

Appendix H: Northern Rocky Mountains Parks' Herbicide Use (2005-2009)

Note: BEPA, BIHO, GOSP, and MIIN figures represent herbicide use by EPMT only, since those parks primarily rely on EPMT for treatment. GOSP 2005 data includes treatment by park staff.

Park Unit	Year	Pesticide	EPA Regulation Number	Undiluted Product (oz)	Undiluted Product (gallon)	Acres Treated	Target Plant(s)
BEPA	2005	NONE	N/A	N/A	N/A	N/A	N/A
	2006	UNKNOWN					Spotted knapweed Canada thistle
	2007	Blaine County Contract Work					Spotted knapweed Canada thistle
	2008	MILESTONE	62719-259				Canada thistle
		Blaine County Contract Work					Spotted knapweed
	2009	MILESTONE	62719-259				Canada thistle
		Blaine County Contract Work					Spotted knapweed
BIHO	2005	CURTAIL	62719-48	64.00	0.5		Spotted knapweed
		TORDON 22K	62719-6	0.06	0.0005		Field bindweed
		TRANSLINE	62719-259	17.66	0.1380		Spotted knapweed Canada thistle Common tansy
	2006	CURTAIL	62719-48	44.416	0.347		Spotted knapweed Canada thistle
		MILESTONE	62719-259	2.944	0.023		Spotted knapweed Canada thistle Bull thistle
	2007	MILESTONE	62719-519	3.1	0.02441	0.654	Spotted knapweed Canada thistle
		TORDON 22K	62719-6	1.4	0.0107	0.044	Field bindweed Leafy spurge Hoary alyssum
	2008	TORDON 22K	62719-6	1.37	0.011	0.043	Field bindweed Leafy spurge Hoary alyssum
		MILESTONE	62719-259	2.92	0.022	0.65	Spotted knapweed Canada thistle
	2009	MILESTONE	62719-259	0.96	0.007	0.16	Spotted knapweed Canada thistle
CIRO	2005	CURTAIL	62719-48	126	0.984	1.312	Canada thistle
		RODEO	524-343	312	2.438	2.16	Canada thistle Musk thistle
	2006	ESCORT	352-439	0.208	0.013	0.013	Hoary cress Field bindweed Houndstongue Field pennycress
		MILESTONE	62719-259	1.8	0.014	3.26	Spotted knapweed Canada thistle Bull thistle Scotch thistle Musk thistle
	2007	ESCORT	352-439	0.2	0.015 lbs	0.688	Hoary cress Field bindweed

							Houndstongue
		MILESTONE	62719-519	61.8	0.483	11.954	Spotted knapweed Canada thistle Bull thistle Scotch thistle Musk thistle
	2008	MILESTONE	62719-259	20.6	0.161	8.34	Spotted knapweed Canada thistle Bull thistle Scotch thistle Musk thistle Common mullein Hoary cress Field bindweed Houndstongue Common burdock
	2009	ESCORT XP	352-439	0.4	0.025 lbs	2	Hoary cress Field bindweed Houndstongue
		MILESTONE	62719-259	64.74	0.505	13.58	Spotted knapweed Canada thistle Bull thistle Musk thistle Rush skeletonweed
		RODEO	62719-324	237.86	1.858	17.35	Canada thistle Musk thistle Field bindweed
		TRANSLINE	62719-259	93.9	0.734	6.15	Canada thistle Bull thistle Musk thistle
	CRMO	2,4-D AMINE 4	34704-120	12.03	0.094	9.77	Leafy spurge Rush skeletonweed Diffuse knapweed Spotted knapweed
		AQUANEAT	228-365-4581	10	0.0781		Canada thistle
		CURTAIL	62719-48	65.28	0.51		Spotted knapweed
		TORDON 22K	62719-6	211.32	1.65	15.33	Leafy spurge Rush skeletonweed Diffuse knapweed Spotted knapweed
		TRANSLINE	62719-259	17.42	0.136		Scotch thistle
		PLATEAU	241-365	6.54	0.051	1.45	Leafy Spurge Cheatgrass
		RODEO	524-343	5	0.039	0.1	Spotted knapweed Canada thistle
		ROUNDUP PRO	524-475	10.67	0.083	0.1	Canada thistle Common mullein Knapweed
	2006	2,4-D AMINE 4	42750-19	142.17	1.111	4.51	Leafy spurge Rush skeletonweed Russian knapweed Diffuse knapweed Spotted knapweed Chicory Canada thistle Bull thistle
		CURTAIL	62719-48	80	0.625		Spotted knapweed
		MILESTONE	62719-259	9.443	0.074	2.73	Spotted knapweed

							Diffuse knapweed Canada thistle Bull thistle Common mullein Common burdock
		PLATEAU	241-365	1.27	0.01	0.13	Leafy Spurge Cheatgrass
		TORDON 22K	62719-6	354.36	2.768	8.7	Leafy spurge Rush skeletonweed Russian knapweed Diffuse knapweed Spotted knapweed Chicory Canada thistle Bull thistle
		TRANSLINE	62719-259	5.92	0.046	1.15	Rush skeletonweed Spotted knapweed Canada thistle Scotch thistle
	2007	2,4-D AMINE 4	42750-19	75	0.586	1.3	Leafy spurge Rush skeletonweed Diffuse knapweed
		ESCORT	352-439	0.1	0.001	0.1	Scotch thistle Common mullein Hoary cress
		MILESTONE	62719-519	14.8	0.116	3.8	Russian knapweed Diffuse knapweed Canada thistle Bull thistle
		TELAR	352-404	4.5	0.035 lbs	1.5	Dyers woad Canada thistle Scotch thistle Dalmatian toadflax
		TORDON 22K	62719-6	761.062	63.5	11.928	Leafy spurge Rush skeletonweed Diffuse knapweed Canada thistle
		TELAR DF	352-522	3.5	0.027		Scotch thistle Dalmatian toadflax
		AQUANEAT	228-365-4581	50	0.391	0.625	Canada thistle Scotch thistle
	2008	TELAR	352-404	3.28	0.026 lbs	2.77	Dyers woad Canada thistle Scotch thistle Dalmatian toadflax
		PLATEAU	241-365	31.126	0.243	1.096	Leafy Spurge Cheatgrass Field bindweed
		TORDON 22K	62719-6	43.016	0.336	1.258	Leafy spurge Rush skeletonweed Common mullein
		HABITAT		0.031	0.0002	0.052	Canada thistle
		MILESTONE	62719-519	116.336	0.909	1.596	Russian knapweed Diffuse knapweed Spotted knapweed Canada thistle
	2009	TELAR	352-404	9.261	0.579 lbs	8.58	Dyers woad Canada thistle Scotch thistle Dalmatian toadflax

		PLATEAU	241-365	8.09	0.063	1.45	Leafy Spurge Cheatgrass Rush skeletonweed
		TORDON 22K	62719-6	59.262	0.463	0.942	Leafy spurge Rush skeletonweed Common mullein Field bindweed
		MILESTONE	62719-519	7.68	0.06	1.99	Russian knapweed Diffuse knapweed Spotted knapweed Canada thistle Bull thistle Scotch thistle
		ESCORT	352-439	0.047	0.003	0.23	Whitetop Diffuse knapweed Spotted knapweed Scotch thistle
FOBU	2005	RODEO	62719-324	21.9	0.171	0.5	Canada thistle Sowthistle Perennial grass
		ROUNDUP ULTRA	524-475	3	0.023	0.1	Canada thistle Field bindweed Perennial grass
		SALVO	34704-609	5.85	0.046	9.8	Yellow sweetclover Annual weeds, forbs
		TRANSLINE	62719-259	31.5	0.246	5	Canada thistle Sowthistle Yellow sweetclover
	2006	ESCORT	352-439	0.04	0.0003	0.044	Hoary cress Yellow sweetclover Pepper grass
		MILESTONE	62719-259	19.07	0.149	3.9	Canada thistle Musk thistle Sowthistle Curly dock
		RODEO	62719-324	5.76	0.045	0.07	Canada thistle Sowthistle Perennial grass
		ROUNDUP ULTRA	524-475	18.61	0.145	0.31	Canada thistle Field bindweed
		SALVO	34704-609	19.5	0.152	0.78	Yellow sweetclover Annual weeds
		TRANSLINE	62719-259	4.13	0.0323	0.27	Canada thistle Sowthistle Yellow sweetclover
	2007	MILESTONE	62719-519	28.416	0.222	4.048	Spotted knapweed Canada thistle Bull thistle Musk thistle Perennial sowthistle
	2008	MILESTONE	62719-519	5.55	0.043	2.45	Spotted knapweed Canada thistle Bull thistle Musk thistle Black henbane
	2009	ESCORT	352-439	1.6	0.1 lbs	0.87	Hoary cress
		MILESTONE	62719-519	15.91	0.124	2.287	Spotted knapweed Canada thistle Bull thistle Musk thistle

		RODEO	62719-324	53.76	0.42	0.557	Fountaingrass Canada thistle Field bindweed
		TELAR XP	352-654	0.003	0 lbs	0.003	Hoary cress
GOSP	2005	2,4-D AMINE WEED KILLER	1386-43	320	2.5	640	Scotch thistle Annual grasses
		ROUNDUP PRO	524-475	2611.2	20.4	640	Scotch thistle Annual weeds
		TRANSLINE	62719-259	0.256	0.002		Scotch thistle
	2007	ESCORT	352-439	1.6	0.098 lbs	1.051	Dyers woad Scotch thistle Moth mullein Common mullein Hoary cress Field bindweed
		HABITAT	241-426	18.0	0.141	0.025	Tamarisk
		MILESTONE	62719-519	0.2	0.002	0.04	Scotch thistle
	2008	ESCORT	352-439	0.195	0.012 lbs	0.706	Dyers woad Scotch thistle Moth mullein Hoary cress Field bindweed
	2009	MILESTONE	62719-259	1.8	0.014	0.25	Scotch thistle
		ESCORT	352-439	5.33	0.33 lbs	2.67	Field bindweed
		TELAR ESCORT	352-404 352-439	0.633 0.633	0.04 lbs 0.04 lbs	0.633	Dyers woad
GRKO	2005	2,4-D AMINE 4	42750-19	23.8	0.186	<i>Included w/Escort</i>	Whitetop
		CURTAIL	62719-48	441.2	3.447	8.5	Spotted knapweed Canada thistle Kochia
		ESCORT	352-439	4.46	0.279 lbs	4.53	Whitetop Perennial pepperweed
		REDEEM R&P	62719-337	501.3	3.916	10.25	Spotted knapweed Canada thistle Babysbreath
		TORDON 22K	62719-6	352.25	2.752	18.01	Spotted knapweed Leafy spurge
		TRANSLINE	62719-259	36.00	0.281	2.00	Spotted knapweed
	2006	2,4-D AMINE 4	42750-19	216.1	1.688	212.8 (2006 total acreage)	Babysbreath
		CURTAIL	62719-48	185.6	1.45		Spotted knapweed Canada thistle
		ESCORT	352-439	31.6	1.81 lbs		Whitetop Perennial pepperweed
		PLATEAU	241-365	764.7	5.974		Leafy Spurge Cheatgrass Yellow toadflax
		MILESTONE	62719-259	134.9	1.054		Spotted knapweed Canada thistle
		REDEEM R&P	62719-337	89.6	0.7		Spotted knapweed Canada thistle
		ROUNDUP ULTRA	524-475	256	2		Cheatgrass
		TORDON 22K	62719-6	2,776	21.688		Spotted knapweed Babysbreath Leafy Spurge Yellow toadflax
	2007	CURTAIL	62719-48	161.5	1.262	3.22	Russian knapweed Babysbreath
		ESCORT	352-439	32.6	2.038 lbs	19.85	Whitetop Perennial pepperweed

