Innovative Trail Technologies

Objectives

- Brief history of trail infrastructure
- Highlight bridge/boardwalk projects
- Helical pile applications and installation
- Alternative decking materials
- Fiberglass bridge construction
- Stone trail construction

Delaware'sTrail History

- Most of our park trails were
  - Old farm roads
  - Fishing trails
  - Social trails

Why Bother?

- Minimize environmental impact
- Decrease long term maintenance/costs
- Increase safety (decrease liability)
- Increase user enjoyment and accessibility

S.C.O.R.P.

- Statewide, 85% of those surveyed said walking or jogging are activities in which a member of their household will participate in over the next 12 months.

Most Participated in Activities Statewide:

1. Walking or jogging
2. Bicycling
3. Swimming at the Beach
4. Passive Recreation in the Outdoors
5. Visiting Historic Sites

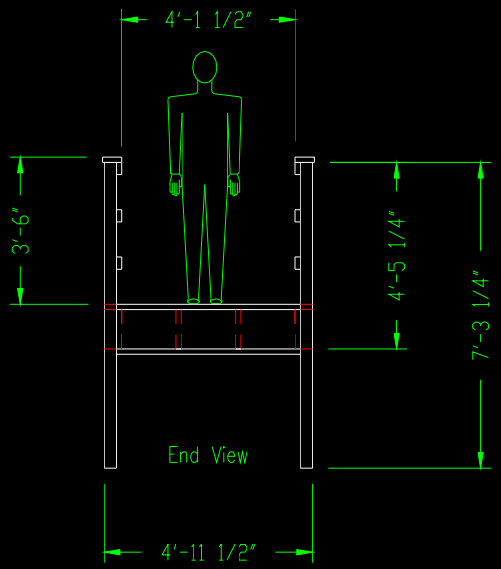
Bridges

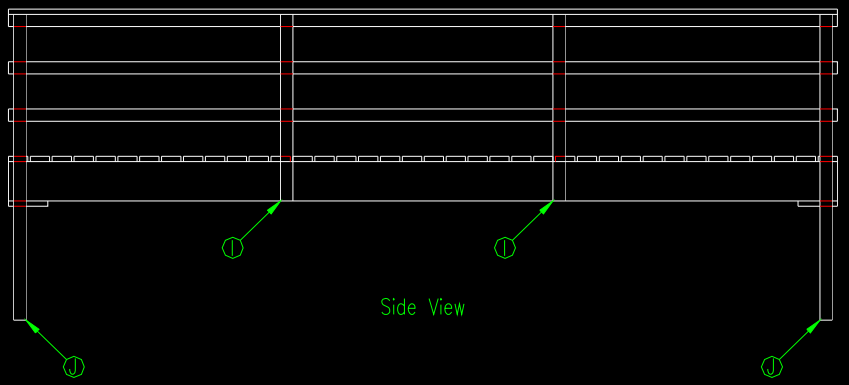
- Protect natural resources
- Increase accessibility
- Enhance safety
- Create overlook opportunities
- Add interest to the trail experience

Bridge Evolution

The Emergence of a Standard

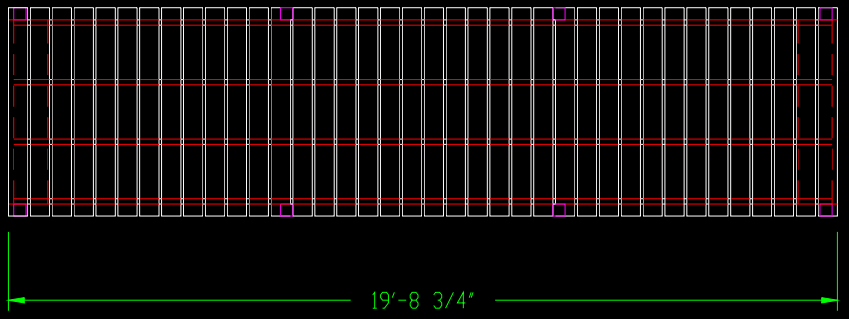
- Developed in 1999 and modified perpetually
- Standard 16 and 20 foot spans
- Multiple bridges can be combined
- All wood with galvanized/stainless hardware
- Eases repairs
- Limits liability
- Can be built without handrails for boardwalk applications





Materials

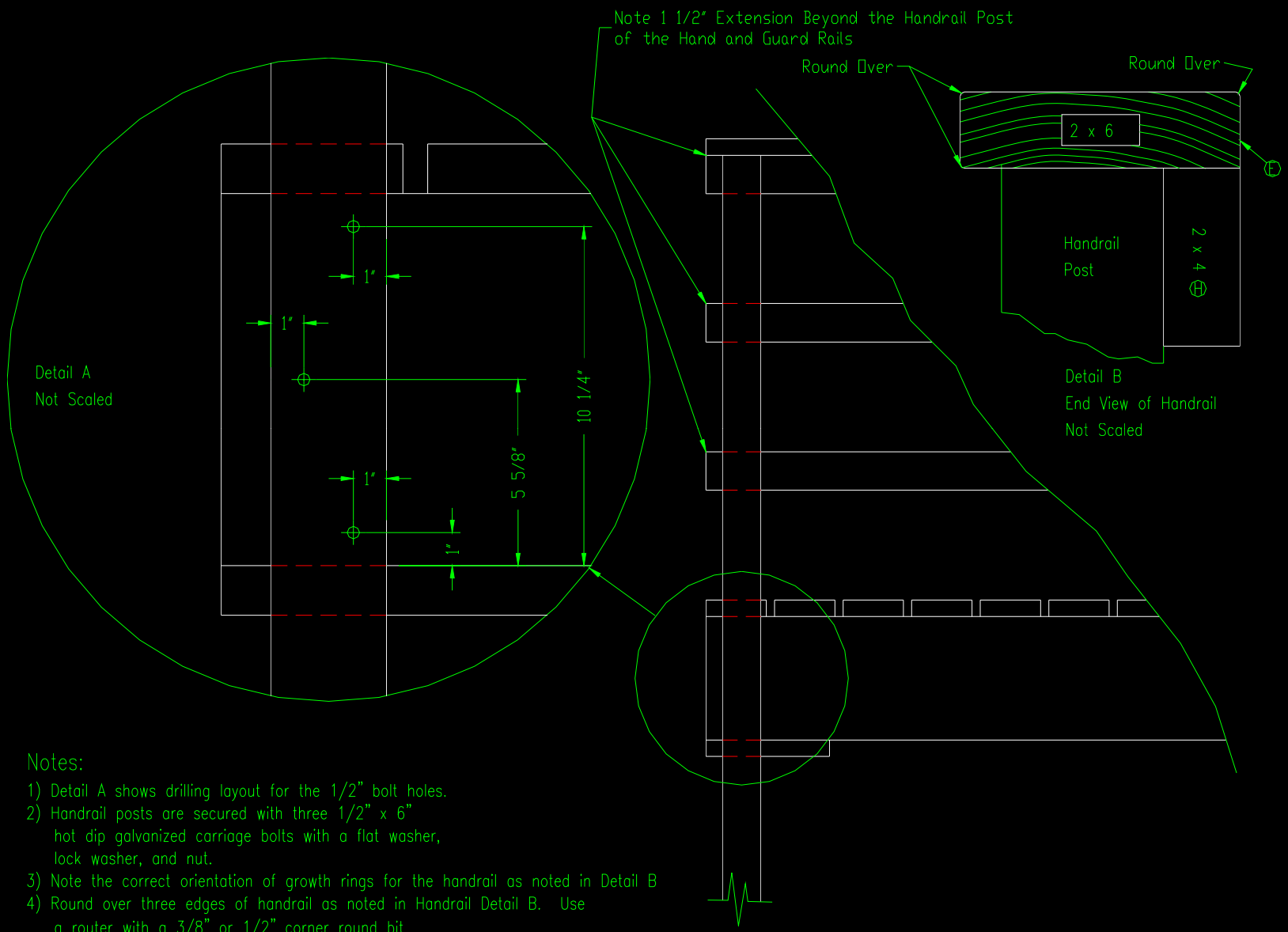
Quan.	Size	Description	Used for:
4	2x12x20'	#2 Pressure Treated Yellow Pine	Joists
2	2x12x10'	#2 Pressure Treated Yellow Pine	Ends and End Plates
1	2x10x8'	#2 Pressure Treated Yellow Pine	Handrail Post Bracing
2	2x6x20'	#2 Pressure Treated Yellow Pine	Handrail Caps
19	2x6x10'	#2 Pressure Treated Yellow Pine	Bridge Decking
10	2x6x10'	#2 Pressure Treated Yellow Pine	Ramp Decking
4	2x6x10'	#2 Pressure Treated Yellow Pine	Ramp Joists
9	2x4x14'	#2 Pressure Treated Yellow Pine	Guard Rails
2	4x4x10'	#2 Pressure Treated Yellow Pine	Handrail Posts
4	4x4x8'	#2 Pressure Treated Yellow Pine	Handrail Posts
24	1/2x6"	Plated Carriage Bolts	Handrail Posts
24	1/2"	Flat Washers	Handrail Posts
24	1/2"	Lock Washers	Handrail Posts
24	1/2"	Nuts	Handrail Posts
15 lbs	16d	Hot Dipped Galvanized Deck Nails	Entire Structure



Plan View

Notes:
1) For the sake of clarity, the side and top views do not show handrail post bracing. Refer to Plate 2.
2) For the sake of clarity, the handrails are not drawn in the plan view.
3) Lettered items are cross referenced with the cut list.

