Works as Part of Embankment Removal and Replacement Opinion of Probable Cost, included in Alternatives E-2 and E-5

New Outlet (Cut and Cover)					
Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 134,750.00	$ 134,750.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Embankment Excavation	150,000	CY	$ 1.50	$ 225,000.00
4	Foundation Preparation	15	AC	$ 2,000.00	$ 30,000.00
5	Concrete Structures	1	LS	$ 2,000,000.00	$ 2,000,000.00
6	Steel Structures	1	LS	$ 1,500,000.00	$ 1,500,000.00
7	Embankmnet Placement	150,000	CY	$ 3.00	$ 450,000.00
8	New Soil Cement	35,000	SY	$ 25.00	$ 875,000.00
9	Site Restoration	15	AC	$ 20,000.00	$ 300,000.00
				Subtotal =	$ 5,524,750
		20% Mapping Uncertaintity =			$ 1,104,950
		20% Construction Contingency =			$ 1,104,950
		Probabale Construction Costs =			$ 7,734,650
		Permitting and Design (8%) =			$ 618,772
		Total Estimated Project Cost =			$ 8,353,422

Table C-6 – Tunneling of New Outlet Pipes Opinion of Probable Cost, included in Alternatives E-1, E-3, E-4, and E-6

New Outlet (Tunneled)					
Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 201,750.00	$ 201,750.00
2	Tunneling	1,000	AC	$ 7,000.00	$ 7,000,000.00
3	Reinforced Concrete Structures	1	LS	$ 500,000.00	$ 500,000.00
4	Steel Structures	1	LS	$ 550,000.00	$ 550,000.00
5	Site Restoration	1	AC	$ 20,000.00	$ 20,000.00
				Subtotal =	$ 8,271,750
		20% Mapping Uncertaintity =			$ 1,654,350
		20% Construction Contingency =			$ 1,654,350
		Probabale Construction Costs =			$ 11,580,450
		Permitting and Design (8%) =			$ 926,436
		Total Estimated Project Cost =			$ 12,506,886

Plum Creek Upgrade Alternatives

Table C-7 – Upgrade of Plum Creek for 2,400 cfs Opinion of Probable Cost, included in Alternatives E-1, E-2, E-3, E-4, E-5, and E-6

Upgrading Plum Creek for 2,400 cfs SDHF					
Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 344,409.00	$ 344,409.00
2	Clearing and Grubbing	15	AC	$ 1,000.00	$ 15,000.00
3	Excavation, Common	675,000	CY	$ 5.00	$ 3,375,000.00
4	Rock Rip Rap Armoring	159,000	CY	$ 55.00	$ 8,745,000.00
5	Salvaging and Spreading Topsoil	150,000	CY	$ 1.00	$ 150,000.00
6	Seeding and Mulching	282	AC	$ 1,100.00	$ 310,200.00
7	Bridge Construction, Concrete Slab Continuous (4 brdiges)	13,440	SF	$ 89.00	$ 1,196,160.00
				Subtotal =	$ 14,135,769
				20% Mapping Uncertaintity =	$ 2,827,154
				20% Construction and Other Costs Contingency =	$ 2,827,154
				Probabale Construction Costs =	$ 19,790,077
				Permitting and Design (8%) =	$ 1,583,206
				Total Estimated Project Cost =	$ 21,373,283

Table C-8 – Upgrade of Plum Creek for 1,200 cfs Opinion of Probable Cost, included in Alternatives E/J-2 Alt 2, Area 1, and E/J-2 Alt 2, Area 2

Upgrading Plum Creek for 1,200 cfs SDHF					
Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 245,666.50	$ 245,666.50
2	Clearing and Grubbing	15	AC	$ 1,000.00	$ 15,000.00
3	Excavation, Common	325,000	CY	$ 5.00	$ 1,625,000.00
4	Rock Rip Rap Armoring	121,000	CY	$ 55.00	$ 6,655,000.00
5	Salvaging and Spreading Topsoil	114,000	CY	$ 1.00	$ 114,000.00
6	Seeding and Mulching	215	AC	$ 1,100.00	$ 236,500.00
7	Bridge Construction, Concrete Slab Continuous (4 brdiges)	13,440	SF	$ 89.00	$ 1,196,160.00
				Subtotal =	$ 10,087,327
				20% Mapping Uncertaintity =	$ 2,017,465
				20% Construction and Other Costs Contingency =	$ 2,017,465
				Probabale Construction Costs =	$ 14,122,257
				Permitting and Design (8%) =	$ 1,129,781
				Total Estimated Project Cost =	$ 15,252,038

J-2 Reregulating Reservoir Outlet Works Alternatives

Table C-9 – J-2 Alt 1

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 300,297.25	$ 300,297.25
2	Clearing and Grubbing	11	AC	$ 1,000.00	$ 11,000.00
3	Earth Fill, Class A Compaction	45,511	CY	$ 5.00	$ 227,555.00
4	Structural Concrete	3,816	CY	$ 500.00	$ 1,908,000.00
5	Radial Gates, Cable Operated with Controls	8	EA	$ 751,000.00	$ 6,008,000.00
6	Sheet Pile, Steel	197,360	SF	$ 10.00	$ 1,973,600.00
7	Rock Rip Rap at Outlet, Class C	1,070	CY	$ 50.00	$ 53,500.00
8	Rock Rip Rap Surfacing, Class B	44,742	CY	$ 40.00	$ 1,789,680.00
9	Gravel Surfacing	2,557	CY	$ 15.00	$ 38,355.00
10	Seeding and Mulching	2	AC	$ 1,100.00	$ 2,200.00
				Subtotal =	**$ 12,312,187**
				20% Construction Contingency =	**$ 2,462,437**
				Probable Construction Costs =	**$ 14,774,625**
				Permitting and Design (8%) =	**$ 1,181,970**
				Land Acquisition Costs (752 ac @$2,000 per ac) =	**$ 1,504,000**
				Total Estimated Project Cost =	**$ 17,460,595**

Table C-10 – J-2 Alt 2, Area 1

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 360,920.25	$ 360,920.25
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Excavation, Dispose off site	679,000	CY	$ 5.00	$ 3,395,000.00
4	Earth Fill, Class A Compaction	1,507,000	CY	$ 4.00	$ 6,028,000.00
5	Sand Drains	4,700	CY	$ 20.00	$ 94,000.00
6	Salvaging and Spreading Topsoil, 12" Thick	688,933	CY	$ 4.00	$ 2,755,732.00
7	Structural Concrete	850	CY	$ 500.00	$ 425,000.00
8	30' w x 13.5' h Radial Gate, Cable Operated with Controls	1	EA	$ 310,000.00	$ 310,000.00
9	40' w x 25' h Radial Gate (2@20'w x 25'h), Cable Operated with Controls	2	EA	$ 344,039.00	$ 688,078.00
10	90' Long x 36' Wide County Bridge	3,240	SF	$ 75.00	$ 243,000.00
11	Rock Rip Rap at Gates, Class C	610	CY	$ 50.00	$ 30,500.00
12	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
13	Seeding and Mulching	430	AC	$ 900.00	$ 387,000.00
				Subtotal =	**$ 14,797,730**
				20% Mapping Uncertainty =	**$ 2,959,546**
				20% Construction Contingency =	**$ 2,959,546**
				Probable Construction Costs =	**$ 20,716,822**
				Permitting and Design (8%) =	**$ 1,657,346**
				Land Acquisition Costs (458 ac @ $4,000 per ac) =	**$ 1,832,000**
				Total Estimated Project Cost =	**$ 24,206,168**

Table C-11 – J-2 Alt 2, Area 2

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 247,764.20	$ 247,764.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Earth Fill, Class A Compaction	617,600	CY	$ 4.00	$ 2,470,400.00
4	Sand Drains	12,000	CY	$ 20.00	$ 240,000.00
5	Salvaging and Spreading Topsoil, 12" Thick	821,187	CY	$ 4.00	$ 3,284,748.00
6	Structural Concrete	600	CY	$ 500.00	$ 300,000.00
7	15' w x 13.5' h Sluice Gate, Cable Operated with Controls	2	EA	$ 232,500.00	$ 465,000.00
8	30' w x 20' h Radial Gate, Cable Operated with Controls	1	EA	$ 325,000.00	$ 325,000.00
9	Inlet Pumps & Motors, 80 cfs each, with controls and structure	3	EA	$ 615,000.00	$ 1,845,000.00
10	Sheet-Pile for Labyrinth Weir	18,748	SF	$ 15.00	$ 281,220.00
11	Concrete Outlet for labyrinth Weir	239	SF	$ 500.00	$ 119,500.00
12	Rock Rip Rap at Gates, Class C	540	CY	$ 50.00	$ 27,000.00
13	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
14	Seeding and Mulching	509	AC	$ 900.00	$ 458,100.00
				Subtotal =	**$ 10,158,332**
				20% Mapping Uncertainty =	**$ 2,031,666**
				20% Construction Contingency =	**$ 2,031,666**
				Probable Construction Costs =	**$ 14,221,665**
				Permitting and Design (8%) =	**$ 1,137,733**
				Land Acquisition Costs (531 ac @ $4,000 per ac) =	**$ 2,124,000**
				Total Estimated Project Cost =	**$ 17,483,398**

Table C-12 – J-2 Alt 2, Area 3

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 626,622.20	$ 626,622.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 9,500.00
3	Excavation, Dispose off site	3,172,000	CY	$ 5.00	$ 15,860,000.00
4	Earth Fill, Class A Compaction	437,460	CY	$ 4.00	$ 1,749,840.00
5	Sand Drains	5,640	CY	$ 20.00	$ 112,800.00
6	Salvaging and Spreading Topsoil, 12" Thick	821,187	CY	$ 4.00	$ 3,284,748.00
7	Structural Concrete	750	CY	$ 500.00	$ 375,000.00
8	15' w x 14' h Sluice Gate, Cable Operated with Controls	2	EA	$ 232,500.00	$ 465,000.00
9	30' w x 20' h Radial Gate, Cable Operated with Controls	1	EA	$ 340,000.00	$ 340,000.00
10	Inlet Pumps & Motors, 75 cfs each, with controls and structure	4	EA	$ 600,000.00	$ 2,400,000.00
11	Rock Rip Rap at Gates, Class C	540	CY	$ 50.00	$ 27,000.00
12	Gravel Surfacing	5,400	CY	$ 15.00	$ 81,000.00
13	Seeding and Mulching	400	AC	$ 900.00	$ 360,000.00
				Subtotal =	**$ 25,691,510**
				20% Mapping Uncertainty =	**$ 5,138,302**
				20% Construction Contingency =	**$ 5,138,302**
				Probable Construction Costs =	**$ 35,968,114**
				Permitting and Design (8%) =	**$ 2,877,449**
				Land Acquisition Costs (424 ac @ $4,000 per ac) =	**$ 1,696,000**
				Total Estimated Project Cost =	**$ 40,541,563**

Table C-13 – J-2 Alt 2, Area 4

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 1,222,125.70	$ 1,222,125.70
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,300.00
3	Excavation, Dispose off site	7,849,000	CY	$ 5.00	$ 39,245,000.00
4	Earth Fill, Class A Compaction	109,400	CY	$ 4.00	$ 437,600.00
5	Clay Blanket, 2' Thick	2,600	CY	$ 4.00	$ 10,400.00
6	Sand Drains	5,800	CY	$ 20.00	$ 116,000.00
7	Salvaging and Spreading Topsoil, 12" Thick	1,053,507	CY	$ 4.00	$ 4,214,028.00
8	Structural Concrete	750	CY	$ 500.00	$ 375,000.00
9	15' w x 14' h Sluice Gate, Cable Operated with Controls	2	EA	$ 232,500.00	$ 465,000.00
10	30' w x 10' h Radial Gate, Cable Operated with Controls	1	EA	$ 310,000.00	$ 310,000.00
11	Inlet Pumps & Motors, 75 cfs each, with controls and structure	5	EA	$ 600,000.00	$ 3,000,000.00
12	Rock Rip Rap at Gates, Class C	540	CY	$ 50.00	$ 27,000.00
13	Gravel Surfacing	5,800	CY	$ 15.00	$ 87,000.00
14	Seeding and Mulching	653	AC	$ 900	$ 587,700
				Subtotal =	**$ 50,107,154**
				20% Mapping Uncertainty =	**$ 15,032,146**
				20% Construction Contingency =	**$ 10,021,431**
				Probable Construction Costs =	**$ 75,160,731**
				Permitting and Design (8%) =	**$ 6,012,858**