		MILESTONE	62719-519	365.5	2.856	58.32	Common mullein Spotted knapweed Canada thistle	
		PLATEAU	241-365	870.5	6.801	96.19	Perennial pepperweed Leafy Spurge Yellow toadflax	
		ROUNDUP PRO	524-475	32	0.25	2	Cheatgrass	
		TORDON 22K	62719-6	364.4	2.847	11.13	Spotted knapweed Babysbreath Leafy Spurge	
		2008	ESCORT	352-439	15.96	0.978 lbs	10.64	Perennial pepperweed Babysbreath Yellow toadflax Common mullein Whitetop Field bindweed
		MILESTONE	62719-259	321.54	2.44	53.24	Russian knapweed Spotted knapweed Canada thistle	
		PLATEAU	241-365	646.4	5.036	56	Leafy Spurge Field bindweed Cheatgrass Yellow toadflax	
		ROUNDUP PRO	524-475	32	0.25	2	Cheatgrass	
		TELAR XP	352-654	3.2	0.2 lbs	2.15	Yellow toadflax	
		TORDON 22K	62719-6	10.2	0.08	0.16	Leafy Spurge	
		2009	ESCORT	352-439	3.055	0.093 lbs	2.09	Perennial pepperweed Babysbreath Common mullein Whitetop Houndstongue Black henbane
			GLY STAR PRO	42750-61	64	0.5	.5	Cheatgrass
			MATRIX	352-556	4	0.25 lbs	0.096	Cheatgrass
			MILESTONE	62719-259	6.96	0.054	1.16	Spotted knapweed Canada thistle
			PLATEAU	241-365	77.4	0.603	6.7	Leafy Spurge Cheatgrass
			TELAR XP	352-654	13.8	0.85 lbs	9.2	Yellow toadflax Canada thistle
	TRANSLINE		62719-259	53.3	0.406	2.54	Diffuse knapweed Spotted knapweed Canada thistle	
	HAFO	2005	RODEO	524-343	14.00	0.109		Purple loosestrife
			ROUNDUP PRO	524-475	42.24	0.33		Canada thistle
TORDON 22K			62719-6	5.76	0.045		Rush skeletonweed	
2006		MILESTONE	62719-259	0.0256	0.0002		Canada thistle Bull thistle Rush skeletonweed Purple loosestrife	
		PLATEAU	241-365	18.944	0.148		Cheatgrass	
		RODEO	524-343	0.512	0.004		Rush skeletonweed Purple loosestrife Russian olive Tamarisk	
		ROUNDUP PRO	524-475	0.076	0.001		Purple loosestrife	
		TRANSLINE	62719-259	32.296	0.307		Rush skeletonweed Diffuse knapweed Canada thistle Spiny sowthistle	

	2007	ESCORT	352-439	0.25	0.016 lbs	0.219	Hoary cress Houndstongue
		HABITAT	241-426	54.0	0.422	0.359	Russian olive Tamarisk Broadleaf weeds
		MILESTONE	62719-519	1.2	0.009	0.39	Canada thistle Bull thistle Scotch thistle
		RODEO	62719-324	135.9	1.062	0.516	Rush skeletonweed Diffuse knapweed Purple loosestrife Russian olive Tamarisk
		ROUNDUP PRO	524-475	56	0.438	0.32	Thistle Broadleaf grasses
		TORDON 22K	62719-6	3.7	0.02852	0.0875	Leafy spurge Rush skeletonweed Knapweed
	2008	GARLON 4	62719-40	2104.32	16.44	4.838	Russian olive Tamarisk Broadleaf weeds
		HABITAT	241-426	32	0.25	2.657	Russian olive Tamarisk Canada thistle Bull thistle Houndstongue Common burdock
		RODEO	62719-324	1.6	.013	.0005	Purple loosestrife Thistle
		TORDON 22K	62719-6	15.38	0.12	0.449	Rush skeletonweed Diffuse knapweed Canada thistle Russian thistle Puncturevine
		ROUNDUP PRO	524-475	89	0.695	5.578	Thistle Broadleaf grasses
	2009	ESCORT	352-439	0.05	0.0004	0.023	Hoary cress Houndstongue
		MILESTONE	241-426	13.74	0.107	2.301	Canada thistle Bull thistle Rush skeletonweed
		GARLON 4	62719-40	336	2.625	3	Russian olive Tamarisk
		RODEO	62719-324	52.24	0.408	1.088	Canada thistle Bull thistle Purple loosestrife
		ROUNDUP POWER MAX	524-549	161.28	1.26	8.795	Thistle Broadleaf grasses
LIBI	2005	2,4-D LV 6	1381-101	437.76	3.42	13.68	Field bindweed Russian thistle Hoary cress
		2,4-D LV 6	42750-20-2935	206.08	1.61	7.04	Field bindweed Russian thistle
		CONFRONT	62719-92	8.19	0.064	0.26	Canada thistle Dandelion
		CORNERSTONE	42750-60-1381	326.4	2.55	2.19	Grasses Broadleaf weeds
		CURTAIL	62719-48	5.76	0.045	0.06	Canada thistle Diffuse knapweed Spotted knapweed

		ESCORT	352-439	0.8	0.05 lbs	0.94	Hoary cress Field bindweed Yellow sweetclover
		PLATEAU	241-365	11.52	0.09	1.92	Cheatgrass
		REDEEM R&P	62719-337	20.06	0.157	0.42	Canada thistle
	2006	2,4-D LV 6	42750-20-2935	336.64	2.63	9.76	Field bindweed Russian thistle Broadleaf weeds
		CORNERSTONE	42750-60-1381	149.76	1.17	1.27	Grasses Broadleaf weeds
		DRIVE 75DF	7969-130	1.76	0.11 lbs	0.68	Field bindweed
		ESCORT	352-439	16	1 lbs	0.39	Broadleaf weeds
		GARLON 4	62719-40	8.96	0.07	0	Russian olive Tamarisk
		MILESTONE	62719-259	8.96	0.07	0.28	Canada thistle Russian knapweed Spotted knapweed
		TORDON 22K	62719-6	428.8	3.35	13.4	Field bindweed
		2,4-D LV 6	42750-20-2935	177.92	1.39	5.6	Field bindweed Russian thistle Broadleaf weeds
	2007	CONFRONT	62719-92	39.68	0.31	1.23	Canada thistle
		CORNERSTONE	42750-60-1381	413.44	3.23	4.99	Grasses Broadleaf weeds
		CURTAIL	62719-48	33.28	0.26	0.34	Canada thistle Diffuse knapweed Spotted knapweed
		DRIVE 75DF	7969-130	80	5 lbs	5	Field bindweed
		ESCORT XP	352-439	0.16	0.01 lbs	0.08	Broadleaf weeds
		GARLON 4	62719-40	2.56	0.02	1	Russian olive Tamarisk Broadleaf weeds
		MILESTONE	62719-259	7.68	0.06	1.09	Canada thistle Russian knapweed Spotted knapweed
		TORDON 22K	62719-6	428.8	3.35	13.4	Field bindweed St. Johnswort Dalmatian toadflax
	2008	2,4-D LV 6	42750-20-2935	288	2.25	9	Field bindweed Russian thistle Broadleaf weeds
		CORNERSTONE PLUS	524-454-1381	130.56	1.02	1.74	Grasses Broadleaf weeds
		DRIVE 75DF	7969-130	83.84	5.24 lbs	5.24	Field bindweed
		GARLON 4	62719-40	243.2	1.9	2	Russian olive Tamarisk Broadleaf weeds
		HI-DEP	2217-703	273.92	2.14	5.58	Broadleaf weeds
		MILESTONE	62719-259	1.28	0.01	0.17	Canada thistle Russian knapweed Spotted knapweed
		PARAMOUNT	7969-113	8	0.5 lbs	1	Field bindweed
		ROUNDUP WEED & GRASS KILLER 1 READY-TO-USE	71995-23	24	0.188	0.01	Grasses Broadleaf weeds
		ROUNDUP WEED & GRASS KILLER CONCENTRATE PLUS	71995-29	24.32	0.19	0.11	Grasses Broadleaf weeds
		TORDON 22K	62719-6	97.28	0.76	1.99	Field bindweed

	2009	TRIANGLE BRAND COPPER SULFATE PENTAHYDRATE	1278-8-1769	208	13 lbs	0	St. Johnswort Dalmatian toadflax Roots
		CONFRONT	62719-92	32	0.25	0.51	Canada thistle
		CORNERSTONE PLUS	524-454- 1381	230.4	1.8	2.9	Grasses Broadleaf weeds Bush honeysuckle
		DRIVE 75DF	7969-130	48	3 lbs	3.04	Field bindweed
		ESCORT XP	352-439	0.64	0.04 lbs	0.32	St. Johnswort Whitetop Spotted knapweed
		GARLON 3A	62719-37	7.68	0.06	0.01	Russian olive
		HI-DEP	2217-703	770.56	6.02	15.16	Broadleaf weeds
		MILESTONE	62719-259	7.68	0.06	1.09	Canada thistle Russian knapweed Spotted knapweed
MIIN	2005	CURTAIL	62719-48	33	0.258		Russian knapweed
	2006	MILESTONE	62719-259	0.0125	0.0001		Russian knapweed
	2007	ESCORT	352-439	0.05	0.003 lbs	0.019	White bryony
		MILESTONE	62719-519	1.0	0.008	0.2	Rush skeletonweed Russian knapweed Canada thistle
		RODEO	62719-324	103.6	0.80962	3.115	White bryony Canada thistle Bull thistle Musk thistle Rush skeletonweed
		TORDON 22K	62719-6	0.6	0.005	0.019	White bryony
	2008	MILESTONE	62719-519	3.393	0.027	0.537	White bryony Russian knapweed Canada thistle Musk thistle Rush skeletonweed Common mullein Common burdock
	2009	MILESTONE	62719-519	1.64	.013	0.273	Rush skeletonweed Canada thistle

