A REGULATORY TREND TOWARD FINE SLOT SIZE (<1.75 MM) WEDGEWIRE SCREEN SYSTEMS IN THE USA

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INTAKE SCREENS, INC.



JULY 11, 2023

FIRST INTERNATIONAL FISH IMPINGEMENT AND ENTRAINMENT CONFERENCE

ADELPHI HOTEL LIVERPOOL- JULY 11-13, 2023

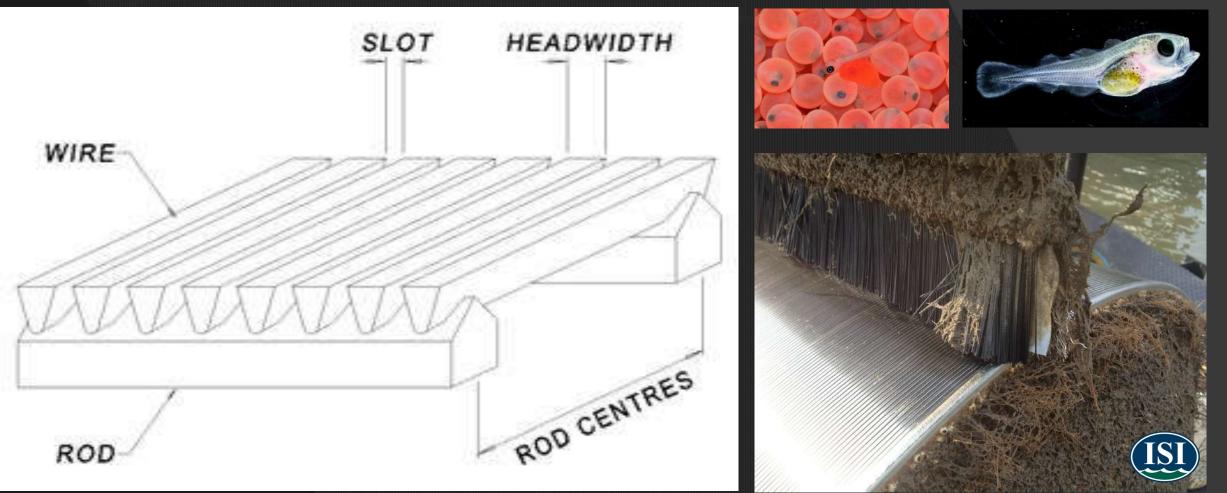
AGENDA

- Fish Protection Using Wedge Wire
- Trend Toward Fine-slot Wedge Wire Screens
- Example Projects





WEDGE WIRE SCREEN MATERIAL



PROTECTING FISH AT WATER INTAKES IN THE <u>WESTERN USA</u> WHERE FEDERALLY PROTECTED SPECIES ARE PRESENT

Regulatory Priorities

- Screens located out in the waterbody
- No fish or debris collection/conveyance
- Small slot opening (≤ 1.75 mm)
- Low approach velocity (≤ 0.12 m/s)
- Uniform velocities over the screen surface
- Active screen cleaning



WHY ACTIVE CLEANING?

To maintain uniform and low velocities over the screen surface



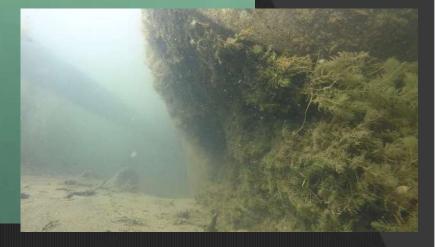
WEDGE WIRE SCREEN WITH AIRBURST CLEANING SYSTEM

Prior to Retrofit with ISI Mechanical Brush-cleaned Screen tem



Post Retrofit with ISI Mechanical Brush-cleaned Screen System





ISI BRUSH CLEANING SYSTEM – CYLINDER SCREEN

- Wedgewire cylinder rotates against brushes to clean
- Fixed position external brush
- Rotating internal brush
- Active cleaning for 6-8 minutes per day











