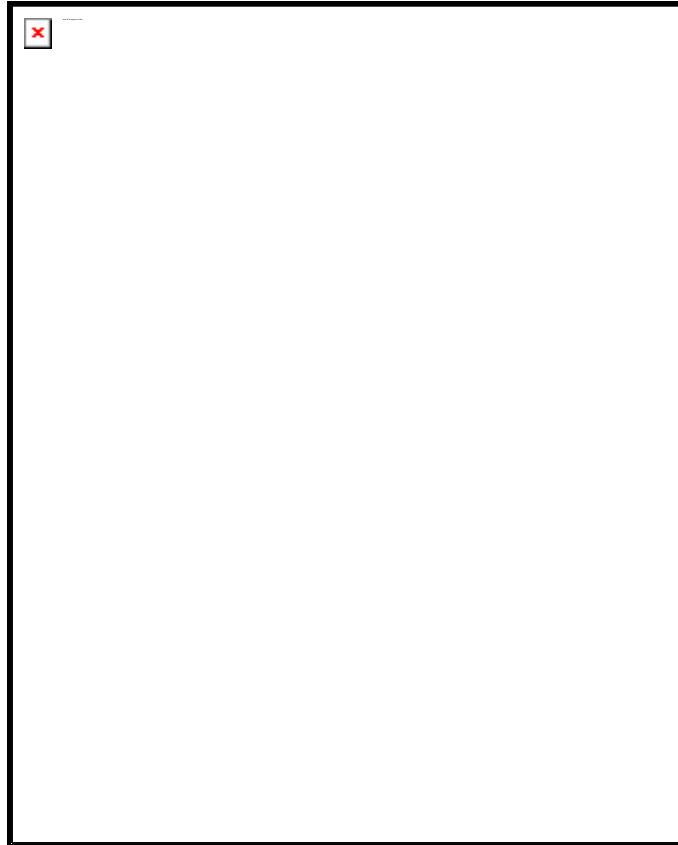


Great Basin Depressional and Slope Wetlands Profiles by Subclass

Introduction

The wetland profiles described in this booklet are based on HGM subclasses. The state is divided into three major Ecoregions – Great Basin (13), Colorado Plateau (20) and Rocky Mountain (19).



EPA Level III Ecoregions

The subclasses in the Great Basin are driven by the salinity of the water and the water regime (determined through principal components factor analysis of reference standard sites in the entire class). The salinity is based on electrical conductivity and given in dS.

The classes of salinity are as follows:

- 1 Low salinity < 7.5 dS
- 2 Moderate salinity ≥ 7.5 and <22.5 dS
- 3 High salinity / hypersaline ≥ 22.5 dS

Water regime classes for depressions are as follows:

- 0 Ephemeral – surface water is present in some years for brief periods (<3 months)
- 1 Seasonal – surface water is present in most years for 3-6 months
- 2 Semi permanent – surface water is common to persistent in most years for 6-12 months
- 3 Permanent – surface water is continuously present in all years.

Water regime classes for slopes are as follows:

- 1 Seasonal slope - Average depth to water table > 20 inches
- 2 Persistent slope - Average depth to water table ≤ 20 inches

Hydrogeomorphic Depression and Slope Wetland Class Descriptions

Depressional wetlands are topographic depressions with closed contours. Water sources are precipitation, runoff and/or groundwater. Water flow vectors are toward the center of the depression. The dominant hydrodynamics are vertical. They may or may not have inlets and outlets.

Slope wetlands occur at points of surface changes, breaks in slope or stratigraphic changes. Groundwater and runoff are the primary water sources. Water flow is unidirectional (down slope/ gradient). Water may discharge to a stream, lake or depression.

Great Basin Ecoregion

The ecoregion is made up of north-south trending, fault block mountain ranges whose bases are buried in their own alluvium. Valley bottoms often contain salt pans, salt flats or fresh to saline lakes and ponds. The slopes directly above the pans are complexes of alluvial fans. Valleys on the east sides of the mountains tend to fall less steeply and are generally longer than those on the west sides. There are few perennial streams (all drain internally) and there are many small springs. Large lakes and marshes occur in the valley bottoms and may be fresh or saline. The natural vegetation from low to higher elevations is saltbrush-greasewood, Great Basin sagebrush, pinyon-juniper woodland and western spruce-fir forest.

The average annual precipitation ranges from about 12 inches in the lower valleys to more than 30 inches at higher elevations. Average annual temperature is in the low 50's in the valleys and low 40's in the mountains. Summers are usually hot and dry. Most of the summer precipitation is the result of thunderstorms that build up over the mountains. Precipitation is light during the summer and early fall. It reaches a maximum in the spring when storms moving in from the Pacific are most intense. About one third of the precipitation falls as snow during the period between December and March.

Soils in the region range from mesic Aridisols at low elevations to frigid Mollisols at higher elevations. Entisols occur on fans, floodplains and in valley bottoms. Basin soils are often saline and alkaline.