Appendix I: Forms

- a. Biological Use Proposal
- b. Pesticide Use Proposal
- c. EPMT Data Collection

a. Pesticide Use Proposal

Integrated Pest Management NRPUPS - Form Section One

SECTION 1		SECTION 2		SECTION 3: USE LOG	
*Proposal Number: LIBI 2010 TRD		Region: []		State: []	
PROPOSAL STATUS:					
Proposal Created: []		Last Updated: []		Submitted to Review: []	
Current Status: []		Official: []		Status Assigned: []	
SELECT A PEST			SELECT TYPE		
*Pest 1: []			*Type: []		
*Pest 2: []			Herbicide: []		
*Pest 3: []					
SELECT A PRODUCT <input type="radio"/> By name <input type="radio"/> By EPA number					
Product Name: []					
EPA Number: []					
APPLICATION					
*Purpose: []			<input type="radio"/> In Acres <input type="radio"/> In Square Feet		
Method: []			*Enter the approximate area to be treated: (do NOT enter a comma)		
*Primary site: []			Acres: []		
Secondary site: []			SQFT: []		
Start month: [] End month: []					
Next >>>					

<http://nrintra.nps.gov/IPM/SectionOne.cfm>[8/17/2010 2:31:37 PM]

National Park Service Integrated Pest Management		National Park Service U.S. Department of the Interior	
NR Pesticide Use Proposal System			
SECTION 1		SECTION 2	
LOGIN TECHNICAL SUPPORT Help Using This System Email Technical Support Process Overview PROPOSALS Browse/Search Proposals Regional Coordinators Share/Search IPM Info		SECTION 3: USE LOG	
Proposal Number: <input type="text"/> LIBI <input type="text"/> 2010 <input type="text"/> TBD Region: <input type="text"/> State: <input type="text"/>			
PROPOSAL STATUS:			
Proposal Created: <input type="text"/>		Last Updated: <input type="text"/>	
Current Status: <input type="text"/>		Submitted to Review: <input type="text"/>	
Official: <input type="text"/>		Status Assigned: <input type="text"/>	
SELECT A PEST		SELECT TYPE	
Pest 1: <input type="text"/>		Type: <input type="text"/>	
Pest 2: <input type="text"/>		Herbicide: <input type="text"/>	
Pest 3: <input type="text"/>			
SELECT A PRODUCT <input type="radio"/> By name <input type="radio"/> By EPA number			
Product Name: <input type="text"/>			
EPA Number: <input type="text"/>			
APPLICATION			
Purpose: <input type="text"/>		<input type="radio"/> In Acres <input type="radio"/> In Square Feet	
Method: <input type="text"/>		Enter the approximate area to be treated: (do NOT enter a comma)	
Primary site: <input type="text"/>		Acres: <input type="text"/>	
Secondary site: <input type="text"/>		SQFT: <input type="text"/>	
Start month: <input type="text"/>		End month: <input type="text"/>	
		<input type="button" value="Next >>>"/>	

National Park Service

Integrated Pest Management

National Park Service
U.S. Department of the Interior

NR Pesticide Use Proposal System

LOGIN

TECHNICAL SUPPORT

Help Using This System

Email Technical Support

Process Overview

PROPOSALS

Browse/Search Proposals

Regional Coordinators

Share/Search IPM Info

SECTION 1
SECTION 2
SECTION 3: USE LOG

Actual Application

Was this product applied during the proposed year?

Yes No ☒ Unknown

Does the value in the Amount Applied box represent the total product applied during the proposed year?

Yes No ☒ Unknown

Enter total amount applied below.
Select UNIT (pound, gallon, etc.) and enter AMOUNT APPLIED as a number only.

Unit: Amount Applied:

Enter the actual area treated (PROPOSED: 0 Acres)

☐ In Acres ☐ In Square Feet

Acres:

Square Feet:

Active Ingredients This section does not allow data entry until the proposal has been reviewed by the Central Office.

#	Code	Name(s)	Unit Conconst.	Conv. Factor	Total Lbs. Applied
NO PRODUCT HAS BEEN SELECTED					

Closed-Out Proposals

Proposals prior to 2005 are considered closed out if these conditions are met:

N-Was applied this proposal year.
Y-Amount is full amount applied this year.
0-Amount applied.

Proposals 2005 and later are considered closed out if one set of these three sets of conditions are met:

N-Was applied this proposal year.
U-Amount is full amount applied this year.
0-Amount applied.

N-Was applied this proposal year.
Y-Amount is full amount applied this year.
0-Amount applied.

Y-Was applied this proposal year.
Y-Amount is full amount applied this year.
>0-Amount applied.

<http://nrintra.nps.gov/IPM/SectionThree.cfm>[8/17/2010 2:30:09 PM]

Appendix I: Forms

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b. Biological Use Proposal

D R A F T

National Park Service

Proposal for Release of Biological Control Agent

Section A - Proposal

1. Year of proposed release _____

2. Name of Park _____

3. Scientific name of organism to be released (proposed organism) including subspecies and variety, if available.

4. Common name(s) of proposed organism.

Stage of Life Cycle _____

5. Scientific name of organism to be controlled (target organism).

6. Common name of target organism.

Estimated number of acres in the park infested with the target organism. _____

7. Purpose of release (choose one)

Establish a seasonal, non-reproducing population _____

Augment a reproducing population _____

Establish a reproducing population _____

Other (describe)

8. Is the proposed organism indigenous to North America?

Yes _____

No _____

9. Is the proposed organism indigenous to the park?

Yes _____ No _____

10. Is the proposed organism now found in the park?

Yes _____ No _____ Unknown _____

11. Is the proposed organism now found within 20 miles of the park?

Yes _____ No _____ Unknown _____

12. Do other individuals or agencies plan on introducing the proposed organism outside the park but within 20 miles of the park?

Yes _____ No _____ Unknown _____

13. Is the proposed release associated with a coordinated effort or partnership?

Yes _____ Name of Partner _____

No _____

14. Does the park have a memorandum of agreement or other written partnership document?

Yes _____

NO _____

15. If the target organism is a plant that is not indigenous to North America, what is the number and date of the permit issued by the Animal and Plant Health Inspection Service permitting release of the proposed organism? (Note: This permit is not issued to individual parks. It is a one-time permit issued to a research organization or other agency seeking approval to release the organism into the wild.)

Permit number Date

Unknown _____

16. Will additional releases be made in subsequent years?

Yes _____ No _____ If required _____

17. Approximate number of organisms to be released. _____

18. Source of proposed organisms.

Collected from wild in this park _____

Collected from wild outside this park _____ Distance in miles from collection point to release point _____

Other agency _____

Commercial Course _____

Other _____

Transfer permit is: Needed ___ Yes ___ No Applied for ___ Yes ___ No
 Received ___ Yes ___ No Date received _____

19. Does the park contain native species in the same genera as the target species?

Yes _____ How many _____

No _____

Unknown _____

20. Are any of these native species listed as threatened or endangered?

Yes _____ No _____

If yes, list the scientific name. _____

List the common name. _____

If yes, has this proposal been coordinated with the U.S. Fish and Wildlife Service?

Yes _____ Describe results of coordination.

No _____

21. What NEPA compliance has been completed for this organism?

Categorical Exclusion _____

Environmental Assessment _____

Environmental Impact Statement _____

If not completed, what is the status?

22. What other methods have been used **in the past** to control the target species? Describe results.

Are any pesticide uses planned for the release site within 24 months of the release?

Yes _____ Brand name _____ Active ingredient _____

Target pest _____

Measures to be taken to mitigate impact on the proposed organism:

No _____

Please attach any other information that would help your cluster or regional IPM specialists evaluate this proposal.

23. Submitted by _____

24. Title _____

25. Telephone _____

Section B - Review and Approval

26. Concurrence by _____
Cluster, Regional or WASO IPM Specialist Date

State conditions of concurrence, if any.

27. Approved by _____
Superintendent Date

State conditions of approval, if any: _____

Section C - Evaluation Plan

This proposal must be accompanied by a plan for evaluating the effects of the proposed release. The plan must, as a minimum, include the following elements.

- The objective of the release and the objective of the evaluation plan.
- The methodology for monitoring the population size (or density) and spread of the organism released.
- The methodology for monitoring the population size (or density) of the organism to be controlled.
- The methodology for measuring negative and positive impacts on native flora and fauna. If this element is not included in the evaluation plan, state the rationale for excluding it.
- The schedule for written reports of the evaluation. As a minimum, there must be a progress report which will be completed by December 31 of the year of the release and a final report. Two copies of each report will be submitted to the IPM specialists approving the release.
- Identification of the individuals who will be responsible for conducting the evaluation.
- A budget for the evaluation.
- Identification of sources of funds for the evaluation.

c. NRM EPMT Data Collection Form

NRM EPMT Daily Datasheet				Recorder Init:		Start:		End:		Page ___ of ___		Ent Date & Init:					
LocationID			New LocationID? Y N		Team		# Indiv		Work		Prep		Travel				
Date: / /		Park:		State:		Client:		YELL-EPMT									
Location Description:						GLAC-EPMT											
						CRMO-EPMT											
						Total Person Hours											
Area GPSed? Y N		GPS Comments:				Photopoint? Y N		Photopoint description:									
GPS File:						Photopoint #											
Precip: none mist drizzle intermit const hail sleet snow						Equipment and Number Used:											
Cloud Cvr: <25% 25-50% 51-75% 76-100%						Wind Dir:		High:		___ Backpack Sprayer		___ Spray Bottle		___ Drill		___ Boat	
										___ Tank Sprayer		___ Chainsaw		___ Shovel		___ Other	
Temp Sun: °F		Temp Shade: °F		RH: %		Avg:		___ ATV		___ Polesaw		___ Bow/Handsaw					
								___ UTV		___ Brushcutter		___ Loppers/Pruners					
Taxon & Infestation ID	Action circle one	% of Total Plants	Hrs. Per Taxon	Acres – Filled out in Office				Treatment circle one	Plant Count	Pheno circle one	LifeStage circle one	Density circle one	Dist. circle one				
				Inv/Mon	Gross Inf	Inf	Trt/Rtr										
	Treatment							Cut/Stump		Dormant	Seedling	None	Clump				
	Retreatment							Basal Bark		Leaf Bud	Juvenile	Trace <1%	ConCov				
	Inventory							Foliar		Leaf-Out	Mature	Light 1-10%	Grad				
	Monitor							Manual		Flower Bud	Rosette	Moderate 10-25%	Isolnd				
								Hack/Squirt		Flower	Bolted	Heavy	IsoPat				
										Imm Fruit	Senesced		Scat				
										Mat Fruit							
										In seed							
	Treatment							Cut/Stump		Dormant	Seedling	None	Clump				
	Retreatment							Basal Bark		Leaf Bud	Juvenile	Trace <1%	ConCov				
	Inventory							Foliar		Leaf-Out	Mature	Light 1-10%	Grad				
	Monitor							Manual		Flower Bud	Rosette	Moderate 10-25%	Isolnd				
								Hack/Squirt		Flower	Bolted	Heavy	IsoPat				
										Imm Fruit	Senesced		Scat				
										Mat Fruit							
										In seed							

