

Appendix A

Habitat Suitability Criteria

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HSC sources and references for the Wilder, Bellows Falls and Vernon projects.

Species	Life Stage	Variable	Original Source	Identified Source	Note:
American Shad	Juvenile	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Excelon, 2012 (Conowingo IFIM)	Based on Greene et al. 2009
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Adult	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Stier and Crance, 1985	
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Spawning	Velocity	Stier and Crance, 1985	Hightower et al., 2012	Modified based on review of data
		Depth	Stier and Crance, 1985	Hightower et al., 2012	Used original Stier and Crance, 1985 endpoint of 50 feet.
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	
Walleye	Fry	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Juvenile	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Adult	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Spawning/ Incubation	Velocity	McMahon et al., 1984	Bozek et al., 2011	Based on reanalysis of Bozek et al., 2011
		Depth	McMahon et al., 1984	Bozek et al., 2011	From Turners Falls project
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
Fallfish	Fry	Velocity	NA	Gomez and Sullivan, 2007	Velocity and depth based on brook trout fry and juvenile HSC curves developed as part of a Delphi Process for the Deerfield River.
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Juvenile	Velocity	NA	Gomez and Sullivan, 2007	
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Adult	Velocity	None identified	Gomez and Sullivan, 2007	Developed in consultation with the New York Department of Environmental Conservation
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	
	Spawning/ Incubation	Velocity	None identified	Gomez and Sullivan, 2007	
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	

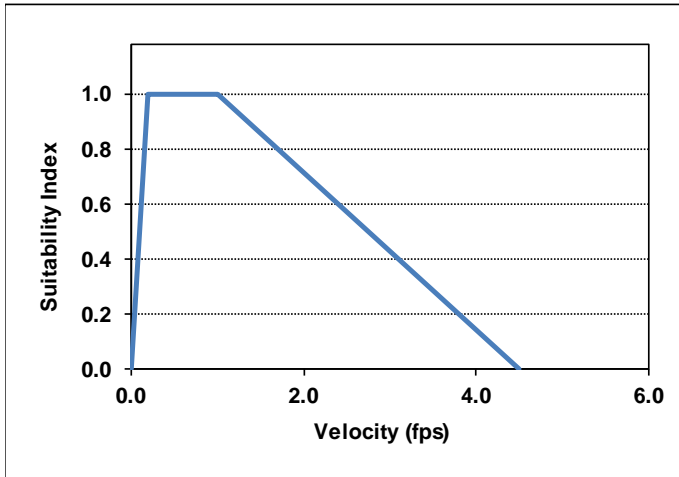
Species	Life Stage	Variable	Original Source	Identified Source	Note:
Longnose dace	Fry	Velocity	USGS HSC Library	Gomez and Sullivan, 2007	Modified by Vermont Department of Fish and Wildlife
		Depth	USGS HSC Library	Gomez and Sullivan, 2007	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2007	
	Juvenile	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2000	
	Adult	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2007	
White sucker	Fry	Velocity	Twomey et al., 1984	Twomey et al., 1984	Modified from original source
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Juvenile/Adult	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Spawning/ Incubation	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Gomez and Sullivan, 2007	
Tessellated darter	Adult	Velocity	Warner et al. 2006	Warner et al. 2006 & Aadland and Kuitunen 2006	Modified by VTDFW-2015
		Depth	Warner et al. 2006		
		Substrate	Aadland and Kuitunen 2006	Aadland and Kuitunen 2006	
Sea lamprey	Spawning	Velocity	Kynard and Horgan, 2013	Kynard and Horgan, 2013	Modified by FWS based on Yergeau, 1983 (depth and substrate); Depth modified by NAI Feb. 2017
		Depth	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
		Substrate	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
Smallmouth bass	Fry	Velocity	NA	Leonard et al., 1986	HSC source for this project
		Depth	NA	Leonard et al., 1986	HSC source for this project
		Substrate	NA	Leonard et al., 1986	HSC source for this project
	Juvenile	Velocity	NA	Groshens and Orth, 1994	HSC source for this project
		Depth	NA	Leonard et al., 1986	HSC source for this project
		Substrate	NA	Leonard et al., 1986	HSC source for this project
	Adult	Velocity	NA	Groshens and Orth, 1994	HSC source for this project
		Depth	NA	Leonard et al., 1986	HSC source for this project
		Substrate	NA	Leonard et al., 1986	HSC source for this project
	Spawning	Velocity	NA	Allen, 1996	HSC source for this project
		Depth	NA	Edwards et al., 1983	HSC source for this project
		Substrate	NA	Allen, 1996	HSC source for this project
Macro-invertebrates	nymphs	Velocity	Unknown	Gomez and Sullivan, 2000	VTDFW modified
		Depth	Unknown	Gomez and Sullivan, 2000	NMPC curve
		Substrate	Unknown	Gomez and Sullivan, 2000	

Species	Variable	Original Source	Identified Source	Note:
Dwarf Wedgemussel	Velocity	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	Delphi process
	Depth	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
	Substrate	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
	Shear Velocity	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
	Bed Shear Stress	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
	Relative Shear Stress	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
	Benthic Velocity	Normandeau & Biodrawverity 2016	Normandeau & Biodrawverity 2016	
Co-occurring Mussels	Velocity	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	
	Depth	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	
	Substrate	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	
	Bed Shear Stress	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	
	Relative Shear Stress	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	
	Benthic Velocity	Normandeau & Biodrawverity 2017	Normandeau & Biodrawverity 2017	

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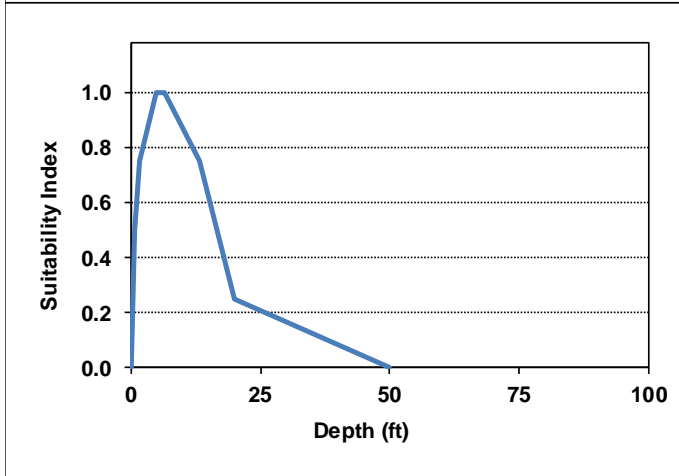
American Shad Juvenile

Source:



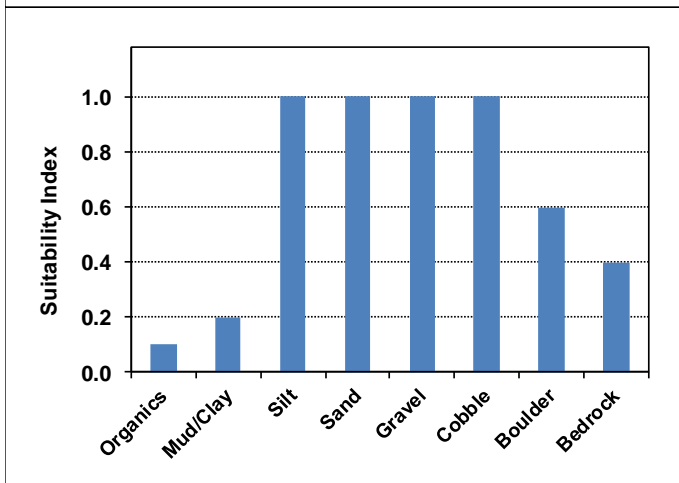
Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.00
0.20	1.00
1.00	1.00
4.50	0.00



Greene et al., 2009

Depth (ft)	SI
0.00	0.00
0.66	0.50
1.50	0.75
4.90	1.00
6.60	1.00
13.20	0.75
20.00	0.25
50.00	0.00

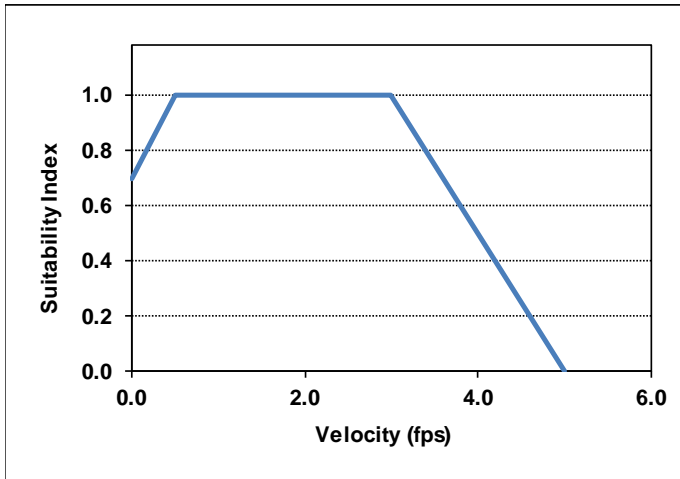


Conowingo IFIM

Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

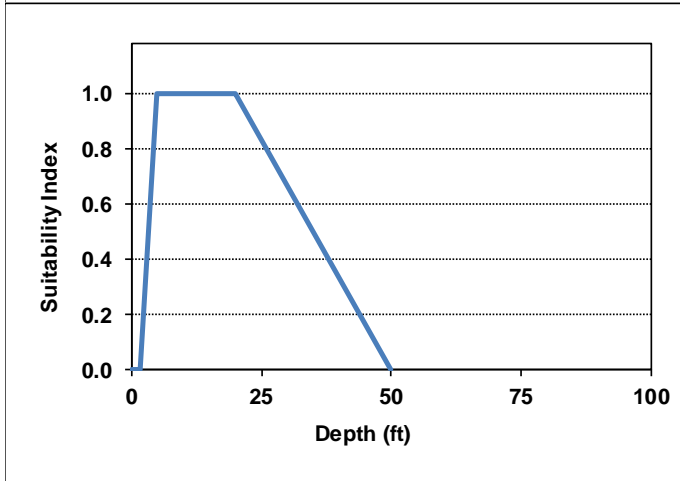
American Shad Adult

Source:



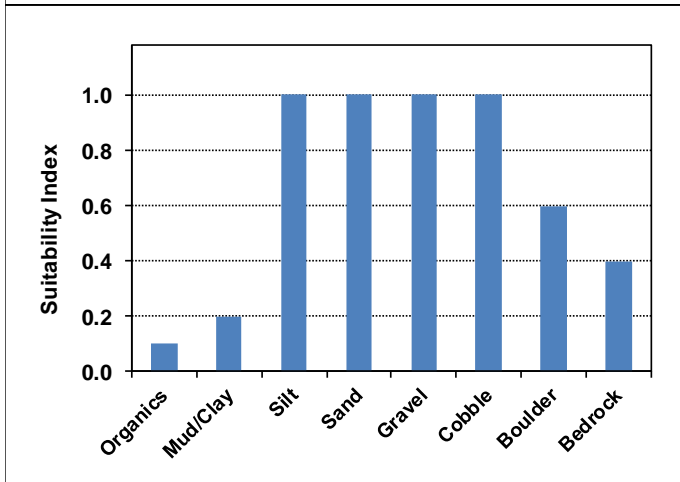
Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.70
0.50	1.00
3.00	1.00
5.00	0.00



Stier and Crance, 1985

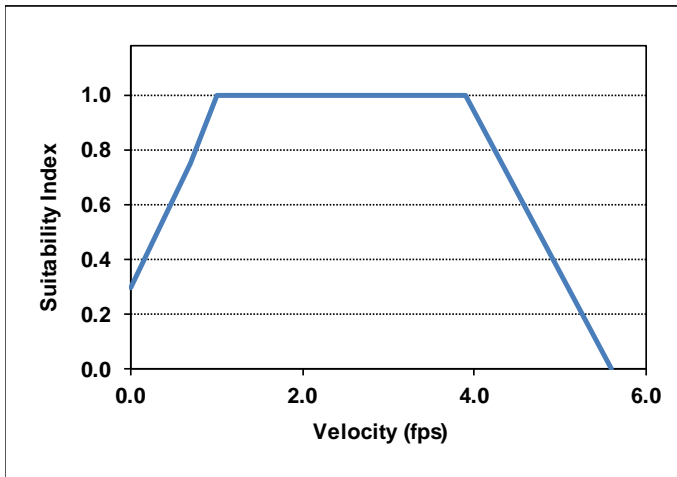
Depth (ft)	SI
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00



Conowingo IFIM

Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

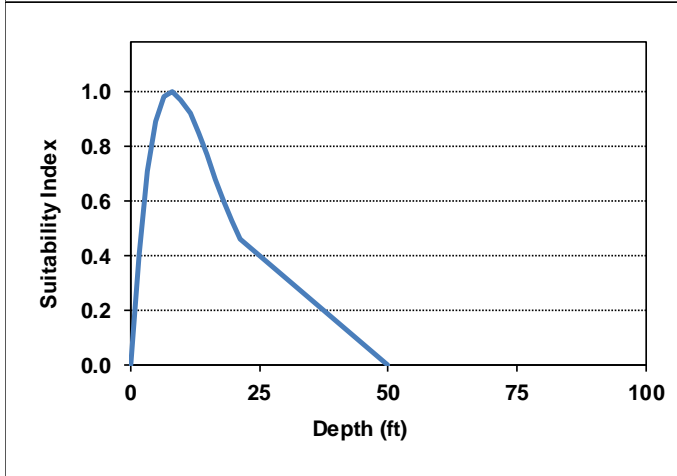
American Shad Spawning



Source:

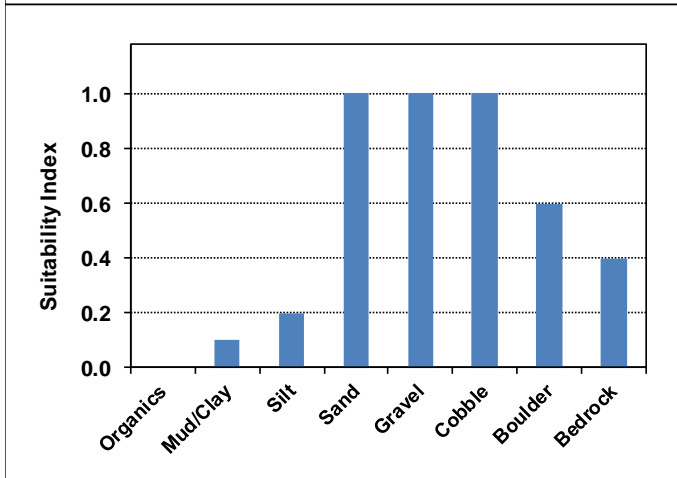
Velocity based on data from
Hightower et al., 2012

Velocity (ft/s)	SI
0.00	0.30
0.70	0.75
1.00	1.00
3.00	1.00
3.90	1.00
5.60	0.00



Hightower et al., 2012
and Stier and Crance, 1985

Depth (ft)	SI
0.00	0.00
1.60	0.40
3.30	0.71
4.90	0.89
6.60	0.98
8.20	1.00
9.80	0.97
11.50	0.92
13.10	0.85
14.80	0.77
16.40	0.68
18.00	0.60
19.70	0.53
21.30	0.46
50.00	0.00



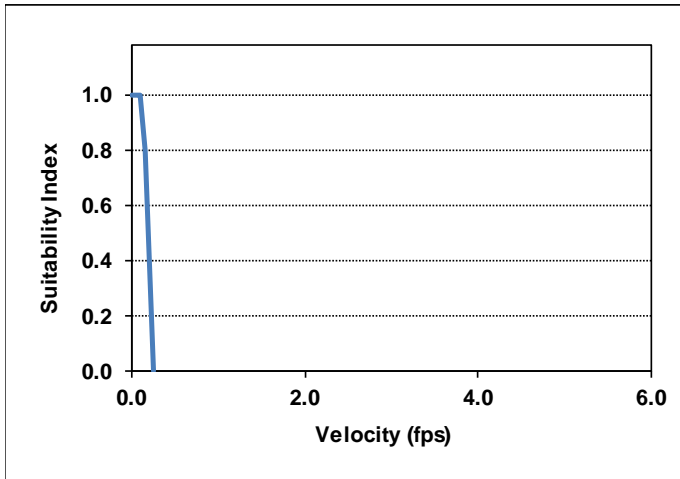
Stier and Crance, 1985

Substrate	SI
Organics	0.00
Mud/Clay	0.10
Silt	0.20
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

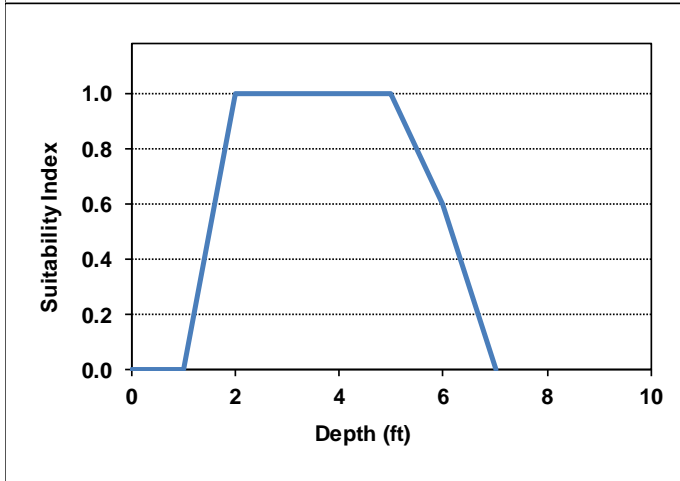
Walleye Fry

Source:

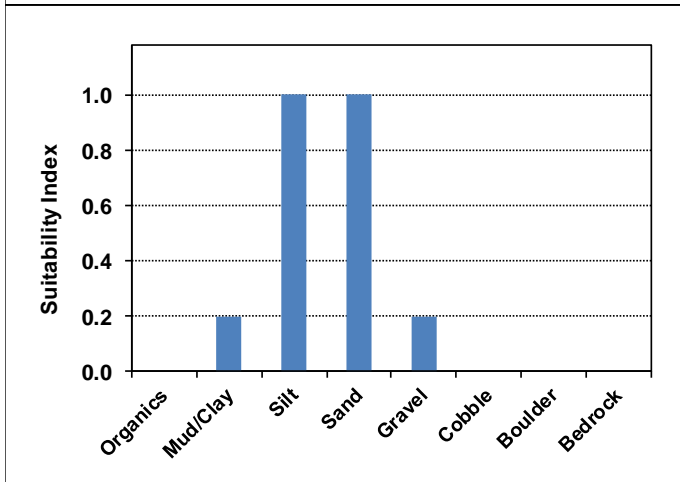
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.10	1.00
0.15	0.80
0.25	0.00
2.00	0.00



Depth (ft)	SI
0.00	0.00
1.00	0.00
2.00	1.00
5.00	1.00
6.00	0.60
7.00	0.00

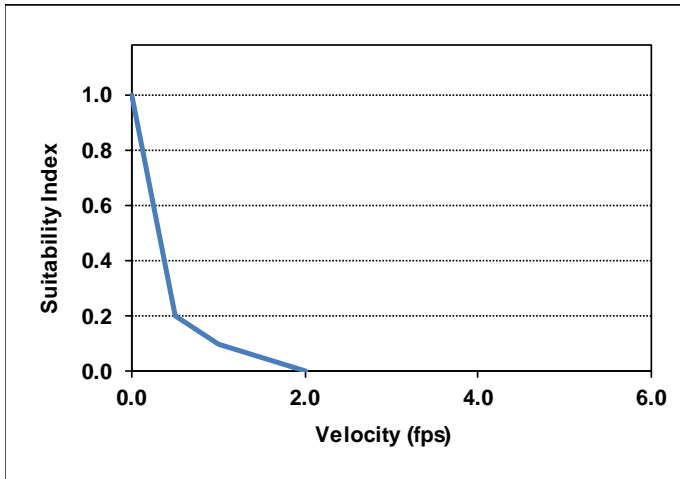


Substrate	SI
Organics	0.00
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

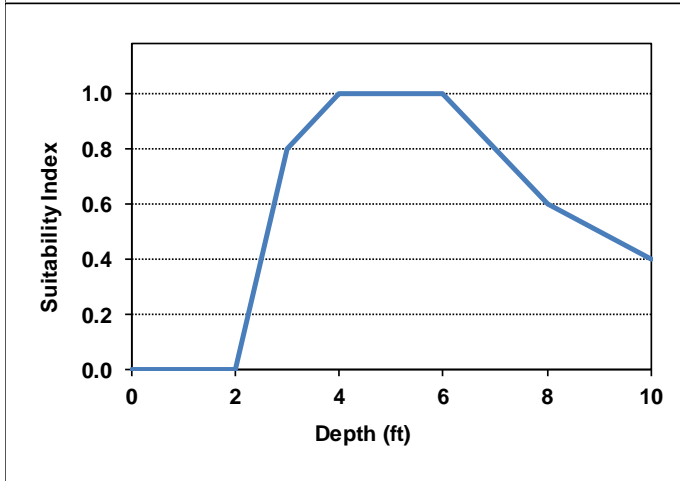
Walleye Juvenile

Source:

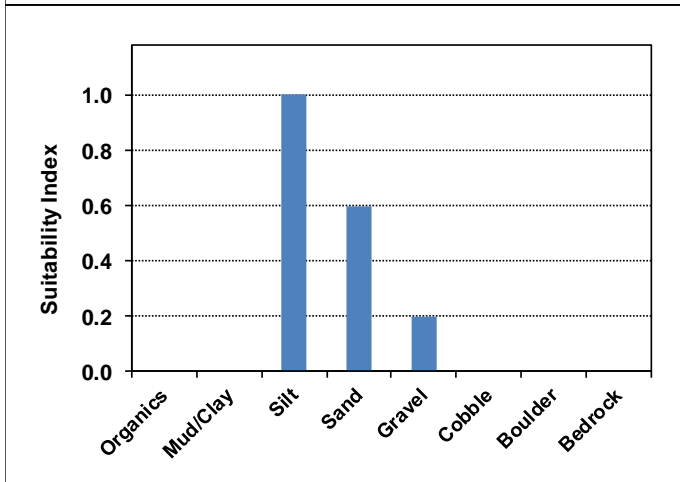
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.50	0.20
1.00	0.10
2.00	0.00



Depth (ft)	SI
0.00	0.00
2.00	0.00
3.00	0.80
4.00	1.00
6.00	1.00
8.00	0.60
10.00	0.40
50.00	0.40

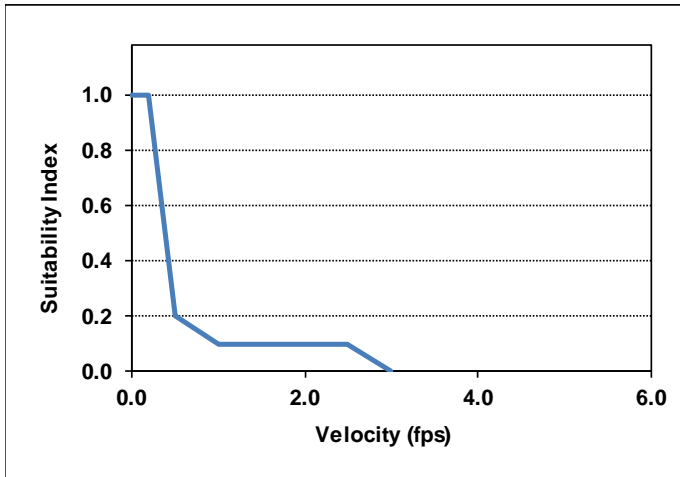


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	0.60
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

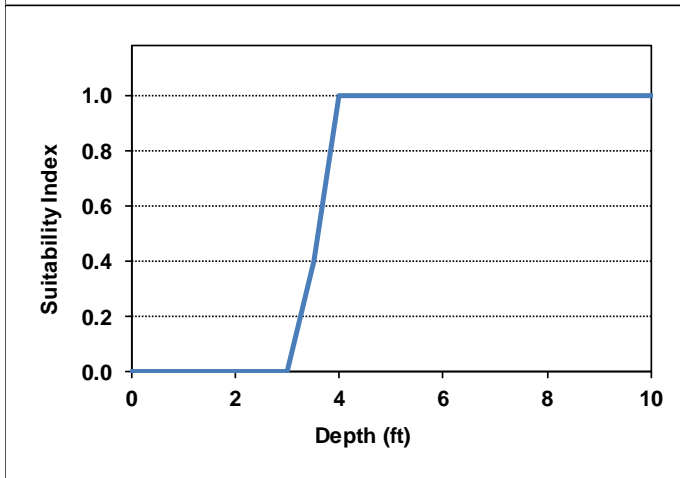
Walleye Adult

Source:

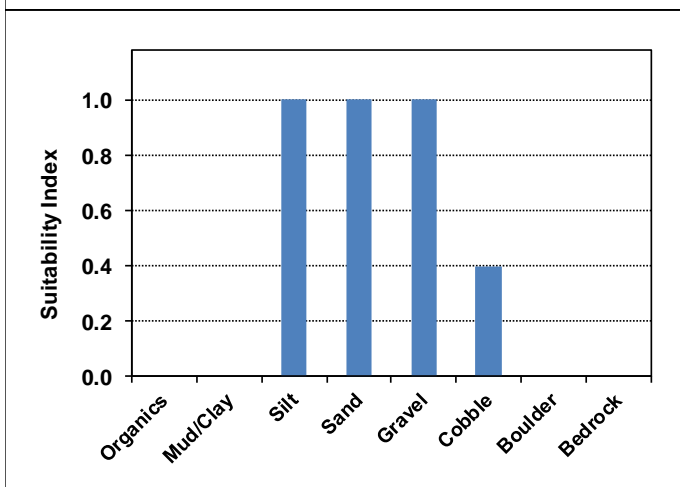
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.20	1.00
0.50	0.20
1.00	0.10
2.50	0.10
3.00	0.00



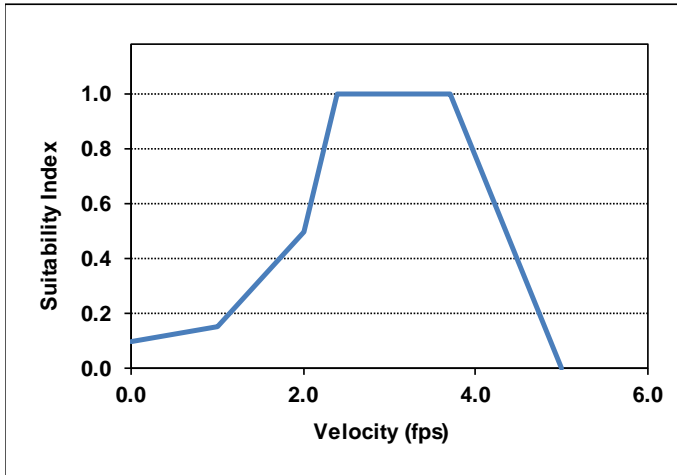
Depth (ft)	SI
0.00	0.00
3.00	0.00
3.50	0.40
4.00	1.00
50.00	1.00



Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	0.40
Boulder	0.00
Bedrock	0.00