Hypersaline (EC > 22.5 dS) seasonal or semi permanent depressions

(these sites may be moderately saline (7.5 – 22.5 dS) at other times of the year)

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species* in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics hypersaline reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,202	4,520	4,284.56	134.03
Native species	1.00	1.00	1.00	0.00
Indicator species*	0.80	0.96	0.88	0.05
Vegetation cover	0.21	0.35	0.27	0.06
TDS water ppm	13,800.00	341,980.00	73,000.00	106,970.60
TSS water mg/L	202.00	365.00	243.00	70.58
EC water dS	24.10	100.00	49.53	23.21
Water pH	7.00	8.30	7.61	0.37
Nitrate-N water mg/L	0.11	0.22	0.18	0.04
Phosphates water mg/L	0.03	0.12	0.07	0.04
NP ratio water	1.42	4.00	3.15	1.19
Silica water mg/L	6.32	21.02	14.94	6.51
Cadmium water mg/L	0.02	0.02	0.02	0.00
Lead water mg/L	0.03	0.06	0.04	0.02
Soil pH	7.68	7.82	7.73	0.05
Soil EC dS	14.10	440.00	131.79	127.59
Soil organic carbon %	2.92	8.63	5.87	2.34
Soil total nitrogen %	0.03	0.29	0.11	0.09
Soil CN ratio	11.55	287.67	114.46	107.50
Cadmium mg/kg	0.05	0.10	0.08	0.03
Lead mg/kg	0.16	1.81	0.84	0.81

**Distichlis stricta* (desert salt grass) is counted as FACW, not FAC

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .26 and it makes up an average of 84% of the total vegetative cover

2nd dominant – *Salicornia utahensis* (Utah samphire) or more often, *Salicornia europaea* (annual samphire) are the second dominant in all reference sites with average cover of .03

3rd dominant - *Triglochin maritima* (maritime arrowgrass) or *Cordylanthus maritimus* (alkali birdsbeak) with average cover of .01 *Scirpus maritimus* (alkali bulrush) at .01 with some disturbance

4th dominant – *Suaeda depressa* (broom seepweed), *Triglochin palustris* (marsh arrowgrass) with average cover of .01

5th dominant – *Sporobolus airoides* (alkali saccaton) and *Triglochin maritima* (maritime arrowgrass) with average cover of .01

*see App. 1

Vegetation species richness –

Average species richness is 4 (range 1-5), often including *-Distichlis stricta* (desert salt grass), *Salicornia europaea* (annual samphire) and *Triglochin maritima* (maritime arrowgrass). Species richness tends to increase with disturbance, with average species richness increasing to between 6 and 7 species.

Typical invasive species

Hordeum jubatum (foxtail barley), *Phragmites australis* (common reed), *Kochia scoparia* (summer cypress)

Plant list for reference standard sites

<i>Distichlis stricta</i> (desert salt grass)	<i>Cordylanthus maritimus</i> (alkali birdsbeak)
<i>Salicornia europea / utahensis</i> (annual and utah samphire)	<i>Scirpus maritimus</i> (alkali bulrush)
<i>Triglochin maritima / palustris</i> (maritime and marsh arrowgrass)	<i>Suaeda depressa</i> (broom seepweed)
	<i>Sporobolus airoides</i> (alkali saccaton)

Sites surveyed are located in Box Elder, Salt Lake, Tooele and Utah Counties. **All sites in Salt Lake and Tooele Counties are below 4217 feet.**

Site location and vegetation scores

Sites	Easting	Northing	Reference	VIBI	Richness
goshenplaya1	12424531	4422782	1.00	1.00	5.00
goshenplaya3	12424531	4422782	1.00	1.00	5.00
saltwellsplaya1	12356517	4619352	1.00	1.00	5.00
saltwellsplaya2	12356517	4619352	1.00	1.00	5.00
saltwellsplaya3	12356517	4619352	1.00	1.00	5.00
goshensalt4	12422972	4428245	1.00	1.00	1.00
bluelakeplaya2	11751222	4487832	.93	.86	7.00
plover	12367854	4508863	.93	1.00	2.00
plover2	12367847	4508875	.93	1.00	3.00
limestone1	12364323	4509462	.93	1.00	3.00
limestone2	12364323	4509462	.93	.73	6.00
southpond1	12406732	4515154	.75	.76	7.00
northpond	12404703	4517581	.75	.51	7.00
saltwellspound1	12356483	4619286	.75	.83	6.00



Plover Playa, Tooele County



Salt Wells Playa, Box Elder County



Goshen Playa, Utah County

Moderately saline (7.5 – 22.5 dS)seasonal depressions

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics seasonal moderately saline reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Species richness	5.00	11.00	7.17	2.04
Elevation ft	4,217	4,520	7.17	116.95
Native species	1.00	1.00	1.00	0.00
Indicator species	0.80	0.96	0.91	0.07
Vegetation cover	0.33	0.44	0.36	0.04
TDS water ppm	5,400.00	7,926.00	6,849.33	852.17
TSS water mg/L	25.00	83.00	50.33	29.69
EC water dS	9.00	13.20	10.98	1.58
water pH	8.50	9.80	9.09	0.54
Nitrate-N water mg/L	0.05	0.16	0.09	0.06
Phosphate water mg/L	0.01	0.02	0.01	0.00
NP ratio water	5.00	16.00	7.80	4.76
Silica water mg/L	0.56	11.86	5.07	5.05
Cadmium water mg/L	0.02	0.02	0.02	
Lead water mg/L	0.03	0.06	0.06	
Soil pH	7.60	8.87	8.07	0.53
Soil EC dS	29.00	590.00	160.67	214.12
Soil organic carbon %	2.92	12.20	6.62	3.83
Soil total nitrogen %	0.01	0.19	0.10	0.07
Soil CN ratio	17.18	356.00	129.76	123.70
Cadmium mg/kg	0.05	0.10	0.06	0.03
Lead mg/kg	0.15	7.21	3.43	2.98

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .28.

2nd / 3rd dominant – *Salicornia utahensis* (Utah samphire)(average cover .01) in 67% of sites, *Scirpus maritimus* (alkali bulrush) (average cover .02) in 83% of sites or *Salicornia europaea* (annual samphire) (average cover .05) in 33 % of sites.

4th and 5th dominant – *Triglochin spp* (arrowgrass) (average cover .01) in 50% of sites, *Allenrolfea occidentalis* (iodine bush) (average cover .01) in 16 %, *Sarcobatus vermiculatus* (greasewood) (average cover .01) in 16% of sites.