	Treatment Retreatment Inventory Monitor							Cut/Stump Basal Bark Foliar Manual Hack/Squirt		Dormant Leaf Bud Leaf-Out Flower Bud Flower Imm Fruit Mat Fruit In seed	Seedling Juvenile Mature Rosette Bolted Senesced	None Trace <1% Light 1-10% Moderate 10-25% Heavy	Clump ConCov Grad IsoInd IsoPat Scat
Herbicide	Rate	Volume Conc.	Total Mix Used	Diluent	Surfactant		Volume Surf.	%Conc	Dye	%Conc			
1.		gal oz	gal oz										
2.		gal oz	gal oz										

Taxon & Infestation ID	Action circle one	% of Total Plants	Hrs. Per Taxon	Acres – Filled out in Office				Treatment circle one	Plant Count	Phenology circle one	Life Stage circle one	Density circle one	Dist. circle one
				Inv/Mon	Gross Inf	Inf	Trt/Rtr						
	Treatment Retreatment Inventory Monitor							Cut/Stump Basal Bark Foliar Manual Hack/Squirt		Dormant Leaf Bud Leaf-Out Flower Bud Flower Imm Fruit Mat Fruit In seed	Seedling Juvenile Mature Rosette Bolted Senesced	None Trace <1% Light 1-10% Moderate 10-25% Heavy >25%	Clump ConCov Grad IsoInd IsoPat Scat
	Treatment Retreatment Inventory Monitor							Cut/Stump Basal Bark Foliar Manual Hack/Squirt		Dormant Leaf Bud Leaf-Out Flower Bud Flower Imm Fruit Mat Fruit In seed	Seedling Juvenile Mature Rosette Bolted Senesced	None Trace <1% Light 1-10% Moderate 10-25% Heavy >25%	Clump ConCov Grad IsoInd IsoPat Scat
	Treatment Retreatment Inventory Monitor							Cut/Stump Basal Bark Foliar Manual Hack/Squirt		Dormant Leaf Bud Leaf-Out Flower Bud Flower Imm Fruit Mat Fruit In seed	Seedling Juvenile Mature Rosette Bolted Senesced	None Trace <1% Light 1-10% Moderate 10-25% Heavy >25%	Clump ConCov Grad IsoInd IsoPat Scat
Herbicide	Rate	Volume Conc.	Total Mix Used	Diluent	Surfactant		Vol. Surf.	%Conc	Dye	%Conc			
3.		gal oz	gal oz										

4.		gal oz	gal oz						
5.		gal oz	gal oz						
6.		gal oz	gal oz						
Comments									

Appendix J: List of Potential Invaders

Key: X = Present, Z= observed in past, -- = not present, ? = unknown

Latin Name	Common Name	CIRO	CRMO	FOBU	GOSP	GRKO	HAFO	MIIN	LIBI	NEPE- BEPa	NEPE- BIHO
<i>Acroptilon repens</i> aka <i>Centaurea repens</i>	Russian Knapweed	X	X	--	X	X	X	X	X	--	--
<i>Aegilops cylindrica</i>	Jointed Goatgrass	--	--	--	--	--	--	?	--	--	--
<i>Agropyron cristatum</i>	Crested Wheatgrass	X	X	X	X	X	X	?	X	Z	--
<i>Agropyron intermedium</i>	Intermediate Wheatgrass	--	X	?	--	--	?	?	--	--	Z
<i>Agrostis gigantea</i>	Redtop	--	--	--	X	X	?	?	X	?	?
<i>Alopecurus arundinaceus</i>	Creeping Foxtail	--	--	X	--	X	?	?	--	?	?
<i>Alyssum alyssoides</i>	Yellow Alyssum	--	--	--	X	X	?	?	X	?	?
<i>Ambrosia tomentosa</i> aka <i>Franseria discolor</i>	Skeleton-Leaf Burr-Ragweed	--	--	--	--	--	?	?	--	--	--
<i>Anchusa arvensis</i>	Annual Bugloss	--	--	--	--	--	?	?	--	?	?
<i>Anchusa officinalis</i>	Bugloss	?	--	--	--	--	?	?	--	?	?
<i>Arctium minus</i>	Common Burdock	X	X	--	?	--	X	?	--	--	--
<i>Artemisia absinthium</i>	Absinth Wormwood	?	--	--	--	--	?	?	--	?	?
<i>Asparagus officinalis</i>	Asparagus	--	--	--	--	--	?	?	X	?	?
<i>Berteroa incana</i>	Hoary Alyssum	--	--	--	--	?	?	?	X	--	X
<i>Bromus hordeaceus</i>	Soft Brome	--	--	--	--	--	?	?	X	?	?
<i>Bromus inermis</i>	Smooth Brome	X	X	X	?	X	?	?	X	X	--
<i>Bromus japonicus</i>	Japanese Brome	X	X	X	X	X	?	?	X	--	--
<i>Bromus tectorum</i>	Cheatgrass Downy Brome	X	X	X	X	X	X	X	X	X	X
<i>Bryonia alba</i>	White Bryony	--	--	--	--	--	?	X	--	--	--
<i>Butomus umbellatus</i>	Flowering Rush	--	--	--	--	--	?	?	--	--	--
<i>Camelina microcarpa</i>	False Flax	X	X	X	--	X	?	?	X	?	?
<i>Cardaria chalepensis</i>	Lens-Podded White Top	X	--	X	--	X	?	?	--	--	--
<i>Cardaria draba</i>	White Top	X	--	--	X	X	Z	Z	X	--	--
<i>Carduus acanthoides</i>	Plumeless Thistle	--	--	--	--	--	?	?	--	--	--
<i>Carduus nutans</i>	Musk Thistle	X	X	X	X	X	?	X	--	--	--
<i>Carum carvi</i>	Caraway	?	--	--	--	--	?	?	--	?	?
<i>Centaurea diffusa</i>	Diffuse Knapweed	X	X	X	?	--	Z	Z	--	--	--
<i>Centaurea pratensis</i> aka: <i>C. nigrescens</i> , and <i>C. debeauxii</i> ssp <i>thuillieri</i>	Meadow Knapweed	--	--	X	--	--	Z	Z	--	--	--
<i>Centaurea solstitialis</i>	Yellow Starthistle	--	--	--	?	--	X	X	--	--	--
<i>Centaurea stoebe</i>	Spotted Knapweed	X	X	X	X	X	--	--	X	X	X
<i>Centaurea virgata</i> aka <i>C. squarrosa</i>	Squarrose Knapweed	--	--	--	--	--	?	?	--	--	--
<i>Chenopodium album</i>	Lambs Quarters	X	X	--	--	X	--	?	X	--	--

<i>Chicorium intybus</i>	Chicory	X	X	--	--	--	?	?	--	?	?
<i>Chondrilla juncea</i>	Rush Skeletonweed	--	X	--	--	--	X	Z	--	--	--
<i>Chrysanthemum leucanthemum</i> or <i>Leucanthemum vulgare</i>	Oxeye Daisy	--	--	--	X	--	?	?	--	--	X
<i>Cirsium arvense</i>	Canada Thistle	X	X	X	X	X	X	X	X	X	X
<i>Cirsium vulgare</i>	Bull Thistle	X	X	X	X	X	?	?	X	--	X
<i>Conium maculatum</i>	Poison Hemlock	X	--	--	--	--	?	?	--	?	?
<i>Convolvulus arvensis</i>	Field Bindweed	X	X	X	X	X	X	X	X	Z	X
<i>Crupina vulgaris</i>	Common Crupina	--	--	--	--	--	?	?	--	--	X
<i>Cynodon dactylon</i>	Bermuda Grass	?	--	--	X	--	?	?	--	?	?
<i>Cynoglossum officinale</i>	Houndstongue	X	--	X	?	X	X	?	X	--	X
<i>Cystisus scoparius</i>	Scotch Broom	--	--	--	--	--	?	?	--	--	--
<i>Descurainia pinata</i>	Western Tansymustard	--	?	X	--	--	?	?	--	--	Z
<i>Descurainia sophia</i>	Flixweed Tansymustard Herb Sophia	X	X	X	X	X	?	?	X	--	--
<i>Dipsacus fullonum</i>	Common Teasel	--	--	--	--	--	?	?	--	?	?
<i>Echium vulgare</i>	Common Viper's Bugloss	--	--	--	--	--	?	?	--	--	--
<i>Egeria densa</i>	Brazilian Elodea	--	--	--	--	--	?	?	--	?	?
<i>Eichhornia crassipes</i>	Common Water Hyacinth	--	--	--	--	--	?	?	--	?	?
<i>Elaeagnus angustifolia</i>	Russian Olive	--	--	--	--	X	X	X	X	--	--
<i>Elymus repens</i> aka <i>Agropyron repens</i>	Quackgrass	X	?	X	X	X	X	X	X	?	?
<i>Eragrostis cilianensis</i>	Strinkgrass	--	--	--	--	--	?	?	X	?	?
<i>Eremopyrum triticeum</i>	Annual False Wheatgrass	--	X	--	X	--	?	?	X	?	?
<i>Euphorbia dentata</i>	Toothed Spurge	--	--	--	--	--	?	?	--	?	?
<i>Euphorbia esula</i>	Leafy Spurge	--	X	--	?	X	?	?	--	--	Z
<i>Festuca rubra</i>	Red Fescue	--	--	--	--	--	?	?	--	?	?
<i>Galega officinalis</i>	Goats Rue	?	--	--	--	--	?	?	--	?	?
<i>Galium aparine</i>	Catchweed	?	?	--	?	--	?	?	X	?	?
<i>Gypsophila paniculata</i>	Babysbreath	--	--	--	--	X	?	?	--	--	--
<i>Halogeton glomeratus</i>	Halogeton	X	X	X	X	--	?	?	X	?	?
<i>Heracleum mantegazzianum</i>	Giant Hogweed	--	--	--	--	--	?	?	--	?	?
<i>Hieracium aurantiacum</i>	Orange Hawkweed	--	--	--	--	--	?	?	--	--	--
<i>Hieracium caespitosum</i>	Meadow Hawkweed	--	--	--	--	--	?	?	--	--	--
<i>Hieracium floribundum</i>	Yellow Devil Hawkweed	--	--	--	--	--	?	?	--	--	--
<i>Hieracium glomeratum</i>	Queen Devil Hawkweed	--	--	--	--	--	?	?	--	--	--
<i>Hieracium piloselloides</i>	Tall Hawkweed	--	--	--	--	--	?	?	--	--	--
<i>Hydrilla verticillata</i>	Hydrilla	--	--	--	--	--	?	?	--	?	?
<i>Hyoscyamus niger</i>	Black Henbane	X	X	X	?	X	?	?	--	--	--
<i>Hypericum perforatum</i>	St. John's Wort	--	Z	X	?	--	?	?	X	--	--
<i>Impatiens glandulifera</i>	Policeman's Helmet	--	--	--	--	--	?	?	--	?	?