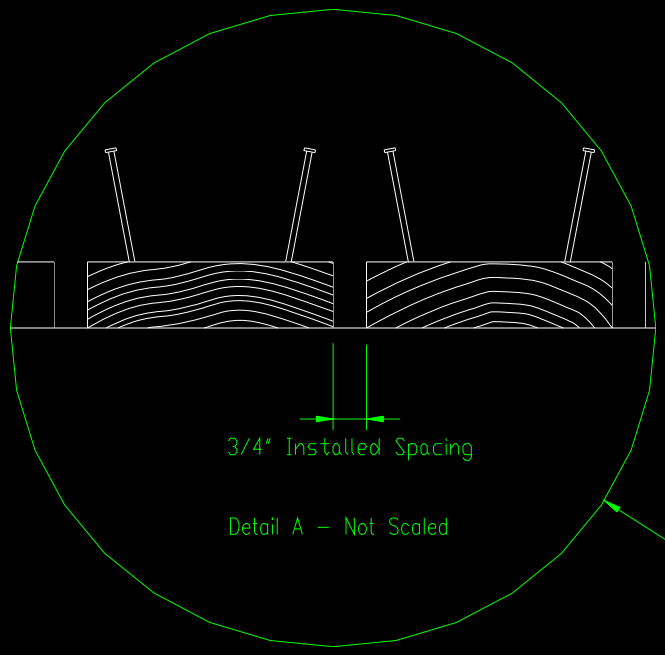
Delaware Division of Parks and Recreation	Drawing By: Peter W. Brakhage	Scale: 1/4" = 1'	Date: 20 Aug 99	Plate Number 1 Of 006
Project No.	Standard 20' Bridge		Revised:	

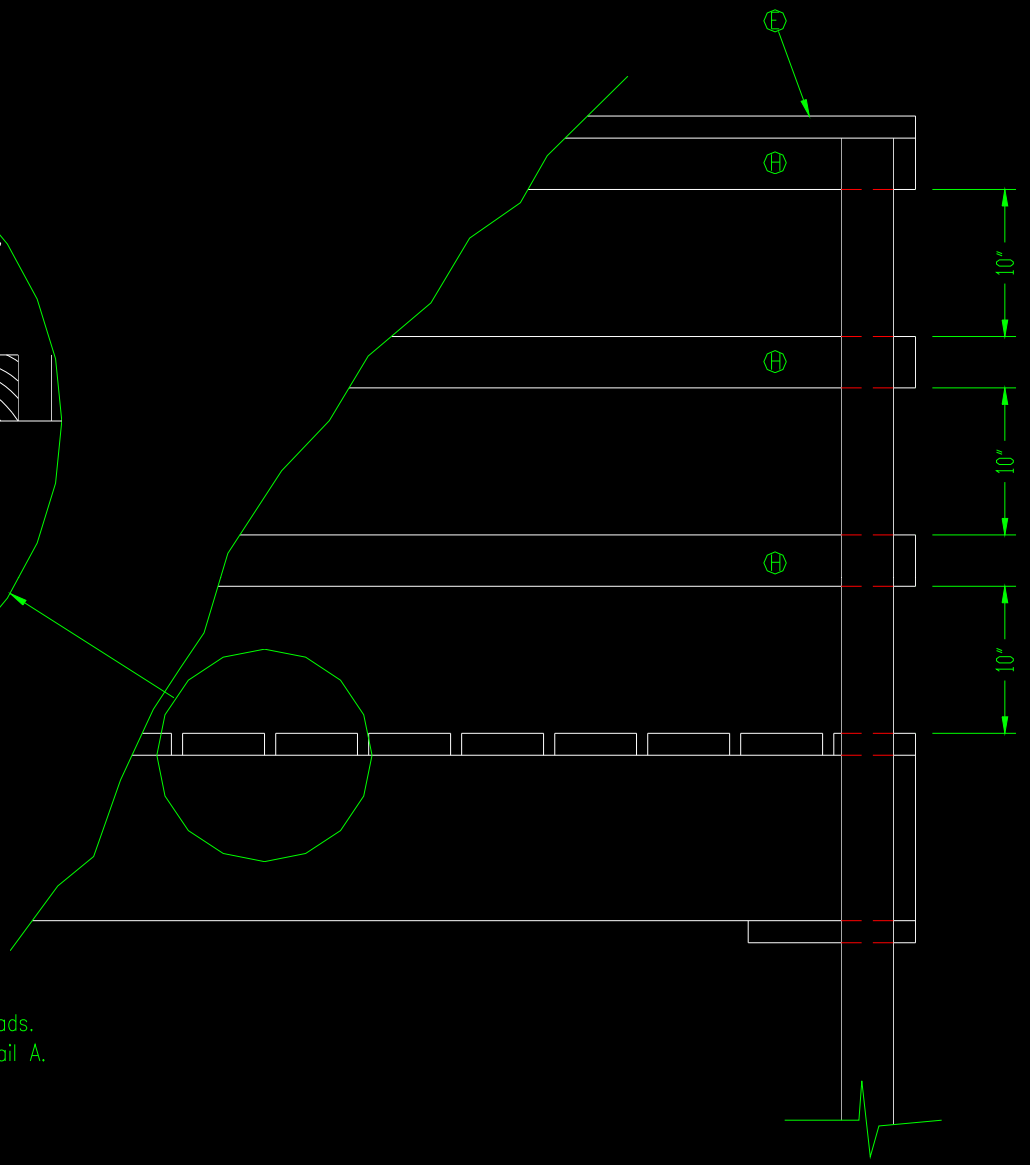


Notes:

1) Detail A shows drilling layout for the 1/2" bolt holes.
2) Handrail posts are secured with three 1/2" x 6" hot dip galvanized carriage bolts with a flat washer, lock washer, and nut.
3) Note the correct orientation of growth rings for the handrail as noted in Detail B
4) Round over three edges of handrail as noted in Handrail Detail B. Use a router with a 3/8" or 1/2" corner round bit.

Delaware Division of Parks and Recreation	Drawing By: Peter W. Brakhage	Scale: 1" = 1'	Date: 25 Aug 99	Plate Number 5 Of 006
Project No.	Standard 20' Bridge Handrail and Post Details		Revised:	