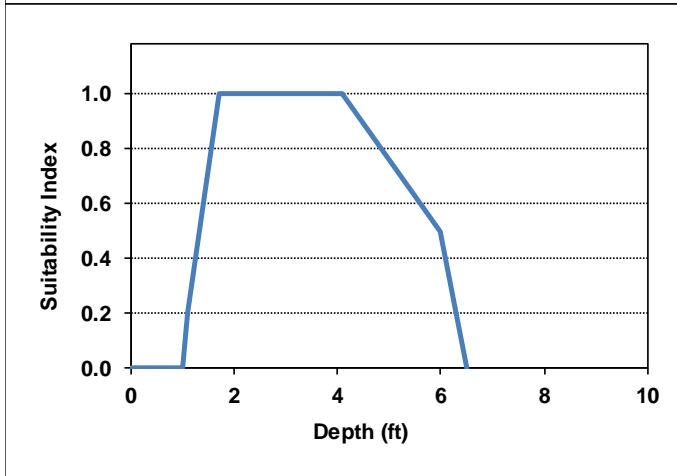
Walleye Spawning & Incubation

Source:



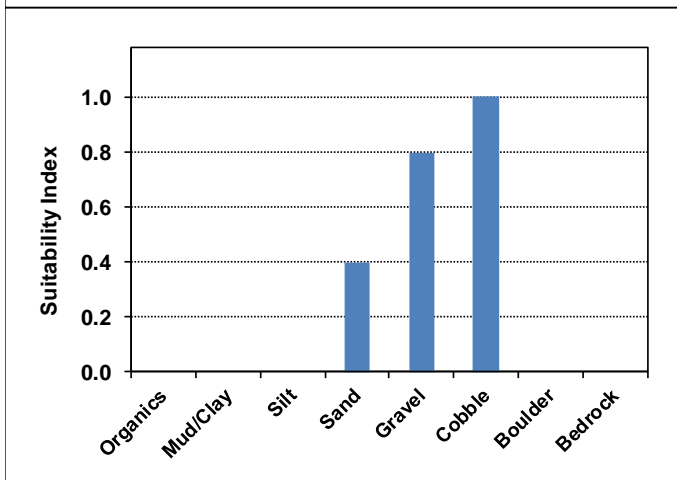
Based on Bozek et al., 2011

Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.40	1.00
3.70	1.00
5.00	0.00
endpoint hypothetical	



Turners Falls based on Bozek et al., 2011

Depth (ft)	SI
0.00	0.00
1.00	0.00
1.10	0.20
1.70	1.00
4.10	1.00
6.00	0.50
6.50	0.00



McMahon et al., 1984

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.40
Gravel	0.80
Cobble	1.00
Boulder	0.00
Bedrock	0.00

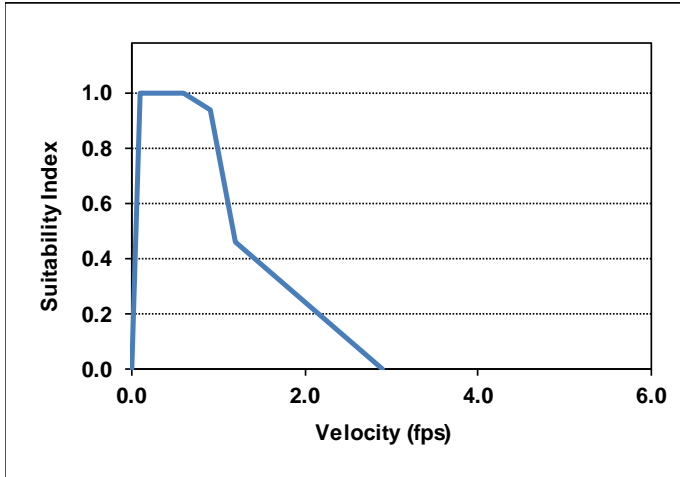
Fallfish Fry

Velocity and depth from brook trout fry curves (Deerfield River)

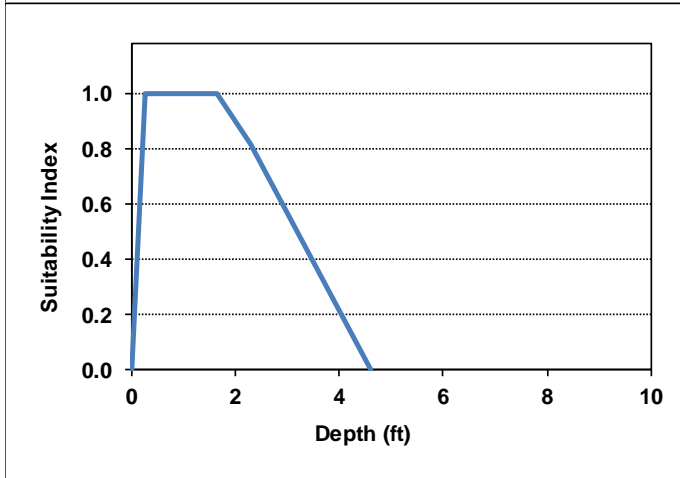
Substrate developed by Charles Ritzi

Source:

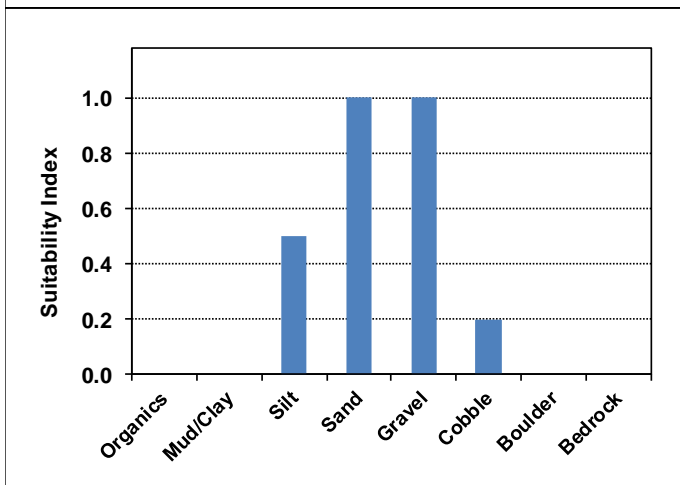
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.60	1.00
0.90	0.94
1.20	0.46
2.90	0.00



Depth (ft)	SI
0.00	0.00
0.25	1.00
1.65	1.00
2.30	0.82
4.60	0.00
100.00	0.00



Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	1.00
Cobble	0.20
Boulder	0.00
Bedrock	0.00

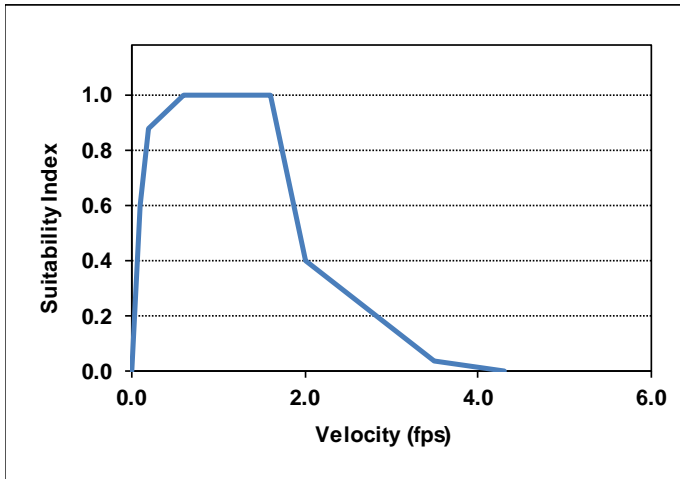
Fallfish Juvenile

Velocity and depth from brook trout fry curves (Deerfield River)

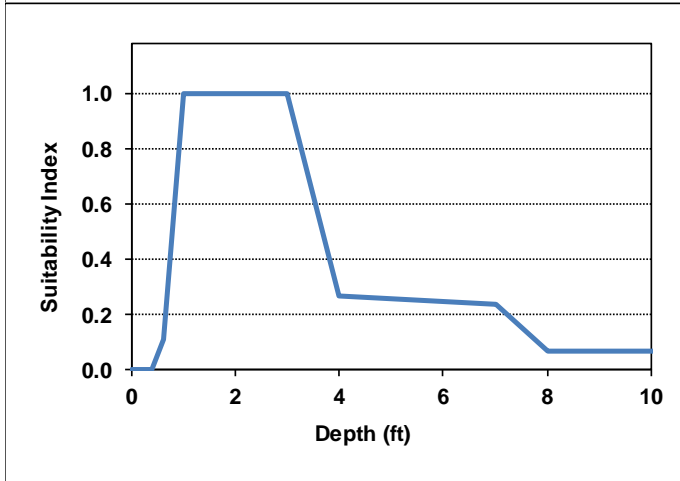
Substrate developed by Charles Ritzi

Source:

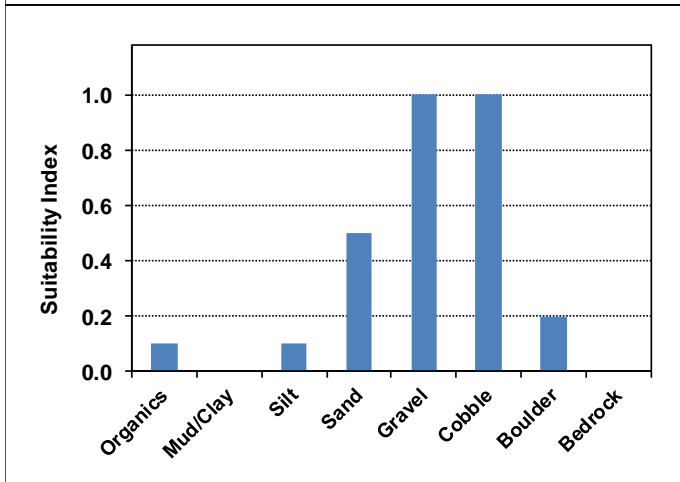
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	0.60
0.20	0.88
0.60	1.00
1.60	1.00
2.00	0.40
3.50	0.04
4.30	0.00



Depth (ft)	SI
0.00	0.00
0.40	0.00
0.60	0.11
1.00	1.00
3.00	1.00
4.00	0.27
7.00	0.24
8.00	0.07
20.00	0.07
100.00	0.07

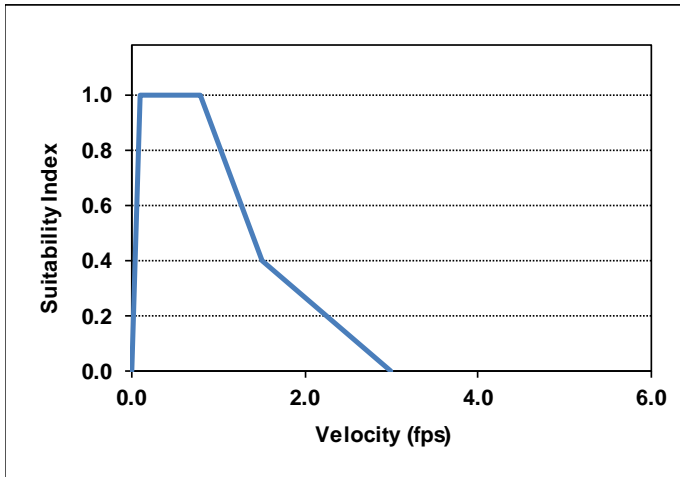


Substrate	SI
Organics	0.10
Mud/Clay	0.00
Silt	0.10
Sand	0.50
Gravel	1.00
Cobble	1.00
Boulder	0.20
Bedrock	0.00

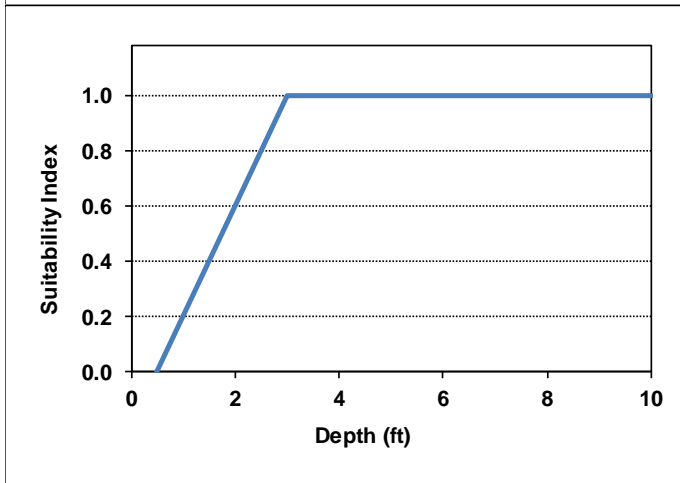
Fallfish Adult

Developed from consultation with NYSDEC
(New York Dept. of Environmental Conservation)

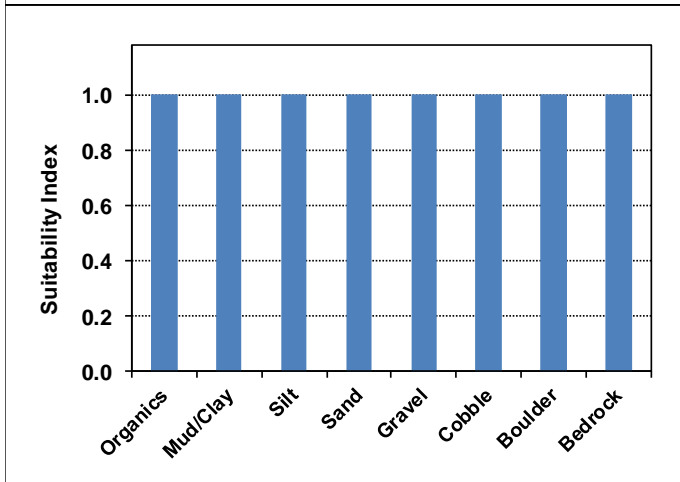
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.80	1.00
1.50	0.40
3.00	0.00