(ISI









US AND INTERNATIONAL FISH PROTECTION REQUIREMENTS – A TREND TOWARD FINE SLOT



Location	Slot Size	Through-screen Velocity (fps)*	Approach Velocity (fps)*	Screen Surface Area (ft ²) per CFS	Screen Surface Area (ft ²) per MGD	Notes
Virginia	1.0		0.09			Subject to permit writer best professional judgement
Canada	2.5	0.20	0.12	8.3	5.4	
New York	0.5-0.75	0.50	0.13	7.6	4.9	Subject to permit writer best professional judgement
California	1.0	0.50	0.18	5.5	3.6	Assumes subsurface intake infeasible
California	1.75	0.40	0.20	5.0	3.2	
USA - West	1.75	0.40	0.20	5.0	3.2	No active cleaning
USA - National	≤2	0.50	0.27	3.8	2.4	Slot size subject to permit writer best professional judgement
USA - National	9.5	0.50	0.33	3.1	2.0	Assumes no entrainment requirements
USA - West Coast	1.75	0.66	0.33	3.0	2.0	
United Kingdom	1-2	0.91	0.33	3.0	2.0	Screen angle 22-90 degrees; larger slot sizes allowed for older eels
Australia	2-3	0.56	0.33	3.0	2.0	
USA - West Coast	1.75	0.80	0.4	2.5	1.6	Actively cleaned screens
New Zealand	2-3.2	0.67	0.4	2.5	1.6	
	Virginia Canada New York California California USA - West USA - National USA - National USA - West Coast United Kingdom Australia USA - West Coast	Virginia1.0Canada2.5New York0.5-0.75California1.0California1.75USA - West1.75USA - National<2	LocationSlot SizeVelocity (fps)*Virginia1.00.25Canada2.50.20New York0.5-0.750.50California1.00.50California1.750.40USA - West1.750.40USA - National≤20.50USA - West Coast1.750.66United Kingdom1-20.91Australia2-30.56USA - West Coast1.750.80	Location Slot Size Velocity (fps)* Velocity (fps)* Virginia 1.0 0.25 0.09 Canada 2.5 0.20 0.12 New York 0.5-0.75 0.50 0.13 California 1.0 0.50 0.13 California 1.0 0.50 0.13 California 1.75 0.40 0.20 USA - West 1.75 0.40 0.20 USA - National ≤2 0.50 0.27 USA - National 9.5 0.50 0.33 United Kingdom 1-2 0.91 0.33 USA - West Coast 1.75 0.66 0.33 USA - West Coast 1.75 0.66 0.33 Ustralia 2-3 0.56 0.33 USA - West Coast 1.75 0.80 0.4	Location Slot Size Integration velocity (fps)* Area (ft ²) per CFS Virginia 1.0 0.25 0.09 11.0 Canada 2.5 0.20 0.12 8.3 New York 0.5-0.75 0.50 0.13 7.6 California 1.0 0.50 0.13 7.6 California 1.0 0.50 0.18 5.5 California 1.75 0.40 0.20 5.0 USA - West 1.75 0.40 0.20 5.0 USA - National ≤2 0.50 0.27 3.8 USA - West Coast 1.75 0.66 0.33 3.1 USA - West Coast 1.75 0.66 0.33 3.0 United Kingdom 1-2 0.91 0.33 3.0 USA - West Coast 1.75 0.80 0.4 2.5	Location Slot Size Welocity (fps)* Velocity (fps)* Area (ft²) per CFS Area (ft²) per MGD Virginia 1.0 0.25 0.09 11.0 7.1 Canada 2.5 0.20 0.12 8.3 5.4 New York 0.5-0.75 0.50 0.13 7.6 4.9 California 1.0 0.50 0.13 7.6 4.9 California 1.0 0.50 0.13 7.6 4.9 California 1.0 0.50 0.18 5.5 3.6 California 1.75 0.40 0.20 5.0 3.2 USA - West 1.75 0.40 0.20 5.0 3.2 USA - National 9.5 0.50 0.33 3.1 2.0 USA - West Coast 1.75 0.66 0.33 3.0 2.0 United Kingdom 1-2 0.91 0.33 3.0 2.0 USA - West Coast 1.75 0.80 0.4 2.5 </td

Note: Fish screen requirements are typically highly nuanced; the above is a summarization of requirements.