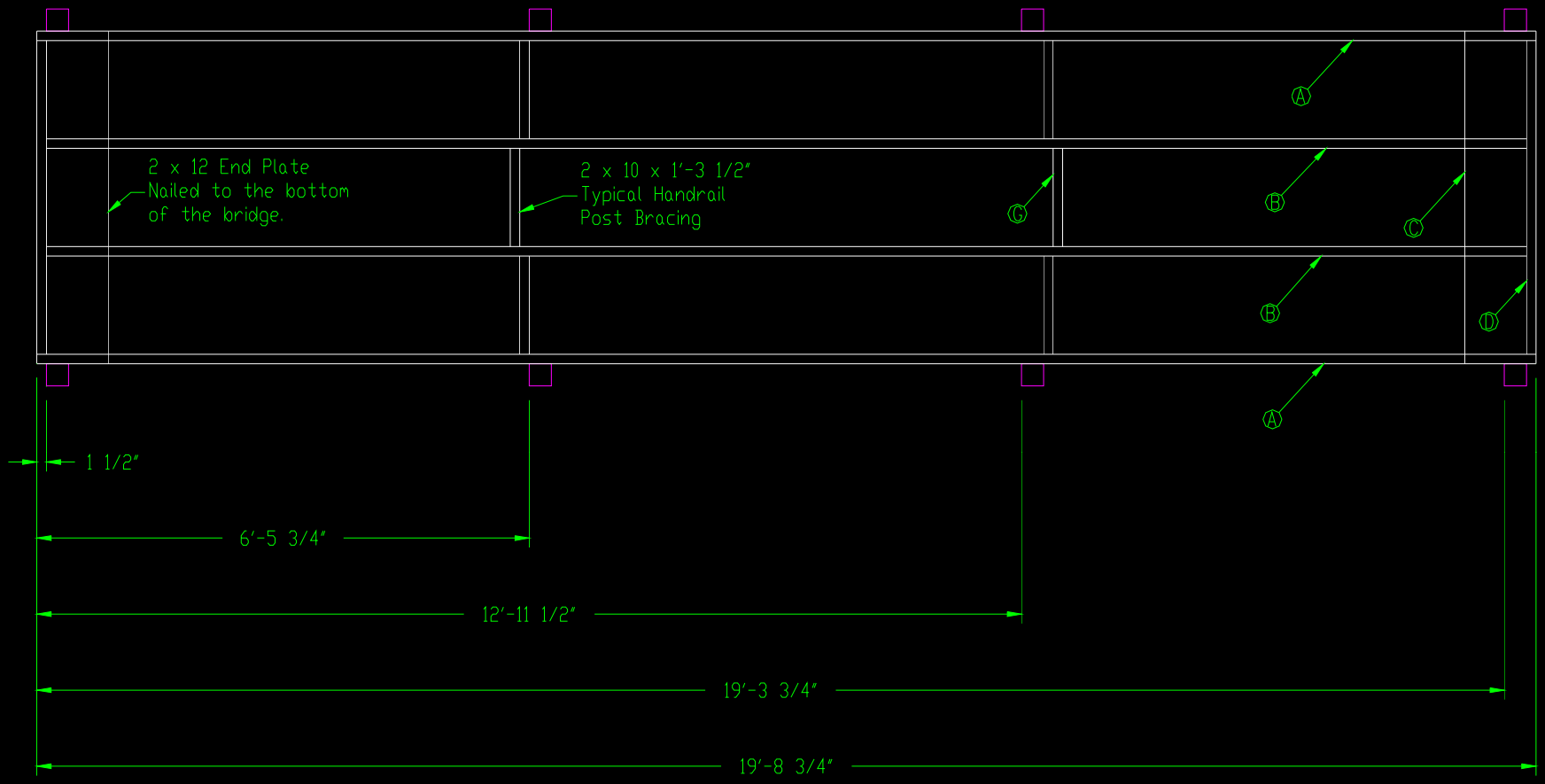




Notes;

1) Two 10" spacers may be used to hold guard rails in position while they are being nailed.
2) Drive nails into the treads at an angle as shown in Detail A (clinching) to avoid nail pop.
3) Place treads with the growth rings oriented as shown in Detail A to prevent water from being held in cupped treads.
4) Use 3/4 ply or 1x shims to space treads as shown in Detail A.
5) Lettered items are cross referenced with the cut list.

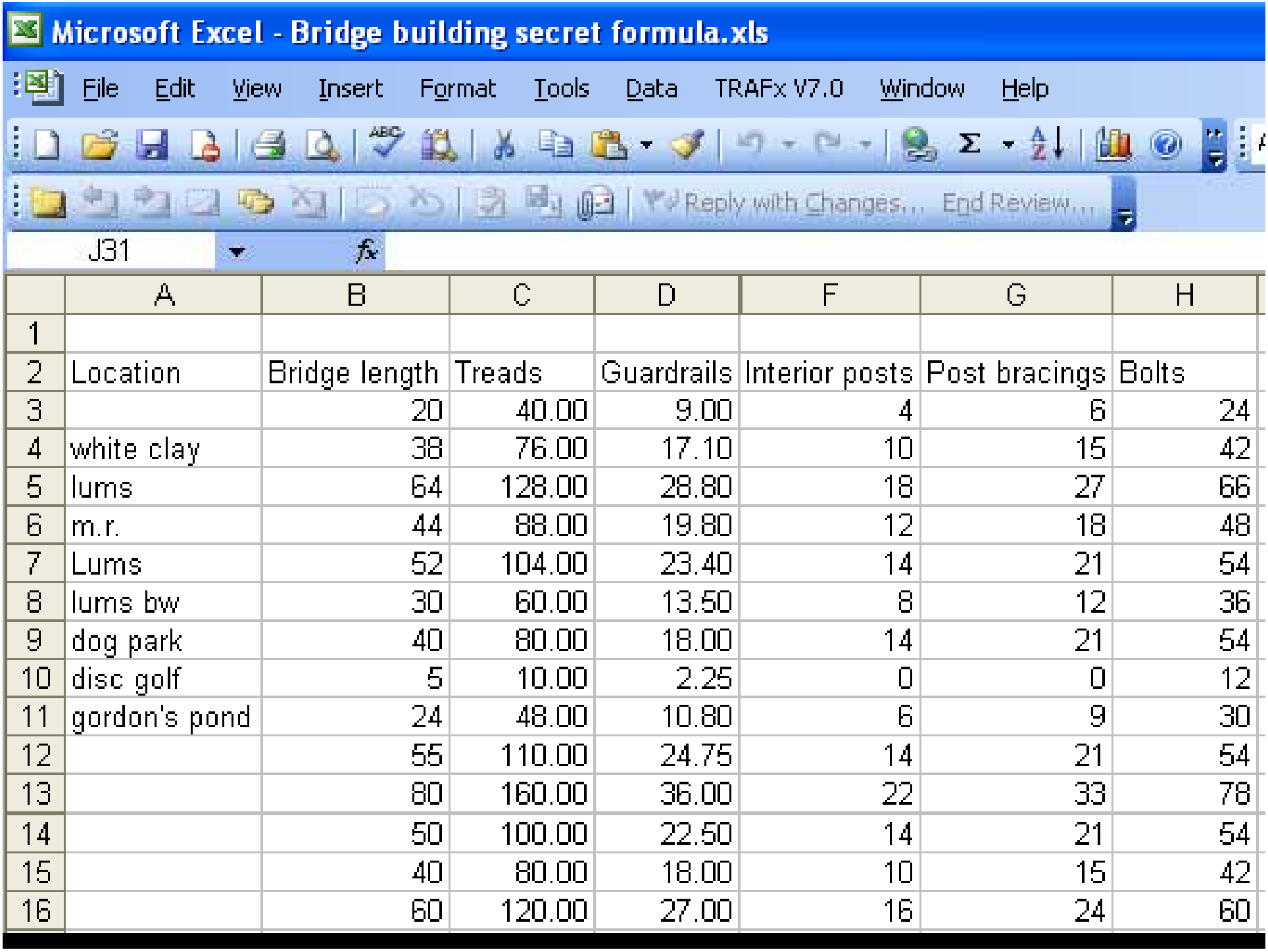
Delaware Division of Parks and Recreation	Drawing By: Peter W. Brakhage	Scale: 1" = 1'	Date: 25 Aug 99	Plate Number 4 Of 006
Project No.	Standard 20' Bridge Details		Revised:	



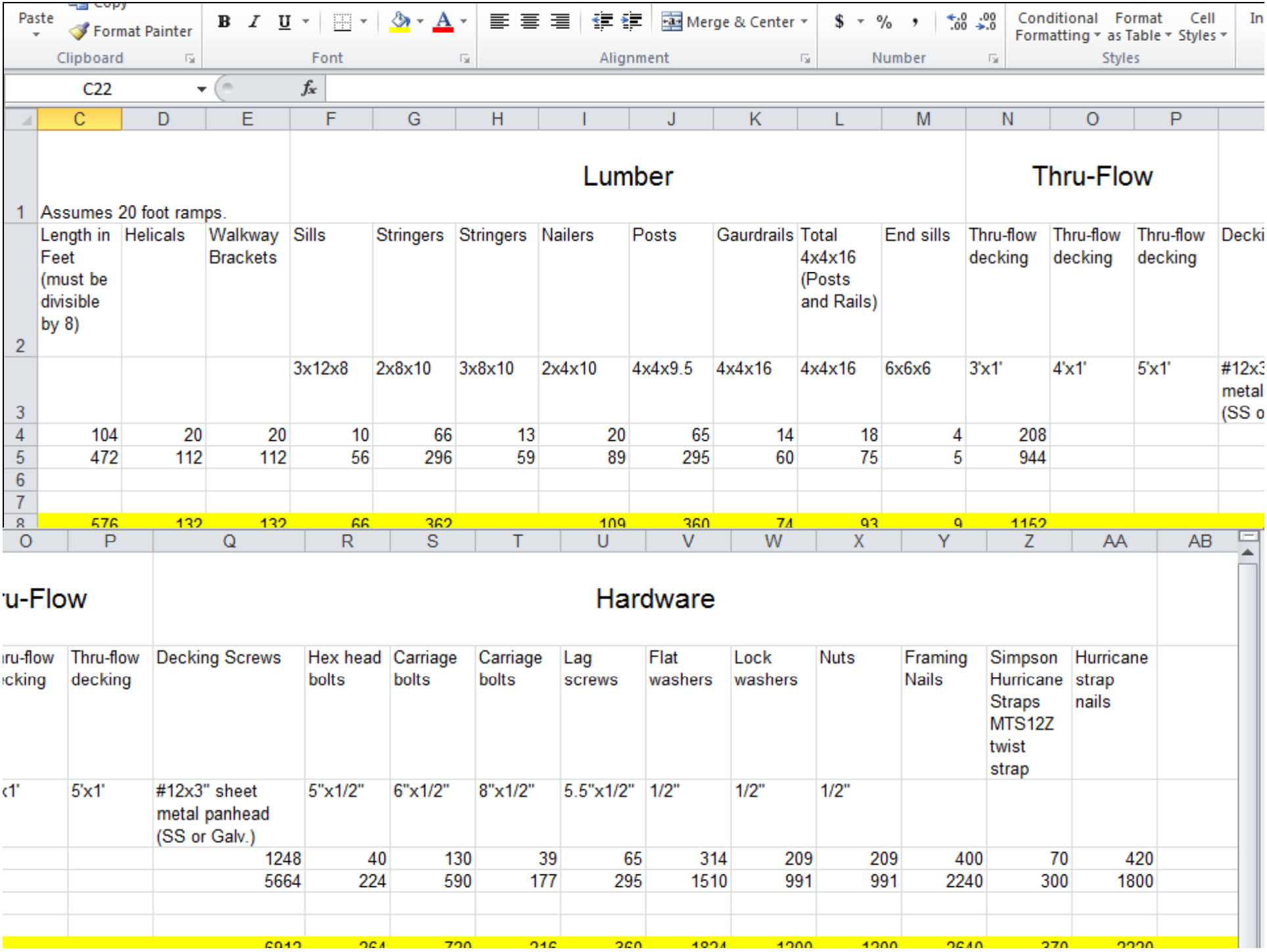
Notes:

1) Joists are 2 x 12 Pressure Treated Yellow Pine (PTYP).
2) Dimensions show post placement layout.
3) Posts are inset from ends to prevent interference between bolt placement and the ends of the substructure.
4) Ends are capped by exterior joists.
5) Ends cap interior joists. (See Plate 3 for layout dimensions for ends)
6) Handrail Post Bracing consists of 2 x 10 PTYP nailed flush with the bottom of the bridge. (See Plate 3)
7) Lettered items are cross referenced with the cut list.

Delaware Division of Parks and Recreation	Drawing By: Peter W. Brakhage	Scale: 1/2" = 1'	Date: 20 Aug 99	Plate Number 2 Of 006
Project No.	Standard 20' Bridge Substructure – Plan View		Revised:	



	A	B	C	D	F	G	H
1							
2	Location	Bridge length	Treads	Guardrails	Interior posts	Post bracings	Bolts
3		20	40.00	9.00	4	6	24
4	white clay	38	76.00	17.10	10	15	42
5	lums	64	128.00	28.80	18	27	66
6	m.r.	44	88.00	19.80	12	18	48
7	Lums	52	104.00	23.40	14	21	54
8	lums bw	30	60.00	13.50	8	12	36
9	dog park	40	80.00	18.00	14	21	54
10	disc golf	5	10.00	2.25	0	0	12
11	gordon's pond	24	48.00	10.80	6	9	30
12		55	110.00	24.75	14	21	54
13		80	160.00	36.00	22	33	78
14		50	100.00	22.50	14	21	54
15		40	80.00	18.00	10	15	42
16		60	120.00	27.00	16	24	60



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C22

	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Assumes 20 foot ramps.			Lumber								Thru-Flow		
2	Length in Feet (must be divisible by 8)	Helicals	Walkway Brackets	Sills	Stringers	Stringers	Nailers	Posts	Gaurdrails	Total 4x4x16 (Posts and Rails)	End sills	Thru-flow decking	Thru-flow decking	Thru-flow decking
3				3x12x8	2x8x10	3x8x10	2x4x10	4x4x9.5	4x4x16	4x4x16	6x6x6	3'x1'	4'x1'	5'x1'
4	104	20	20	10	66	13	20	65	14	18	4	208		
5	472	112	112	56	296	59	89	295	60	75	5	944		
6														
7														
8	576	132	132	66	362		109	360	74	93	9	1152		

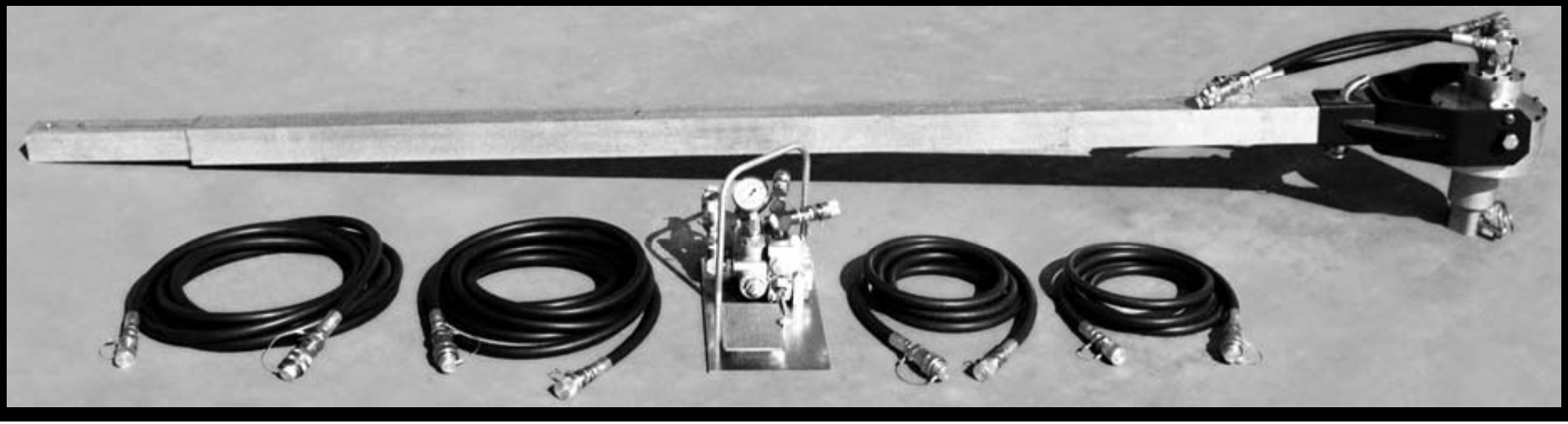
	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	ru-Flow		Hardware											
2	ru-flow cking	Thru-flow decking	Decking Screws	Hex head bolts	Carriage bolts	Carriage bolts	Lag screws	Flat washers	Lock washers	Nuts	Framing Nails	Simpson Hurricane Straps MTS12Z twist strap	Hurricane strap nails	
3	x1'	5'x1'	#12x3" sheet metal panhead (SS or Galv.)	5"x1/2"	6"x1/2"	8"x1/2"	5.5"x1/2"	1/2"	1/2"	1/2"				
4			1248	40	130	39	65	314	209	209	400	70	420	
5			5664	224	590	177	295	1510	991	991	2240	300	1800	
6														
7														
8			6912	264	720	216	360	1824	1200	1200	2640	370	2220	

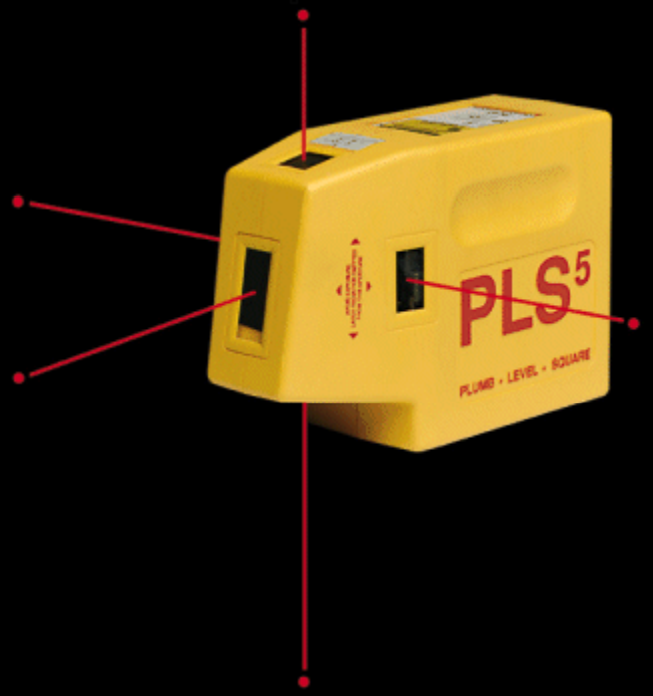
Standards Change

- Wood decking is replaced with composite decking

Helical Pile Foundations

- Available in multiple sizes and shapes
- Adaptable to a variety of soil types
- Last longer that wood
- 1,000 ft/lbs of torque= 10,000lbs capacity