Depth (ft)	SI
0.00	0.00
0.50	0.00
3.00	1.00
100.00	1.00

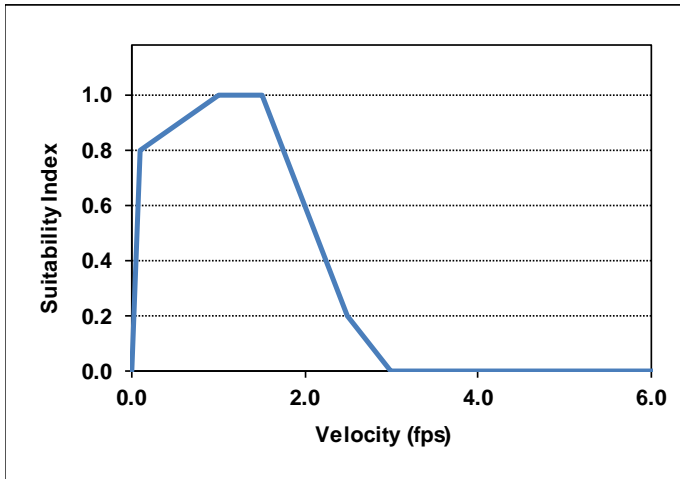


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

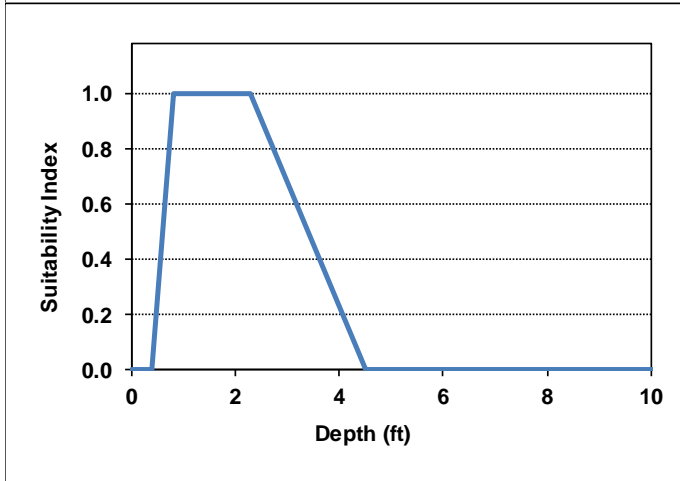
Fallfish Spawning & Incubation

Developed from consultation with NYSDEC
(New York Dept. of Environmental Conservation)

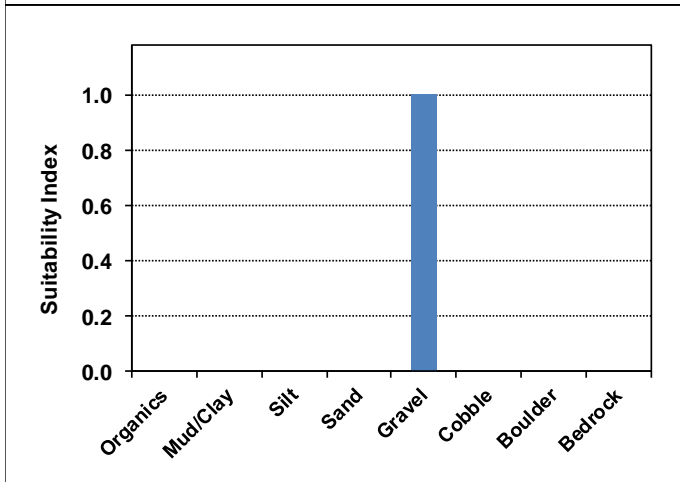
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	0.80
1.00	1.00
1.50	1.00
2.50	0.20
3.00	0.00
100.00	0.00



Depth (ft)	SI
0.00	0.00
0.40	0.00
0.80	1.00
2.30	1.00
4.50	0.00
100.00	0.00

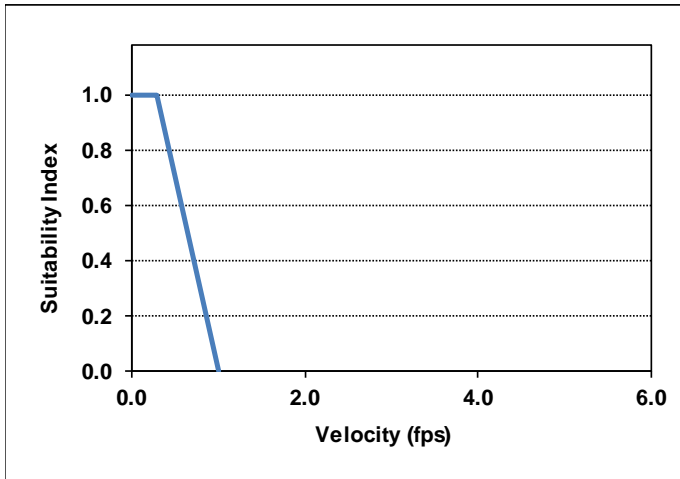


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.00
Gravel	1.00
Cobble	0.00
Boulder	0.00
Bedrock	0.00

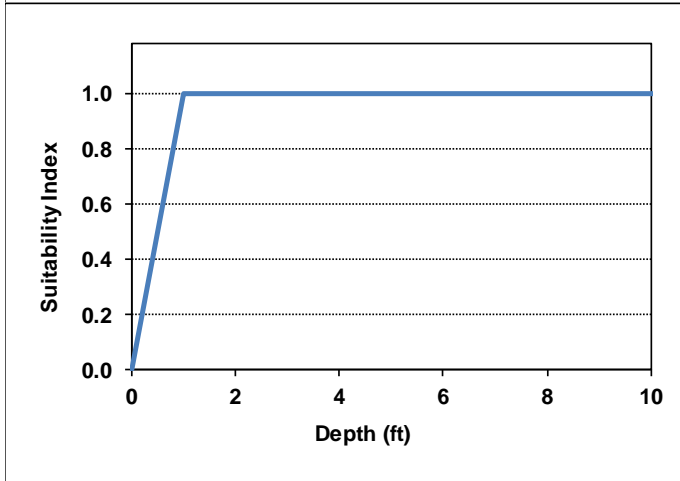
White Sucker Fry

Source:

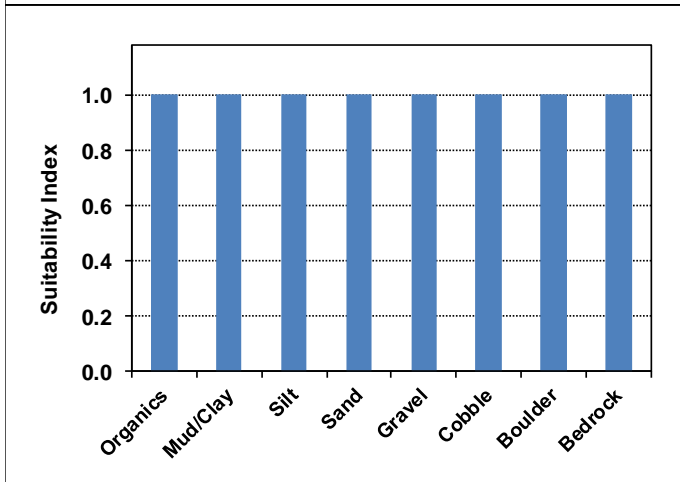
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.30	1.00
1.00	0.00



Depth (ft)	SI
0.00	0.00
1.00	1.00
100.00	1.00

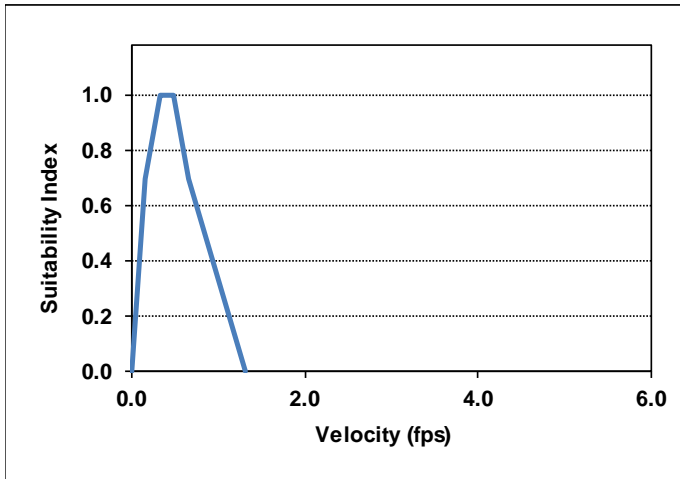


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

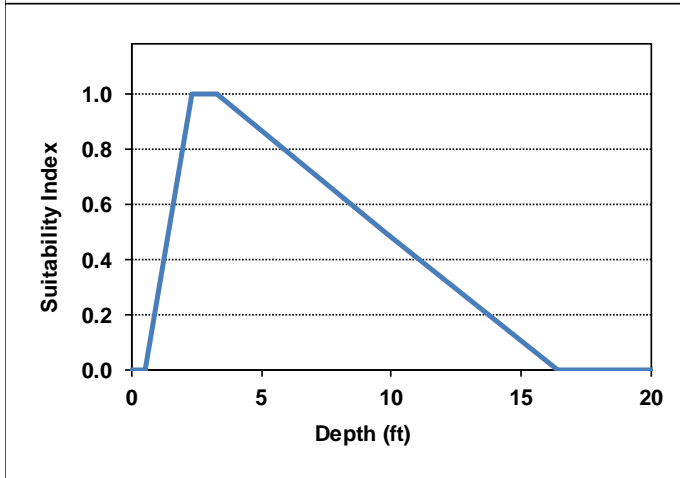
White Sucker Adult/Juvenile

Source:

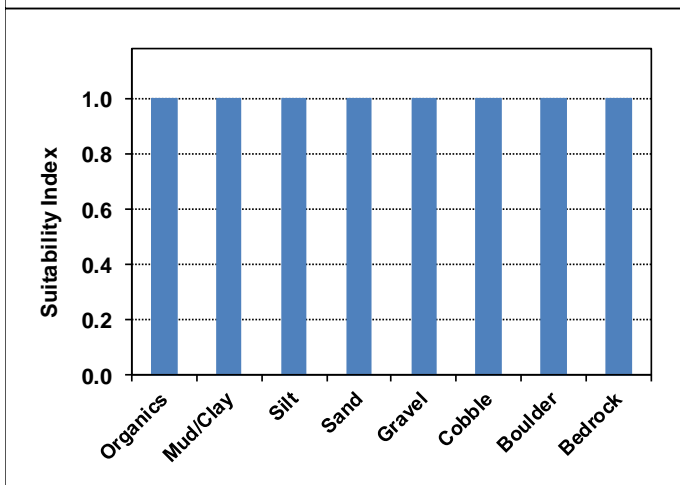
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	0.00
0.16	0.70
0.33	1.00
0.49	1.00
0.66	0.70
1.31	0.00



Depth (ft)	SI
0.00	0.00
0.50	0.00
2.30	1.00
3.30	1.00
9.80	0.50
16.40	0.00
100.00	0.00

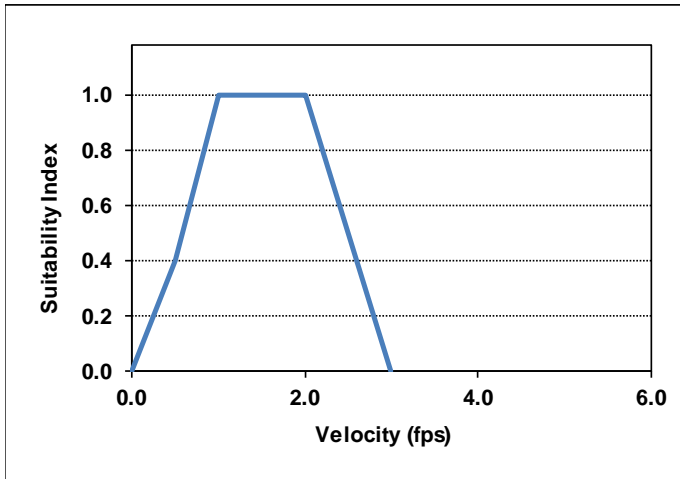


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

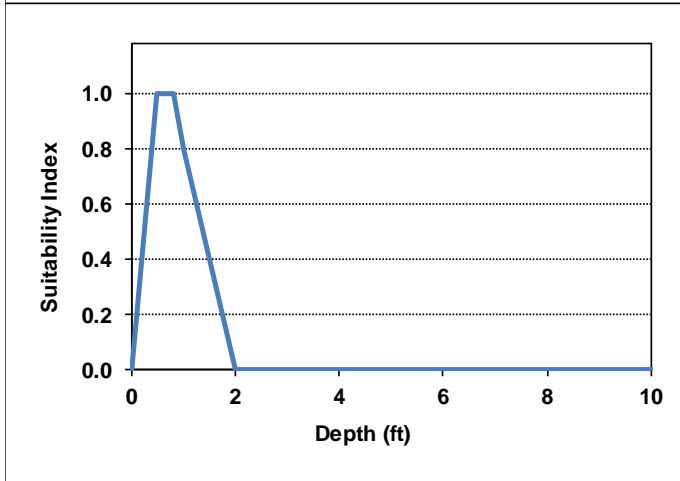
White Sucker Spawning & Incubation

Source:

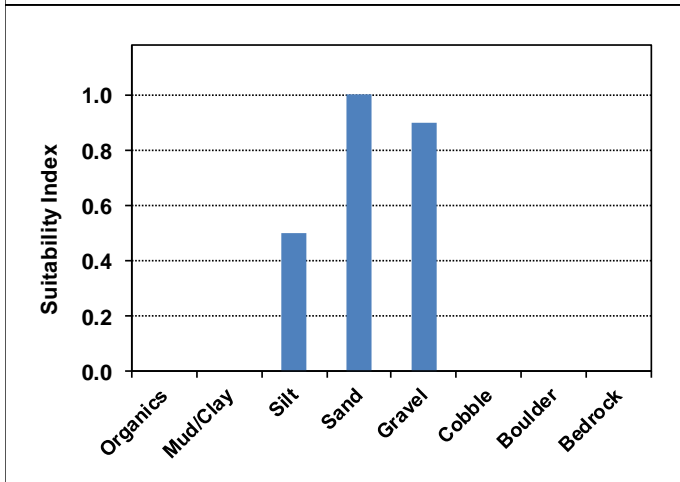
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	0.00
0.50	0.40
1.00	1.00
2.00	1.00
3.00	0.00



Depth (ft)	SI
0.00	0.00
0.50	1.00
0.80	1.00
1.00	0.80
2.00	0.00
100.00	0.00



Substrate Source:

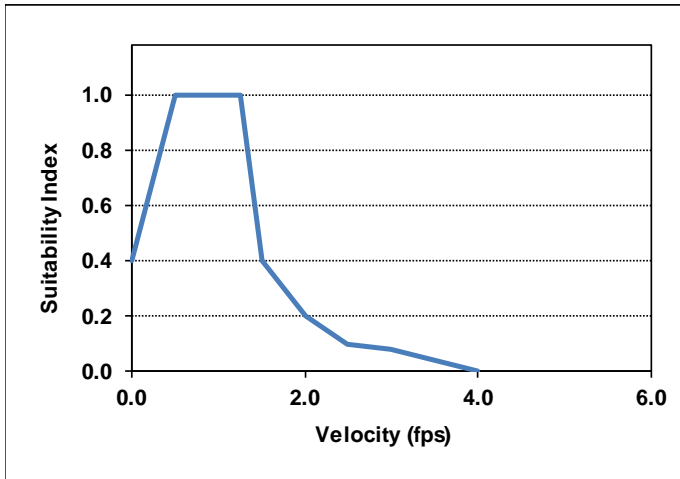
Gomez and Sullivan, 2007

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	0.90
Cobble	0.00
Boulder	0.00
Bedrock	0.00

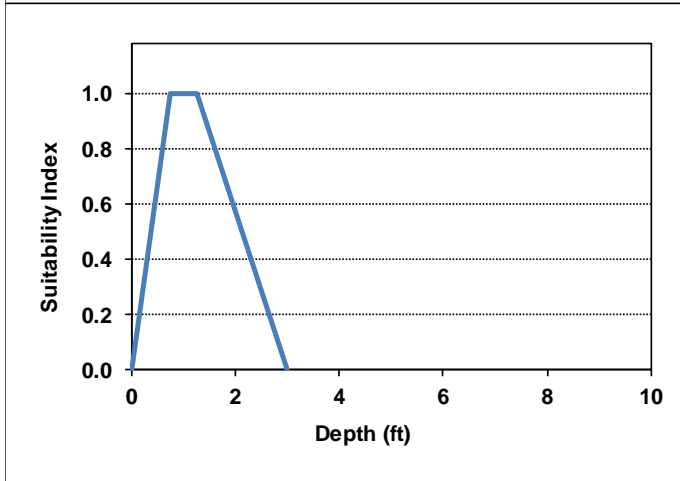
Longnose Dace Fry

Original curve identified as from USFWS HSC library
 Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

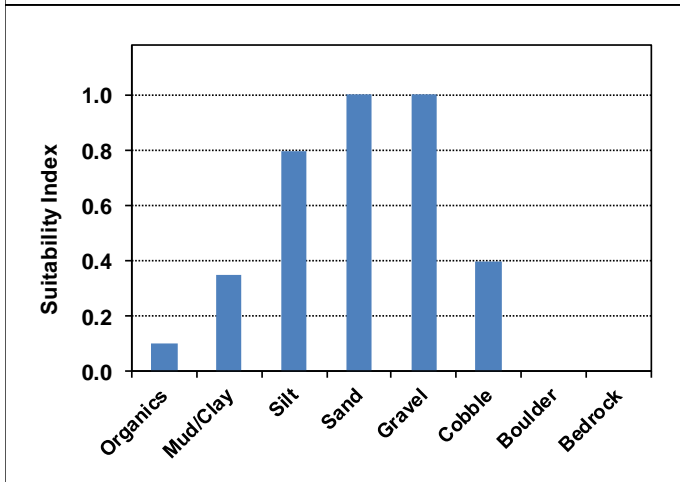
Source:
 Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.40
0.50	1.00
1.25	1.00
1.50	0.40
2.00	0.20
2.50	0.10
3.00	0.08
4.00	0.00



Depth (ft)	SI
0.00	0.00
0.75	1.00
1.25	1.00
3.00	0.00

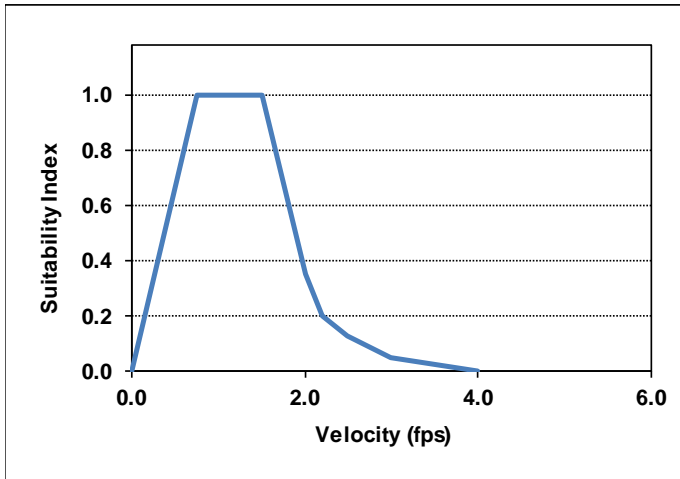


Substrate	SI
Organics	0.10
Mud/Clay	0.35
Silt	0.80
Sand	1.00
Gravel	1.00
Cobble	0.40
Boulder	0.00
Bedrock	0.00

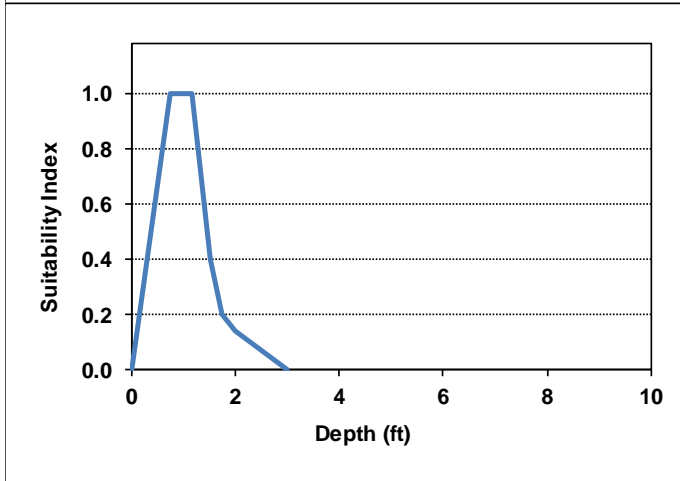
Longnose Dace Juvenile

Original curve identified as from USFWS HSC library
 Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

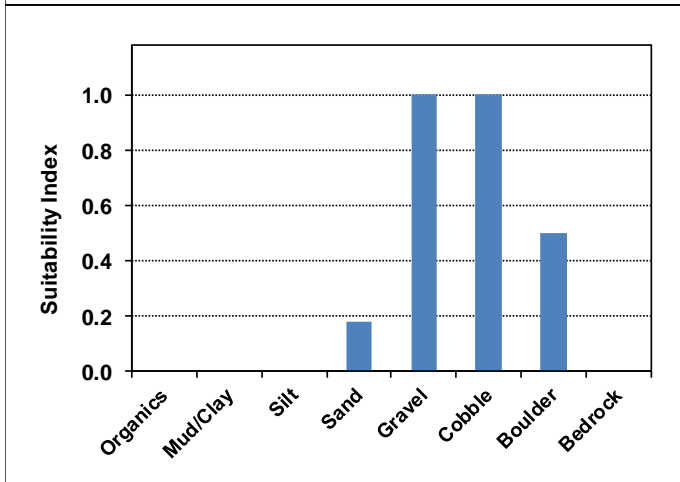
Source:
 Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.50	1.00
2.00	0.35
2.20	0.20
2.50	0.13
3.00	0.05
4.00	0.00



Depth (ft)	SI
0.00	0.00
0.75	1.00
1.15	1.00
1.50	0.40
1.75	0.20
2.00	0.14
3.00	0.00

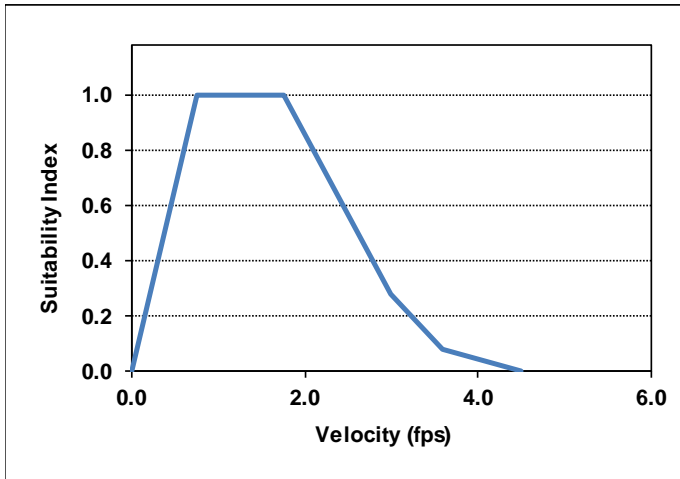


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.18
Gravel	1.00
Cobble	1.00
Boulder	0.50
Bedrock	0.00

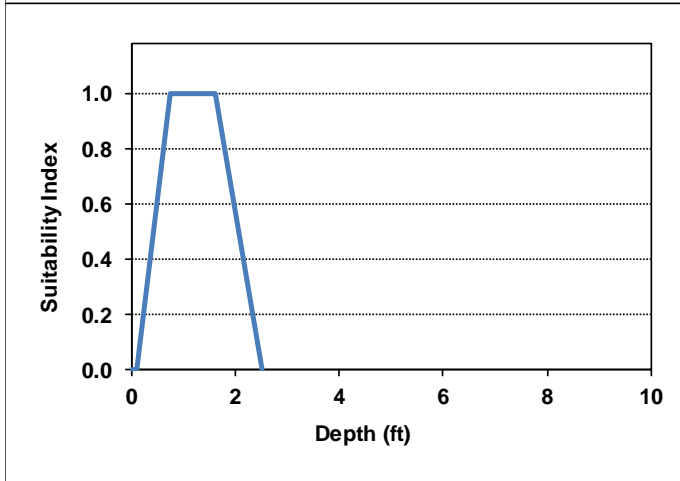
Longnose Dace Adult

Original curve identified as from USGS HSC library
 Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

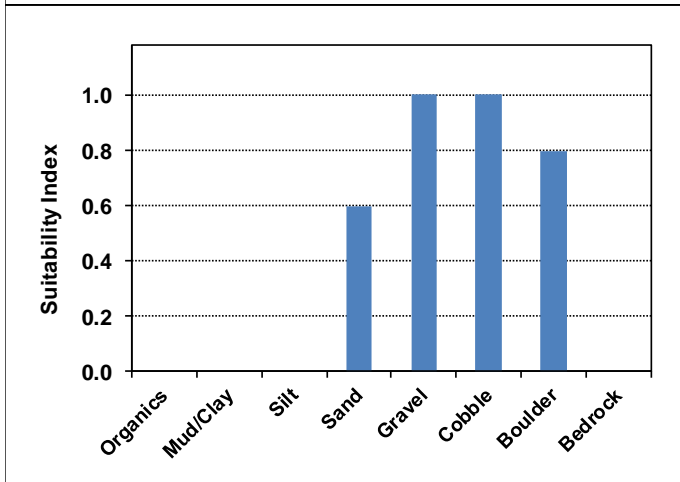
Source:
 Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.75	1.00
3.00	0.28
3.60	0.08
4.50	0.00



Depth (ft)	SI
0.00	0.00
0.10	0.00
0.75	1.00
1.60	1.00
2.50	0.00



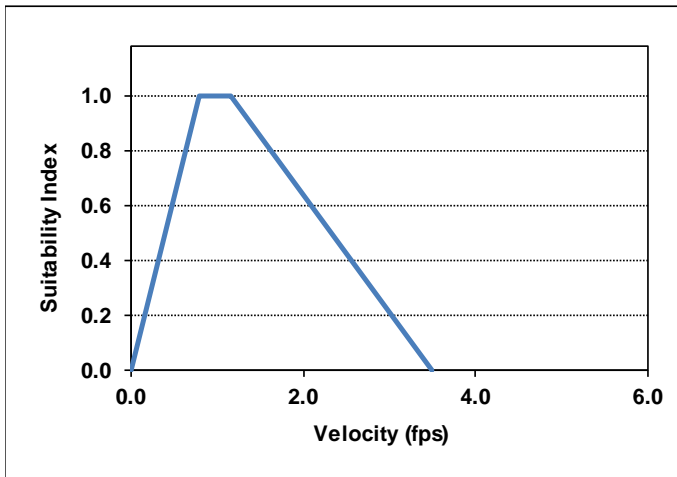
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.60
Gravel	1.00
Cobble	1.00
Boulder	0.80
Bedrock	0.00