Other species occurring – *Puccinellia nuttalliana* (Nuttall’s alkaligrass), *Scirpus acutus* (hardstem bulrush) and *S. americanus* (Olney’s threesquare)

Nonnative/ invasive species – *Hordeum jubatum* (foxtail barley), *Polypogon monspeliensis* (rabbitfoot grass)

Vegetation species richness

Species richness of plants in reference sites averages 7 species, ranging from 5-7. In disturbed sites, it falls to 3 and climbs as high as 11.

Plant list for references standard sites

Distichlis stricta (desert salt grass)

Salicornia europea / utahensis (annual and utah samphire)

Scirpus maritimus(alkali bulrush)

Triglochin maritime / palustris

(maritime and marsh arrowgrass)

Allenrolfea occidentalis (iodine bush)

Scirpus acutus (hardstem bulrush)

Sarcobatus vermiculatus (greasewood)

Puccinellia nuttalliana (Nuttall’s alkaligrass)

Suaeda depressa (broom seepweed)

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
bluelakeplay1	11751222	4487832	0.93	1.00	7.00
bluelakeplay3	11751222	4487832	0.93	1.00	7.00
bluelakeplay4	11751222	4487832	0.93	1.00	7.00
goshenplay2	12424531	4422782	1.00	1.00	5.00
duckplaya2	12391395	4604369	0.92	1.00	6.00
migrate1	12343716	4617473	0.91	0.90	10.00
migrate2	12343716	4617473	0.91	0.90	10.00
migrate3	12343716	4617473	0.91	0.90	10.00
airport22	12411865	4519420	0.83	0.76	8.00
airport23	12411865	4519420	0.83	0.76	5.00
airport30	12411810	4519614	0.83	0.88	4.00
airport32	12411810	4519614	0.83	0.95	5.00
airport33	12411810	4519614	0.83	0.88	4.00
airport34	12411810	4519614	0.83	0.88	4.00
airport20	12411865	4519420	0.83	0.68	8.00
amalgabarrn	12422773	4634164	0.75	0.72	3.00
airport21	12411865	4519420	0.83	0.51	7.00



Salt Lake Airport, Salt Lake County

Moderately saline (7.5 – 22.5 dS) semi permanent and permanent depressions

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics semi-permanent and permanent moderately saline reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Species richness	1.00	7.00	4.45	2.54
Elevation ft	4,220	4,500	4,319.00	118.38
Native species	1.00	1.00	1.00	0.00
Indicator species	0.80	0.92	0.87	0.05
Vegetation cover	0.56	0.79	0.69	0.09
TDS water ppm	6,960.00	11,520.00	9,197.45	1,885.23
TSS water mg/L	18.00	22.30	20.15	3.04
Water EC dS	10.10	20.10	15.08	3.55
Water pH	7.50	8.90	8.04	0.56
Nitrate-N water mg/L	0.03	0.21	0.09	0.08
Phosphate water mg/L	0.01	0.05	0.02	0.02
NP ratio water	1.00	21.00	7.50	9.15
Silica water mg/L	5.47	16.80	11.64	4.29
Cadmium water mg/L	0.02	0.02	0.02	0.00
Lead water mg/L	0.03	0.20	0.10	0.08
Soil pH	7.40	8.10	7.84	0.26
Soil EC dS	8.60	140.00	51.27	48.89
Soil organic carbon %	1.28	12.80	6.09	3.60
Soil total nitrogen %	0.08	0.57	0.21	0.14
Soil CN ratio	12.13	67.37	33.96	22.10
Cadmium mg/kg	0.02	0.10	0.05	0.02
Lead mg/kg	0.44	5.22	2.40	1.79

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .56.

2nd / 3rd dominant – *Salicornia utahensis*(Utah samphire) (average cover .02) in 18 % of sites, *Scirpus americanus* (Olney’s threesquare) (average cover .07) in 73% of sites, *Juncus arcticus* (wiregrass) (average cover .11) in 18% or *Eleocharis palustris* (common spikerush) (average cover .07) in 27 % of sites.

4th and 5th dominant – *Triglochin spp* (arrowgrass) (average cover .01) in 27% of sites, *Sporobolus airoides* (alkali saccaton) (average cover .02) in 27% of sites and *Cordylanthus maritimus*(alkali birdsbeak) (average cover .01) in 18% of sites

Other species occurring - *Puccinellia nuttalliana* (Nuttall's alkaligrass), *Allenrolfea occidentalis* (iodine bush), *Suaeda depressa* (broom seepweed)

Nonnative/invasive species –*Bromus tectorum* (cheatgrass), *Hordeum jubatum*(foxtail barley) and *glaucum/murinum*(rabbit barley), *Phragmites australis*(common reed)

Vegetation species richness

In reference sites, average is 4 species, ranging from 1-7. In disturbed sites, it climbs as high as 11.