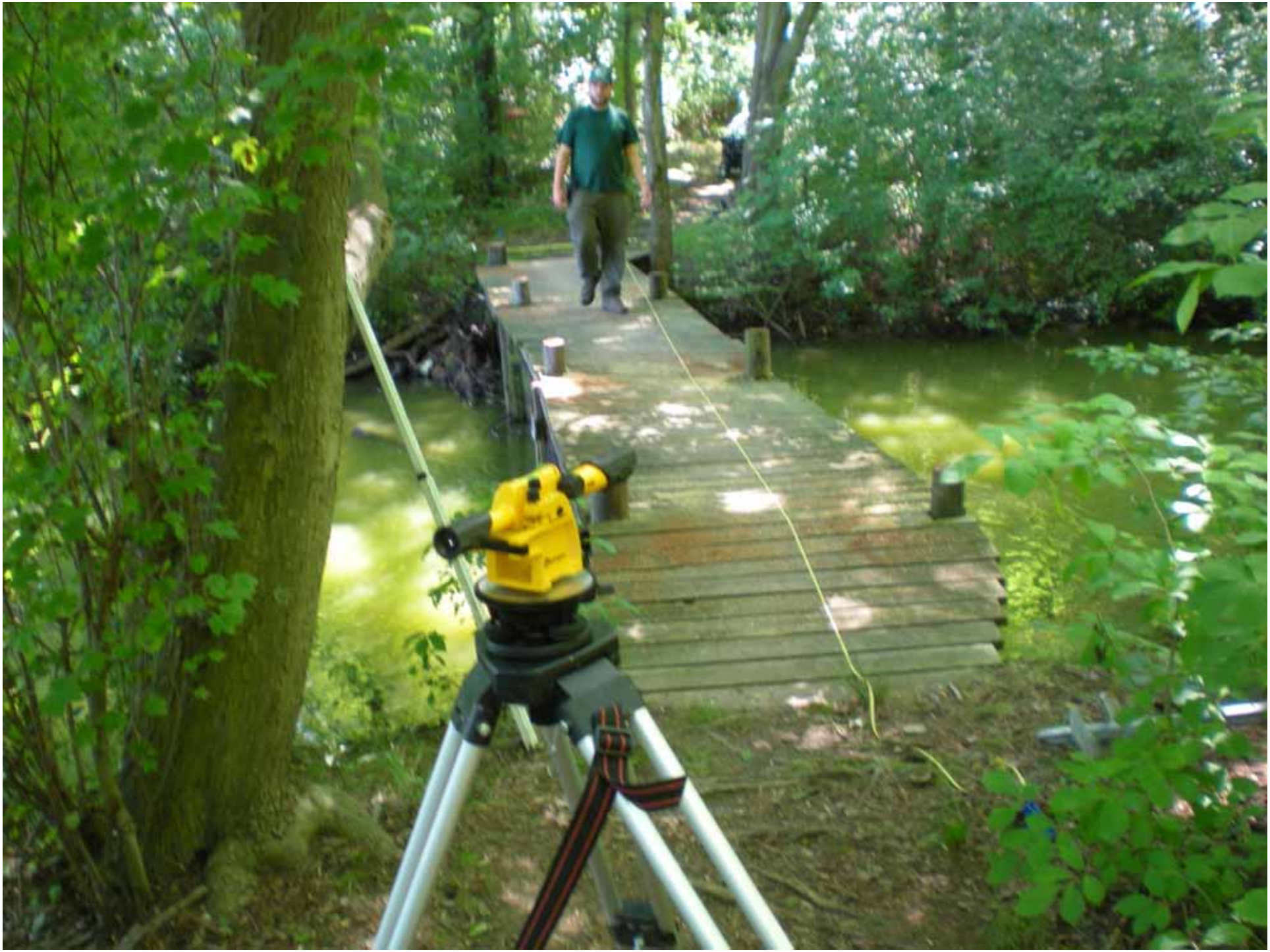


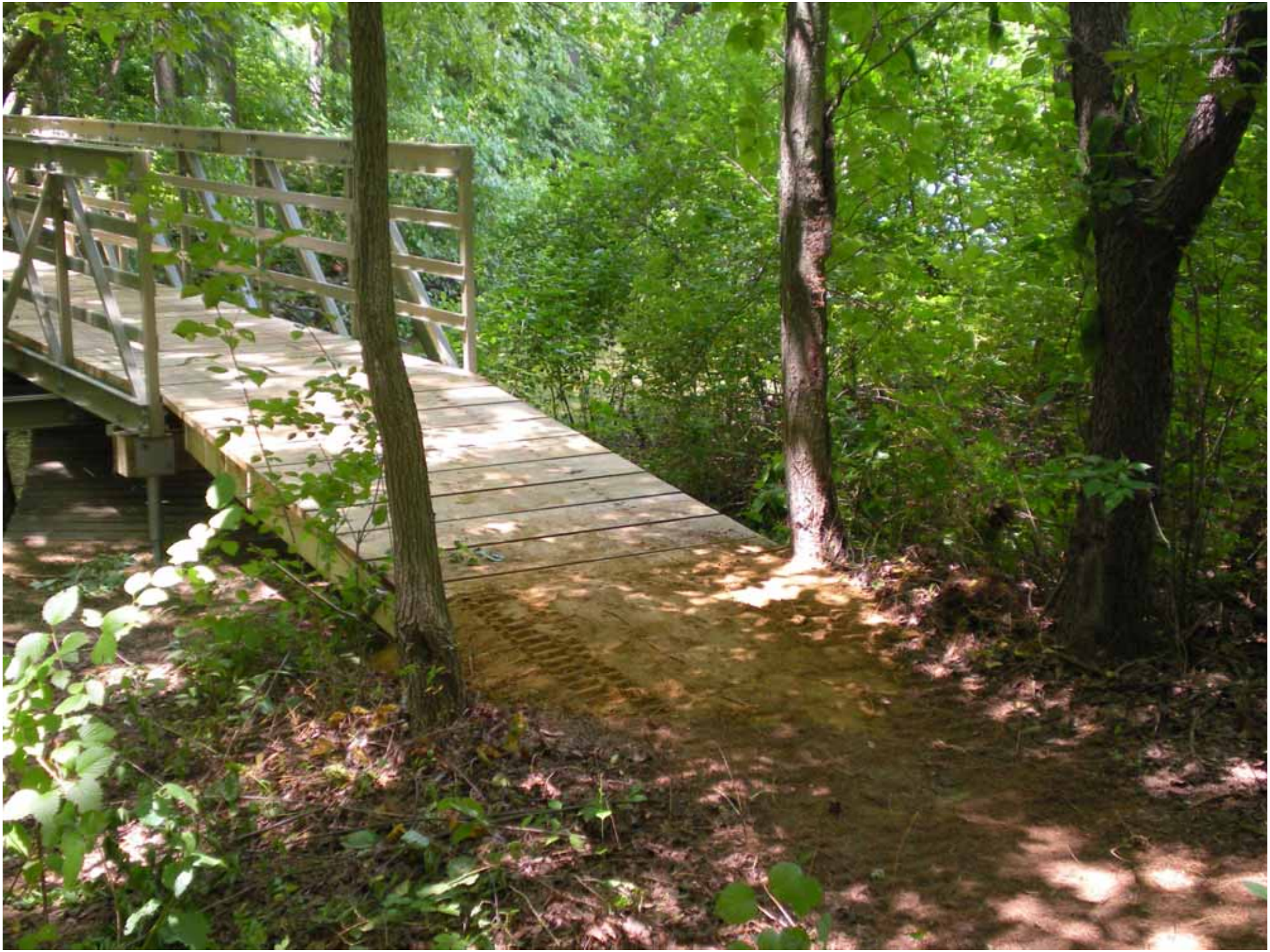

PLS5
PLUMB • LEVEL • SQUARE


HONDA

Lums Pond Fiberglass Bridge

- Cost less than steel
- Can be carried in by hand
- Easily assembled by hand
- Can be designed to fit many applications