<i>Iris pseudacorus</i>	Yellow Flag Iris	--	--	--	--	--	?	?	--	--	--
<i>Isatis tinctoria</i>	Dyers Woad	--	X	--	X	--	?	?	--	--	--
<i>Knautia arvensis</i>	Field Scabious	?	--	--	--	--	?	?	--	?	?
<i>Kochia scoparia</i>	Kochia	X	X	X	--	X	X	X	X	Z	--
<i>Lactuca serriola</i>	Prickly Lettuce	X	X	X	X	X	?	?	X	Z	--
<i>Lepidium latifolium</i>	Perennial Pepperweed	--	--	--	X	X	?	?	--	--	--
<i>Lepidium perfoliatum</i>	Clasping Pepperweed	X	X	X	X	X	?	?	X	?	?
<i>Linaria dalmatica</i>	Dalmatian Toadflax	--	X	--	X	--	?	?	X	--	--
<i>Linaria vulgaris</i>	Yellow Toadflax	--	--	--	?	X	?	?	--	--	--
<i>Lolium pratense</i>	Meadow Fescue	--	--	--	--	--	?	?	X	?	?
<i>Lonicera tatarica</i>	Tatarian Honeysuckle	--	--	--	--	--	?	?	X	?	?
<i>Lycium halimifolium</i>	Matrimony Vine	?	--	--	--	--	?	?	--	?	?
<i>Lythrum salicaria</i>	Purple Loosestrife	--	--	--	?	--	X	?	--	--	--
<i>Lythrum virgatum</i>	European Wand Loosestrife	--	--	--	--	--	?	?	--	--	--
<i>Matricaria maritima</i>	Scentless Chamomile	?	Z	--	--	--	?	?	--	?	?
<i>Matricaria perforata</i>	Scentless Chamomile	--	Z	--	--	--	?	?	--	?	?
<i>Medicago lupulina</i>	Black Medic	--	X	X	--	X	?	?	X	--	--
<i>Medicago sativa</i>	Alfalfa	--	X	X	--	X	?	?	X	Z	?
<i>Melilotus officinalis</i>	Yellow Sweetclover	X	X	X	X	X	?	?	X	Z	X
<i>Millium vernale</i>	Millium	--	?	--	--	--	?	?	--	?	?
<i>Myriophyllum aquaticum</i>	Parrot Feather Milfoil	--	--	--	--	--	?	?	--	?	?
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil	--	--	--	--	--	?	?	--	--	--
<i>Nardus stricta</i>	Matgrass	--	--	--	--	--	?	?	--	?	?
<i>Onopordum acanthium</i>	Scotch Cottonthistle	X	X	--	X	--	?	X	--	--	--
<i>Phalaris arundinacea</i>	Reed Canarygrass	--	?	X	--	X	?	?	--	Z	--
<i>Phleum pratense</i>	Timothy	X	X	X	--	X	?	?	X	--	X
<i>Poa bulbosa</i>	Bulbous Bluegrass	X	X	X	X	--	?	?	X	?	?
<i>Poa compressa</i>	Canada Bluegrass	--	--	X	--	X	?	?	X	?	?
<i>Poa pratensis</i>	Kentucky Bluegrass	X	X	X	X	X	?	?	X	?	?
<i>Polygonum cuspidatum</i>	Japanese Knotweed	--	--	--	--	--	?	?	--	--	--
<i>Polygonum polystachum</i>	Himalayan Knotweed	--	--	--	--	--	?	?	--	--	--
<i>Polygonum sachalinense</i>	Giant Knotweed	--	--	--	--	--	?	?	--	--	--
<i>Polygonum x bohemicum</i>	Bohemian Knotweed	--	--	--	--	--	?	?	--	--	--
<i>Potamogeton crispus</i>	Curly Leaf Pondweed	?	--	--	--	--	?	?	--	?	?
<i>Potentilla recta</i>	Sulfur Cinquefoil	--	--	--	X	X	?	?	--	--	--
<i>Ranunculus acris</i>	Meadow/Tall Buttercup	X	--	X	--	X	?	?	--	--	--
<i>Reseda lutea</i>	Yellow Mignonette	X	--	--	--	--	?	?	--	?	?
<i>Rumex crispus</i>	Curly Dock	X	X	X	X	X	?	?	X	Z	X
<i>Salsola tragus (aka S. kali and S. iberica)</i>	Prickly Russian Thistle	X	X	--	X	X	?	?	X	--	--
<i>Salvia aethiopsis</i>	Mediterranean Sage	--	--	--	--	--	?	?	--	?	?
<i>Senecio jacobaea</i>	Tansy Ragwort	--	--	--	--	--	?	?	--	--	--

<i>Silene alba</i>	White Campion	?	X	--	--	X	?	?	--	?	?
<i>Silybum marianum</i>	Milk Thistle	?	--	--	--	--	?	?	--	?	?
<i>Sisymbrium altissimum</i>	Tumblemustard	X	X	--	X	X	?	?	X	?	?
<i>Solanum elaeagnifolium</i>	Silverleaf Nightshade	--	--	--	--	--	?	?	--	?	?
<i>Solanum nigrum</i>	Black Nightshade	--	--	--	--	--	?	?	X	?	?
<i>Solanum rostratum</i> (this is native to the great plains)	Buffalo Bur	?	--	--	--	--	?	?	--	?	?
<i>Sonchus arvensis</i>	Field Sowthistle	X	--	--	--	X	?	?	--	--	--
<i>Sorghum halpense</i>	Johnsongrass	--	--	--	X	--	?	?	--	?	?
<i>Sphaerophysa salsula</i>	Swainson Pea	--	--	--	--	--	?	?	--	?	?
<i>Taeniatherum caput-medusae</i>	Medusahead	--	?	--	X	--	?	?	--	?	?
<i>Tamarix ramosissima</i>	Saltcedar	--	--	Z	X	--	X	?	X	--	--
<i>Tanacetum vulgare</i>	Common Tansy	--	X	--	X	X	?	?	--	--	X
<i>Taraxacum officinale</i>	Dandelion	X	X	X	X	X	?	?	X	?	X
<i>Thlaspi arvense</i>	Field Pennycress	X	X	X	--	--	?	?	X	Z	X
<i>Tragapogon dubius</i>	Yellow Salsify	--	X	X	X	X	?	?	X	--	Z
<i>Tribulus terrestris</i>	Puncturevine	--	X	--	X	--	X	?	--	--	--
<i>Trifolium repens</i>	White Clover	X	X	X	--	X	?	?	X	?	Z
<i>Verbascum blattaria</i>	Moth Mullein	--	X	--	X	--	?	?	--	--	--
<i>Verbascum thapsus</i>	Common Mullein	X	X	X	X	X	?	X	X	--	X
<i>Zygophyllum fabago</i>	Syrian Bean-Caper	--	--	--	--	--	?	?	--	?	?
		39	47.5	39.5	40	48	13	12.5	49	8	18

Appendix L: Top 10 Early Detection and Rapid Response (EDRR) Plants in Northern Rocky Mountains Parks (2010)

City of Rocks EDRR Species

<i>Bryonia alba</i>	White bryony
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Centaurea virgata</i> aka <i>C. squarrosa</i>	Squarrose knapweed
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Euphorbia esula</i>	Leafy spurge
<i>Hieracium</i> sp.	Hawkweed complex
<i>Impatiens glandulifera</i>	Policeman's helmet
<i>Isatis tinctoria</i>	Dyers woad
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Linaria dalmatica</i>	Dalmatian toadflax

Craters of the Moon EDRR Species

<i>Bryonia alba</i>	White bryony
<i>Cardaria draba</i>	Hoary Cress / Whitetop
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Cynoglossum officinale</i>	Houndstongue
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Linaria vulgaris</i>	Yellow toadflax
<i>Salvia aethiopsis</i>	Mediterranean sage
<i>Sonchus arvensis</i>	Field sowthistle
<i>Taeniatherum caput-medusae</i>	Medusahead
<i>Tribulus terrestris</i>	Puncturevine

Fossil Butte EDRR Species

<i>Acroptilon repens</i> aka <i>Centaurea repens</i>	Russian knapweed
<i>Cardaria draba</i>	White top
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chrysanthemum leucanthemum</i>	Oxeye daisy
<i>Euphorbia esula</i>	Leafy spurge
<i>Isatis tinctoria</i>	Dyers woad
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Linaria dalmatica</i>	Dalmatian toadflax
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Tamarix ramosissima</i>	Saltcedar / Tamarisk
<i>Centaurea stoebe</i>	Spotted knapweed

Golden Spike EDRR Species

<i>Aegilops cylindrica</i>	Jointed goatgrass
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<i>Centaurea diffusa</i>	Diffuse knapweed
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Centaurea virgata</i> aka <i>C. squarrosa</i>	Squarrose knapweed
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Cynoglossum officinale</i>	Houndstongue
<i>Euphorbia esula</i>	Leafy spurge
<i>Hyoscyamus niger</i>	Black henbane
<i>Hypericum perforatum</i>	St. Johnswort
<i>Linaria vulgaris</i>	Yellow toadflax

Grant-Kohrs EDRR Species

<i>Berteroa incana</i>	Hoary alyssum
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Hieracium aurantiacum</i> and <i>H. caespitosum</i>	Orange and meadow hawkweed
<i>Iris pseudacorus</i>	Yellow flag iris
<i>Isatis tinctoria</i>	Dyers woad
<i>Linaria dalmatica</i>	Dalmatian toadflax
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Polygonum cuspidatum</i>	Japanese knotweed and Knotweed complex
<i>Tamarix ramosissima</i>	Saltcedar / Tamarisk

Hagerman Fossil Beds EDRR Species

<i>Acroptilon repens</i>	Russian knapweed
<i>Bryonia alba</i>	White bryony
<i>Butomus umbellatus</i>	Flowering rush
<i>Cardaria draba</i>	Hoary Cress / Whitetop
<i>Centaurea stoebe</i>	Spotted knapweed
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Euphorbia esula</i>	Leafy spurge
<i>Isatis tinctoria</i>	Dyers woad
<i>Lepidium latifolium</i>	Perennial pepperweed

Little Bighorn EDRR Species

<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Euphorbia esula</i>	Leafy spurge
<i>Hieracium</i> sp	Hawkweed complex
<i>Hyoscyamus niger</i>	Black henbane
<i>Isatis tinctoria</i>	Dyer's woad
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Linaria vulgaris</i>	Yellow toadflax
<i>Ranunculus acris</i>	Meadow/tall buttercup