Plants list for reference sites

<i>Distichlis stricta</i> (desert salt grass)	<i>Cordylanthus maritimus</i> (alkali birdsbeak)
<i>Scirpus americanus</i> (Olney's threesquare)	<i>Scirpus acutus</i> (hardstem bulrush)
<i>Juncus arcticus/ balticus</i> (wiregrass)	<i>Scirpus maritimus</i> (alkali bulrush)
<i>Eleocharis palustris</i> (common spikerush)	<i>Allenrolfea occidentalis</i> (iodine bush)
<i>Salicornia utahensis</i> (Utah samphire)	<i>Suaeda depressa</i> (broom seepweed)
<i>Triglochin maritima/ palustris</i> (maritime and marsh arrowgrass)	<i>Puccinellia nuttalliana</i> (Nuttall's alkaligrass)
<i>Sporobolus airoides</i> (alkali saccaton)	

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
bluelakepond1	11750755	4487823	1.00	1.00	5.00
horseshoe2	12355359	4497291	0.92	0.47	9.00
bluelakespring2	11750368	4487395	1.00	1.00	7.00
saltwellsm1	12356059	4621998	1.00	1.00	3.00
southhull	12391552	4602077	0.92	0.85	10.00
bullrush	12366021	4507953	0.83	1.00	4.00
cement	12366922	4507159	0.92	1.00	4.00
goshenssalt2	12423251	4427893	1.00	1.00	1.00
goshenssalt1	12423251	4427893	1.00	1.00	1.00
bluelakepond 2	11750755	4487823	1.00	1.00	8.00
bluelakespringu	11750368	4487395	1.00	1.00	7.00
horseshoe 1	12355359	4497291	0.92	0.61	8.00
lowerwest1	12405269	4516670	0.75	0.62	7.00
lowerwest2	12405269	4516670	0.75	0.59	6.00
bluelakepond3	11750779	4487646	1.00	1.00	7.00
lowerwest3	12405269	4516670	0.75	0.50	6.00
saltwellsm 2	12356059	4621998	1.00	1.00	2.00
saltwellsm 3	12356059	4621998	1.00	1.00	4.00
goshensalt3	12423251	4427893	1.00	1.00	1.00
goggin1	12405792	4518993	0.75	0.47	3.00
goggin2	12405792	4518993	0.75	0.68	4.00



South of Goshen, Utah County



South of Hull Lake, Public Shooting Grounds, Box Elder County



Pond in Blue Lake Complex, Tooele County

Freshwater($EC \leq 7.5$ dS) seasonal, semi permanent and permanent depressions

Note: There are virtually no natural, unimpacted sites in this subclass. All natural sites are impacted to some degree and all other sites are created or 'enhanced'/impounded management areas.

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Seasonal freshwater depressions

Among the seasonal sites, water quality is least impacted at Duck Lake, Public Shooting Grounds, although lead is elevated (.06), with the average being .02-.03 mg/L. Duck Lake scores a 1.00 for it's vegetation IBI.

<u>Water chemistry Duck Lake</u>	
TDS ppm	4792
TSS mg/L	43
EC dS	6.90
PH	8.90
Nitrate-N mg/L	.05
Phosphates mg/L	.04
NP ratio	1.39
Silica mg/L	5.86
Lead mg/L	.06
Cadmium mg/L	.02

**Descriptive Statistics freshwater
seasonal reference standard sites**

	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,205	4,221	4,213.00	11.31
Native species	0.80	1.00	0.90	0.14
Indicator species	0.80	0.92	0.86	0.08
Vegetation cover	0.46	0.50	0.48	0.03
TDS water ppm	3,420.00	4,792.00	4,106.00	970.15
TSS water mg/L	43.00	67.50	55.25	17.32
Water EC dS	5.70	6.90	6.30	0.85
Water pH	8.30	8.90	8.60	0.42
Nitrate-N water mg/L	0.05	0.65	0.35	0.42
Phosphate water mg/L	0.03	0.04	0.03	0.00
NP ratio water	1.39	21.67	11.53	14.34
Silica water mg/L	5.86	14.32	10.09	5.98
Lead water mg/L	0.05	0.06	0.06	0.01
Cadmium water mg/L	0.02	0.02	0.02	0.00
Soil pH	8.52	8.61	8.57	0.06
Soil EC dS	2.00	99.00	50.50	68.59
Soil organic carbon %	3.41	3.49	3.45	0.06
Soil total nitrogen %	0.04	0.10	0.07	0.04
Soil CN ratio	34.10	87.25	60.68	37.58
Cadmium soil mg/kg	0.05	0.10	0.08	0.04
Lead soil mg/kg	7.21	10.80	9.01	2.54

Dominant species

- 1st** – *Distichlis stricta* (desert salt grass) (average cover .22) in all reference sites
2nd – *Scirpus americanus* (Olney’s threesquare) and/or *Scirpus maritimus* (alkali bulrush) (average cover .11) in all reference sites
3rd *Salicornia europaea* (annual samphire) in all reference sites (cover .06)
4th / 5th In 50 % of sites *Sarcobatus vermiculatus* (greasewood) and/or *Allenrolfea occidentalis* (iodine bush) (cover .01)

Species occasionally occurring – *Puccinellia nuttalliana* (Nuttall’s alkaligrass) *Poa palustris* (fowl bluegrass)

Common nonnative and invasive species - *Polypogon monspeliensis* (**rabbitfoot grass**), *Hordeum jubatum* (**foxtail barley**), *Phragmites australis* (**common reed**), *Typha spp* (cattail), *Agrostis stolonifera* (**redtop bentgrass**)

Vegetation species richness

In reference standard sites average species richness is 6. In disturbed sites it climbs as high as 15 species. In general, disturbance increases the species diversity.