Table C-14 – J-2 Alt 3

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 88,327.50	$ 88,327.50
2	Clearing and Grubbing	19	AC	$ 1,000.00	$ 19,000.00
3	Earth Fill, Class A Compaction	114,000	CY	$ 4.00	$ 456,000.00
4	Feed Lot Lagoon Repairs	1	EA	$ 25,000.00	$ 25,000.00
5	Sand Drains	400	CY	$ 20.00	$ 8,000.00
6	Salvaging and Spreading Topsoil, 6" Thick	15,000	CY	$ 4.00	$ 60,000.00
7	Structural Concrete	4,300	CY	$ 500.00	$ 2,150,000.00
8	15' w x 15' h Radial Gate, Cable Operated with Controls	1	EA	$ 295,000.00	$ 295,000.00
9	30' w x 15' h Sluice Gate, Cable Operated with Controls	1	EA	$ 357,000.00	$ 357,000.00
10	Turf Reinforcement Mat for Spillway	5,000	SY	$ 9.00	$ 45,000.00
11	Rock Rip Rap at Gates, Class C	610	CY	$ 50.00	$ 30,500.00
12	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
13	Seeding and Mulching	19	AC	$ 900.00	$ 17,100.00
				Subtotal =	**$ 3,621,428**
				20% Mapping Uncertainty =	**$ 724,286**
				20% Construction Contingency =	**$ 724,286**
				Probable Construction Costs =	**$ 5,069,999**
				Permitting and Design (8%) =	**$ 405,600**
				Land Acquisition Costs (146 ac @ $4,000 per ac) =	**$ 584,000**
				Total Estimated Project Cost =	**$ 6,059,598**

Table C-15 – J-2 Alt 2 Area 1 & 2

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 582,058.95	$ 582,058.95
2	Clearing and Grubbing	20	AC	$ 1,000.00	$ 20,000.00
3	Excavation, Dispose offsite	834,996	CY	$ 5.00	$ 4,174,980.00
4	Earth Fill, Class A Compaction	2,124,600	CY	$ 4.00	$ 8,498,400.00
5	Sand Drains	16,700	CY	$ 20.00	$ 334,000.00
6	Salvaging and Spreading Topsoil, 12" Thick	1,510,120	CY	$ 4.00	$ 6,040,480.00
7	Structural Concrete	1,450	CY	$ 500.00	$ 725,000.00
8	30' w x 13.5' h Radial Gate, Cable Operated with Controls	1	EA	$ 310,000.00	$ 310,000.00
9	15' w x 13.5' h Sluice Gate, Cable Operated with Controls	2	EA	$ 232,500.00	$ 465,000.00
10	40' w x 25' h Radial Gate (2@20'w x 25'h), Cable Operated with Controls	2	EA	$ 344,039.00	$ 688,078.00
11	30' w x 20' h Radial Gate, Cable Operated with Controls	1	EA	$ 325,000.00	$ 325,000.00
12	Sheet-Pile for Labyrinth Weir	18748	SF	$ 15.00	$ 281,220.00
13	Concrete Outlet for labyrinth Weir	239	SF	$ 500.00	$ 119,500.00
14	90' Long x 36' Wide County Bridge	3,240	SF	$ 75.00	$ 243,000.00
15	Rock Rip Rap at Gates, Class C	1,150	CY	$ 50.00	$ 57,500.00
16	Gravel Surfacing	10,340	CY	$ 15.00	$ 155,100.00
17	Seeding and Mulching	939	AC	$ 900.00	$ 845,100.00
				Subtotal =	**$ 23,864,417**
				20% Mapping Uncertainty =	**$ 4,772,883**
				20% Construction Contingency =	**$ 4,772,883**
				Probable Construction Costs =	**$ 33,410,184**
				Permitting and Design (8%) =	**$ 2,672,815**
				Land Acquisition Costs (989 ac @ $4,000 per ac) =	**$ 3,956,000**
				Total Estimated Project Cost =	**$ 40,038,998**

Appendix D

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PHOTOLOG

Photo 1. Elwood Reservoir dam

Photo 2. Elwood Reservoir

PHOTOLOG

Photo 3. Elwood Reservoir pump station

Photo 4. Downstream view from Elwood Dam

PHOTOLOG

Photo 5. E-65 Canal

Photo 6. Phelps Canal siphon at Plum Creek

PHOTOLOG

Photo 8. Plum Creek at confluence with Platte River

Photo 9. J2 wasting station

PHOTOLOG

Photo 10. J2 below the J-2 Wasting Station

Photo 11. Platte River at J2 wasting station

PHOTOLOG

Photo 12. Platte River below the J-2 Wasting Station

Photo 13. State Highway 283 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 14. State Highway 283 bridge over Plum Creek, downstream face

Photo 15. County Road 429 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 16. County Road 429 bridge over Plum Creek, downstream face

Photo 17. County Road 430 culvert in Plum Creek, upstream face

PHOTOLOG

Photo 18. County Road 430 culvert in Plum Creek, downstream face

Photo 19. County Road 432 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 20. County Road 432 bridge over Plum Creek, downstream face

Photo 21. County Road 433 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 22. County Road 433 bridge over Plum Creek, downstream face

Photo 23. County Road 746 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 24. County Road 746 bridge over Plum Creek, downstream face

Photo 25. County Road 435 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 26. County Road 435 bridge over Plum Creek, downstream face

Photo 27. County Road 436 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 28. County Road 436 bridge over Plum Creek, downstream face

Photo 29. County Road 437 culvert in Plum Creek, upstream face

PHOTOLOG

Photo 30. County Road 437 culvert in Plum Creek, downstream face

Photo 31. County Road 749 bridge over Plum Creek, upstream face

PHOTOLOG

Photo 32. County Road 749 bridge over Plum Creek, downstream face

Photo 33, NPPD Canaday Station steam power plant

PHOTOLOG

Photo 34, NPPD Canaday Station steam power plant cooling water intake on J-2 Return Canal

Photo 35, Approach to J-2 Return wasting station

PHOTOLOG

Photo 36, J-2 Return wasting station radial gate discharge to the south channel of the Platte River

Photo 37, Downstream of the J-2 Return wasting station, canal leads to the south channel of the Platte River

PHOTOLOG

Photo 38, Approach to the Phelps Canal siphon under Plum Creek

Photo 39, CNPPID J-2 Hydropower station

Appendix E

J-2 Seepage Analysis Memorandum

OLSSON ASSOCIATES

MEMO

	Overnight
	Regular Mail
	Hand Delivery
	Other: ___________

TO:	Eric Dove, Olsson Associates
FROM:	Ryan Beckman, Olsson Associates
RE:	J-2 Alternative Analysis
DATE:	November 10, 2009
PROJECT #:	009-1466

This memorandum is provided to address the three alternative design options for the J-2 Return project located along the Platte River near Jeffreys Island. The purpose of this memorandum is to outline the general soil characteristics and associated seepage conditions in this region. The three alternatives were evaluated separately with the findings summarized below. In addition, preliminary embankment stability assessments and seepage conditions were completed for Alternative 1 and 2 based on assumed soil parameters of similar material previously evaluated in this region of Nebraska along with the available soil properties noted in the Natural Resource Conservation Services database.

Soil and Seepage Conditions Present for Alternatives 1, 2 and 3

Upon a review of the Soil Survey for Gosper and Phelps County by the Natural Resource Conservation Services, it was determined that variable soil conditions are present in the alternative areas. Based on the information available at this time, the presence of the sandy loams and poorly graded sands can have significant impacts on the general seepage conditions for each alternative. The following table highlights for each alternative the surface area of each soil type along with the associated surface area percentage and potential seepage impacts.

Table 1

Soil Properties and Seepage Rates

Soil Type	Surface Area (Percent)	Soil Depth (inches)	Soil Characteristics	Seepage Rates (cm/sec)
Alternative 1				
Gothenberg	85.4	3 - 11	Fine Sand	0.0042 – 0.0141
		11- 60	Fine to Coarse Sand	0.0042 – 0.0141
Platte	12.0	0 – 7	Loam	0.00042 – 0.00141
		7 – 13	Very fine sandy loam	0.0004 – 0.0042
		13 - 60	Silt loam	0.0014 – 0.0141
Alternative 2				
Lex	43.8	0 – 12	Loam	0.00042 – 0.00141
		12 – 29	Sandy loam to silty clay loam	0.00014 – 0.00141
		29 – 60	Gravelly sand	0.0141 – 0.0705
Cozad	14.7	0 – 13	Silt loam	0.0042 – 0.00141
		13 – 33	Very fine sandy loam	0.0042 – 0.00141
		33 - 60	Silt loam	0.0042 – 0.00141
Platte	19.1	0 – 7	Loam	0.00042 – 0.00141
		7 – 13	Very fine sandy loam	0.0004 – 0.0042
		13 - 60	Silt loam	0.0014 – 0.0141
Gosper	9.0	0 – 12	Loam	0.00042 – 0.00141
		12 – 24	Sandy clay loam	0.00042 – 0.00141
		24 - 52	Fine sandy loam	0.0042 - 0.0141
Hord	5.0	0 - 60	Silt loam	0.00042 – 0.00141
Alternative 3				
Coly	94.5	0 - 60	Silt loam	0.000423 – 0.00141
Kensaw/Coly	3.9	0 - 60	Silt loam	0.000423 – 0.00141

For additional information regarding the areas evaluated for the three alternatives along with the proximity of each soil type please refer to the attached Figures 1, 2, and 3 in Attachment A.

Preliminary Slope Configuration

Given the soil properties and parameters, a preliminary seepage and stability analysis was completed for Alternatives 1 and 2 to identify the typical cross section. As a result of the analysis, preliminary cost estimates were then completed based on the acceptable cross sections that were established. Figures 4 and 5 highlight the proposed cross-sections based on the very limited soil property information available at the time of this report.