Tessellated Darter Adult

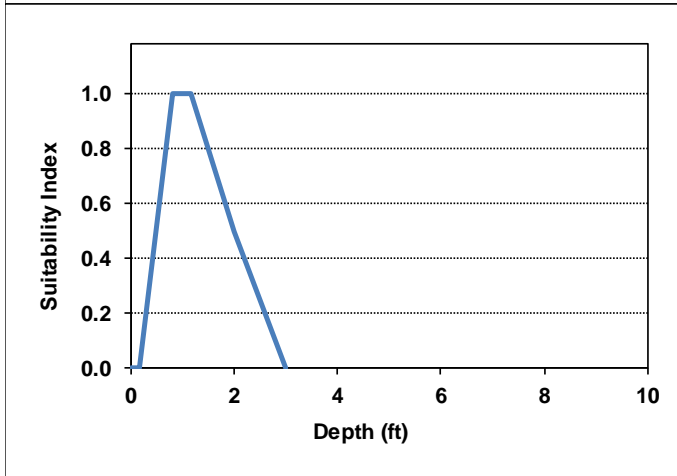
Modified by VDFW (2015) using sources

Source:

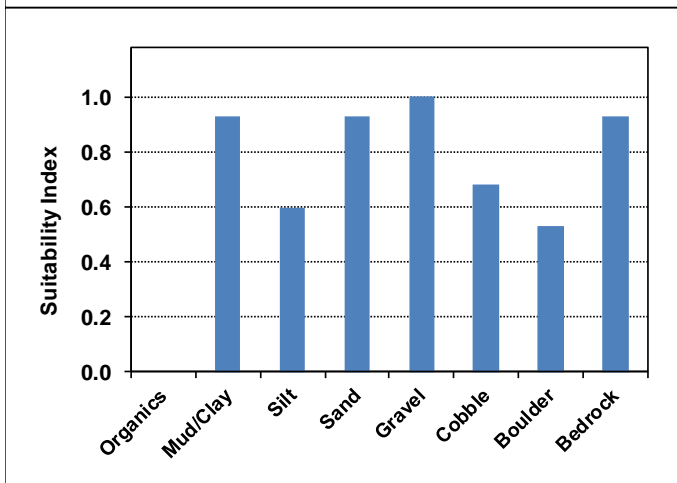
Warner et al. 2006,
Aadland and Kuitunen 2006



Velocity (ft/s)	SI
0.00	0.00
0.80	1.00
1.15	1.00
3.50	0.00



Depth (ft)	SI
0.00	0.00
0.16	0.00
0.80	1.00
1.15	1.00
2.00	0.50
3.00	0.00



Substrate Source: Aadland and Kuitunen, 2006
Johnny Darter- Surrogate for Tessellated Darter
(PPL Bell Bend 2012)

Substrate	SI
Organics	0.00
Mud/Clay	0.93
Silt	0.60
Sand	0.93
Gravel	1.00
Cobble	0.68
Boulder	0.53
Bedrock	0.93

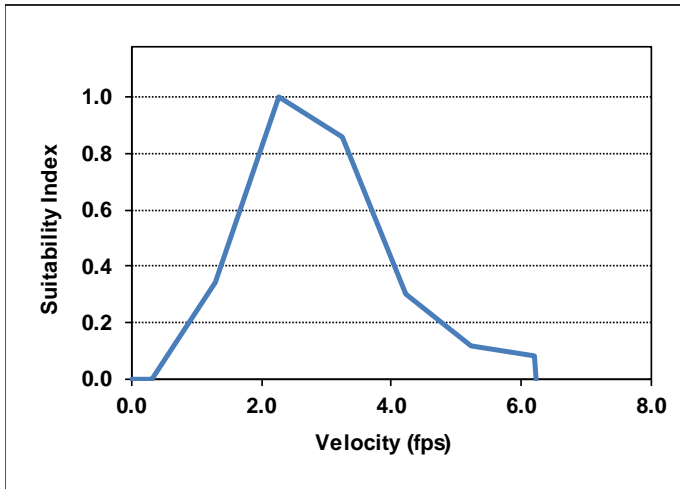
Sea Lamprey Spawning & Incubation

Modified by USFWS (2014) based on Yergeau 1983 (depth and substrate)

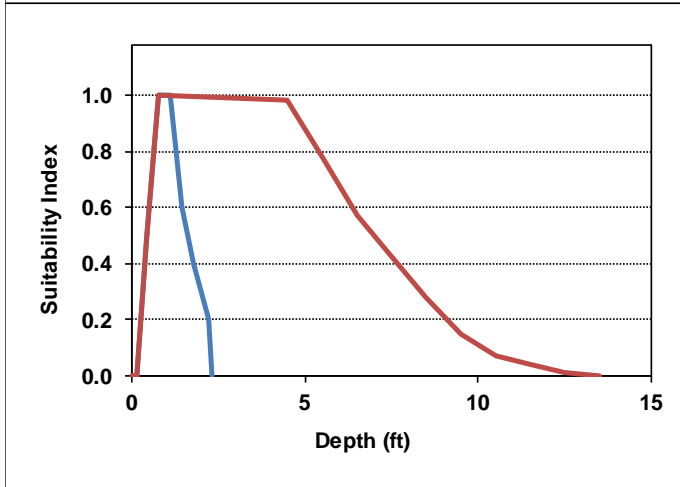
Source:

Kynard and Horgan, 2013

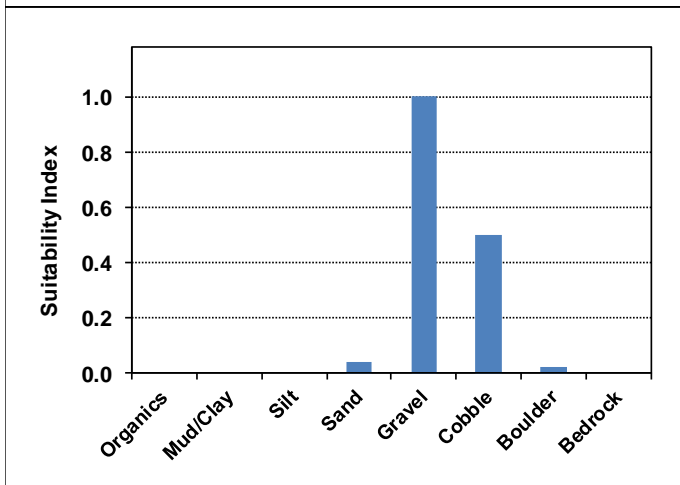
Yergeau, 1983



Velocity (ft/s)	SI
0.00	0.00
0.30	0.00
1.28	0.34
2.26	1.00
3.25	0.86
4.23	0.30
5.22	0.12
6.20	0.08
6.23	0.00



Modified by NAI			
Depth (ft)	SI	Depth (ft)	SI
0.00	0.00	0.00	0.00
0.13	0.00	0.13	0.00
0.46	0.50	0.46	0.50
0.79	1.00	0.79	1.00
1.12	1.00	4.50	0.98
1.44	0.60	5.50	0.78
1.77	0.40	6.50	0.57
2.20	0.20	7.50	0.43
2.30	0.00	8.50	0.28
		9.50	0.15
		10.50	0.07
		11.50	0.04
		12.50	0.01
		13.50	0.00

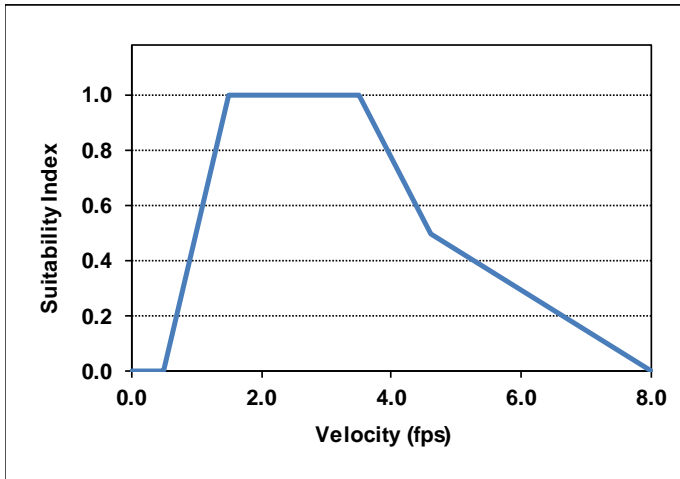


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.04
Gravel	1.00
Cobble	0.50
Boulder	0.02
Bedrock	0.00

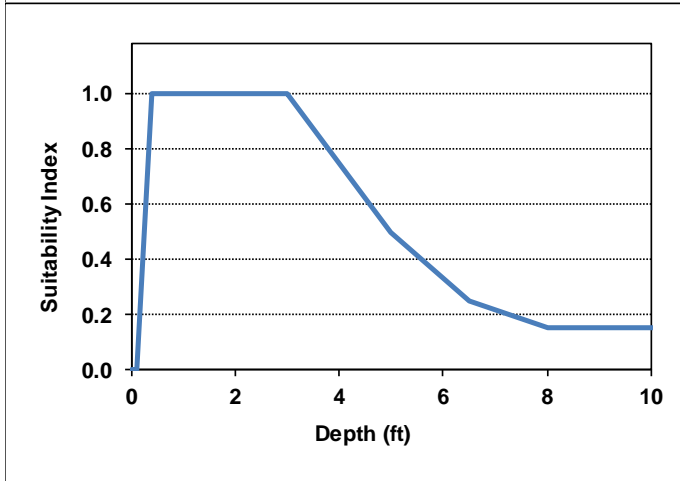
Macroinvertebrates

Source:

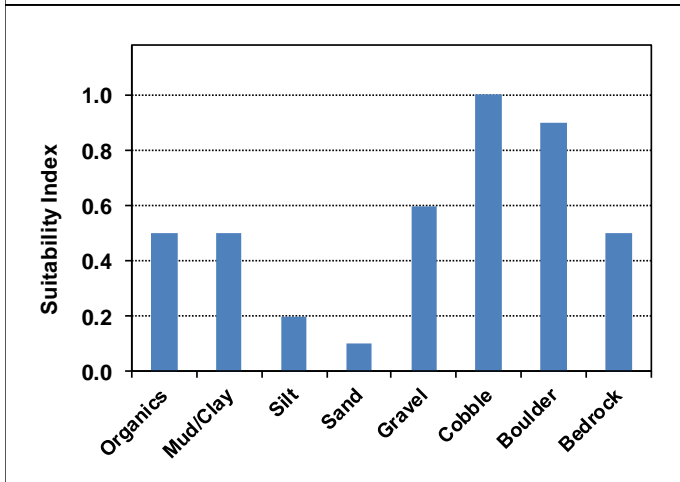
Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.50	0.00
1.50	1.00
3.50	1.00
4.60	0.50
8.00	0.00



Depth (ft)	SI
0.00	0.00
0.10	0.00
0.40	1.00
3.00	1.00
5.00	0.50
6.50	0.25
8.00	0.15
10.00	0.15
100.00	0.00

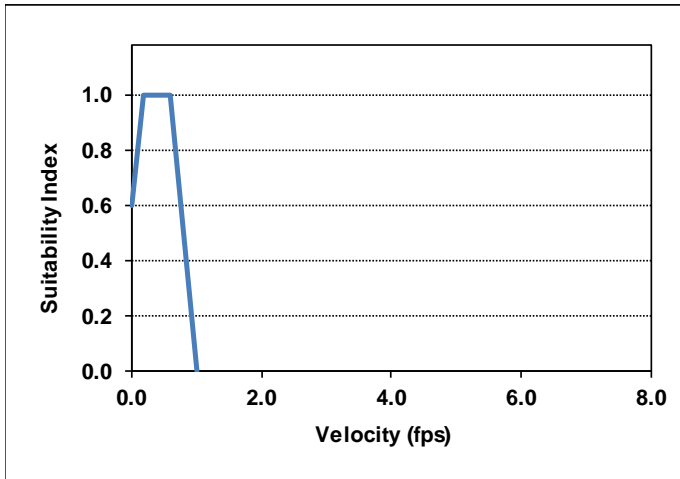


Substrate	SI
Organics	0.50
Mud/Clay	0.50
Silt	0.20
Sand	0.10
Gravel	0.60
Cobble	1.00
Boulder	0.90
Bedrock	0.50

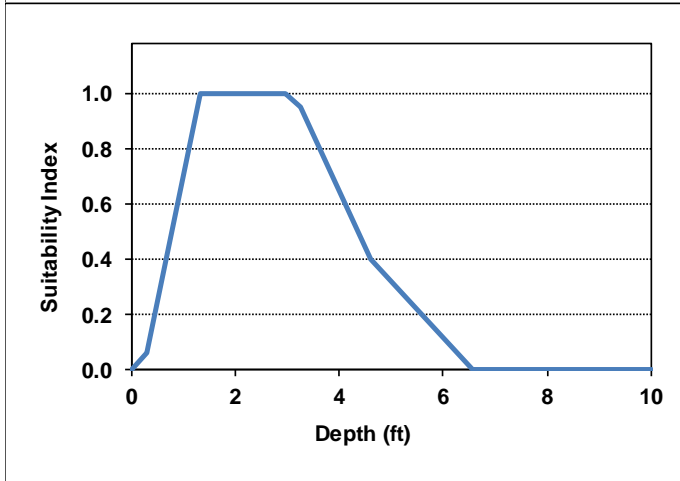
Smallmouth Bass Fry

Source:

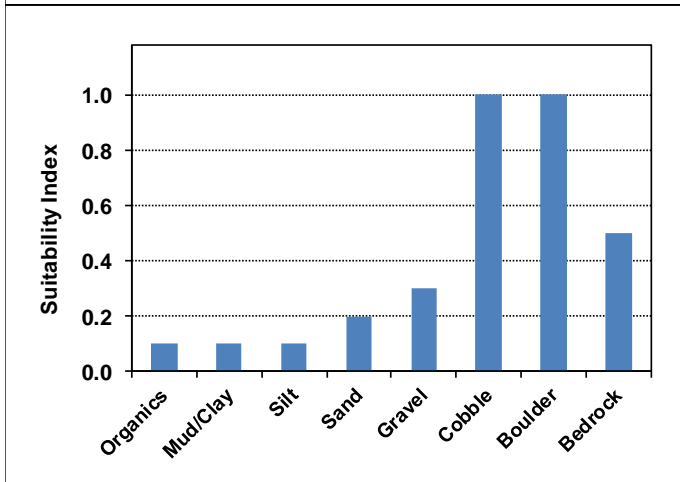
Leonard et al, 1986



Velocity (ft/s)	SI
0.00	0.60
0.19	1.00
0.59	1.00
1.00	0.00



Depth (ft)	SI
0.00	0.00
0.28	0.06
1.31	1.00
2.95	1.00
3.25	0.95
4.59	0.40
6.56	0.00
10.00	0.00

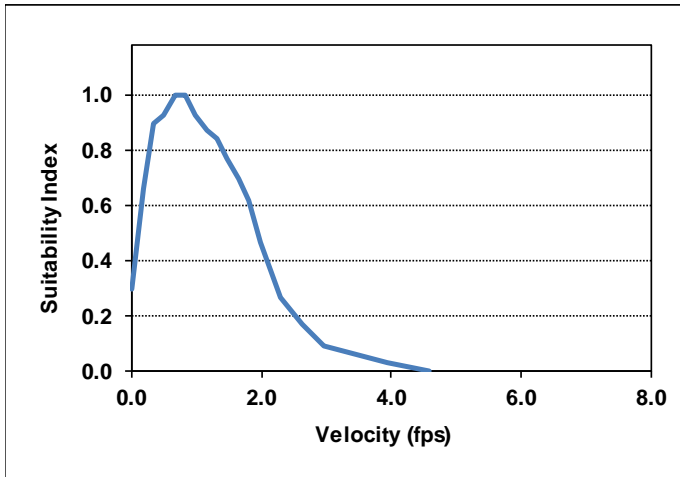


Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

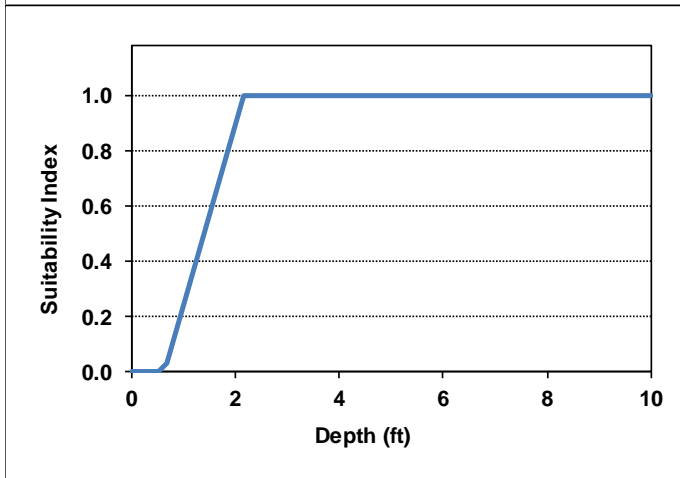
Smallmouth Bass Juvenile

Source:

Groshens and Orth 1994

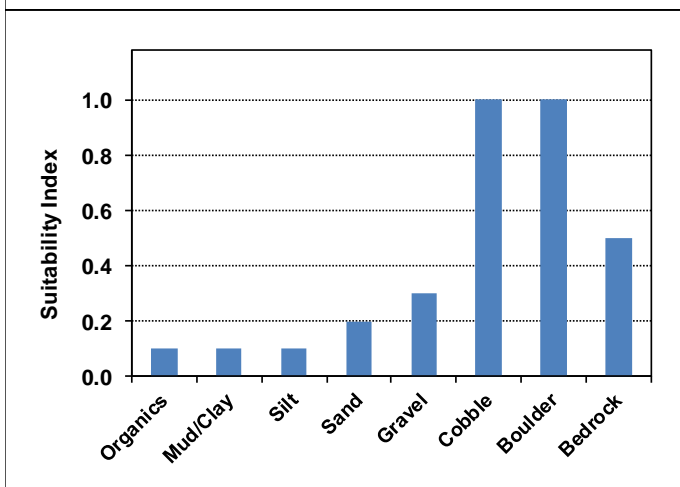


Velocity (ft/s)	SI
0.00	0.30
0.17	0.66
0.33	0.90
0.50	0.93
0.66	1.00
0.83	1.00
0.98	0.93
1.15	0.87
1.31	0.84
1.47	0.77
1.64	0.70
1.81	0.62
1.98	0.47
2.30	0.27
2.62	0.17
2.95	0.09
3.94	0.03
4.59	0.00



Leonard et al, 1986

Depth (ft)	SI
0.00	0.00
0.52	0.00
0.67	0.03
2.15	1.00
10.00	1.00

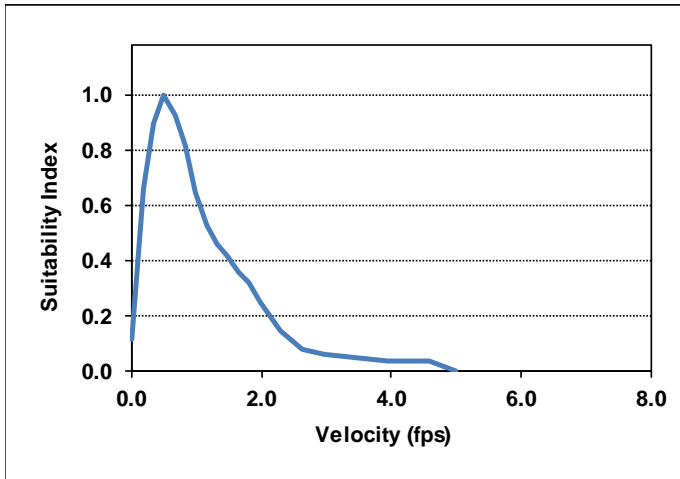


Leonard et al, 1986

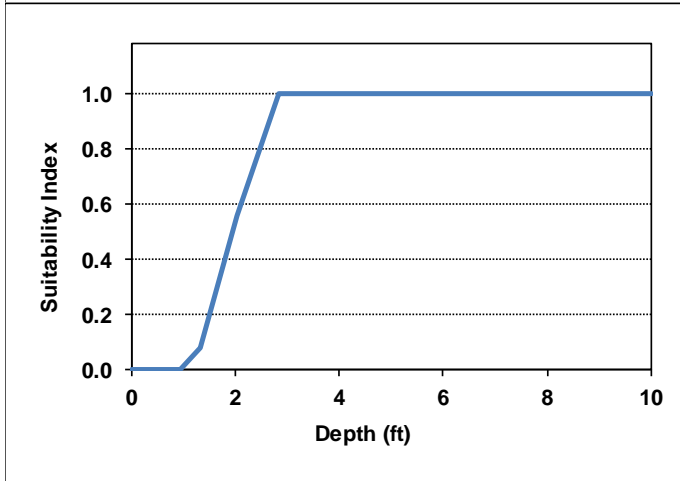
Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

Smallmouth Bass Adult

Source:
Grosheins and Orth 1994

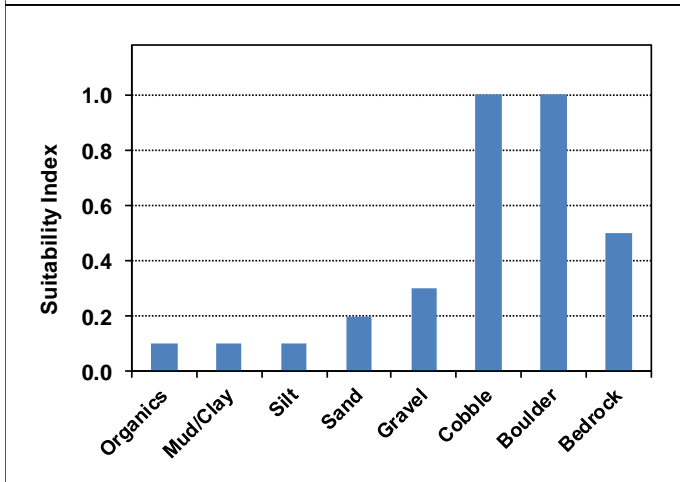


Velocity (ft/s)	SI
0.00	0.12
0.17	0.66
0.33	0.90
0.50	1.00
0.66	0.93
0.83	0.82
0.98	0.65
1.15	0.53
1.31	0.46
1.47	0.42
1.64	0.36
1.81	0.32
1.98	0.25
2.30	0.15
2.62	0.08
2.95	0.06
3.94	0.04
4.59	0.04
5.00	0.00



Leonard et al, 1986

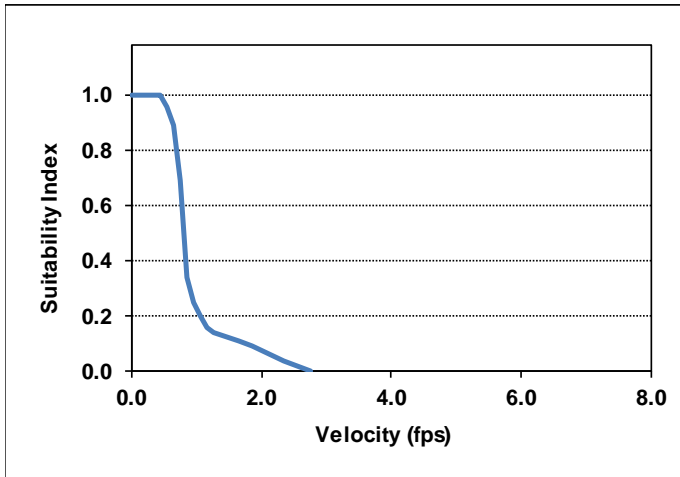
Depth (ft)	SI
0.00	0.00
0.92	0.00
1.31	0.08
2.03	0.56
2.82	1.00
6.00	1.00
10.00	1.00



Leonard et al, 1986

Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

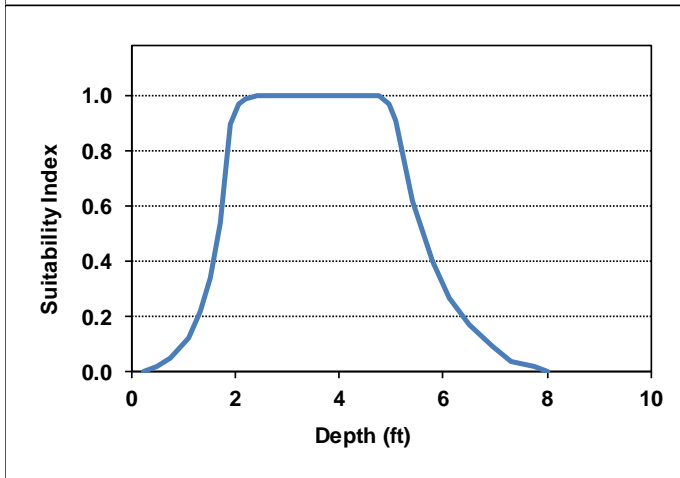
Smallmouth Bass Spawning



Source:

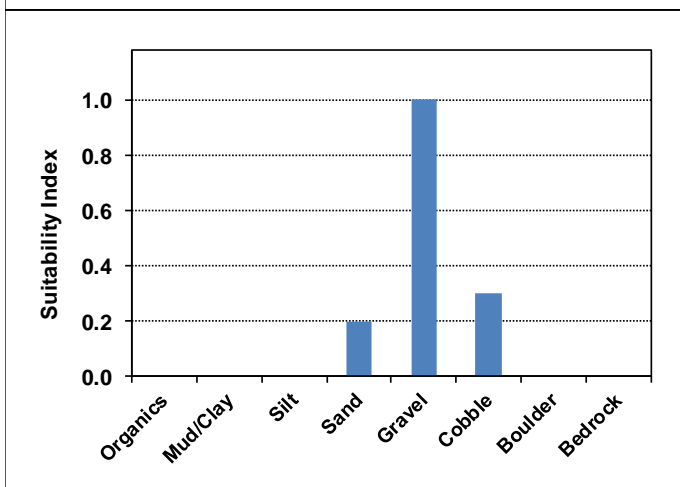
Allen, 1996

Velocity (ft/s)	SI
0.00	1.00
0.45	1.00
0.55	0.96
0.65	0.89
0.75	0.69
0.85	0.34
0.95	0.25
1.05	0.20
1.15	0.16
1.25	0.14
1.65	0.11
1.85	0.09
2.35	0.04
2.55	0.02
2.75	0.00



Edwards et al., 1983

Depth (ft)	SI
0.22	0.00
0.50	0.02
0.74	0.05
1.10	0.12
1.32	0.22
1.53	0.34
1.70	0.54
1.90	0.90
2.05	0.97
2.18	0.99
2.40	1.00
4.75	1.00
4.95	0.97
5.10	0.91
5.40	0.62
5.80	0.40
6.10	0.27
6.50	0.17
6.95	0.09
7.30	0.04
7.75	0.02
8.00	0.00