Plants list for reference standard sites

Distichlis stricta (desert salt grass)
Scirpus americanus (Olney's threesquare)
Scirpus acutus (hardstem bulrush)
Scirpus maritimus (alkali bulrush)
Eleocharis palustris (common spikerush)
Alisma plantago-aquatica (water plantain)
Salicornia europaea (annual samphire)
Salicornia utahensis (Utah samphire)
Poa palustris (fowl bluegrass)*
Juncus arcticus (wiregrass)
Allenrolfea occidentalis (iodine bush)
Carex praegracilis (blackcreeper or clustered field sedge)
Carex nebrascensis (Nebraska sedge)
Carex spp.
Iris missouriensis * (Missouri iris)
Nitrophila occidentalis (western boraxweed or niterwort)
Elymus triticoides (beardless or creeping wild rye)
Potamogeton species (pondweed)
Agropyron trachycaulum (slender wheatgrass)
Potentilla anserina (common silverweed)
Senecio hydrophilus (water groundsel)
Solidago missouriensis (goldenrod)
Sarcobatus vermiculatus (greasewood)
Ranunculus spp. (buttercup)
Sagittaria cuneata (arrowleaf)
Suaeda depressa (seepweed)
Mentha arvensis (field mint)
Aster chilensis (common California daisy)
Asclepias speciosa (showy milkweed)

Semi-permanent and permanent freshwater depressions

Among the semi-permanent and permanent sites, water quality is least impacted at Fish Springs. It does not, however, score well on the vegetation IBI and zebra snails were collected from the site.

Water chemistry Fish Springs	
TDS ppm	348
TSS mg/L	6.50
EC dS	5.80
pH	7.70
Nitrate-N mg/L	.12
Phosphates mg/L.	01
NP ratio	12.00
Silica mg/L	9.52
Lead mg/L	.03
Cadmium mg/L	.02

Descriptive Statistics freshwater semi- permanent and permanent reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,204	4,784	4,441.33	280.78
Native species	0.80	1.00	0.87	0.10
Indicator species	0.92	1.00	0.95	0.03
Vegetation cover	0.62	0.84	0.76	0.09
TDS water ppm	480.00	3,420.00	1,374.67	1,135.75
TSS water mg/L	17.50	169.00	60.60	63.77
EC water dS	0.80	5.70	2.19	1.85
pH water	7.60	9.40	8.47	0.76
Nitrate-N water mg/L	0.04	0.65	0.26	0.27
Phosphates water mg/L	0.02	0.70	0.15	0.27
NP ratio water	0.17	27.50	9.65	11.98
Silica water mg/L	6.22	24.48	13.38	6.91
Lead water mg/L	0.03	0.03	0.03	0.00
Cadmium water mg/L	0.02	0.02	0.02	0.00
Soil pH	7.07	8.52	7.81	0.55
Soil EC dS	1.50	5.40	2.38	1.50
Soil organic carbon %	3.41	11.40	7.35	3.61
Soil Total nitrogen %	0.10	1.02	0.62	0.39
Soil CN ratio	9.27	34.10	15.68	9.48
Cadmium mg/kg	0.02	0.14	0.07	0.05
Lead mg/kg	0.46	25.26	7.99	9.53

Dominant species

1st – *Eleocharis palustris* (common spikerush) (average cover .29) in 75% reference sites

2nd – *Scirpus spp.*, usually *Scirpus americanus* (Olney's threesquare) (average cover .23) in all reference sites

3rd *Juncus arcticus* (wiregrass) in 75% reference sites (average cover .09)

4th / 5th In 50 % of sites *Distichlis stricta*(desert salt grass) (average cover .14)

Species occasionally occurring – *Alisma plantago-aquatica*(water plantain), *Potamogeton spp.* (pondweed), *Carex praegracilis* (blackcreeper or clustered field sedge), *Iris missouriensis* (Missouri iris), *Asclepias speciosa* (showy milkweed)

Common nonnative and invasive species - *Polypogon monspeliensis* (**rabbitfoot grass**), *Hordeum jubatum*(**foxtail barley**), *Phragmites australis*(**common reed**), *Typha spp.*(cattail), *Rumex crispus* (curley dock), *Nasturtium officinale* (watercress), *Trifolium repens* (white clover), *Lythrum salicaria*** (**purple loosestrife**)

Vegetation species richness

In reference standard sites average species richness is 11-12. In disturbed sites it climbs as high as 22-23 or drops as low as 5 species.

Plants list for reference standard sites

Distichlis stricta (desert salt grass)

Scirpus americanus(Olney's threesquare)

Scirpus acutus (hardstem bulrush)

Scirpus maritimus(alkali bulrush)

Eleocharis palustris(common spikerush)

Alisma plantago-aquatica (water plantain)

Salicornia europaea (annual samphire)

Salicornia utahensis (Utah samphire)

Poa palustris (fowl bluegrass)

Juncus arcticus (wiregrass)

Allenrolfea occidentalis(iodine bush)

Carex praegracilis (blackcreeper or clustered field sedge)

Carex nebrascensis (Nebraska sedge)

Carex spp.

Iris missouriensis (Missouri iris)

Nitrophila occidentalis (western boraxweed or niterwort)

Elymus triticoides (beardless or creeping wild rye)

Potamogeton species (pondweed)

Agropyron trachycaulum (slender wheatgrass)

Potentilla anserina (common silverweed)

Senecio hydrophilus (water groundsel)

Solidago missouriensis (goldenrod)

Sarcobatus vermiculatus (greasewood)

Ranunculus spp. (buttercup)

Sagittaria cuneata (arrowleaf)
Suaeda depressa (seepweed)
Mentha arvensis (field mint)
Aster chilensis (common California daisy)
Asclepias speciosa (showy milkweed)

**** at one site in the semi-permanent / permanent sites , we found exotic zebra snails which are a vector for a fish killing disease and are reported from another site in this group of surveyed sites**