FIGURE 4: Alternative 1

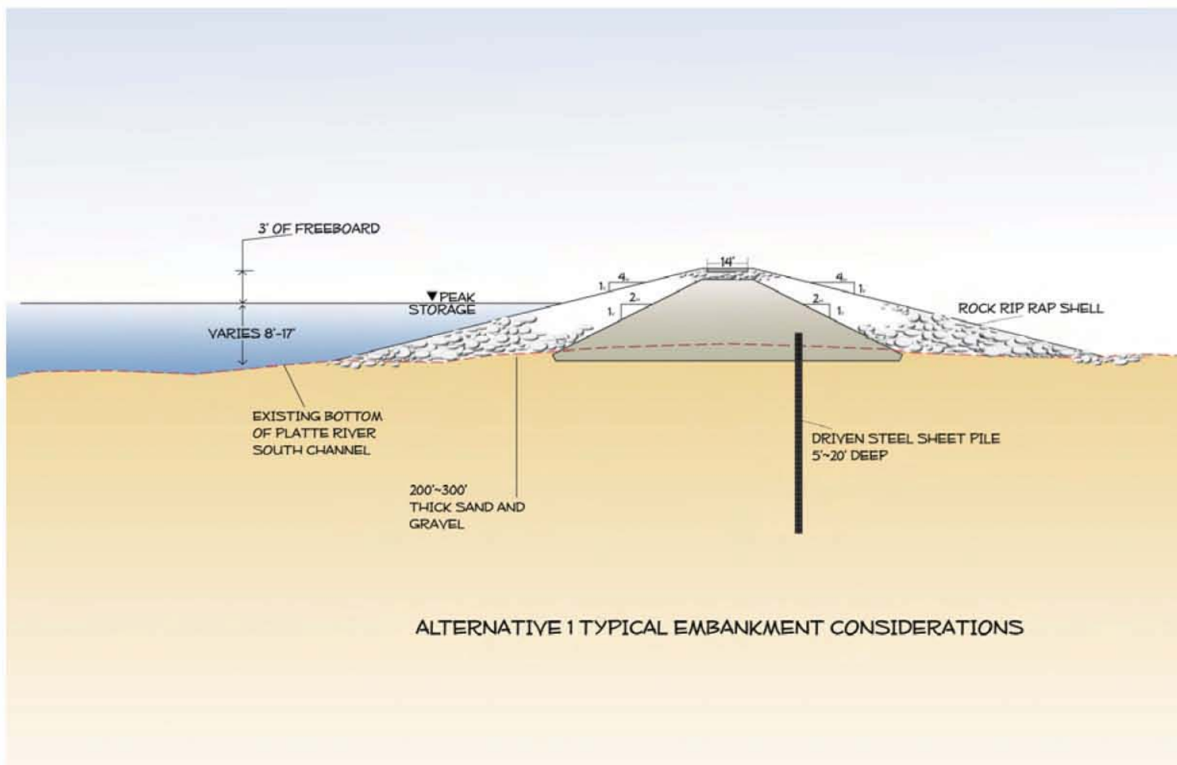
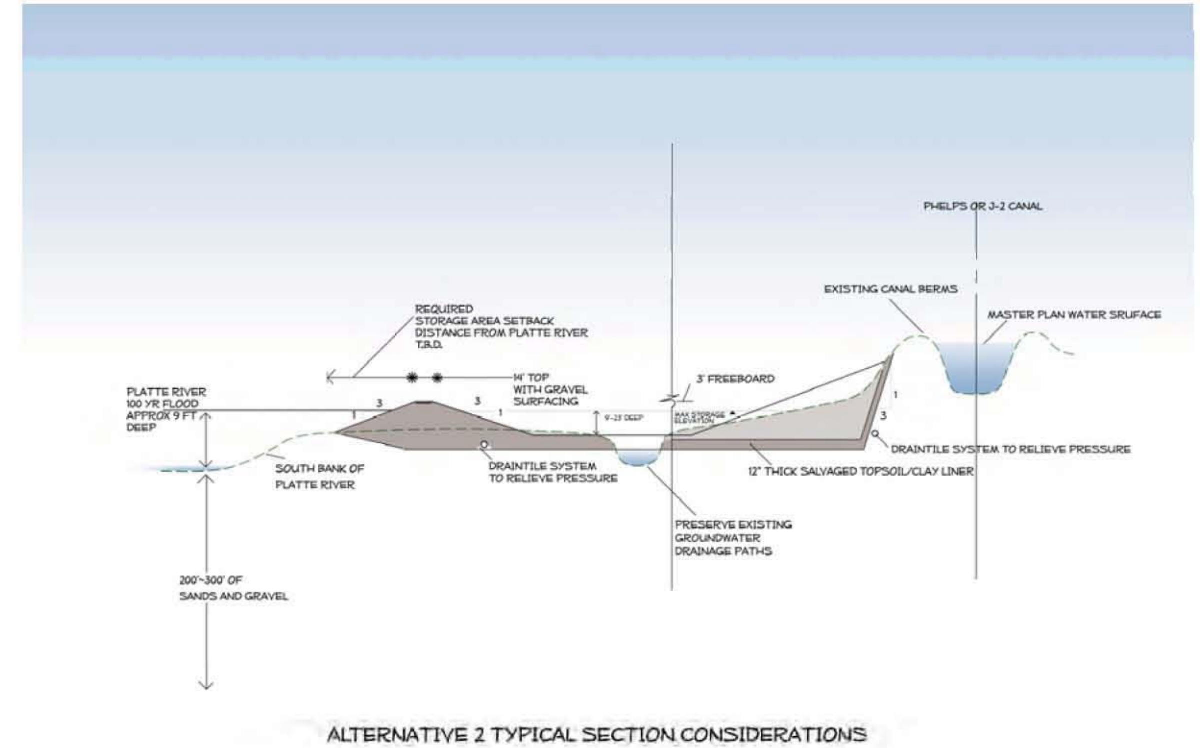


FIGURE 5: Alternative 2



SEEPAGE

For analysis of seepage, vertical soil permeability of 8.8×10^{-2} cm/sec and 1.0×10^{-5}cm/sec were utilized to calculate seepage rates for the cohesionless and cohesive soils, respectively. Our analysis includes a horizontal to vertical permeability ratio of 10 for the cohesionless and cohesive soils. The permeability results are based on the average values obtained from the Soil Survey for Gosper and Phelps County by the Natural Resource Conservation Services. A rip rap permeability rate of 0.14 cm/sec, with a horizontal to vertical permeability ratio of 1, was utilized in the seepage analysis for Alternative #1.

Table 2

Alternative 1 Seepage Analysis

Structure	Maximum Height of Impounded Water (feet)	Cutoff wall depth (feet)
J-2-D	17	34
J-2-C	12	20
J-2-B	11	17
J-2-A	8	10

In order to manage the total potential seepage out of the bottom of the storage areas for Alternative 2, a 12-inch liner is recommended at the base. Further investigation and analysis is warranted to determine the potential uplift concerns and remedial measures related to the Phelps canal and the exit gradients at the Platte River.

SLOPE STABILITY

Shear strength parameters utilized in the slope stability analyses for the J-2 Return project were determined based on our engineering judgment. The soil properties with the shear strength parameters are summarized in Table 4.

TABLE 4

SOIL PROPERTIES FOR ANALYSIS

Material	**Wet Density, pcf**	**φ', degrees**	**c', psf**
Alluvium clay	120.0	28.0	25
Foundation-Alluvium sand	120.0	32	0
Rip rap	125.0	38.0	0

Based upon the assumed soil properties for Alternatives 1 and 2, the embankments were stable under the analyzed conditions of steady seepage and rapid drawdown. The maximum water height for both conditions was set at 3 feet below the top of the embankment.

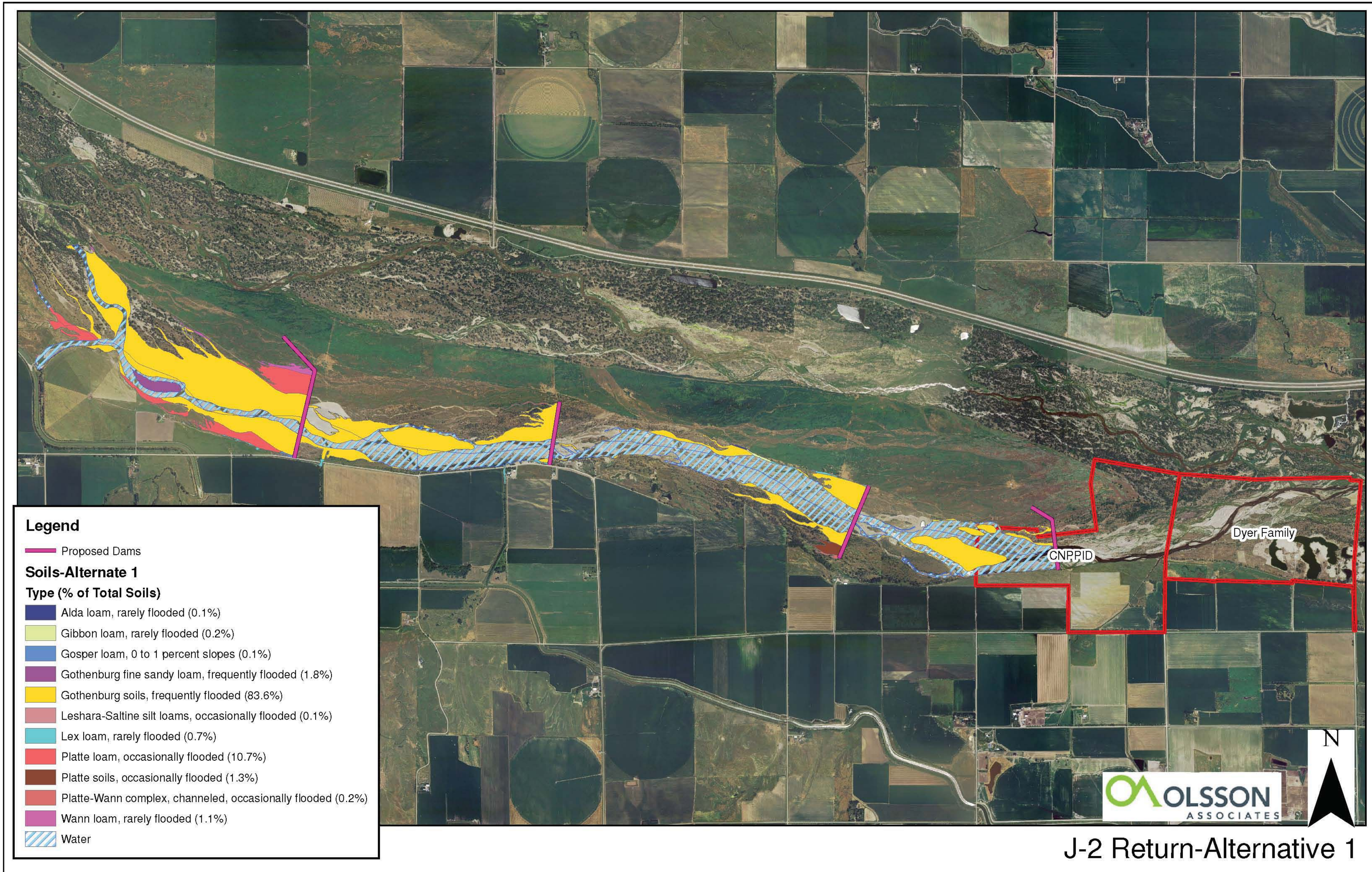
Should you have any questions regarding the recommendations provided in this memorandum, please feel free to call me at (402) 458-5908.