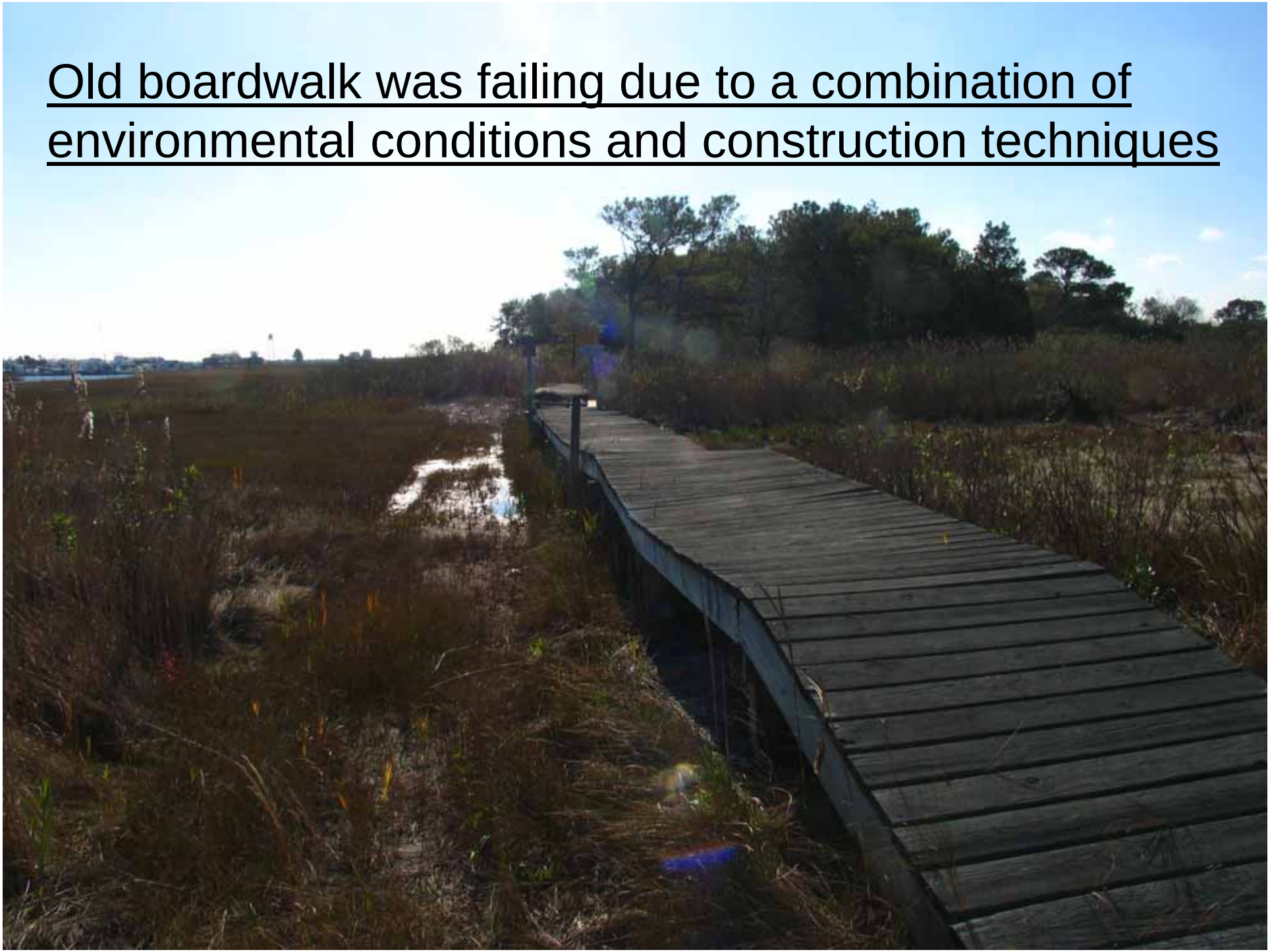




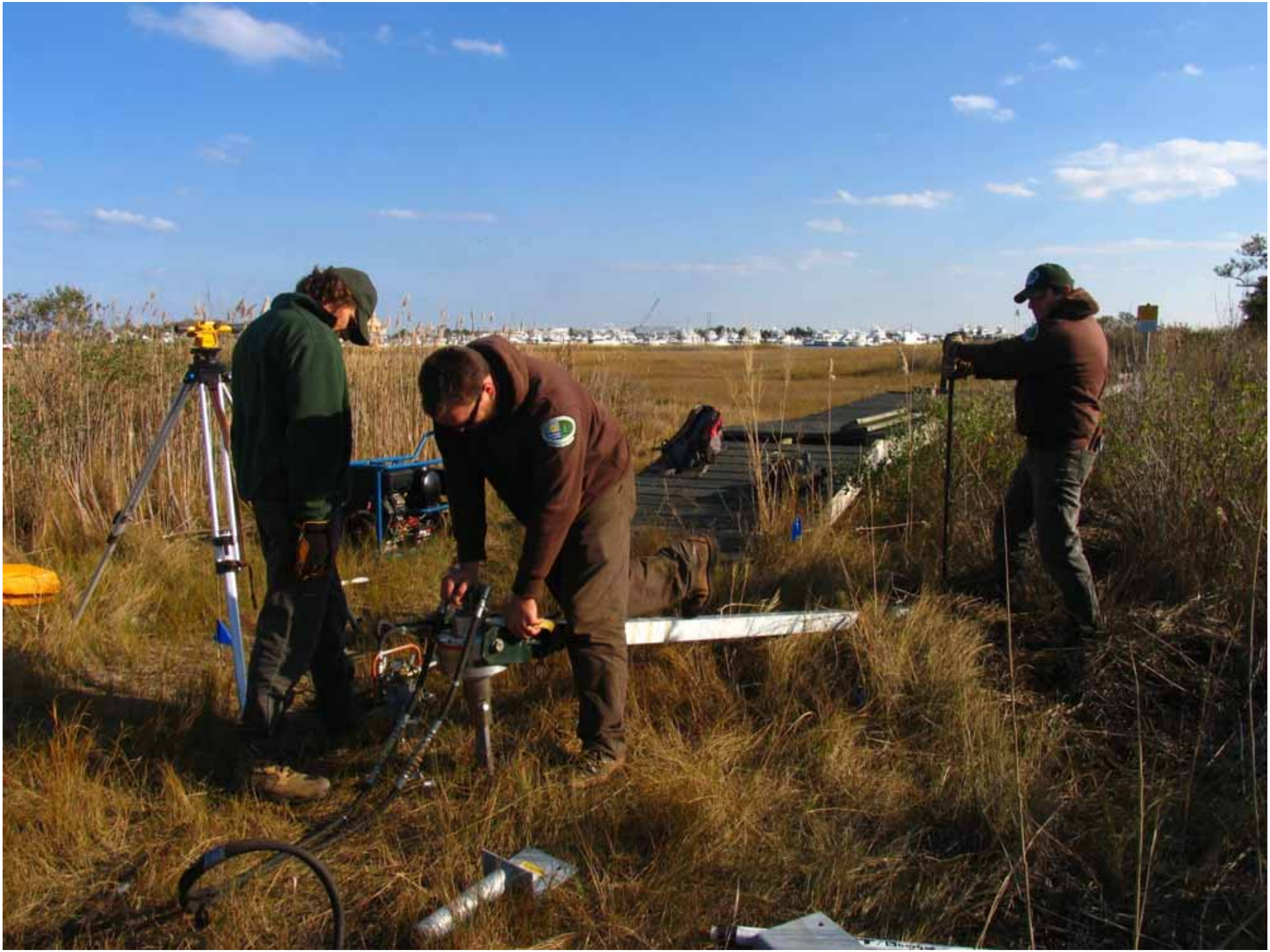
Burtons Island Boardwalks

- Specifically designed for a salt marsh environment
- Utilized helical piles
- Thru-flow decking required for permitting

Old boardwalk was failing due to a combination of environmental conditions and construction techniques