*Light grey values are calculated

US AND INTERNATIONAL FISH PROTECTION REQUIREMENTS – A TREND TOWARD FINE SLOT



Regulation Description	Location	Slot Size	Through-screen Velocity (fps)*	Approach Velocity (fps)*	Screen Surface Area (ft ²) per CFS	Screen Surface Area (ft ²) per MGD	Notes
Surface Water Withdrawal Intake Design and Operation Standards	Virginia	1.0	0.25	5 0.09	9 11.0	7.1	Subject to permit writer best professional judgement
Small Intakes (<5.3 cfs)	Canada	2.5	0.20	0.12	2 8.3	3 5.4	,
Commissioner Policy 52 - 316(b)	New York	0.5-0.75	0.50	0.13	3 7.6	5 4.9	Subject to permit writer best professional judgement
Ocean Plan (2019)	California	1.0	0.50	0.18	3 5.5	5 3.6	5 Assumes subsurface intake infeasible
Delta Smelt	California	1.75	0.40	0.20	5.0	3.2	
Western States - Passive Screens	USA - West	1.75	0.40	0.20	5.0	3.2	2 No active cleaning
Clean Water Act 316(b) - Entrainment	USA - National	≤2	. 0.50	0.27	7 3.8	3 2.4	Slot size subject to permit writer best professional judgement
Clean Water Act 316(b) - Impingement	USA - National	9.5	0.50	0.33	3.1	1 2.0	Assumes no entrainment requirements
Anadromous Salmonids	USA - West Coast	1.75	0.66	5 0.33	3 3.0	2.0	1
European Eel (Elvers)	United Kingdom	1-2	0.91	0.33	3 3.0	2.0	Screen angle 22-90 degrees; larger slot sizes allowed for older eels
Design specifications for fish- protection screens in Australia	Australia	2-3	0.56	o 0.33	3 3.0	2.0	
Anadromous Salmonids/Trout	USA - West Coast	1.75	0.80	0.4	4 2.5	1.6	6 Actively cleaned screens
Fish Screen Design for Sport Fish	New Zealand	2-3.2	0.67	7 0.4	4 2.5	5 1.6	,
Note: Fish screen requirements are ty	unically highly nuan	ced: the abc	ve is a summarizat	ion of requirement	, tc	,,	<u>.</u>

Note: Fish screen requirements are typically highly nuanced; the above is a summarization of requirements

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US AND INTERNATIONAL FISH PROTECTION REQUIREMENTS – A TREND TOWARD FINE SLOT



Location	Slot Size	Through-screen Velocity (fps)*	Approach Velocity (fps)*	Screen Surface Area (ft ²) per CFS	Screen Surface Area (ft ²) per MGD	Notes
Virginia	1.0	0.25	0.09			Subject to permit writer best
Canada	2.5	0.20	0.12	2 8.3	3 5.4	r
New York	0.5-0.75	0.50	0.13	3 7.6	5 4.9	Subject to permit writer best professional judgement
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USA - National	≤2	0.50	0.27	7 3.8	3 2.4	Slot size subject to permit writer best professional judgement
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New Zealand	2-3.2	0.67	0.4	4 2.5	5 1.6	į
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Note: Fish screen requirements are typically highly nuanced; the above is a summarization of requirements

*Light grey values are calculated

PROTECTING FISH AT WATER INTAKES IN THE LOCATIONS WHERE VERY FINE SLOT SIZES (<1.75 MM) ARE REQUIRED

Priorities

- Small slot opening (≤ 1 mm)
- Screens located out in the waterbody
- No fish or debris collection/conveyance
- Through-screen velocity (<0.15 m/s)
- Very low approach velocity (≤ 0.06 m/s)
- Uniform velocities over the screen surface
- Active screen cleaning



CAYUGA POWER PLANT

Cooling Water IntakeCRITERIA:38,643 m3/h (245 MGD, 379 cfs) with 0.75 mm slotsand 0.45 fps TSVSCREENS:QTY 16 ISI D83-120EA Fixed Vertical DrumsLOCATION:Cayuga Lake, Lansing, NYINSTALLED:2016OWNER:Heorot Power

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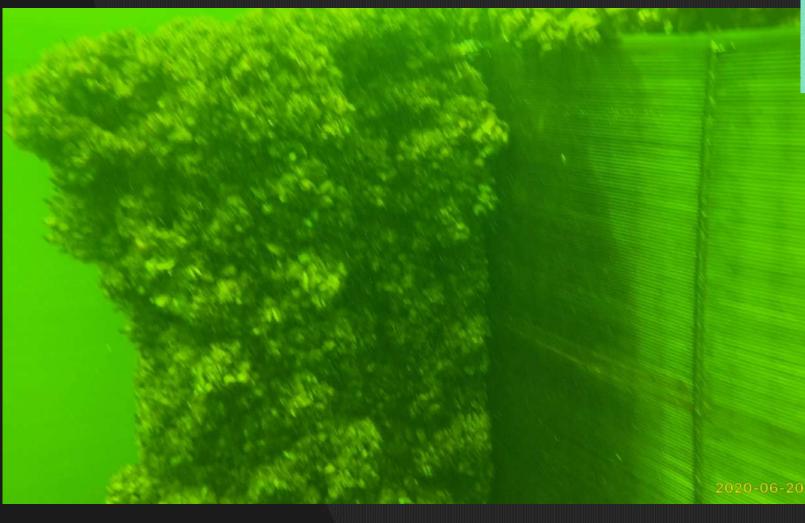