Attachment A – Figures 1, 2, and 3

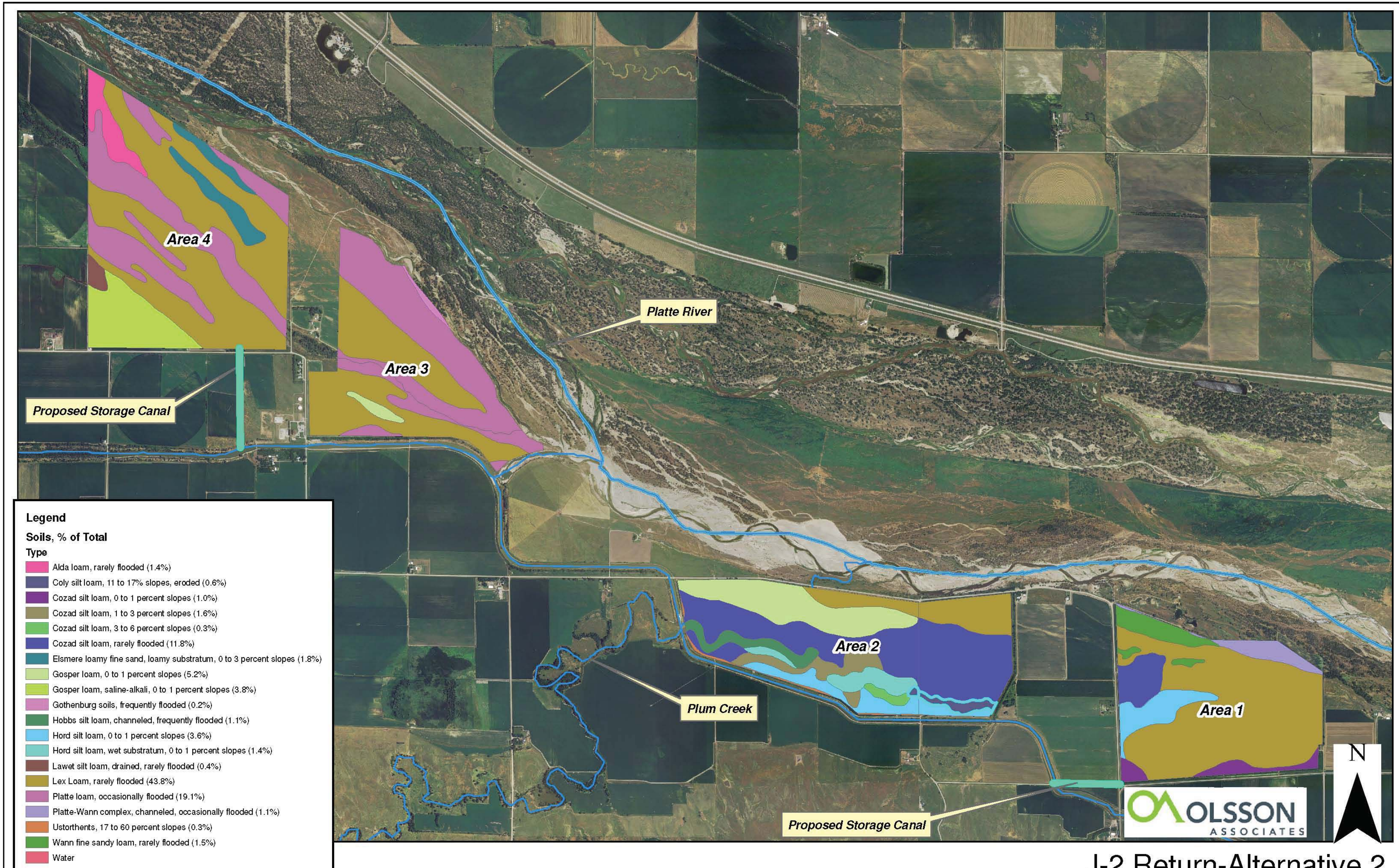
F:\Projects\009-1466\Gtech\MEMO_SeepageStabilty.doc

ATTACHMENT A

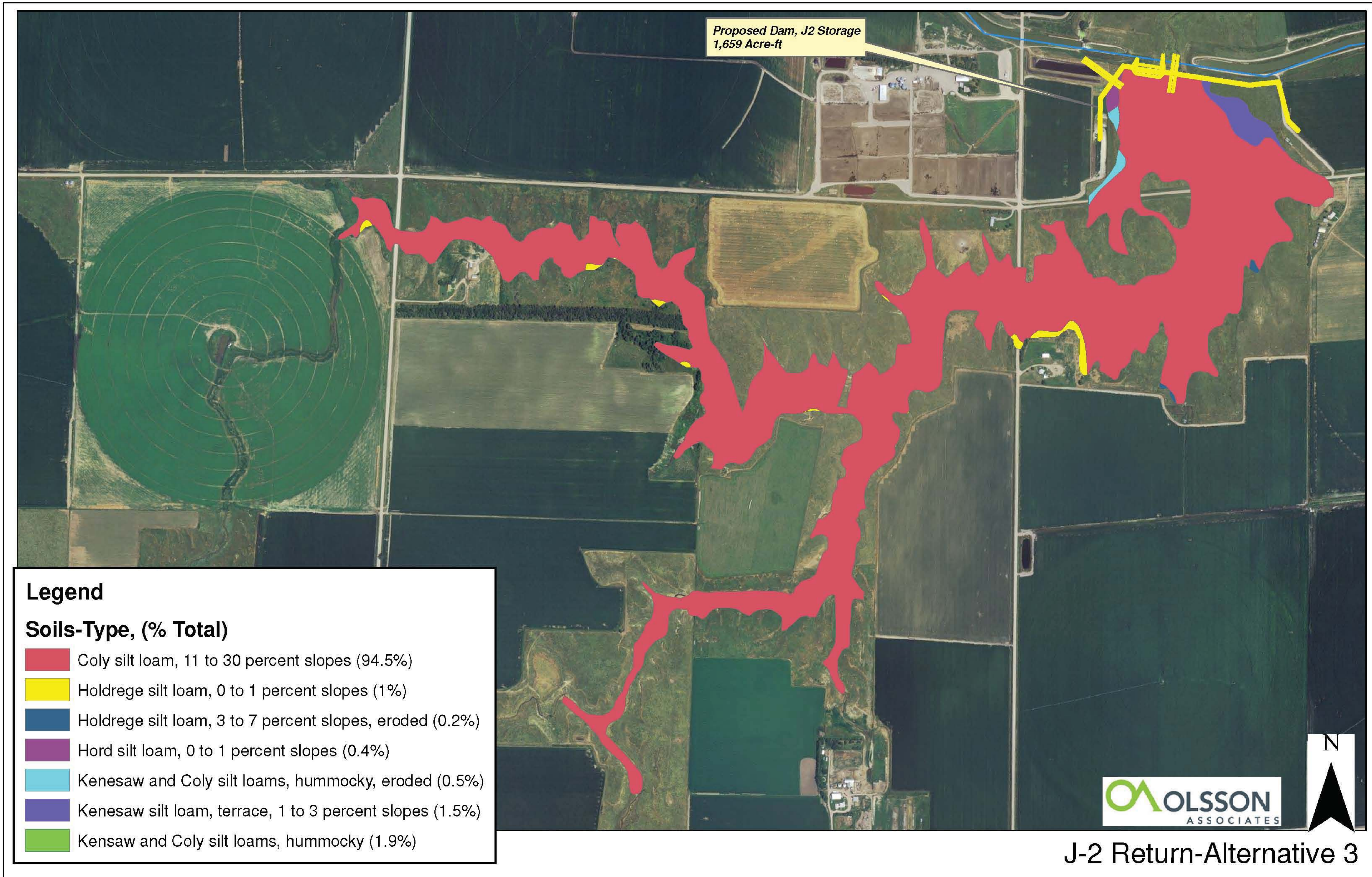
Borrow Location Maps



J-2 Return-Alternative 1



J-2 Return-Alternative 2


Proposed Dam, J2 Storage
1,659 Acre-ft
Legend
Soils-Type, (% Total)
Coly silt loam, 11 to 30 percent slopes (94.5%)
Holdrege silt loam, 0 to 1 percent slopes (1%)
Holdrege silt loam, 3 to 7 percent slopes, eroded (0.2%)
Hord silt loam, 0 to 1 percent slopes (0.4%)
Kenesaw and Coly silt loams, hummocky, eroded (0.5%)
Kenesaw silt loam, terrace, 1 to 3 percent slopes (1.5%)
Kensaw and Coly silt loams, hummocky (1.9%)
N
OLSSON ASSOCIATES
J-2 Return-Alternative 3

Appendix F

Plum Creek HEC-RAS and Platte River and Plum Creek Peak Flow Analyses

Plum Creek HEC-RAS Modeling Results

River Sta	400 cfs				1,200 cfs				2,000 cfs				2,400 cfs			
	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Max Vel (ft/s)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Max Vel (ft/s)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Max Vel (ft/s)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Max Vel (ft/s)
146128	123	2.8	0.46	3.5	175	4.2	0.58	5.3	203	5.2	0.67	6.7	216	5.5	0.68	7.0
144810	61	6.0	1.01	6.6	105	6.1	0.78	7.2	137	5.9	0.66	7.1	149	6.0	0.65	7.4
142835	96	2.5	0.35	3.2	131	3.9	0.46	5.0	146	5.2	0.56	6.5	154	5.6	0.59	7.1
137443	130	3.3	0.61	3.5	221	3.5	0.49	4.2	288	3.4	0.42	4.2	312	3.5	0.41	4.4
131070	94	2.0	0.23	2.1	139	2.7	0.26	3.1	246	2.7	0.27	3.3	280	2.8	0.28	3.5
126128	61	6.0	1.01	6.0	95	7.5	1.01	7.7	117	8.2	1.00	8.7	126	8.6	1.01	9.2
121468	223	1.2	0.17	1.4	350	1.4	0.15	1.7	424	1.5	0.16	1.9	453	1.6	0.16	1.8
116311	73	2.4	0.28	2.5	193	2.5	0.29	3.1	257	2.8	0.29	3.5	282	2.9	0.29	3.6
108989	70	2.9	0.37	3.3	105	3.9	0.41	4.8	127	4.5	0.42	5.5	136	4.7	0.42	5.7
103454	105	2.0	0.26	2.2	161	2.6	0.27	2.8	194	3.0	0.28	3.3	207	3.2	0.29	3.6
96433	138	1.5	0.18	1.7	254	1.8	0.19	2.3	320	2.0	0.20	2.6	347	2.1	0.20	2.8
90195	63	3.5	0.47	4.0	96	4.6	0.50	5.7	117	5.2	0.50	6.5	126	5.4	0.50	6.7
85050	114	1.7	0.20	2.1	155	2.2	0.21	2.7	186	2.4	0.20	2.8	198	2.5	0.20	3.1
79310	44	3.7	0.42	4.3	69	4.5	0.40	5.5	108	4.6	0.41	5.8	139	4.5	0.41	5.9
73749	58	2.5	0.27	3.2	158	3.6	0.32	4.7	188	4.3	0.35	5.6	200	4.6	0.36	6.0
68314	55	4.6	0.65	5.3	66	6.0	0.60	6.8	74	6.5	0.56	7.4	78	6.6	0.54	7.5
60655	79	1.9	0.20	2.1	98	2.6	0.21	2.9	110	3.1	0.23	3.4	115	3.3	0.23	3.7
53254	60	2.7	0.31	3.2	85	4.1	0.39	5.0	111	4.7	0.42	5.9	124	4.7	0.41	6.0
45419	101	2.0	0.25	2.6	163	2.3	0.23	3.1	201	2.6	0.23	3.4	211	2.8	0.25	3.7
39423	47	2.8	0.29	3.0	70	3.8	0.32	4.2	870	1.7	0.26	3.4	874	1.8	0.26	3.7
34109	29	5.4	0.59	6.5	45	6.7	0.58	8.2	83	6.5	0.59	8.5	100	6.3	0.57	8.6
30057	57	2.2	0.22	2.8	77	3.1	0.25	3.8	92	3.5	0.25	4.4	97	3.7	0.26	4.6
23493	39	3.7	0.40	4.4	61	4.7	0.40	5.8	134	5.3	0.47	6.8	172	5.6	0.49	7.2
19909	73	2.5	0.30	3.1	91	4.3	0.43	5.2	112	4.5	0.40	5.5	121	4.5	0.38	5.5
12784	93	2.9	0.41	3.4	113	3.3	0.32	3.7	120	4.4	0.39	4.9	122	5.0	0.44	5.6
7525	75	1.8	0.19	2.3	103	2.7	0.22	3.3	1807	2.7	0.22	3.3	1807	2.7	0.21	3.3
1853	68	4.4	0.66	4.6	88	6.1	0.72	6.7	101	7.1	0.75	7.9	106	7.5	0.76	8.4

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Bulletin 17B Frequency Analysis
    08 Oct 2009   04:55 PM
-------------------------------


--- Input Data ---

Analysis Name: Plum Creek near Smithfield
Description:

Data Set Name: PLUM CREEK-SMITHFIELD, NE-FLOW-ANNUAL PEAK
DSS File Name: F:\Projects\009-1466\HEC-SSP\J-2_Return\J-2_Return.dss
DSS Pathname: /PLUM CREEK/SMITHFIELD, NE/FLOW-ANNUAL PEAK/01jan1900/IR-CENTURY/USGS/

Report File Name:
F:\Projects\009-1466\HEC-SSP\J-2_Return\Bulletin17bResults\Plum_Creek_near_Smithfiel
d\Plum_Creek_near_Smithfield.rpt
XML File Name:
F:\Projects\009-1466\HEC-SSP\J-2_Return\Bulletin17bResults\Plum_Creek_near_Smithfiel
d\Plum_Creek_near_Smithfield.xml

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.3
Regional Skew MSE: 0.3

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 1 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
  Based on 53 events, 10 percent outlier test deviate K(N) = 2.79
                        Computed low outlier test value = 10.26

            0 low outlier(s) identified below test value of 10.26



-----------------------
<< High Outlier Test >>
-----------------------
  Based on 53 events, 10 percent outlier test deviate K(N) = 2.79
                    Computed high outlier test value = 7,605.06

        0 high outlier(s) identified above test value of 7,605.06
```

--- Final Results ---

<< Plotting Positions >>
PLUM CREEK-SMITHFIELD, NE-FLOW-ANNUAL PEAK

Events Analyzed		Ordered Events			
Day Mon Year	FLOW CFS	Rank	Water Year	FLOW CFS	Weibull Plot Pos
23 Jun 1947	2,800.0	1	1947	2,800.0	1.85
23 Jun 1948	2,230.0	2	1948	2,230.0	3.70
06 Jun 1949	1,220.0	3	2008	1,440.0	5.56
30 May 1950	404.0	4	1967	1,320.0	7.41
10 Jun 1951	588.0	5	1949	1,220.0	9.26
27 May 1952	90.0	6	1969	1,140.0	11.11
10 May 1953	18.0	7	1965	985.0	12.96
16 May 1954	220.0	8	1968	938.0	14.81
16 Jun 1955	196.0	9	1989	905.0	16.67
05 Jul 1956	116.0	10	1966	865.0	18.52
16 Jun 1957	844.0	11	1957	844.0	20.37
27 Feb 1958	259.0	12	1960	620.0	22.22
26 Mar 1959	175.0	13	1951	588.0	24.07
22 Mar 1960	620.0	14	1962	562.0	25.93
17 Aug 1961	470.0	15	1963	558.0	27.78
07 Jun 1962	562.0	16	1985	549.0	29.63
15 Jun 1963	558.0	17	1961	470.0	31.48
20 Apr 1964	156.0	18	1975	462.0	33.33
24 May 1965	985.0	19	1991	437.0	35.19
18 Oct 1965	865.0	20	1984	427.0	37.04
13 Jun 1967	1,320.0	21	1950	404.0	38.89
10 Aug 1968	938.0	22	1970	355.0	40.74
18 Sep 1969	1,140.0	23	1999	346.0	42.59
12 Jun 1970	355.0	24	2005	335.0	44.44
25 Mar 1971	17.0	25	1973	332.0	46.30
24 Jun 1972	242.0	26	1977	323.0	48.15
01 Sep 1973	332.0	27	2007	306.0	50.00
12 Jun 1974	15.0	28	1986	280.0	51.85
22 Jun 1975	462.0	29	1978	270.0	53.70
09 Apr 1976	143.0	30	1998	264.0	55.56
22 May 1977	323.0	31	1958	259.0	57.41
11 Mar 1978	270.0	32	1996	242.0	59.26
28 Jul 1981	130.0	33	1972	242.0	61.11
14 Aug 1982	44.0	34	1988	222.0	62.96
18 May 1983	26.0	35	1954	220.0	64.81
05 Jul 1984	427.0	36	1990	218.0	66.67
06 Sep 1985	549.0	37	1955	196.0	68.52
10 May 1986	280.0	38	1987	186.0	70.37
11 Jun 1987	186.0	39	2006	184.0	72.22
19 Jul 1988	222.0	40	2003	175.0	74.07
25 Jun 1989	905.0	41	1959	175.0	75.93
12 Aug 1990	218.0	42	1964	156.0	77.78
07 Sep 1991	437.0	43	1976	143.0	79.63
27 May 1996	242.0	44	1981	130.0	81.48
13 Aug 1997	34.0	45	1956	116.0	83.33
30 Jul 1998	264.0	46	1952	90.0	85.19
28 Jun 1999	346.0	47	2004	89.0	87.04
24 May 2003	175.0	48	1982	44.0	88.89

10 Jul 2004	89.0	49	1997	34.0	90.74
03 Jun 2005	335.0	50	1983	26.0	92.59
11 Sep 2006	184.0	51	1953	18.0	94.44
23 Aug 2007	306.0	52	1971	17.0	96.30
24 May 2008	1,440.0	53	1974	15.0	98.15

<< Skew Weighting >>

Based on 53 events, mean-square error of station skew = 0.148
Mean-square error of regional skew = 0.3

<< Frequency Curve >>
PLUM CREEK-SMITHFIELD, NE-FLOW-ANNUAL PEAK

Computed Curve FLOW, CFS	Expected Probability FLOW, CFS	Percent Chance Exceedance	Confidence Limits 0.05 FLOW, CFS	Confidence Limits 0.95 FLOW, CFS
5,134.2	5,841.2	0.2	9,648.0	3,191.8
3,999.9	4,427.6	0.5	7,205.2	2,559.8
3,228.6	3,507.3	1.0	5,612.4	2,116.6
2,532.7	2,701.8	2.0	4,232.8	1,704.8
1,729.4	1,806.1	5.0	2,724.3	1,210.1
1,210.5	1,245.1	10.0	1,811.5	874.8
768.1	780.0	20.0	1,085.2	573.8
299.3	299.3	50.0	393.4	228.6
105.8	103.7	80.0	141.3	75.2
59.0	56.7	90.0	82.3	38.9
35.7	33.4	95.0	52.2	21.8
13.2	11.4	99.0	21.5	6.8

<< Systematic Statistics >>
PLUM CREEK-SMITHFIELD, NE-FLOW-ANNUAL PEAK

Log Transform: FLOW, CFS		Number of Events	
Mean	2.446	Historic Events	0
Standard Dev	0.514	High Outliers	0
Station Skew	-0.670	Low Outliers	0
Regional Skew	0.300	Zero Events	0
Weighted Skew	-0.350	Missing Events	0
Adopted Skew	-0.350	Systematic Events	53

```
-------------------------------
Bulletin 17B Frequency Analysis
    14 Oct 2009   03:20 PM
-------------------------------


--- Input Data ---

Analysis Name: Platte River - Overton, NE, Annual Peak Flow
Description:

Data Set Name: PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK
DSS File Name: F:\Projects\009-1466\HEC-SSP\J-2_Return\J-2_Return.dss
DSS Pathname: /PLATTE RIVER/OVERTON, NEBR./FLOW-ANNUAL
PEAK/01jan1900/IR-CENTURY/USGS/

Report File Name:
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E,_Annual_Peak_Flow\Platte_River_-_Overton,_NE,_Annual_Peak_Flow.rpt
XML File Name:
F:\Projects\009-1466\HEC-SSP\J-2_Return\Bulletin17bResults\Platte_River_-_Overton,_N
E,_Annual_Peak_Flow\Platte_River_-_Overton,_NE,_Annual_Peak_Flow.xml

Start Date:
End Date:

Skew Option: Use Station Skew
Regional Skew: 0.0
Regional Skew MSE: 0.0

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
 Based on 91 events, 10 percent outlier test value K(N) = 2.984

          0 low outlier(s) identified below test value of 727.6



-----------------------
<< High Outlier Test >>
-----------------------
 Based on 91 events, 10 percent outlier test value K(N) = 2.984