<i>Tribulus terrestris</i>	Puncturevine
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Minidoka EDRR Species

<i>Cardaria draba</i>	Hoary Cress / Whitetop
<i>Centaurea stoebe</i>	Spotted knapweed
<i>Centaurea virgata</i> aka <i>C. squarrosa</i>	Squarrose knapweed
<i>Cynoglossum officinale</i>	Houndstongue
<i>Euphorbia esula</i>	Leafy spurge
<i>Hieracium caespitosum</i> / <i>Hieracium</i> sp. complex	Meadow hawkweed, and the hawkweed complex
<i>Impatiens glandulifera</i>	Policeman's helmet
<i>Isatis tinctoria</i>	Dyers woad
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Linaria dalmatica</i> and <i>L. vulgaris</i>	Yellow and Dalmatian toadflax

Nez Perce: Bear Paw EDRR Species

<i>Acroptilon repens</i>	Russian knapweed
<i>Cardaria draba</i>	White top
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Convolvulus arvensis</i>	Field bindweed
<i>Euphorbia esula</i>	Leafy spurge
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Ranunculus acris</i>	Meadow/tall buttercup
<i>Tamarix ramosissima</i>	Saltcedar

Nez Perce: Big Hole EDRR Species

<i>Acroptilon repens</i>	Russian knap-weed
<i>Cardaria draba</i>	White top
<i>Centaurea solstitialis</i>	Yellow starthistle
<i>Chondrilla juncea</i>	Rush skeletonweed
<i>Iris pseudacorus</i>	Yellow flag iris
<i>Isatis tinctoria</i>	Dyer's woad
<i>Lepidium latifolium</i>	Perennial pepperweed
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Tamarix ramosissima</i>	Saltcedar

Appendix M: Alien Plant Ranking System (APRS) and APRS Questions

APRS Questions

The 23 questions

(Note: Ignore the numbers in brackets after A, B, C etc. These are used in the software to compute the scores. First number in brackets is Impact weight, second is Pest weight, third Control weight.)

The questions that are more open to interpretation are followed by examples, or interpretations in italics. Note: Be consistent. Park representative will vary slightly in their interpretation of these questions. That is okay as long as they're consistent for all weeds.

I. Significance of Threat or Impact (Site Characteristics)

1. Distribution relative to disturbance regime

- A [0][0][0] found only within sites disturbed within the last 3 years or sites regularly disturbed
- B [1][0][0] found in sites disturbed within the last 10 years
- C [2][0][0] found in mid-successional sites disturbed 11 to 50 years before present (BP)
- D [5][0][0] found in late-successional sites disturbed 51 to 100 years BP
- E [10][0][0] found in high quality natural areas with no known major disturbance for 100 years

Examples

- A. *Occurs in a new parking lot put in 1-3 years BP; roadsides, along trails*
- B. *Occurs in a new parking lot put in 4-10 years BP; a site that burned 4-10 years BP*
- C. *Occurs where grazing occurred, but ceased 11-50 years BP; or in a staging area for construction 11-50 years BP, or examples in B that occurred 11-50 years BP*
- D. *See examples of B and C, but 51-100 years BP*
- E. *Weed occurs in an area where there has been no known disturbance in the last 100 years (no livestock grazing, fire, heavy offroad/off trail use, etc).*

2. Areal extent of populations (answer in percentages or hectares)

- A [0][0][0] not in site, but in adjacent areas
- B [1][0][1] found in less than 5% of site
- C [2][0][2] found in between 5% and 10% of site
- D [3][0][5] found in between 10% and 25% of site
- E [5][0][10] found in more than 25% of site

3. Numerical dominance of species within a community

- A [0][0][0] not found on site
- B [1][0][1] usually observed as a single individual (or fewer than 5 per 5 square meters)
- C [2][0][3] usually observed in numbers less than the 2 or 3 most common native species in the community (but more than 5 per 5 square meters)
- D [3][0][5] usually observed in numbers approximately equivalent to the most common native species in the community
- E [5][0][10] usually observed in numbers greater than the most common native species in the community

4. Association with native community

- A [0][0][0] associated with weedy (early successional) species
- B [3][0][0] associated with midsuccessional species
- C [6][0][0] associated with dominant (late-successional) species
- D [10][0][0] displaces native plant community

Examples of early, mid- and late-successional species will vary widely by park.

Early successional species are generally characterized as colonizers-species that fill in rapidly after a disturbance, have high growth rates, and typically are able to reproduce in first year. When resources are available, they use them up quickly, but are less tolerant of low nutrient levels. Late-successional species are generally slower growing, take one or more years before reproductive capacity, and tolerate lower nutrient levels.

- A. *Will vary depending on park. Examples may include non-native species like Bromus tectorum, Alyssum desertorum, Salsola tragus, and many others. Examples of native early successional species include Poa sandbergii (instead of Stipa sp.), Elymus elymoides.*
- B. *Highly variable. Examples in shrublands: Chrysothamnus species (rabbitbrush) instead of Artemisia species (sagebrush).*
- C. *Highly variable. Examples in shrublands: Artemisia sp. predominate rather than Chrysothamnus, greater forb diversity*
- D. *Invades and outcompetes native plants, reducing or eliminating them.*

5. Hybridization with native species

A [0][0][0] not known to hybridize with native species

B [5][0][0] known to hybridize with native species

6. Degree of threat and impact

A [0][0][0] little or no increase in numbers of individuals and populations and no invasion of native communities

B [1][0][0] present in native communities, but static or decreasing

[2][0][0] moderate rate of increase in numbers of individuals and populations; little or no invasion of native communities

C [5][0][0] moderate rate of increase in numbers of individuals and populations; invading native plant communities

D [10][0][0] high rate of increase of numbers of individuals and populations; invading and replacing or highly modifying native plant communities

This question assumes park managers have been present for many years and have been fairly observant. This is very hard to answer for representatives new to the park (less than 2 years), or without some data collection records.

- A. *The majority do not occur in native, intact communities, only in disturbed areas. Over 2 or more years, no observed increase.*
- B. *Occurs in native communities, but at low levels, not increasing, and possibly decreasing.*
- C. *Spreading moderately, increasing beyond current patch size into native communities.*
- D. *Spreading rapidly into native communities and displacing them/modifying them.*

7. Effects on management goals

A [0][0][0] no effect

B [3][0][0] little impact on site management goals

C [5][0][0] moderate impact on site management goals

D [10][0][0] large impact on site management goals

Depends on the specific location of the weed within the park. Consider visitor experience and view shed; size of the population in the park; status (is it a listed noxious weed); ecological impact (is it changing fire regimes, modifying habitat for species of concern, outcompeting valued native species).

Examples

- A. *Weed is present, but in an area that is low priority (e.g. around a storage shed out of sight, not aggressive, nor likely to spread)*
- B. *Weed is present in low priority areas, e.g. Canada thistle along an irrigation ditch. The area surrounding ditch is dry, not good habitat. It is not spreading into other areas of the park, but may become more of a problem in particularly moist years.*

- C. Cheatgrass occurring in a native plant display garden in front of the visitor's center.
- D. Cheatgrass occurring on a jeep trail, likely to cause a fire after collecting in the undercarriage of vehicles.

II. Innate Ability to be a Pest (Species Characteristics)

8. Mode of reproduction

- A[0][0][0] rarely, if ever, reproduces in area
- B[0][1][0] reproduces almost entirely by vegetative means
- C[0][2][0] reproduces only by seeds
- D[0][4][0] reproduces vegetatively and by seeds

9. Vegetative reproduction

- A[0][0][0] no vegetative reproduction (if question 8 is C, this will be A, and therefore no need to review this question)
- B[0][1][0] vegetative reproduction rate maintains population
- C[0][2][0] vegetative reproduction rate results in moderate increase in population size
- D[0][4][0] vegetative reproduction rate results in rapid increase in population size

B, C or D will vary depending on site conditions (e.g. Canada thistle on a dry site may be B or C, whereas in a moister area, it could be D. Similarly, white top is considered a poor competitor in shrublands, but aggressive in grasslands. Consider surrounding plant community, and its vigor.

10. Frequency of sexual reproduction for mature plant

- A[0][0][0] almost never reproduces sexually in area
- B[0][1][0] once every five or more years
- C[0][3][0] every other year (for biennials)
- D[0][5][0] one or more times a year (annuals, perennials)
- E[0][3][0] bursts of sexual reproduction in response to environmental stimulus, e.g., rain in the desert

11. Number of seeds per plant

- A[0][0][0] rarely, if ever, produces seeds in area
- B[0][1][0] few (0-10)
- C[0][3][0] moderate (11-1000)
- D[0][5][0] many (>1000)

12. Dispersal ability

- A[0][0][0] little potential for long-distance dispersal
- B[0][5][0] great potential for long-distance dispersal

A) For seeds that are heavy (no wind dispersal), not especially palatable to animals, or don't survive in the gut of animals.

B) For seeds with hairy pappus for wind dispersal, or appendages on seed that allow them to attach to fur, clothing, animals. Note: other ranking systems have this question divided into two categories: innate dispersal ability and human caused dispersal ability. Because this is not separated, I've rated species like spotted knapweed as great potential for long distance dispersal. While spotted knapweed seeds do not have a hairy pappus or barbed seed, the most common method of dispersal is in the undercarriage of vehicles (based on plant height, ability to break off), meaning great potential for long distance dispersal.

13. Germination requirements

- A[0][0][0] requires open soil and disturbance to germinate
- B[0][2][0] can germinate in vegetated areas but in a narrow range or in special conditions
- C[0][4][0] can germinate in existing vegetation in a wide range of conditions

- A) *Requires a recent disturbance, open clearing to germinate, and in the spring, or only after a summer rain event.*
- B) *Can germinate in a relatively healthy plant community, but only in the spring when moisture is adequate, or only with unusually large summer rain event*
- C) *Can germinate in a nearly closed canopy, throughout the growing season.*

14. Seed banks

- A[0][0][0] seeds remain viable in the soil for less than 1 year
 B[0][3][3] seeds remain viable in the soil for 1 to 5 years
 C[0][5][5] seeds remain viable in the soil for more than 5 years

15. Competitive ability

- A[0][0][0] poor competitor
 B[0][2][0] moderately successful competitor
 C[0][4][0] highly successful competitor

This will vary from park to park depending on the health of the existing plant community, disturbance regimes, and climate. If you don't know, you can use what I've found in the literature, but if you can modify based on what you've seen in your park-that's much better.