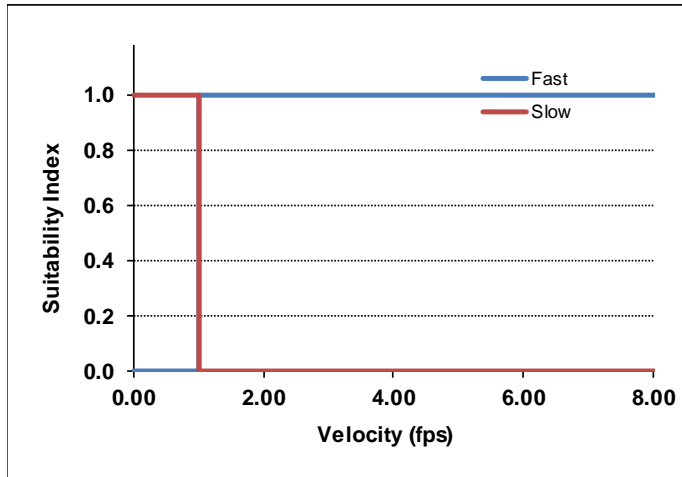


Allen, 1996

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.20
Gravel	1.00
Cobble	0.30
Boulder	0.00
Bedrock	0.00

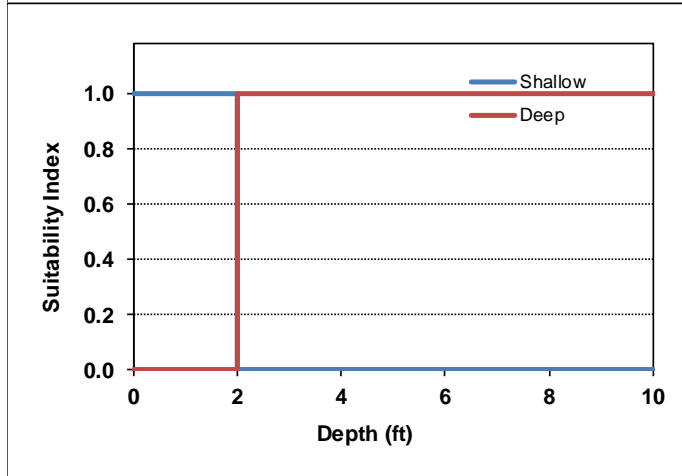
Generalized Habitat Criteria (GHC)

Source:
VDFW



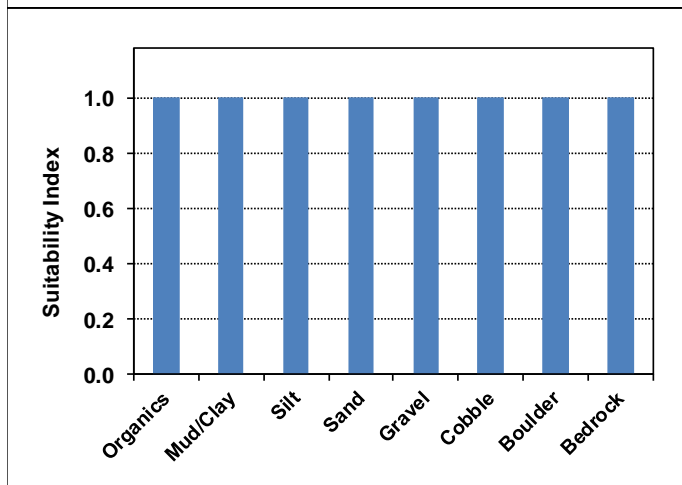
Fast	
Velocity (ft/s)	SI
0.00	0.00
1.00	0.00
1.01	1.00
10.00	1.00

Slow	
Velocity (ft/s)	SI
0.00	1.00
1.00	1.00
1.01	0.00
10.00	0.00



Shallow	
Depth (ft)	SI
0.00	1.00
2.00	1.00
2.01	0.00
10.00	0.00

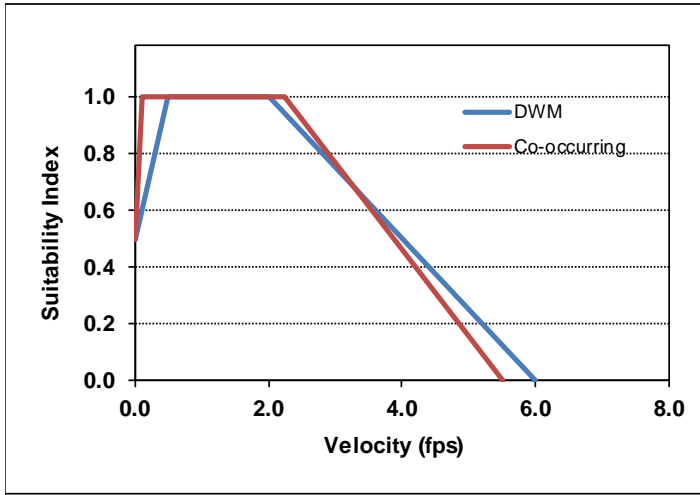
Deep	
Depth (ft)	SI
0.00	0.00
2.00	0.00
2.01	1.00
100.00	1.00



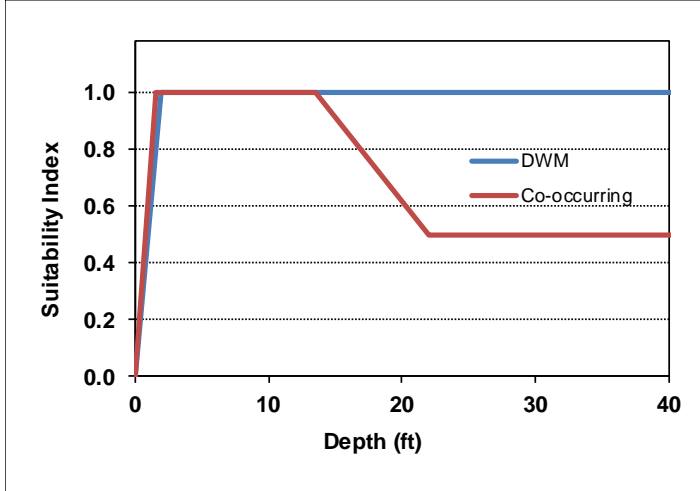
Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

**Mussels - Dwarf Wedgemussel (DWM)
Co-Occurring**

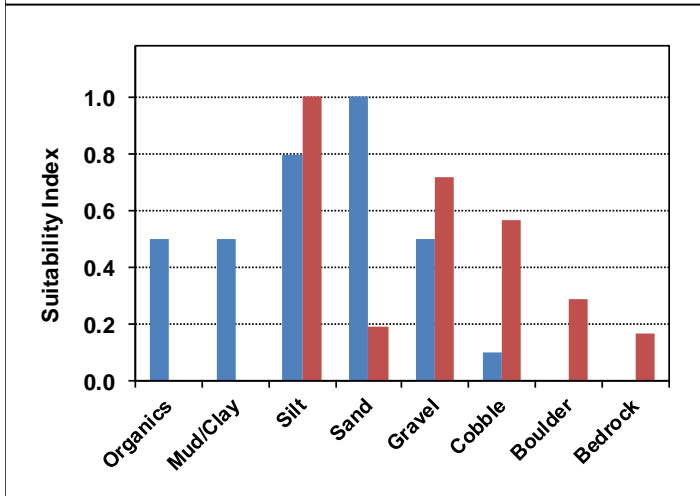
Source: DWM Normandeau and Biodiversity 2016
Co-occurring Normandeau and Biodiversity 2017



DWM		Co-occurring	
MCV (ft/s)	SI	MCV (ft/s)	SI
0.00	0.50	0.00	0.50
0.50	1.00	0.10	1.00
2.00	1.00	2.25	1.00
6.00	0.00	5.50	0.00



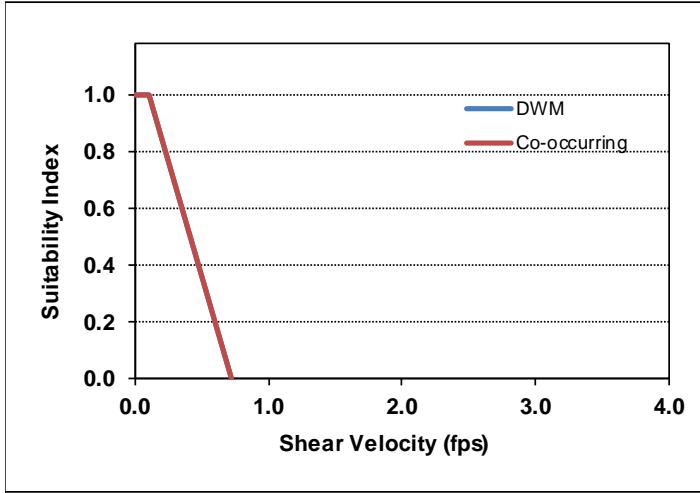
DWM		Co-occurring	
Depth (ft)	SI	Depth (ft)	SI
0.00	0.00	0.00	0.00
2.00	1.00	1.50	1.00
40.00	1.00	13.50	1.00
100.00	1.00	22.00	0.50
		30.00	0.50
		100	0.5



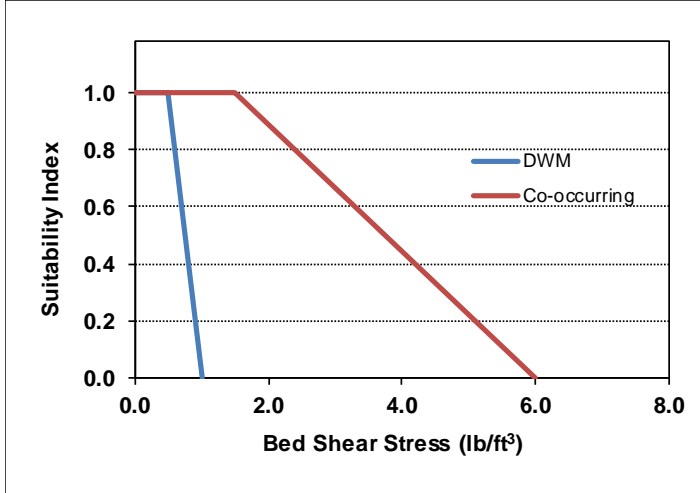
DWM		Co-occurring	
Substrate	SI	Substrate	SI
Organics	0.50	Organics	0.00
Mud/Clay	0.50	Mud/Clay	0.00
Silt	0.80	Silt	1.00
Sand	1.00	Sand	0.19
Gravel	0.50	Gravel	0.72
Cobble	0.10	Cobble	0.57
Boulder	0.00	Boulder	0.29
Bedrock	0.00	Bedrock	0.17

**Mussels - Dwarf Wedgemussel (DWM)
Co-Occurring**

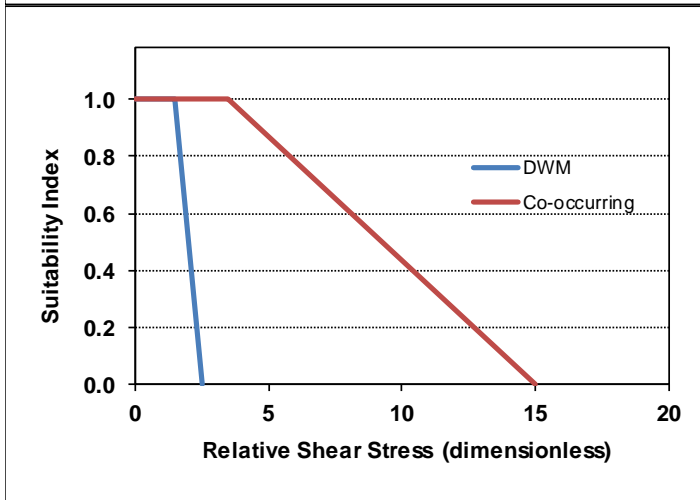
Source: DWM Normandeau and Biodiversity 2016
Co-occurring Normandeau and Biodiversity 2017



DWM		Co-occurring	
Velocity (ft/s)	SI	Velocity (ft/s)	SI
0.00	1.00	0.00	1.00
0.10	1.00	0.10	1.00
0.72	0.00	0.72	0.00



DWM		Co-occurring	
SS (lb/ft³)	SI	SS (lb/ft³)	SI
0.00	1.00	0.00	1.00
0.50	1.00	1.50	1.00
1.00	0.00	6.00	0.00

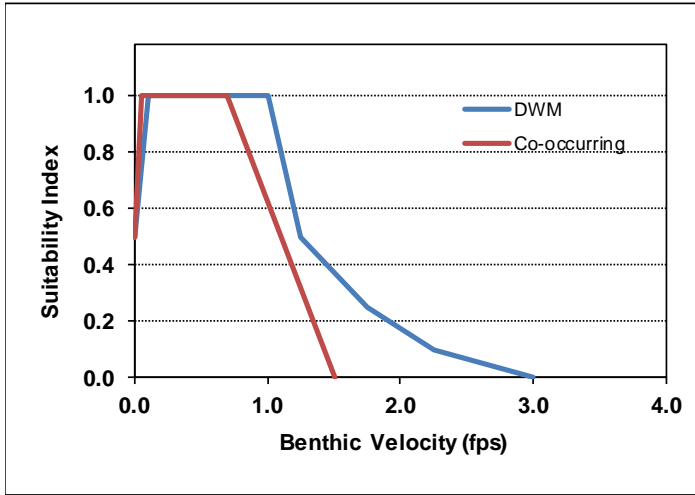


DWM		Co-occurring	
RSS	SI	RSS	SI
0	1.00	0	1.00
1.5	1.00	3.5	1.00
2.5	0.00	15	0.00

**Mussels - Dwarf Wedgemussel (DWM)
Co-Occurring**

Source: DWM
Normandeau and
Biodrawversity 2016

Co-Occurring
Normandeau and
Biodrawversity 2017



DWM		Co-occurring	
Velocity (ft/s)	SI	Velocity (ft/s)	SI
0.00	0.50	0.00	0.50
0.10	1.00	0.05	1.00
1.00	1.00	0.70	1.00
1.25	0.50	1.50	0.00
1.75	0.25		
2.25	0.10		
3.00	0.00		

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