     0 high outlier(s) identified above test value of 59,309.81
```

--- Final Results ---

<< Plotting Positions >>
PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK

Events Analyzed				Ordered Events			
			FLOW		Water	FLOW	Weibull
Day	Mon	Year	CFS	Rank	Year	CFS	Plot Pos
29	May	1915	19,600	1	1935	37,600	1.09
24	May	1916	5,200	2	1921	37,000	2.17
02	Jun	1917	29,300	3	1917	29,300	3.26
10	Oct	1918	9,000	4	1928	23,000	4.35
18	May	1920	21,500	5	1983	22,900	5.43
14	Jun	1921	37,000	6	1923	22,000	6.52
23	May	1922	9,400	7	1920	21,500	7.61
17	Jun	1923	22,000	8	1915	19,600	8.70
20	Jun	1926	15,500	9	1973	19,100	9.78
19	Apr	1927	12,800	10	1929	19,000	10.87
12	Jun	1928	23,000	11	1947	18,700	11.96
07	Jun	1929	19,000	12	1971	15,700	13.04
13	May	1930	9,940	13	1984	15,600	14.13
04	Apr	1931	10,600	14	1926	15,500	15.22
18	Mar	1932	6,120	15	1942	15,200	16.30
23	Apr	1933	8,440	16	1949	15,100	17.39
01	Feb	1934	5,210	17	1980	14,600	18.48
05	Jun	1935	37,600	18	1965	14,600	19.57
05	Mar	1936	6,100	19	1995	14,500	20.65
20	Mar	1937	7,050	20	1927	12,800	21.74
28	Feb	1938	7,680	21	1999	12,200	22.83
18	Mar	1939	9,660	22	2008	11,200	23.91
02	Mar	1940	8,940	23	1997	11,000	25.00
16	Mar	1941	2,330	24	1931	10,600	26.09
10	May	1942	15,200	25	1930	9,940	27.17
12	Apr	1943	3,860	26	1939	9,660	28.26
12	May	1944	4,070	27	1922	9,400	29.35
11	Jun	1945	5,530	28	1919	9,000	30.43
16	Mar	1946	3,490	29	1940	8,940	31.52
23	Jun	1947	18,700	30	1974	8,810	32.61
23	Jun	1948	5,990	31	1970	8,660	33.70
24	Jun	1949	15,100	32	1933	8,440	34.78
14	Nov	1949	3,210	33	1938	7,680	35.87
18	May	1951	7,550	34	1986	7,590	36.96
27	Mar	1952	5,710	35	1979	7,580	38.04
09	Jan	1953	4,640	36	1951	7,550	39.13
06	Nov	1953	2,930	37	1957	7,530	40.22
10	Mar	1955	2,370	38	1969	7,260	41.30
31	Mar	1956	1,970	39	1985	7,160	42.39
25	May	1957	7,530	40	1962	7,100	43.48
26	May	1958	5,800	41	1937	7,050	44.57
29	Mar	1959	2,960	42	1960	6,950	45.65
24	Mar	1960	6,950	43	1987	6,890	46.74
19	Jun	1961	3,490	44	1996	6,300	47.83
09	Jun	1962	7,100	45	1932	6,120	48.91
15	Feb	1963	3,020	46	1967	6,100	50.00
07	Apr	1964	2,360	47	1936	6,100	51.09
26	Jun	1965	14,600	48	1998	6,070	52.17
02	Mar	1966	3,410	49	1948	5,990	53.26

08 Jul 1967	6,100	50	1977	5,890	54.35
22 Feb 1968	2,550	51	1958	5,800	55.43
30 Jun 1969	7,260	52	1952	5,710	56.52
26 Jun 1970	8,660	53	1945	5,530	57.61
13 Jun 1971	15,700	54	1975	5,500	58.70
14 May 1972	4,750	55	1934	5,210	59.78
15 May 1973	19,100	56	1916	5,200	60.87
21 Mar 1974	8,810	57	1988	4,990	61.96
21 Jun 1975	5,500	58	1993	4,930	63.04
11 Apr 1976	2,860	59	1972	4,750	64.13
22 May 1977	5,890	60	1953	4,640	65.22
15 Mar 1978	3,600	61	1991	4,590	66.30
28 Jun 1979	7,580	62	2000	4,480	67.39
25 May 1980	14,600	63	2007	4,420	68.48
28 Jul 1981	3,730	64	1989	4,090	69.57
09 Mar 1982	2,520	65	1944	4,070	70.65
28 Jun 1983	22,900	66	1943	3,860	71.74
13 Jun 1984	15,600	67	1981	3,730	72.83
23 Feb 1985	7,160	68	1978	3,600	73.91
18 Jun 1986	7,590	69	1961	3,490	75.00
31 May 1987	6,890	70	1946	3,490	76.09
24 Feb 1988	4,990	71	1966	3,410	77.17
27 Jun 1989	4,090	72	1992	3,230	78.26
15 Aug 1990	3,200	73	1950	3,210	79.35
24 May 1991	4,590	74	1990	3,200	80.43
28 Aug 1992	3,230	75	2001	3,160	81.52
09 Mar 1993	4,930	76	1963	3,020	82.61
04 Mar 1994	2,900	77	1959	2,960	83.70
15 Jun 1995	14,500	78	1954	2,930	84.78
23 Sep 1996	6,300	79	1994	2,900	85.87
19 Jun 1997	11,000	80	1976	2,860	86.96
04 Apr 1998	6,070	81	1968	2,550	88.04
19 Aug 1999	12,200	82	1982	2,520	89.13
01 Oct 1999	4,480	83	1955	2,370	90.22
21 Oct 2000	3,160	84	1964	2,360	91.30
10 Apr 2002	2,060	85	1941	2,330	92.39
17 Apr 2003	2,010	86	2006	2,180	93.48
01 Mar 2004	2,140	87	2004	2,140	94.57
05 Jun 2005	2,120	88	2005	2,120	95.65
30 Mar 2006	2,180	89	2002	2,060	96.74
02 Jun 2007	4,420	90	2003	2,010	97.83
25 May 2008	11,200	91	1956	1,970	98.91

<< Skew Weighting >>

Based on 91 events, mean-square error of station skew =   0.076
Mean-square error of regional skew =   0

<< Frequency Curve >>

PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK

Computed Curve	Expected Probability	Percent Chance	Confidence Limits 0.05	Confidence Limits 0.95
FLOW, CFS		Exceedance	FLOW, CFS	

74,015	81,104	0.2	106,566	55,350
55,226	59,109	0.5	76,574	42,503
43,640	45,970	1.0	58,741	34,350
33,955	35,281	2.0	44,318	27,353
23,593	24,142	5.0	29,512	19,613
17,283	17,530	10.0	20,911	14,712
12,037	12,123	20.0	14,096	10,471
6,306	6,306	50.0	7,164	5,544
3,501	3,481	80.0	4,029	2,984
2,632	2,605	90.0	3,080	2,186
2,103	2,070	95.0	2,502	1,707
1,418	1,376	99.0	1,743	1,101

<< Systematic Statistics >>
PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK

Log Transform: FLOW, CFS		Number of Events	
Mean	3.8175	Historic Events	0
Standard Dev	0.3202	High Outliers	0
Station Skew	0.3333	Low Outliers	0
Regional Skew	0.0000	Zero Events	0
Weighted Skew	0.0000	Missing Events	0
Adopted Skew	0.3333	Systematic Events	91

Appendix G

Scope of Work for Feasibility Analysis of Preferred Alternative

Scope of Work for Feasibility Analysis of Preferred Alternative

The next step for implementation of the preferred option should be a feasibility analysis to refine the design, costs, constraints and schedule of the project. The following is a brief description of the major subjects to be analyzed.

Topographic Information

Before any further analysis in performed, much better and more accurate topographic information is required. Therefore, the aforementioned LiDar must become available, or the area should be mapped with conventional aerial photography methods.

Geotechnical Analysis

Assuming that the alternative that moves forward for further analysis is a combination of a new J-2 reservoir and the Elwood reservoir, further geotechnical analysis, including soil borings, needs to be conducted. Even if Elwood is not used for the bulk of SDHFs, any change to its operation should be analyzed in more detail than it has been so far with the additional geotechnical information.

Likewise, further analysis of any J-2 reservoir alternative should be with the benefit of additional geotechnical information. Seepage is still a major concern and lining options should be evaluated.

Permitting Information

A much more in depth evaluation than that performed during the alternative screening of the exact environmental permitting requirements, with an emphasis on time frames, needs to be conducted during the feasibility analysis.

Conceptual Design and Conceptual Design Level Opinions of Construction Costs