**** at one seasonal site – found New Zealand mud snails**

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
kayscreekpond	12414754	4541873	0.90	0.61	14.00
towerpond	12413714	4543006	0.95	0.78	8.00
airport24	12411865	4519420	0.83	0.60	5.00
duckplaya	12391505	4604408	0.97	1.00	6.00
lelandharrislow	12251791	4382891	0.93	1.00	11.00
2impoundfbwma2	12423882	4531348	0.85	0.49	7.00
davispond2	12423276	4534161	0.90	0.59	7.00
lelandharrisup	12251791	4382891	0.93	0.79	22.00
davispond	12423291	4533882	0.90	0.40	10.00
2impoundfbwma	12423882	4531348	0.85	0.40	5.00
airportpond	12411607	4518726	0.58	0.51	12.00
nolaneplaya	12422670	4624969	0.90	0.76	7.00
nolaneplaya2	12422670	4624969	0.90	0.59	7.00
loosestrife	12421789	4523685	0.33	0.20	25.00
upperwestpond2	12405451	4516624	0.75	0.39	8.00
upperwestpond	12405451	4516624	0.75	0.39	8.00
dumppond	12422453	4528844	0.58	0.31	14.00
bearriverbottoms1	12424787	4641273	0.92	0.63	12.00
tnepond	12410229	4544016	0.83	0.66	7.00
bearriverbottoms2	12424787	4641273	0.92	0.63	12.00
fishspring1	12293681	4418044	0.87	0.69	12.00



Duck Playa – Public Shooting Grounds



Leland Harris Complex, Juab County



TNC Layton Marsh, Davis County

Ephemeral depressions

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics ephemeral reference standard sites	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,205	4,210	4,206.67	2.89
Native species	0.67	1.00	0.89	0.19
Indicator	0.67	1.00	0.89	0.19
Cover	0.05	0.29	0.21	0.14
TDS water ppm	10,100.00	26,400.00	18,250.00	11,525.84
Water EC dS	17.70	46.50	32.10	20.36
Water pH	7.90	7.90	7.90	0.00
Soil pH	8.20	8.30	8.23	0.06
Soil EC dS	93.00	103.00	99.67	5.77
Soil organic carbon %	0.56	1.30	0.81	0.43
Soil total nitrogen %	0.06	0.07	0.06	0.01
Soil CN ratio	9.33	19.00	12.56	5.58
Cadmium soil mg/kg	0.09	0.09	0.09	.
Lead soil mg/kg	15.50	15.50	15.50	.

Dominant species

Salicornia europaea (annual samphire) is the dominant species in all reference sites with an average cover of .20

Sarcobatus vermiculatus (greasewood) occurs in 33% of sites with an average cover of .01

Invasive species include *Hordeum jubatum*(foxtail barley) and *murinum* (rabbit barley), *Kochia scoparia*(summer cypress), *Puccinellia distans* (weeping alkaligrass)

Species richness

Average species richness is 1-2 species. With disturbance richness climbs to 5-6 species.

Plant list for reference standard sites

Salicornia europaea (annual samphire)

Sarcobatus vermiculatus(greasewood)

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI
southdryplaya	12405656	4515582	0.75	0.88
woodscross	12420469	4526895	0.75	0.67
airport4	12411809	4519365	0.83	0.80
brownisland	12409199	4520497	1.00	0.84
lakeplaya2	12410247	4544574	1.00	1.00
lakeplaya1	12410247	4544574	1.00	1.00



Playa on The Nature Conservancy Layton Marshes at 4205 ft. It has had water 2 of the last 8 years, water was overflow from GSL.

Freshwater seasonal and persistent slopes

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Dominant species

1st *Eleocharis palustris* (common spikerush) in all reference sites

2nd *Distichlis stricta*(desert salt grass) 70% of sites

3rd *Juncus arcticus*(wiregrass) 60% of sites

4th *Carex nebrascensis* (Nebraska sedge) and *Scirpus americanus* (Olney’s threesquare) 50% of sites

5th *Carex lanuginosa* (wooley sedge), *praegracilis* (blackcreeper or clustered field sedge) or *microptera* (small wing sedge) 40% of sites

Others species –*Puccinellia nuttalliana*(Nuttall’s alkaligrass), *Carex simulata* (short beaked sedge), *Scirpus acutus* (hardstem bulrush), *Mentha arvensis* (field mint), *Mimulus guttatus* (common monkey flower), *Sagattaria cuneata* (arrowleaf), *Ranunculus spp.* (buttercup)

Invasive species – *Trifolium repens* (**white clover**), *Polypogon monspeliensis* (rabbitfoot grass), *Polypogon interruptis*, *Hordeum marinum* (Mediterranean barley), *Nasturtium officinale*(**watercress**), *Rumex crispus* (**curley dock**), *Xanthium strumarium* (cocklebur), *Lactuca serriola* (prickly lettuce), various species of *Elymus/Agropyron* and their hybrids, *Agrostis stolonifera*(redtop bentgrass), *Poa pratensis* (Kentucky bluegrass)

Vegetation species richness

In reference sites, species richness averages 13 and ranges from 10-21 species.

Descriptive Statistics reference standard slopes by salinity				
Water salinity		Minimum	Maximum	Mean
nonsaline	species richness	10.00	21.00	13.14
	water EC dS	1.04	7.00	3.69
	native species	1.00	1.00	1.00
	shrub	0.000	0.000	0.00
	herb	0.81	0.95	0.87
	TDS ppm	508.00	3,750.00	2175.60
	water pH	7.30	8.50	7.86
	soil pH	7.60	8.10	7.88
	soil EC dS	1.40	16.00	6.06
	soil organic carbon	1.66	11.80	6.82
	soil total nitrogen	0.09	0.63	0.35
	CN ratio	12.00	48.00	23.33
	Cadium mg/kg	0.050	0.100	0.08
	Lead mg/kg	1.240	2.790	2.02