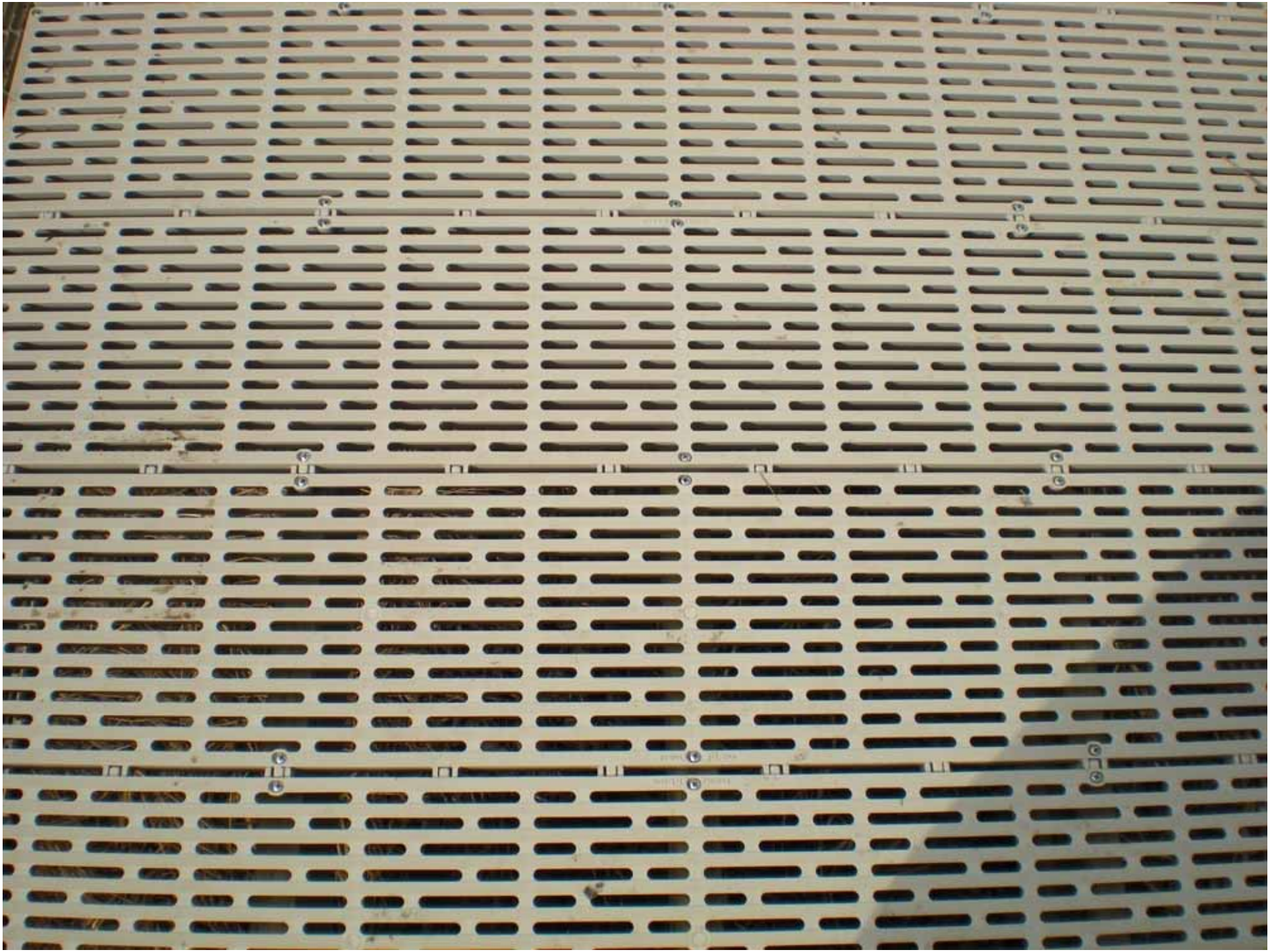



TRAIL
CLOSED
BEYOND
THIS
POINT

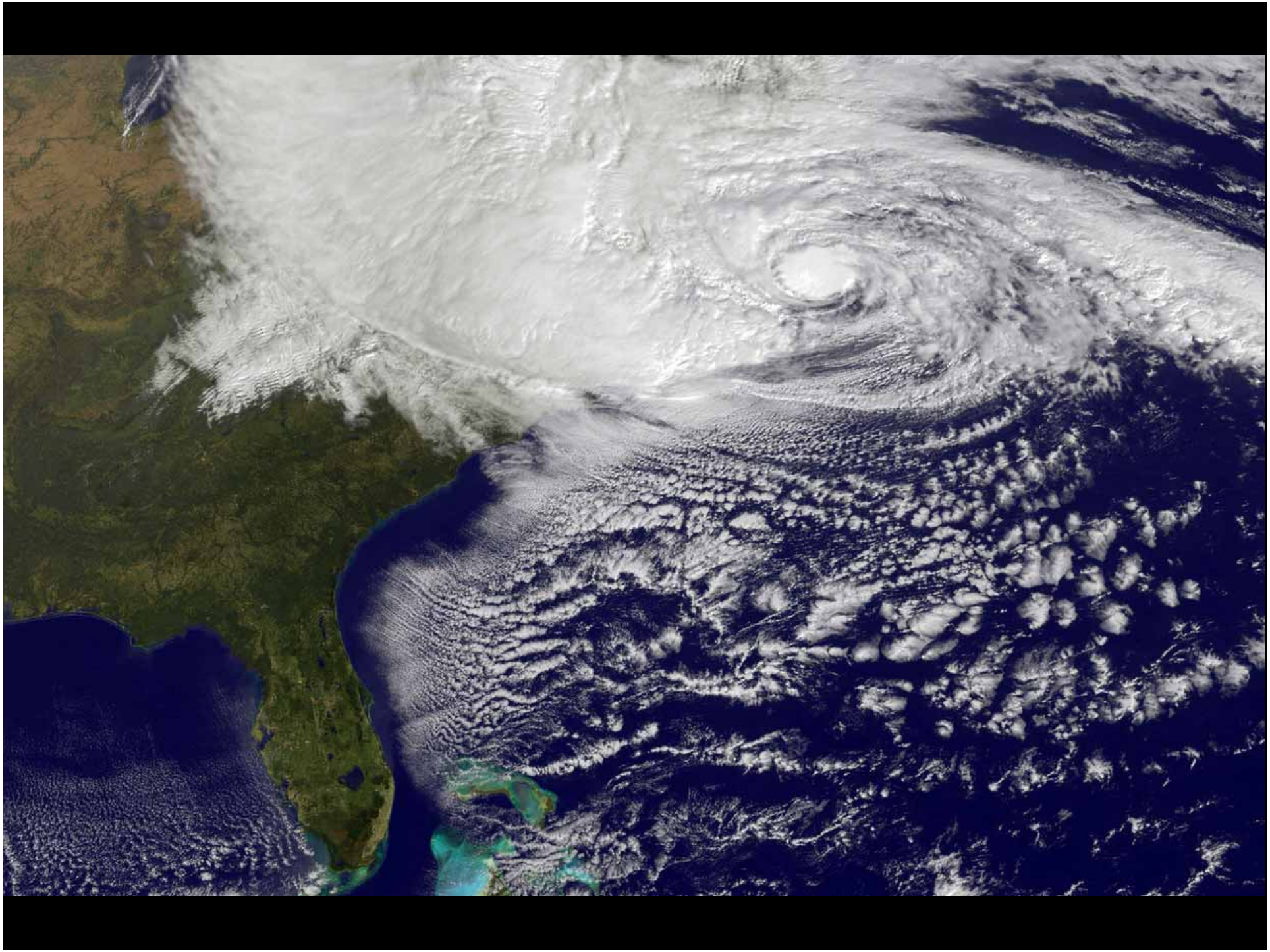



BURTONS ISLAND
NATURE TRAIL
TEMPORARILY
CLOSED
AUTHORIZED
PERSONNEL ONLY
BEYOND THIS POINT
TRAIL
CLOSED
BEYOND
THIS
POINT