The cost estimates in the screening analysis should be further refined with the benefit of better topography, more complete geotechnical information and more developed design. Therefore, the following components of design should undergo conceptual level design:

- Outlet works from Elwood reservoir
- Conveyance from the outlet works to Plum Creek
- Upgrades to Plum Creek
- Earthwork for the proposed J-2 reservoir
- Outlet gate for the proposed J-2 reservoir

Model Operations and Refine the Impact on Operational Costs

The entire operations should be modeled one more time, and this will allow operational costs to be more accurately estimated.

Land Acquisition Requirements and Costs

A more accurate assessment of land acquisition needs and the associated costs need to be performed.

Schedule

A complete upgraded schedule is important at this time. Implementation by the year 2014 is still achievable, but a detailed schedule including critical path elements would be a useful tool for moving forward. The major components that need to be scheduled include:

- Preliminary Design
- Environmental permitting
- Land Acquisition
- Final Design and construction documents
- Construction
- Operational start up

Appendix H

Elwood Embankment Stability Analysis

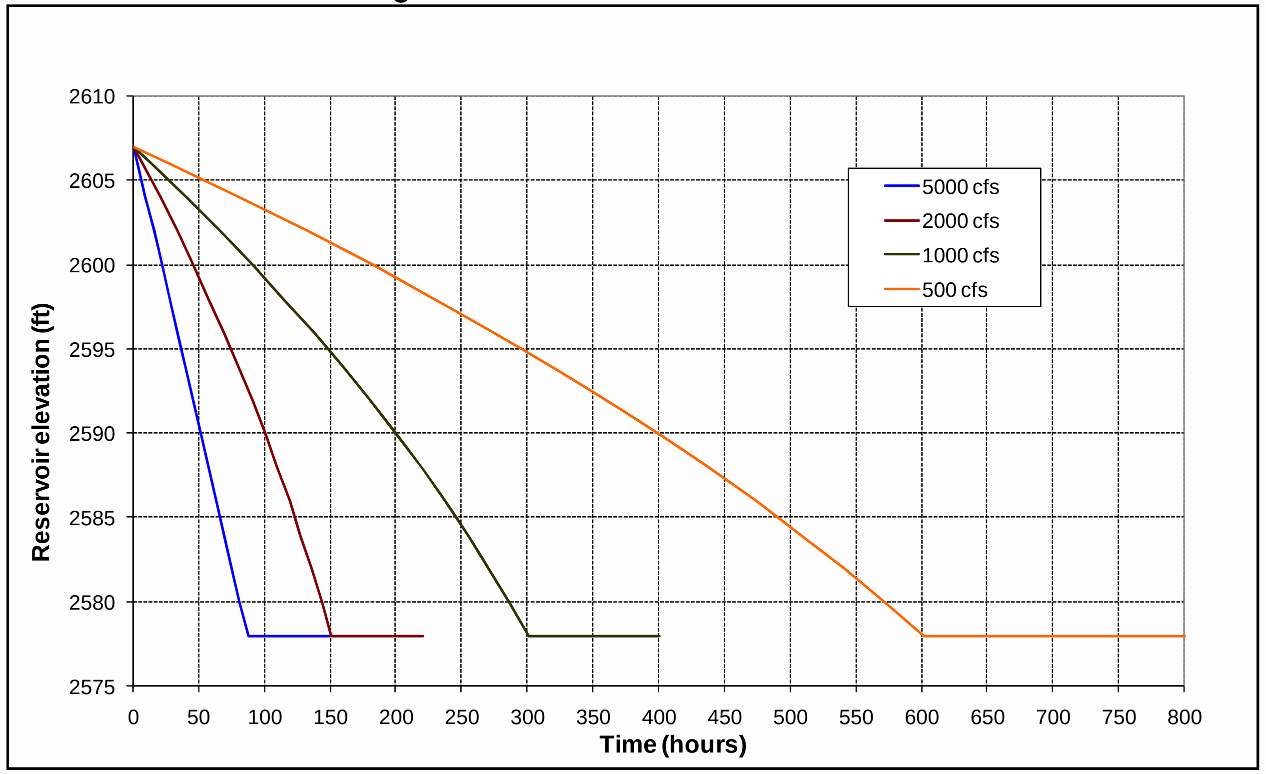
ELWOOD EMBANKMENT STABILITY ANALYSIS

The results and conclusions of the stability analysis of the Elwood Reservoir embankment is discussed in Section 3.1. The technical analysis is described in detail below.

Drawdown Curves

A set of drawdown curves was produced for the reservoir based on the reservoir storage curve and the required capacity of a new outlet. Drawdown curves ranging between 5,000 cfs and 500 cfs are included as Figure I-1, below. The discharge capacity reduces as the head on the pipe is reduced, but so does the reservoir storage. These two variables combine to create a drawdown curve that is almost linear over the operating range, see Figure I-1.

Figure I-1 – Elwood Drawdown Curves



Embankment Stability Analyses

The dam embankment cross-section used for the analyses, at dam centerline station 26+20, has been taken from the dam plans provided by the Nebraska Department of Natural Resources. The preliminary design parameters considered are listed below in Table I-1.

The first set of analyses uses the minimum values of all the parameters, with the exception of the soil cement where the maximum value has been used.

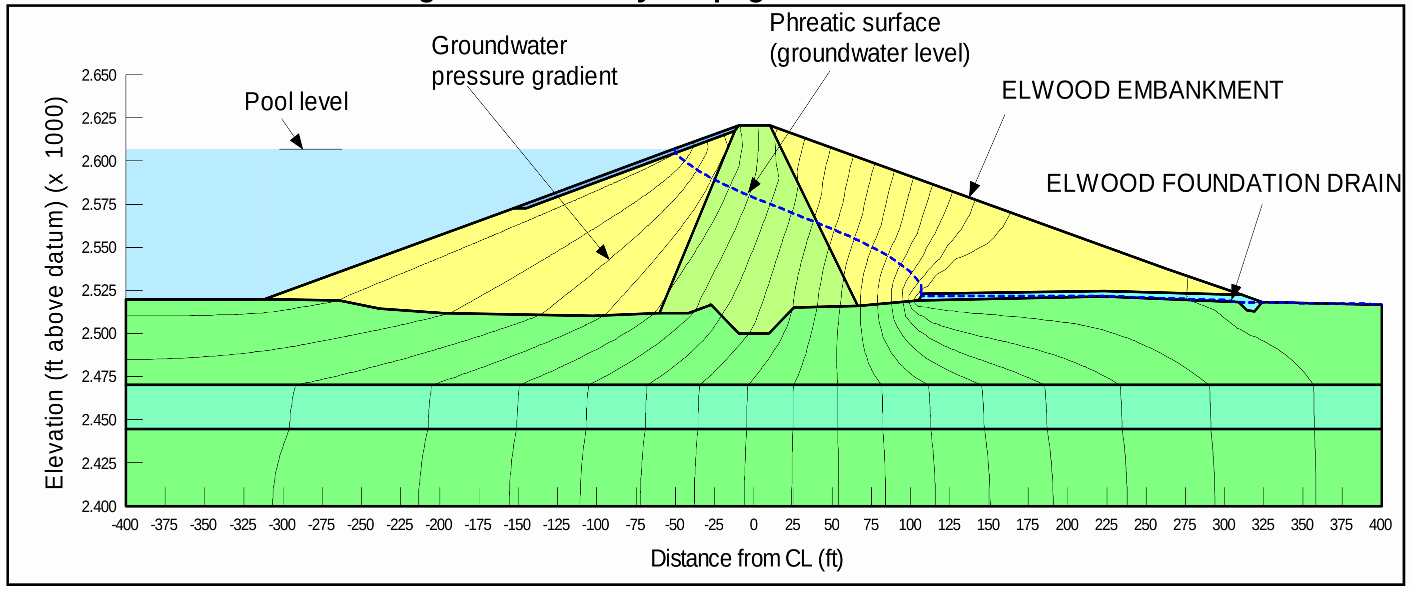
Geotechnical properties shown below are assumed values and have been established based on experience with similar material through discussion with members of our team who have worked with the soils in this area.

Table I-1 – Elwood Reservoir Embankment Preliminary Design Parameters

Material	Density (pcf)		c′ (psf)		ϕ′ (°)		k (cm/sec)		anisotropy k_h/k_v	
	min	max	min	max	min	max	min	max	min	max
Shoulder fill	120	128	0	100	25	27	1e-7	5e-6	1	3
Core fill	118	125	0	50	25	27	1e-7	1e-6	1	3
Soil cement	125	130	50	200	30	35	3e-12	As fill	0.1	1
Drainage material	120	130	0	0	30	33	1e-3	1e-1	1	1
Foundation clayey silt	125	130	0	150	25	27	5e-8	5e-6	1	10
Foundation silty sand	125	130	0	50	28	32	1e-6	1e-5	1	10

The steady state phreatic surface through the embankment is shown in Figure B-2. As the material properties in the shell and core are very similar there is no change in permeability through the embankment. We also have assumed the permeability of the soil cement is similar to the embankment. These assumptions generate a phreatic surface without significant drops or changes.

Figure I-2 – Steady Seepage Results – Run 1



Stability analyses to determine the factor of safety against failure were performed using the limit equilibrium computer program Slope/W. This program was used to search multiple failure surface and the most critical of these surface are reported. Only rapid drawdown stability was evaluated.

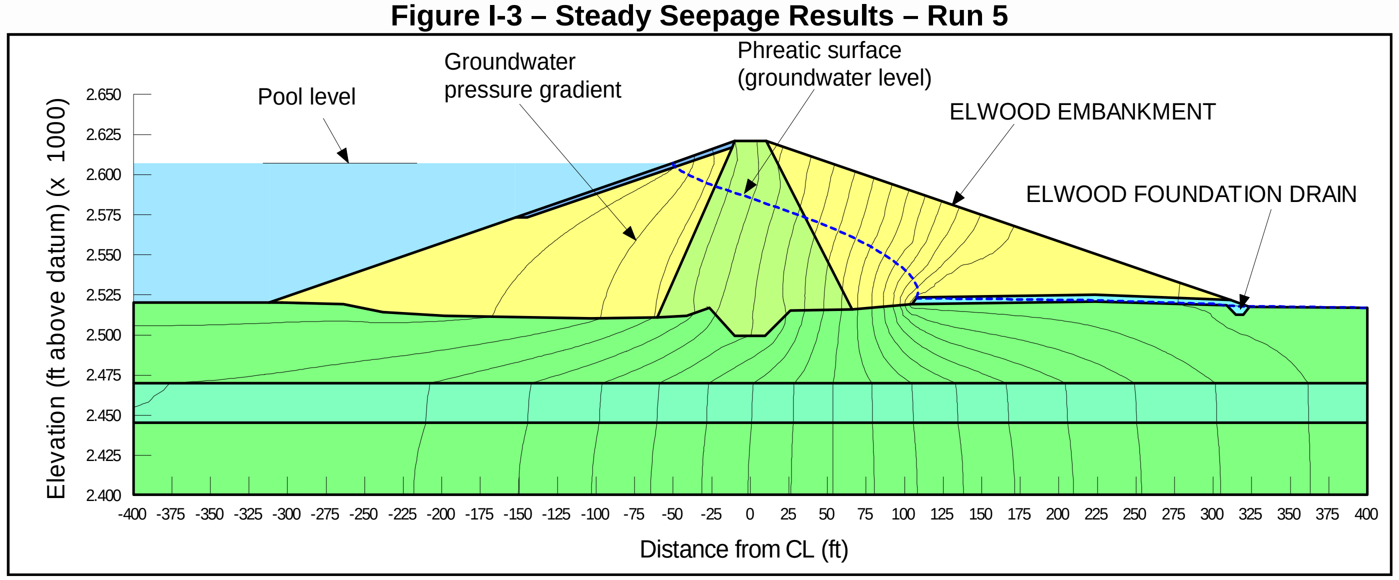
The factor of safety for varying drawdown rates is shown below in Table I-2. Runs 1 to 4 give the minimum factors of safety, obtained by varying the drawdown rate while maintaining the other parameters unchanged. It can be seen that even with the drawdown rate reduced to 500 cfs, the rate is too fast to maintain a minimum factor of safety of greater than the typically accepted value of 1.2, during drawdown. The effect of the slower drawdown is just apparent in the results but with the permeability assumed, the drawdown would need to be significantly slower for any real improvement in stability.

Table I-2 – Calculated Factors of Safety

Run No.	Draw-down rate	Permeability (cm/sec)		Min Factor of Safety	Comments
		Fill	Soil-Cement		
	Constant permeability - varied drawdown rate				
1	5000 cfs	1e-7	1e-7	0.93	
2	2000 cfs	1e-7	1e-7	0.93	
3	1000 cfs	1e-7	1e-7	0.94	
4	500 cfs	1e-7	1e-7	0.95	
	Constant rate of drawdown – varied permeability				
5	2000 cfs	1e-6	1e-6	0.85	
6	2000 cfs	1e-7	1e-8	0.99	

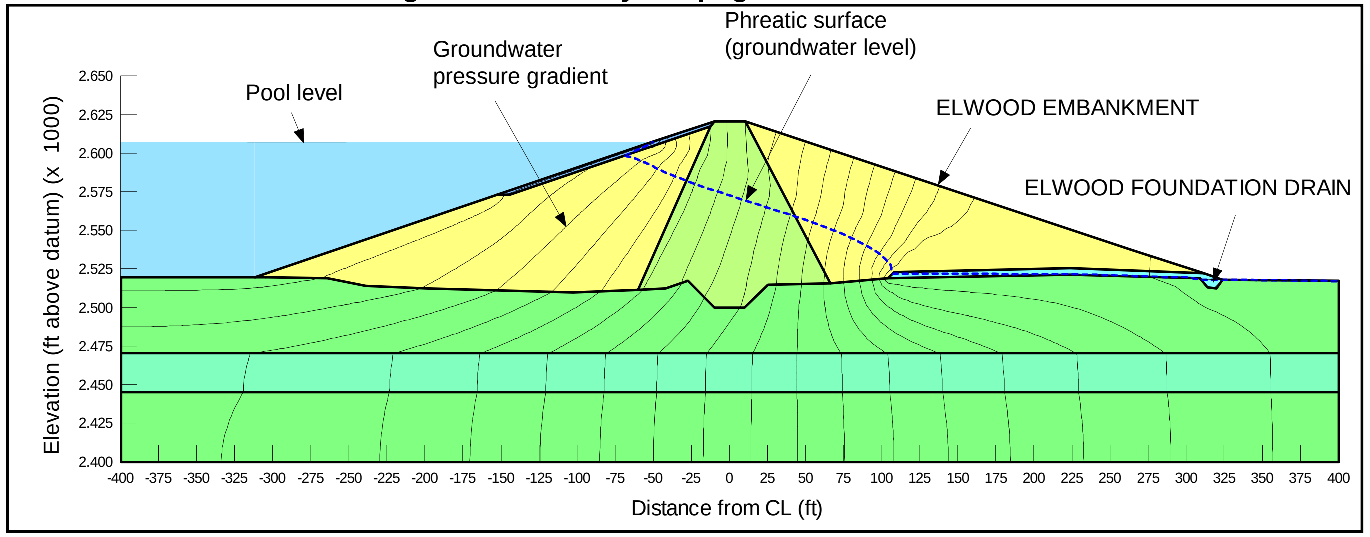
Runs 5 and 6 evaluate the effects of small variations in the permeability of the fill and of the soil-cement. In Run 5, the permeability of both these materials is increased by a factor of 10. At first sight, it would be expected that the increase in permeability would improve the stability, however just the opposite occurs. A comparison between Run 1 and Run 4, where the rate of drawdown is varied by the same factor of 10, indicates that this is an insufficient change to significantly affect the stability and a factor of safety of about 0.95 would be expected. However, there is a reduction from 0.95 to 0.85 when a permeability factor of 10 is applied. On examination of the output, it appears this is the effect of increased flow to the blanket drain, which appears to be surcharged, resulting in a rise in the steady-state phreatic surface. A comparison of Figure I-3 and Figure I-4 shows this small difference. These results demonstrate that small changes in one part of the model can have an unexpected effect elsewhere.

Figure I-3 – Steady Seepage Results – Run 5



The results from Run 6 show that although the lower permeability in the soil-cement gives a reduced steady state phreatic surface (Figure I-4), the minimum factor of safety during drawdown is not significantly affected.

Figure I-4 – Steady Seepage Results – Run 6