Plant list for all reference standard slope sites

Carex nebrascensis (Nebraska sedge)
Carex praegracilis(blackcreeper or clustered field sedge)
Carex lanuginosa (wooley sedge)
Carex microptera(small wing sedge)
Carex simulata(short beaked sedge)
Eleocharis palustris(common spikerush)
Eleocharis rostellata (Torrey's spikerush)
Scirpus acutus(hardstem bulrush)
Scirpus americanus(Olney's threesquare)
Scirpus maritimus (alkali bulrush)
Juncus arcticus(wiregrass)
Juncus ensifolius (swordleaf rush)
Juncus torreyi (Torrey's rush)
Distichlis stricta(desert salt grass)
Agropyron trachycaulum (slender wheatgrass)
Elymus triticoides(beardless or creeping wild rye)
Sphenopholis obtusato (prairie wedge grass)
Sporobolus airoides(alkali saccaton)

Solidago missouriensis (Missouri goldenrod)
Allenrolfea occidentalis(iodine bush)
Rosa woodsii (Woods rose)
Sarcobatus vermiculatus(greasewood)

Centaureium exaltatum (Great Basin centaury)
Cicuta douglasii (water hemlock)
Comandra umbellata(bastard toadflax)
Cordylanthus maritimus(alkali birdsbeak)
Epilobium ciliatum (northern willowherb)
Iris missouriensis (Missouri iris)
Lycopus asper (rough bungleweed)
Mentha arvensis(field mint)
Mimulus guttatus(common monkey flower)
Nitrophilia occidentalis(western boraxweed or niterwort)
Potentilla anserina(common silverweed)
Potamogeton spp(pondweed)
Ranunculus sceleratus/cymbalaria (blister and marsh buttercup)
Sagittaria cuneata(arrowleaf)
Salicornia europea/ utahensis (annual and utah samphire)
Senecio hydrophilus (water groundsel)
Sium suave (hemlock water parsnip)
Suaeda depressa(broom seepweed)
Triglochin maritima(annual samphire)
Veronica americana (American brookline)

Nonsaline slope location and vegetation scores

Site	Easting	Northing	Reference	Richness	VIBI
bearriverrf2	12,411,624	4,591,521	0.75	19.00	0.67
bearriverrf2b	12,411,624	4,591,521	0.75	18.00	0.66
brigham1	12,412,115	4,594,651	0.75	13.00	0.53
gloverlane	12,423,901	4,534,960	0.67	12.00	0.37
loosestrife	12,421,789	4,523,685	0.42	25.00	0.20
fairgrounda	12,424,094	4,536,103	0.58	16.00	0.55
brigham2	12,412,778	4,594,643	0.75	11.00	0.47
fairgroundc	12,424,094	4,536,103	0.58	16.00	0.45
benjamin2	12,432,138	4,440,077	0.83	13.00	0.85
goshenbay1	12,426,300	4,428,770	0.75	13.00	0.81
goshenbay2	12,426,601	4,428,770	0.75	13.00	0.81
fairgroundb	12,424,094	4,536,103	0.58	22.00	0.52
bearriverrf1a	12,411,738	4,591,329	0.75	15.00	0.87
bearriverrf1b	12,411,738	4,591,329	0.75	15.00	0.87
perry1	12,412,406	4,592,864	0.75	15.00	0.70
perry2	12,412,406	4,592,864	0.75	16.00	0.58
golfb	12,421,732	4,525,130	0.83	10.00	0.80
golfc	12,421,732	4,525,130	0.83	11.00	0.72
quaketnc2	12,414,988	4,543,880	0.83	19.00	0.64
widgeond	12,391,114	4,602,958	0.95	10.00	1.00
deweyville2	12,410,137	4,618,868	0.83	10.00	0.65
quaketnc	12,414,602	4,543,952	0.83	19.00	0.84
deweyville1	12,409,736	4,619,723	0.83	17.00	0.64
deweyville1b	12,409,736	4,619,723	0.83	17.00	0.64
gandy2	12,249,321	4,375,542	0.90	21.00	0.90
gandy1	12,249,321	4,375,542	0.90	21.00	0.90
laytonc	12,414,485	4,543,911	0.83	23.00	0.64
laytona	12,414,485	4,543,911	0.83	18.00	0.71
benjamin1b	12,431,549	4,442,738	0.95	10.00	0.90
benjamin1	12,431,549	4,442,738	0.95	10.00	0.90
laytonb	12,414,485	4,543,911	0.83	20.00	0.70
widgeonc	12,391,114	4,602,958	0.95	4.00	0.75
golfa	12,421,732	4,525,130	0.83	11.00	0.72
widgeonb	12,391,350	4,603,011	0.95	10.00	0.90

Moderately and hypersaline persistent slopes

Vegetation index of biological integrity(VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Dominant species

- 1st** *Distichlis stricta*(desert salt grass) in all reference standard sites
- 2nd** *Scirpus americanus*(Olney's threesquare) in 83% of sites
- 3rd** *Juncus arcticus*(wiregrass) in 42% of sites
- 4th** *Scirpus maritimus*(alkali bulrush), *Sporobolus airoides* (alkali saccaton), *Triglochin spp.* (arrowgrass) in 25% of sites
- 5th** *Salicornia utahensis*(Utah samphire), *Cordylanthus maritimus*(alkali birdsbeak), *Eleocharis palustris*(common spikerush) in 17% of sites

Other species –*Suaeda depressa*(broom seepweed), *Scirpus acutus* (hardstem bulrush), *Allenrolfea occidentalis*(iodine bush)

Invasive species – *Hordeum jubatum*(foxtail barley), *Kochia scoparia*(summer cypress), *Elaeagnus angustifolia* (Russian olive), *Helianthus annuus* (common sunflower)

Vegetation species richness

In reference sites average species richness is 4 species, ranging from 1-7 species.