Examples

- A) *Only survives in open, recently disturbed areas. E.g. after a disturbance, it rapidly fills in, but through time, native plants return and the weed fades out.*
- B) *Can germinate and survive in an existing plant community. Doesn't necessarily outcompete existing plants.*
- C) *Can germinate, survive and displace/outcompete existing plant community. Will often form a monoculture when conditions are ideal.*

16. Ecological effects (select all that apply)

- A[0][3][0] produces persistent litter or shade that affects germination or growth of native species
 B[0][3][0] produces allelochemicals
 C[0][3][0] affects availability of soil nutrients, e.g., a nitrogen fixer
 D[0][4][0] affects water availability to native plants
 E[0][4][0] changes natural fire regime
 [0][0][0] none of the above

- A) *plants with large rosettes (some thistles), or an abundance of persistent litter (cheatgrass)*
- B) *Self-explanatory. e.g. spotted knapweed*
- C) *Self-explanatory.*
- D) *While all weeds will affect water availability, this will focus on those that have a competitive edge spatially or temporally e.g. cheatgrass can germinate in fall, continues growth all winter, exploits soil water in the spring before native plants begin growth. By contrast, bindweed has a long narrow taproot. Not expected to compete for soil water.*
- E) *Produces abundant litter, e.g. cheatgrass, or has a high amount of volatile oils.*

17. Known level of impact in natural areas

- A[0][0][0] not known to cause impacts in any other natural area
 B[0][1][0] known to cause impacts in natural areas, but with different habitats and climate zones
 C[0][3][0] known to cause low impact in natural areas with similar habitats and climate zones
 D[0][5][0] known to cause moderate impact in natural areas with similar habitats and climate zones
 E[0][10][0] known to cause high impact in natural areas with similar habitats and climate zones and/or on the list of most invasive alien plants for the region

Examples

- A. *Early successional species. Occurs after a disturbance, and typically naturally declines through time. Not poisonous, doesn't modify soil properties, nor displace native species, etc.*
- B. *E.g. an aquatic species like Eurasian watermilfoil in a park without bodies of water. Another example: meadow knapweed is reported to be especially problematic in moister areas like Oregon and Washington. It may not be such a problem in the more arid parks.*
- C. *Plumeless thistle which has low dispersal ability and is not considered highly competitive.*
- D. *Cheatgrass that may exist as an understory plant, but then be particularly aggressive when native plant communities are under stress, potentially displacing them. Increases the risks of a major wildfire.*
- E. *E.g. Japanese knotweed that may establish along roadsides, ditches, open fields and will aggressively outcompete native species, forming dense monocultures. Once established, it is extremely difficult if not impossible to eradicate.*

III. Difficulty of Control

18. Likelihood of successful control

A[0][0][0] this species has been eradicated in a natural area

B[0][0][3] control (populations declining) of this species has been achieved in a natural area

C[0][0][6] limited control (species is no longer spreading, but persists near pre-control levels) of this species has been achieved in a natural area

D[0][0][10] control of this species has never been achieved in a natural area

This is assuming it's an established patch, where the chance for early detection, rapid response has been missed. The patch has existed for at least 3 years. While not a review question, if any park manager knows of a situation where it has been eradicated, please indicate if A is not already selected, and share this information with other parks.

19. Saturation in surrounding region

A[0][0][0] not present in areas surrounding the site

B[0][0][1] present in few areas surrounding the site

C[0][0][3] present in several areas but not entirely surrounding the site

D[0][0][5] present in most areas surrounding the site

Recall that this question is regarding ease of control, not impact, or ability to be a pest. If the weed is on all sides of the park it's going to be much more difficult to control compared to it being on only one side, or not present in areas surrounding the site.

A) Not surrounding, nor likely to occur within next 2 years. Example: City of Rocks has reports of leafy spurge to the south, but it is more than ~2-5 miles away, meaning managers should keep their eyes out for it, but it is not within immediate vicinity.

B) On one edge of the park. Example: Craters of the Moon has spotted knapweed on the north side of the park along the highway. That is the main point of entry. While it's possible for it enter from other sides, they can focus the majority of their efforts in that area and are not constantly battling it from all sides.

C) On two sides of park (e.g. whitetop encroaching from the south and east side).

D) On three or more sides: Example: Bear Paw battlefield has Canada thistle bordering it along a neighboring ranch, and along two other sides of the park.

20. Effectiveness of community management

A[0][0][0] protection from disturbance effectively controls target species

B[0][0][2] cultural techniques (burning, flooding) can be used to control target species

C[0][0][5] restoration or preservation practices effectively control target species

D[0][0][10] the above options are not effective

- A) *e.g. plumeless thistle, Russian thistle, many others that rarely occur without a major disturbance.*

- B) *For the intermountain region, burning typically favors non-native species, and flooding is not an option for any of the parks. This will rarely be selected for any of the weeds.*
- C) *Over a two to five year period, a series of efforts can be undertaken so that the native plant community is on a trajectory to suppress the weed, and no or very minor weed control efforts (spot spraying small patches) will be required in the future. For example, Russian knapweed could be sprayed at the recommended time (see word document), and followed by fall seeding of rhizomatous grasses. Assuming the grass establishment is adequate, research has demonstrated that these efforts can control, and ultimately decrease Russian knapweed. The weed may still exist as a minor component, but is not expected to spread beyond the current location, nor displace the native plants.*
- D) *Needs very aggressive control methods. Yearly, or every other year, managers need to repeatedly use control efforts such as spot spraying in order to prevent the weed from spreading widely.*

21. Vegetative regeneration

- A[0][0][0] no resprouting following removal of aboveground growth
- B[0][0][5] sprouts from roots or stumps
- C[0][0][10] any plant part is a viable propagule

A) We're interpreting this to mean to hand-pulling to remove some root, not mowing, clipping. For example, if you clip cheatgrass, it will grow back, but if you pull it, it will not resprout. Please note, that some species marked A, could be B if they are removed when the soil is dry, and the root breaks off near the surface. For species marked A, check descriptions of the weed in the word document for more details.

B) e.g. Russian knapweed will resprout from rhizomes when hand-pulled.

C) Any plant part is a viable propagule meaning it can sprout from stem fragments as well as rhizomes or seeds. Examples are Canada thistle, Japanese knotweed, or Eurasian watermilfoil.

22. Biological control

- A[0][0][0] biological control feasible
- B[0][0][5] potential may exist for biological control
- C[0][0][10] biological control not feasible (not practical, possible, or probable)

*B is when a biological control is currently under investigation, but has not yet been approved for release. C is for species where a biological control is unavailable and unlikely in the future, e.g. sulfur cinquefoil (*Potentilla recta*) which is very similar to native species and cultivated strawberries, or nearly all plants in the mustard family (*Brassicaceae*).*

23. Side effects of control measures

- A[0][0][0] control measures have little potential to affect native communities
- B[0][0][3] control measures are likely to cause moderate impacts on community
- C[0][0][5] control measures are likely to cause major impacts on community
- D[0][0][5] side effects of control unknown

This depends on the control measures used and the surrounding plant community. Regarding C, some control measures are likely to cause major impacts on the community, but it may be the failure to act would result in a monoculture of this weed, or some other unacceptable result.

Hand-pulling: *If done at the appropriate time, it is likely to have little effect (A). However, if soil is excessively muddy, and desirable plants are trampled it could be B or C as this will increase disturbance, damage existing plant community, bring new weed seeds into the area on muddy boots.*

Mowing *will have little to major impacts depending on the surrounding plant community. If the existing community is only grasses, and mowing is recommended for the particular weed, it may reinvigorate the desirable species, causing little impact. If mowing in areas where existing plants are in poor condition, mowing may only further open up the community to other nonnative invasive plants, having a moderate to major impact.*

Spot spraying is likely to have moderate impact, even if applicator is careful to spray only the target plant. However, if spot spraying a broadleaf weed in a grassy meadow with a selective herbicide, the spot spraying is likely to have little potential to affect native communities (A). By contrast, if spot spraying a broadleaf forb like Canada thistle in a diverse community of shrubs, forbs and grasses, the spraying will weaken the forbs or shrub, the functional group most similar to Canada thistle. This means spraying will have a moderate to major impact (B or C). Spraying with herbicides like Tordon with long residual, are likely to have a major impact, even though it must be assumed that this will have less of an impact than not controlling the weed at all.

Spraying and not reseeding areas with no desirable remnant vegetation is likely to have a major impact, as spraying will need to be done repeatedly, and create conditions for other nonnative invasive plants as well.

Biological controls like insects are likely to have little potential to affect native communities. Exceptions are parks releasing insects for control of non-native thistles where they have high diversity of native thistles that may be targeted as well. Targeted grazing (e.g. with trained cattle at Grant-Kohrs) will have little potential to affect native communities as long as grazing is monitored closely.

Appendix O: Relative Aquifer Vulnerability Evaluation (RAVE) Analysis

RAVE: Relative Aquifer Vulnerability Evaluation

An on- farm scoring system to evaluate aquifer vulnerability to pesticide contamination; 2nd Ed.

Introduction

Pesticide applicators of today are faced with growing concern over the potential for pesticide contamination of ground water. Over 50% of all Montanans and 95% of the agricultural community consume ground water as their source of drinking water. Protecting this fragile resource from pesticide contamination is imperative, because some pesticides may be harmful to humans at very low concentrations and clean-up of ground water is extremely difficult. Pesticide residues in ground water may also adversely affect sensitive crops and wildlife.

To help farmers and pesticide applicators reduce the potential for contaminating ground water with pesticides, an aquifer vulnerability scoring system; RAVE: Relative Aquifer Vulnerability Evaluation has been developed. This numeric scoring system helps individuals evaluate pesticide selection for on- site ground water contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application required in all situations.

In most cases pesticide contamination of ground water can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors in a particular area determine the relative vulnerability of ground water to pesticide contamination. Nine of these factors have been incorporated into the RAVE score card and are defined below. A Value for most of these factors can be determined by a simple on- site inspection. If a value for a particular factor is not known, contact the appropriate agency for assistance. A listing of agency contacts is provided below. Pesticide leaching potential is based on the soil persistence and mobility of a pesticide. A list of leaching potentials for some commonly used pesticides is given on pages 3- 4.

Factor Definitions

Irrigation Practice: A rating based on whether a field is flood, sprinkler or non- irrigated.

Depth to Ground Water: The distance, in vertical feet, below the soil surface to the water table.

Distance to Surface Water: The distance, in feet, from the field boundary to the nearest flowing or stationary surface water.

Percent Organic Matter: The relative amount of decayed plant residue in the soil (see soil test results, county soil survey or consult the SCS). This may be estimated by soil color; darker soil generally indicates higher organic matter (most Montana soils are < 3 %).

Pesticide Application Frequency: The number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: A rating based on whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate ground water based upon the persistence, sorptive potential and solubility of the pesticide.

Topographic Position: Physical surroundings of the field to which the pesticide application is to be made. Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling up- lands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

Sources of Information

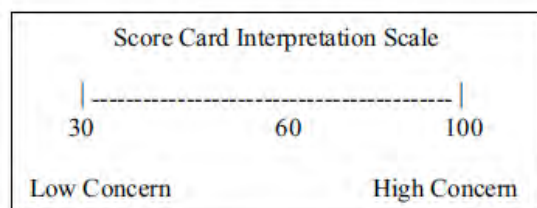
Soils Information: (1) USDA- SCS soil survey, district offices in most county seats; (2) Montana State University (MSU) Extension Service in most county seats, State Soil Specialist in Bozeman (994- 4601); (3) MSU Department of Plant, Soil and Environmental Sciences (994- 4601).