Plots of factor of safety against reservoir level (shown as time) are given in Figures I-5 and I-6. Figure I-5 shows the full range of results for runs 1 to 4, inclusive. Within the range of drawdown rates considered, the factor of safety is not affected by the rate but only by the reservoir level. The assumed permeability of the embankment causes drainage of the embankment to be so slow -- that only extremely slow drawdown rates will maintain an acceptable factor of safety throughout the drawdown.

This would seem to indicate that the stability of the existing embankment over the years has been achieved because of its rapid filling and draining. This operation has inhibited the formation of steady state seepage conditions within the embankment.

Figure I-5 – Effect of Drawdown Rate on Factors of Safety (Permeability of shoulder, core and soil-cement = 1e-7 cm/sec)

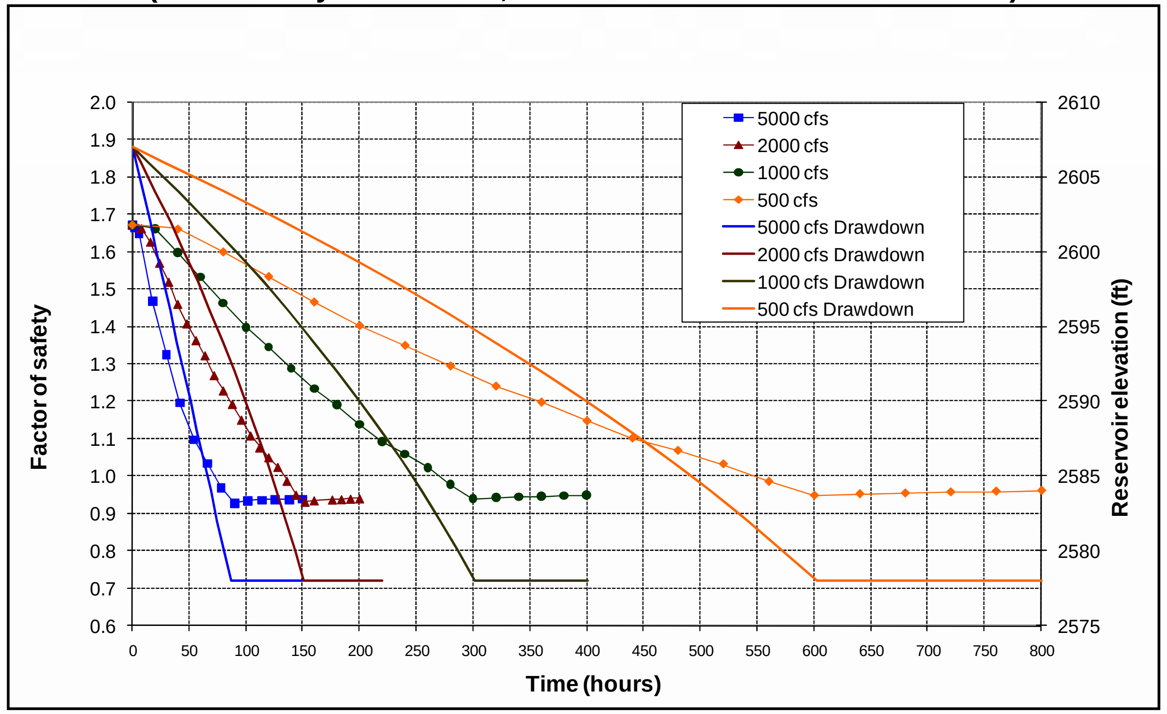


Figure I-6 – Effects of Permeability Variations on Factor of Safety with 2,000 cfs Drawdown Rate

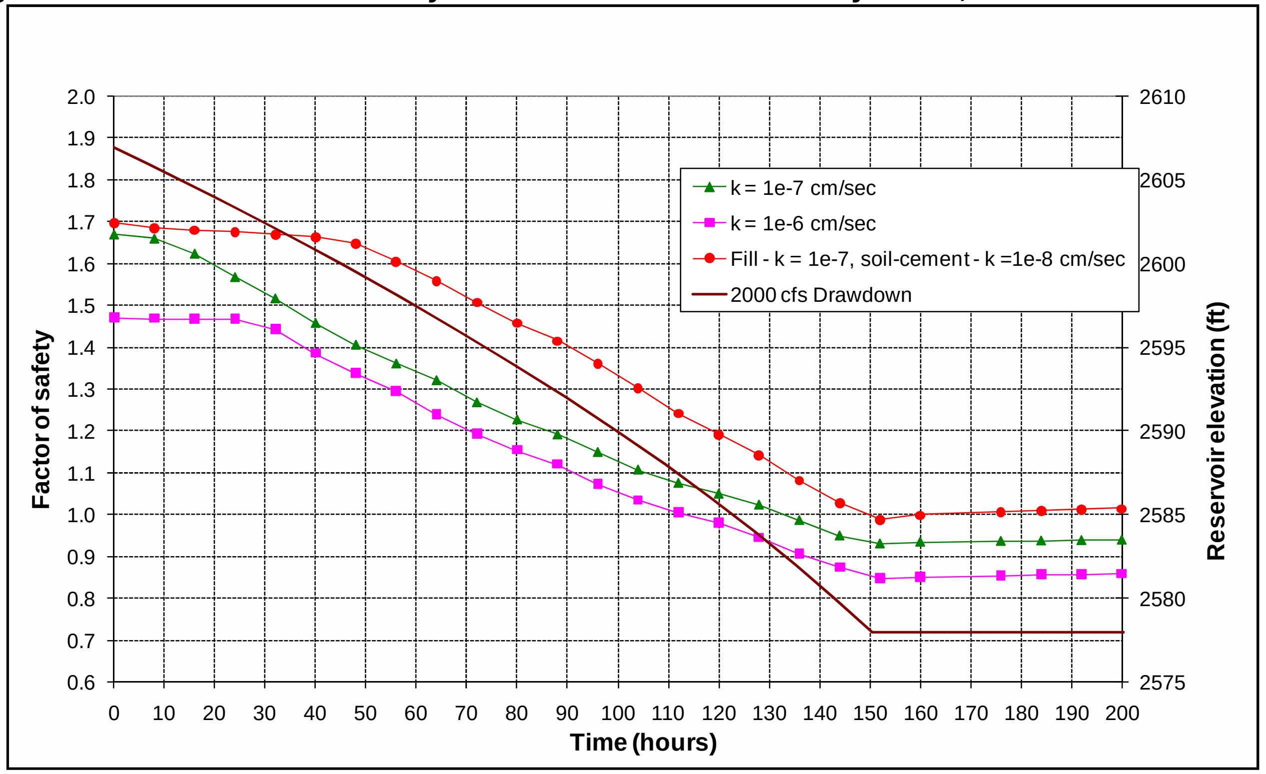
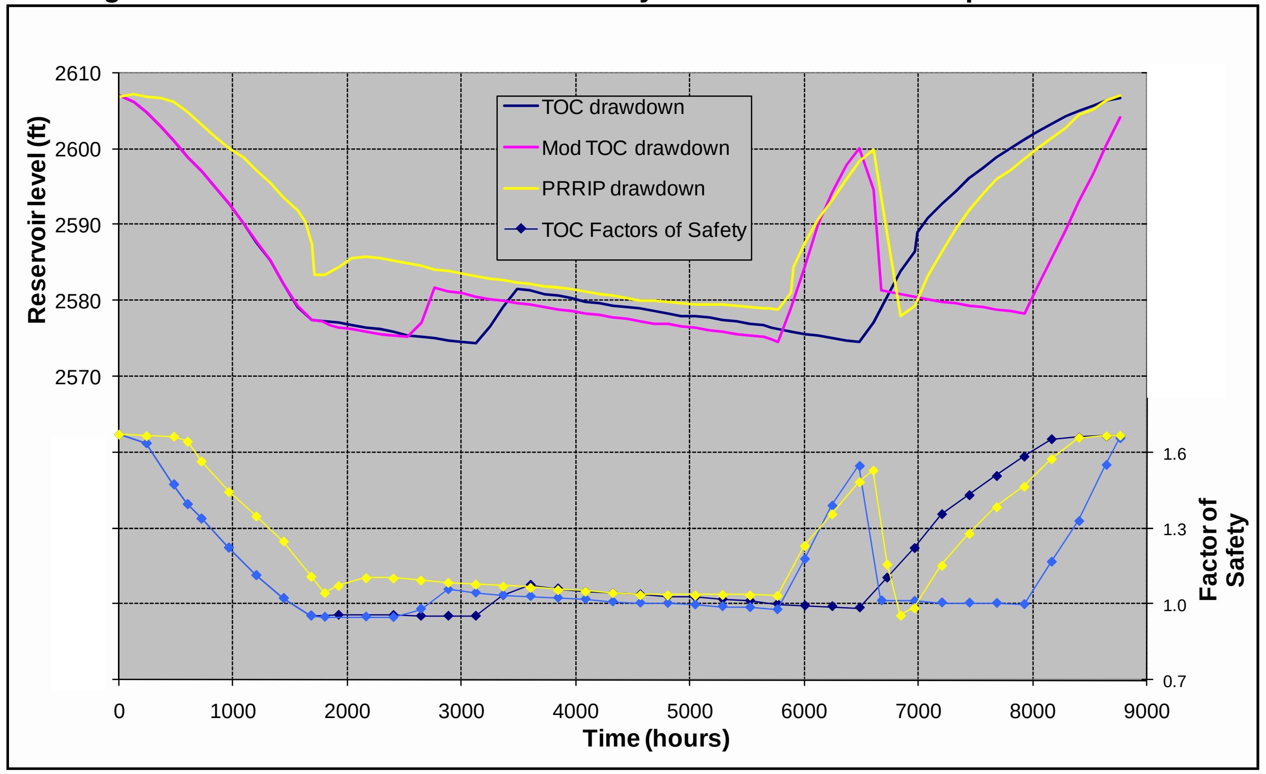


Figure I-6 shows the results of Runs 2, 5 and 6. It is interesting to note that the effect of the higher fill permeability is to reduce the steady state factor of safety, below the usual requirement of 1.5.

Lastly, stability analyses of the embankment based on provided target operation curves was performed. These curves include a normal Target Operating Curve (TOC) and two operating curve scenarios where short duration high capacity flows would be delivered from Elwood. These two operating curves are identified as the Modified TOC and the PRRIP drawdown.

Again, without substantial data, broad assumptions were made as part of these analyses. These assumptions include utilizing the same geotechnical characteristics as our previous analyses. We also made the assumption that the embankment and internal phreatic surface was at a steady state condition prior to the initiation of these operation curves. We have plotted the embankment factor of safety at each stage of reservoir operation on the attached figure for each operating curve.

Figure I-7 – Embankment Factor of Safety for Three Reservoir Operation Curves



These analyses show that instability of the embankment begins to occur when the reservoir elevation is close to 2,580 feet, regardless of the planned operation curve. However, it is important to restate that we have assumed the embankment is in a steady state seepage condition at the beginning of these analyses. Instability likely has not occurred to date because it does not appear the reservoir has been filled long enough for steady state seepage conditions to develop at the Elwood Dam. Because of the possibility of this condition occurring at Elwood, we believe this is the most conservative condition from which to perform these analyses. We recognize that the operation of the reservoir may not have allowed steady state seepage conditions, under full reservoir heads, to fully develop.

Conclusions of Existing Embankment Stability Analysis

a. The analyses performed indicate that changing the operation of the Elwood Dam to release 2,400 cfs over three days has the potential to destabilize the upstream slope. This destabilization is likely to occur if rapid drawdown were to occur after steady state conditions had been established. Steady state conditions could exist if the reservoir were filled to its normal elevation and maintained there for an extended period of time. Without a better understanding of the permeability characteristics of the embankment material, it is difficult to estimate how long it will take for steady state conditions to be established.

b. Assuming the existing dam consists of homogenous materials (the characteristics of which are detailed in the stability analysis in Appendix I), the factors of safety during rapid drawdown of 2,400 cfs drop well below the normally accepted value of 1.2 to a minimum of 0.93

c. Reducing the drawdown rate to 500 cfs would not significantly improve the rapid drawdown stability situation. Therefore, it was concluded that the stability of the existing dam would not be acceptable under any reasonable drawdown rate that would be beneficial for SDHF augmentation.

d. The results are sensitive to variations in relative permeability of the various fill materials, including the drainage materials. No sensitivity analysis was done on the strength parameters but the results are likely to be less sensitive to a realistic variation in strength as opposed to the conservative estimates used in the analysis. In situ and laboratory permeability testing of all materials will be required to improve the estimate of rapid drawdown stability. This testing needs to be complemented by particle size analyses to assess the variability. Effective stress shear strength tests also will be necessary.

Appendix I

Summary of J-2 Options and Additional J-2 Options Not Scored

Summary of J-2 Options and Additional J-2 Options Not Scored

Number	Alternative	Description	Storage Area (ac-ft)	Storage Area (ac-ft)	Storage Area (ac-ft)	Storage Area (ac-ft)
1	South Channel Impoundments	Dams J2-A, J2-B, J2-C, and J2-D al located on the south channel, cascading impoundments no excavation, impounding water from Jeffrey's Island to the south shore of the south channel'	J2-A 268	J2-B 657	J2-C 642	J2-D 1608
2	South Channel Excavation	Excavation areas cutting back along the banks of the south channel Areas 3 and 4 would impound water above J2 return entrance level and therefore would require pumping	Area 1 9716	Area 2 6818	Area 3 4516 note - 2533 ac-ft without pumping	Area 4 6137 note - 960 without pumping
3	9-7 Canal Impoundment	Located at discharge of the 9-7 Canal				
4	Widen J-2 Canal	limited storage				
5	Impoundment on North Channel	The North Channel of the Platte has Threatened and Endangered Species habitat.				
6	South Channel Impoundments higher than the south bank	Without excavation and containment, inundation would involve houses, crop land, etc.				
7	Raise embankments of J2 return	limited ability, due to the operation of the hydropower station				
8	Raise county road 749, and impound water behind it					
9	Use of wells and pumps					
10	Combination of Alternatives 1 and 2					
11	Balancing earthwork for Alternative 2					

Alternative Color Code

(pink)	Full Capability options
(green)	option with limited SDHF / Target Flow
(white)	discussion only