Descriptive Statistics reference standard slopes by salinity				
Water salinity saline		Minimum	Maximum	Mean
	water EC dS	12.70	19.90	15.91
	native species	1.00	1.00	1.00
	shrub	0.000	0.030	0.00
	herb	0.48	0.84	0.69
	TDS ppm	7,110.00	11,200.00	8630.00
	water pH	7.60	8.30	7.88
	soil pH	7.40	8.10	7.81
	soil EC dS	4.00	53.00	23.91
	soil organic carbon	1.20	12.67	4.62
	soil total nitrogen	0.08	0.45	0.21
	CN ratio	6.00	67.00	25.22
	Cadium mg/kg	0.050	0.100	0.06
	Lead mg/kg	1.460	6.080	3.18

Saline slope location and vegetation scores

Site	Easting	Northing	Reference	Richness	VIBI
widgeona	12,391,350	4,603,011	0.95	10.00	0.92
bluelake	11,751,442	4,487,440	0.86	5.00	1.00
benjamin3	12,436,336	4,443,966	0.83	6.00	0.67
horseshoeb	12,355,130	4,497,501	0.95	5.00	0.61
saltwellsr2	12,357,605	4,619,010	0.95	4.00	1.00
loco2	12,339,098	4,617,039	0.75	6.00	0.93
bluelakeupper	11,750,454	4,487,219	1.00	5.00	1.00
bluelakeuppond	11,750,965	4,487,491	1.00	7.00	1.00
goshensalta	12,423,251	4,427,893	0.95	1.00	1.00
bluelakeupspring	11,750,454	4,487,219	1.00	7.00	1.00
saltwellsr1	12,357,384	4,619,132	0.92	6.00	0.93
horseshoea	12,355,130	4,497,501	0.95	8.00	0.71
goshensaltc	12,423,251	4,427,893	0.95	1.00	1.00
saltwellsm	12,356,043	4,621,738	1.00	4.00	1.00
saltwellsm2	12,356,043	4,621,738	1.00	4.00	1.00
goshensaltb	12,423,251	4,427,893	0.95	1.00	1.00
saltwellsm3	12,356,043	4,621,738	1.00	4.00	1.00
bluelakeplaya	11,751,214	4,487,592	1.00	7.00	0.79
saltcreek1b	12,395,790	4,613,172	0.83	9.00	0.79
saltcreek1	12,395,790	4,613,172	0.83	9.00	0.79
jordon	12,422,106	4,483,009	0.75	7.00	0.61
saltcreek2	12,395,746	4,613,209	0.83	13.00	0.75

Plant list for all reference standard slope sites

Carex nebrascensis(Nebraska sedge)
Carex praegracilis(blackcreeper or clustered field sedge)
Carex lanuginosa(wooley sedge)
Carex microptera(small wing sedge)
Carex simulata(short beaked sedge)
Eleocharis palustris(common spikerush) /*rostrata*
Scirpus acutus(hardstem bulrush)
Scirpus americanus(Olney's threesquare)
Scirpus maritimus (alkali bulrush)
Juncus arcticus(wiregrass)
Juncus ensifolious(swordleaf rush)
Juncus torreyi (Torrey's rush)

Distichlis stricta(desert salt grass)
Agropyron trachycaulum (slender wheatgrass)
Elymus triticoides (beardless or creeping wild rye)
Sphenopholis obtusato (prairie wedgegrass)
Sporobolus airoides(alkali saccaton)

Solidago missouriensis (Missouri goldenrod)

Allenrolfea occidentalis(iodine bush)

Rosa woodsii (Woods rose)

Centaurium exaltatum (Great Basin centaury)

Cicuta douglasii (water hemlock)

Comandra umbellata (bastard toadflax)

Cordylanthus maritimus(alkali birdsbeak)

Epilobium ciliatum (northern willowherb)

Iris missouriensis(Missouri iris)

Lycopus asper (rough bungleweed)

Mentha arvensis(field mint)

Mimulus guttatus(common monkey flower)

Nitrophilia occidentalis(western boraxweed or niterwort)

Potentilla anserina(common silverweed)

Potamogeton spp(pondweed)

Ranunculus sceleratus/cymbalaria (blister and marsh buttercup)

Sagittaria cuneata(arrowleaf)

Salicornia europea/ utahensis (annual and Utah samphire)

Senecio hydrophilus (water groundsel)

Sium suave (hemlock water parsnip)

Suaeda depressa(broom seepweed)

Triglochin maritima(annual samphire)

Veronica americana (American brookline)



Blue Lake Slope complex, Tooele County



Widgeon Marsh slope complex, managed, Public Shooting Grounds, Box Elder County



Salt Wells Meadow, Box Elder County



Salt Creek WMA, Box Elder County

Appendix 1. Nonnative / invasive plant species

Hordeum jubatum, glaucum, murinum
Phragmites australis
Kochia scoparia
Polypogon monspeliensis, interruptis
Bromus tectorum
Agrostis stolonifera
Rumex crispus
Nasturtium officinale
Trifolium repens, fragiferum, pretense
Lythrum salicaria
Poa pratensis, compressa, trivialis
Xanthium strumarium
Lactuca serriola
Veronica anagallis-aquatica
Puccinellia distans
Salix babylonica, fragilis
Phleum pratense
Elaeagnus angustifolia
Tamarisk spp.
Agropyron repens
Agrostis alba
Bassia hyssopifolia
Berula erecta
Bidens cernua
Chenipodium spp
Dipsacus sylvestris
Fescue arundinacea, pratensis
Helianthus annuus
Solanum dulcamara
Melilotus alba, officinalis
Salsola kali
Sonchus spp
Stachys palustris
Taraxacum officinale
Thlaspi arvense
Urtica dioica
Conium maculatum
Arctium minus
Cirsium spp
Typha spp