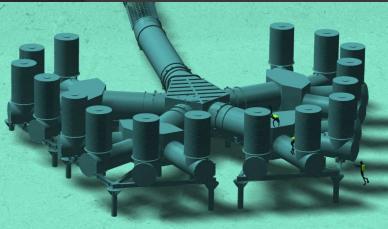




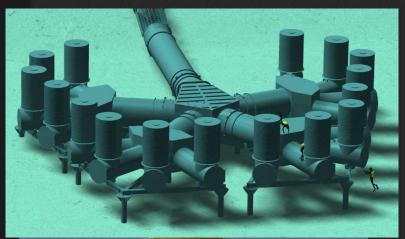
JUNE 2020 DIVE SURVEY

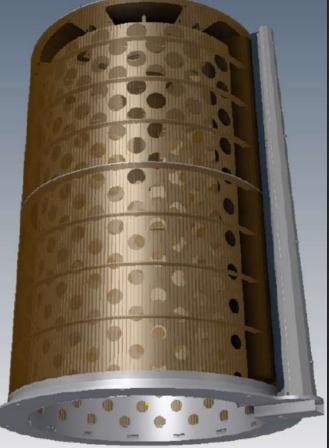
3.5 YEARS AFTER INSTALLATION











JUNE 2020 DIVE SURVEY

3.5 YEARS AFTER INSTALLATION



New York State Office of General Services

CRITERIA: 14,511 m3/h (92 MGD, 142 cfs) with 0.75 mm slots and 0.45 fps TSV SCREENS: QTY 4 ISI T72-84EA-R Retrievable Tee Screens LOCATION: Hudson River, Albany, NY INSTALLED: 2022

In the Income of the

OWNER: New York State Office of General Services



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Wedge Wire Screen Being Raised from Operational Position to Deck Level



© 2022 Intake Screen, Inc.

Greenidge Generation

CRITERIA:15,445 m3/h (98 MGD, 151 cfs) with 0.5 mm slots and0.45 fps TSVSCREENS:QTY 6 ISI D83-132EA-F Fixed Horizontal Drum ScreensLOCATION:Seneca Lake, Dresden, NYINSTALLED:2022OWNER:Greenidge Generation Holding, Inc.



GREENIDGE GENERATION





GREENIDGE GENERATION



- SCREEN JUNCTION BOX

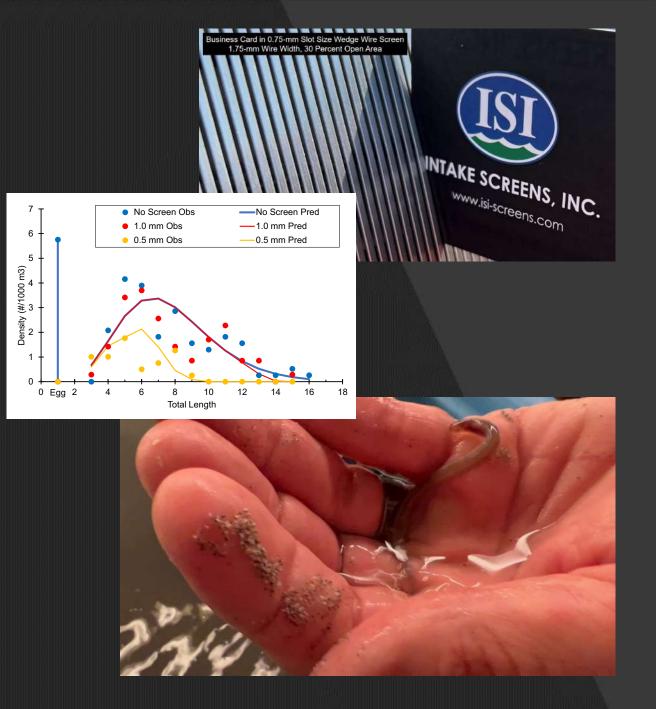
WEDGE WIRE SCREEN -

MAIN CONTROL PANEL -

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SUMMARY

- Fish protection regulatory stringency increases rather than decreases over time
- Fine-slot wedge wire screens (0.5-2-mm) exist and have been demonstrated and arguably provide the highest level of fish protection available today



THANK YOU



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