Ground Water Information: (1) Montana Bureau of Mines and Geology in Butte (496- 4155), in Billings (657- 2938); (2) United States Geological Survey in Helena (449- 5225); (3) Montana Department of Health and Environmental Sciences, Water Quality Division (444- 2406); (4) Montana Department of Natural Resources and Conservation, Water Resource Division (444- 6601).

Pesticide Information: (1) Montana Department of Agriculture, Agricultural Sciences Division. Headquarters: Helena (444- 5400), Regional offices: Billings (652- 3615), Bozeman (587- 9067), Great Falls (761- 0926), Glasgow (228- 9510), Missoula (329- 1340); (2) MSU Extension Service offices in most county seats, Pesticide Specialist in Bozeman (994- 3518); (3) US EPA Montana Office in Helena (457- 2690).

Directions for Use of the RAVE Score Card

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper write down the appropriate value for each of the nine factors listed on the score card. For example; at a sprinkler irrigated site the "Irrigation Practice Factor" would be assigned a value of 7. Once all of the factors have been assigned a value, total all values. This total should then be compared to the Score Card Interpretation Scale to determine the relative vulnerability of ground water to contamination by an individual pesticide. Higher scores indicate higher vulnerability of ground water to pesticide contamination. If a high score is received, select an alternative pesticide and compare the results.



THE RAVE SCORE CARD

DEPTH TO GROUND WATER:

*2- 10 ft	<u>20</u>	
10- 25 ft	<u>12</u>	
25- 50 ft	<u>5</u>	
> 50 ft	<u>0</u>	

DISTANCE TO SURFACE WATER:

1- 100 ft	<u>5</u>	
100- 500 ft	<u>3</u>	
> 500 ft	<u>2</u>	

TOPOGRAPHIC POSITION:

Floodplain	<u>15</u>	
Alluvial bench	<u>10</u>	
Rolling foothill	<u>5</u>	
Upland plain	<u>2</u>	

SOIL TEXTURE:

Gravelly	<u>15</u>	
Sandy	<u>15</u>	
Loamy	<u>10</u>	
Clayey	<u>5</u>	

PERCENT SOIL ORGANIC MATTER:

0- 1%	<u>5</u>	
**1- 3%	<u>3</u>	
> 3%	<u>2</u>	

IRRIGATION PRACTICE:

Flood irrigated	<u>10</u>	
Sprinkler irrigated	<u>7</u>	
Non- irrigated	<u>2</u>	

PESTICIDE APPLICATION FREQUENCY:

> 1/year	<u>5</u>	
1/year	<u>2</u>	

PESTICIDE APPLICATION METHOD:

Soil applied	<u>5</u>	
Foliar applied	<u>2</u>	

PESTICIDE LEACHING INDEX:

***High	<u>20</u>	
Moderate	<u>10</u>	
Low	<u>5</u>	

Total ALL Rankings for the field and pesticide in question here:

- * If water table < 2 feet deep, applications should probably not be made
- ** If unknown, use this value
- *** See Table 1 for pesticide leaching index

Interpretation of RAVE Scores

The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of ground water to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for ground water contamination. In such instances alternative pesticides should be sought which have a lower leaching potential. Scores of 80 or greater indicate that pesticide applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 64 indicate a moderate to low potential for ground water contamination and scores less than 45 indicate a low potential for ground water contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect ground water.

Table 1. Commonly used pesticides, an example trade name and relative pesticide leaching potentials. Chemicals bolded have been found in ground water in Montana (Adapted from McBride et al., 1989.)

<u>Pesticide</u>	<u>Leachability</u>	<u>Pesticide</u>	<u>Leachability</u>
Insecticides		Herbicides	
acephate (Orthene)	low	acifluorin (Blazer)	low
aldicarb (Temik)	high	acrolein (Magnacide H)	high
aldrin	low	alachlor (Lasso EC)	med
azinphos- methyl (Guthion)	low	ametryn	med
carbaryl (Sevin)	low	amitrole (Amitrole T)	med
carbofuran (Furadan)	high	atrazine (AAtrex)	high
chlorpyrifos (Lorsban)	low	benefin (Balan)	low
diazinon	low	bentazon (Basagran)	med
dimethoate (Cygon)	med	bromacil (Hyvar)	high
disulfoton (Di- Syston)	low	bromoxynil (Butricil)	low
endosulfan (Thiodan)	low	butylate (Sutan+)	low
esfenvalerate (Asana XL)	low	chloramben (Amiben)	high
fenvalerate (Pydrin)	low	chlorsulfuron (Glean)	high
fonofos (Dyfonate)	med	clopyralid (Stinger, Curtail)	high
lindane	med	cyanazine (Bladex)	med
malathion (Cythion)	low	cycloate (Ro- Neet)	med
methamidophos (Monitor)	high	dalapon	high
methidathion (Supracide)	med	desmedipham (Betanex)	low
methomyl (Lannate, Nudrin)	med	dicamba (Banvel)	high
methyl parathion (Penncap- M)	low	diclofop (Hoelon)	low
parathion	low	difenzoquat (Avenge)	low
permethrin (Ambush, Pounce)	low	diuron (Karmex)	med
phorate (Thimet, Rampart)	med	endothall (Des- I- Cate, Herbicide 273)	low
terbufos (Counter)	low	EPTC (Eptam, Eradicane)	med
tralomethrin (Scout- Xtra)	low	ethalfuralin (Sonalan)	low
trichlorfon (Dylox, Proxol)	high	ethofumesate (Nortron)	high
vitavax (Lindane & Thiram)	med	fenoxaprop (Whip)	low
		fenoxaprop- P- ethyl (Cheyenne, Puma)	low
Fungicides		fluazifop- P- butyl (Fusilade 2000)	low
benalaxyl	low	Fosamine Ammonium (Krenite)	low
benomyl (Benlate, Tersan 1991)	low	Glufosinate ammonium (Finale)	low
captan	low	glyphosate (Roundup)	low
chlorothalonil (Bravo, Daconil)	low	hexazinone (Velpar)	high
copper hydroxide (Kocide, Champion)	low	imazamethabenz- methyl (Assert)	high
mancozeb (Dithane, Manzate, Penncozeb)	low	imazapic (Plateau)	high
maneb	low	imazapyr (Arsenal)	high
metalaxyl (Ridomil)	high	MCPA	high
PCNB (Terraclor)	low	MCPA amine (Weedar)	high
propiconazole (Tilt)	med	MCPA ester	low
sulfur (Magnetic 6, Thiolux)	low	MCPA ester (Curtail M)	high
thiophanate methyl (Topsin M)	low	MCPP	high
thiram	low	metolachlor (Dual)	med
triadimefon (Bayleton)	med	metribuzin (Sencor, Lexone)	high
triforine	low	metsulfuron methyl (Ally)	high
		MSMA (Daconate)	low
		oryzalin (Surflan)	low

<u>Pesticide</u>	<u>Leachability</u>
Herbicides	
paraquat (Gramoxone Extra, Cyclone)	low
pendimethalin (Prowl)	low
phenmedipham (Betamix)	low
picloram (Tordon)	high
prometon (Pramitol)	high
pronamide (Kerb)	low
propachlor (Ramrod)	low
propanil (Stampede)	low
pyrazon (Pyramin)	low
sethoxydim (Poast)	low
simazine (Princep)	high
sulfometuron methyl (Oust)	med
tebuthiuron (Spike)	high
terbacil (Sinbar)	high
thifensulfuron (Harmony)	high
tralkoxydim (Achieve)	low
triasulfuron (Amber)	low
triallate (Far-Go)	low
tribenuron (Express)	high
triclopyr (Garlon)	med
trifluralin (Treflan)	low
triflursulfuron methyl (Upbeet)	med
vernolate (Vernam, Surpass)	med
2,4- D	high
2,4- D amine (Curtail)	high
2,4- D ester (Curtail M)	high
2,4- DB (Butyrac)	high
2,4- DP (Weedone)	high
Rodenticides	
aluminum phosphide	low
chlorophacinone	low
diphacinone	low
strychnine	low
zinc phosphide	low

Ratings Determination

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Supplemental Table Herbicides and their Properties (for use with RAVE Scorecard)						
Common Name	Trade Name	Solubility in Water (ppm)	Soil Sorption Index (Koc)	Half Life in Soil (days)	Surface Runoff (Loss) Potential	Leaching Potential
Chlorsulfuron	Telar	300 (pH 5) 28,000 (pH7)	40 @ pH 7 (average)	30 for acid soil 30+ for alkaline soil	Small	Large
Clopyralid	Curtail, Transline, Stinger, Reclaim, Lontrel	1,000 (acid) 300,000 (salt)	1.4	20	Small	Large
2,4-D (amine)	2,4-D, Aqua-Kleen, Barrage, Weedone	890	20	10	Small	Medium
2,4-D (ester)		900	100 (estimated)	10	Medium	Small
Glyphosate	Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown	12,000	24,000	30	Large	Small
Imazapic	Plateau, Cadre, Plateau Eco-Paks	2,200	10-267 (depends on soil type)	31-410 (176.25 average)	Small	Medium
Metsulfuron methyl	Escort	548 @ pH 5 2,790 @ pH 7 213,000 @ pH 9	37 @ pH 7	120	Medium	Large
Picloram	Tordon, Grazon PC, Tordon K, Tordon 22	430	16 - average for the K salt (17-160 range)	90	Small	Large
Quinclorac	Paramount	64	13-54	18-176	Variable, depends on soil type	Medium
Triclopyr	Garlon products	430	780	46	Large	Medium

Source: McCrea, J. 2001. Supplemental Table for RAVE.

The following was summarized from personal correspondence with Amy Bamber, Montana Department of Agriculture (Amy Bamber pers. comm. 2006).

Pesticide leaching index for pesticides other than what is listed (and future pesticides) can be determined by the following method using the half life and binding capacity, which can be found in factsheets on the EPA Office of Pesticide Programs website <http://www.epa.gov/pesticides/> or through the manufacturer. Use the half life and binding capacity to determine the Ground Water Ubiquity Score (GUS). The GUS is useful for predicting and ranking a pesticide's potential to move to ground water. GUS relates a pesticide's half life (T_{1/2}) in days and binding capacity (K_{oc}) to mobility.

$$\text{GUS} = \log T_{1/2} * (4 - \log K_{oc})$$

GUS scale:

< 0.1	extremely low
0.1 - 1.0	very low
1.0 - 2.0	low
2.0 - 3.0	moderate
3.0 - 4.0	high
> 4.0	very high