DEWALT
DEWALT

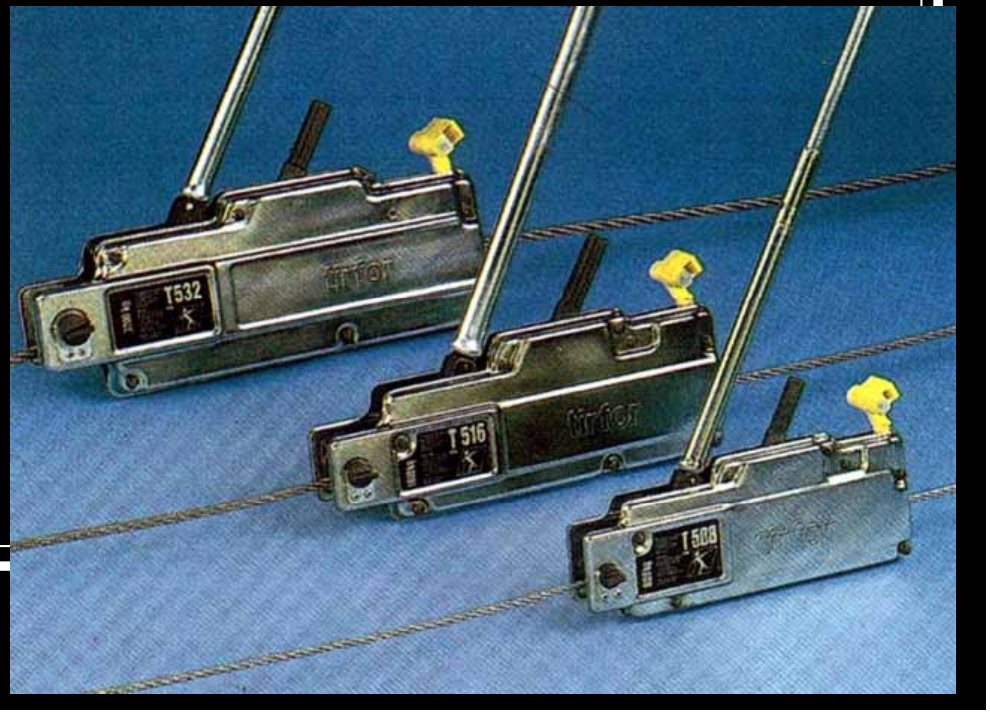


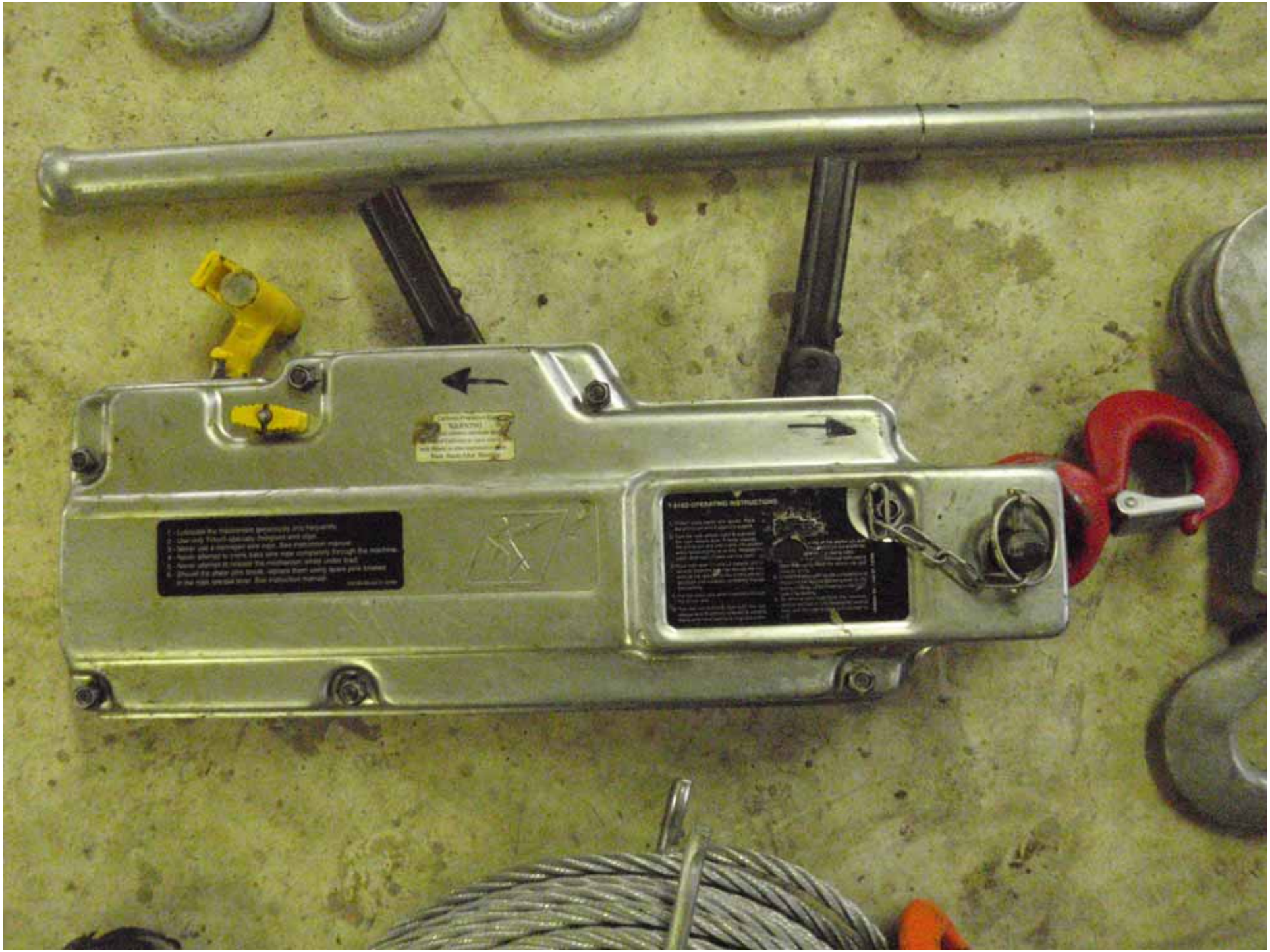

Hurricane Sandy
Chicago
Toronto
Moosonee
St. Louis
Tuesday 8:00 PM EDT
50 mph
Burlington
Roanoke
Washington
New York
Boston
Norfolk
Monday 8:00 PM EDT
80 mph

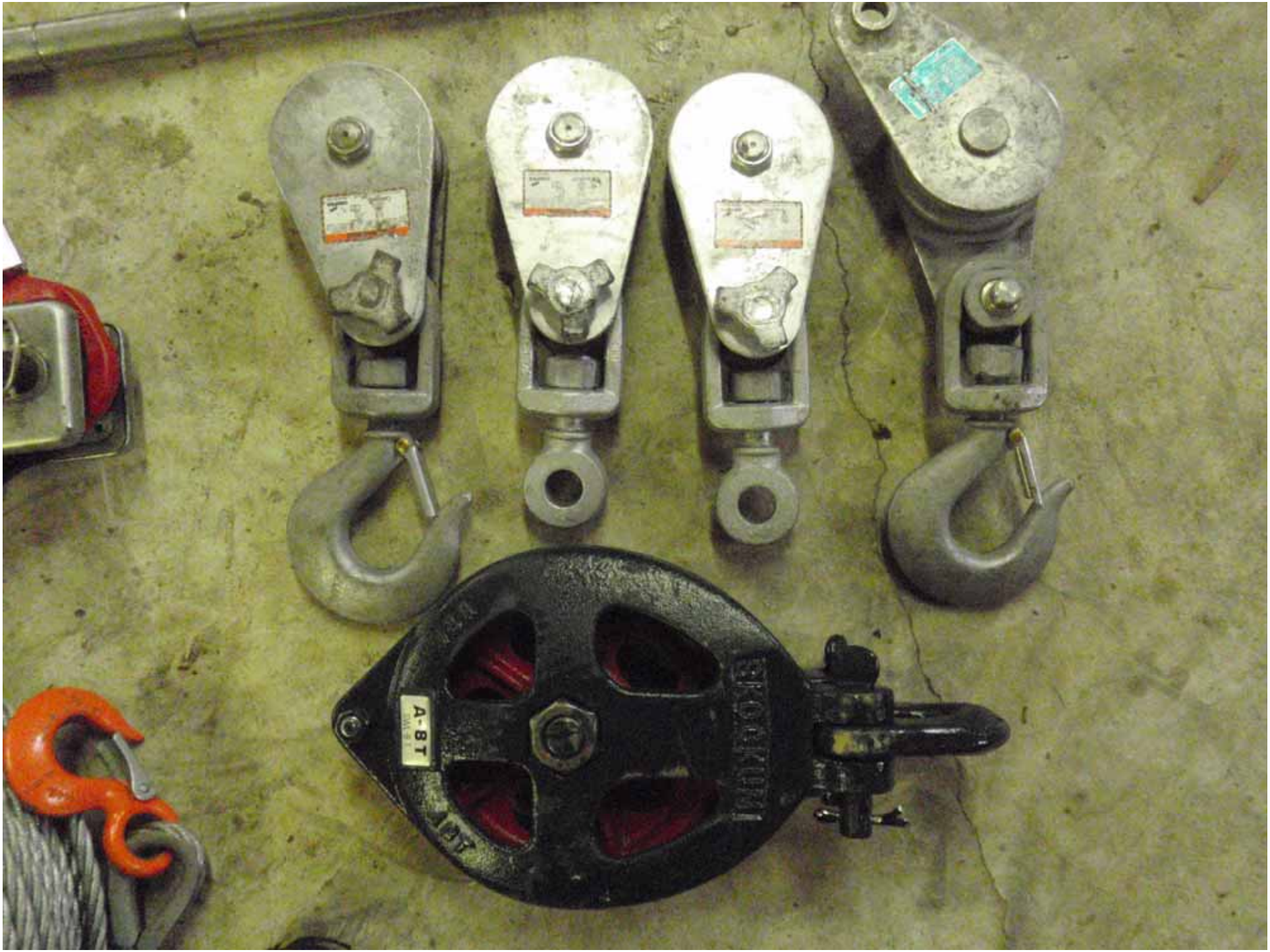


Griphoist

- Capable of pulling over 4000 lbs.
- Low impact, can be carried in by hand
- Capable of moving very heavy materials without machinery






A-8T

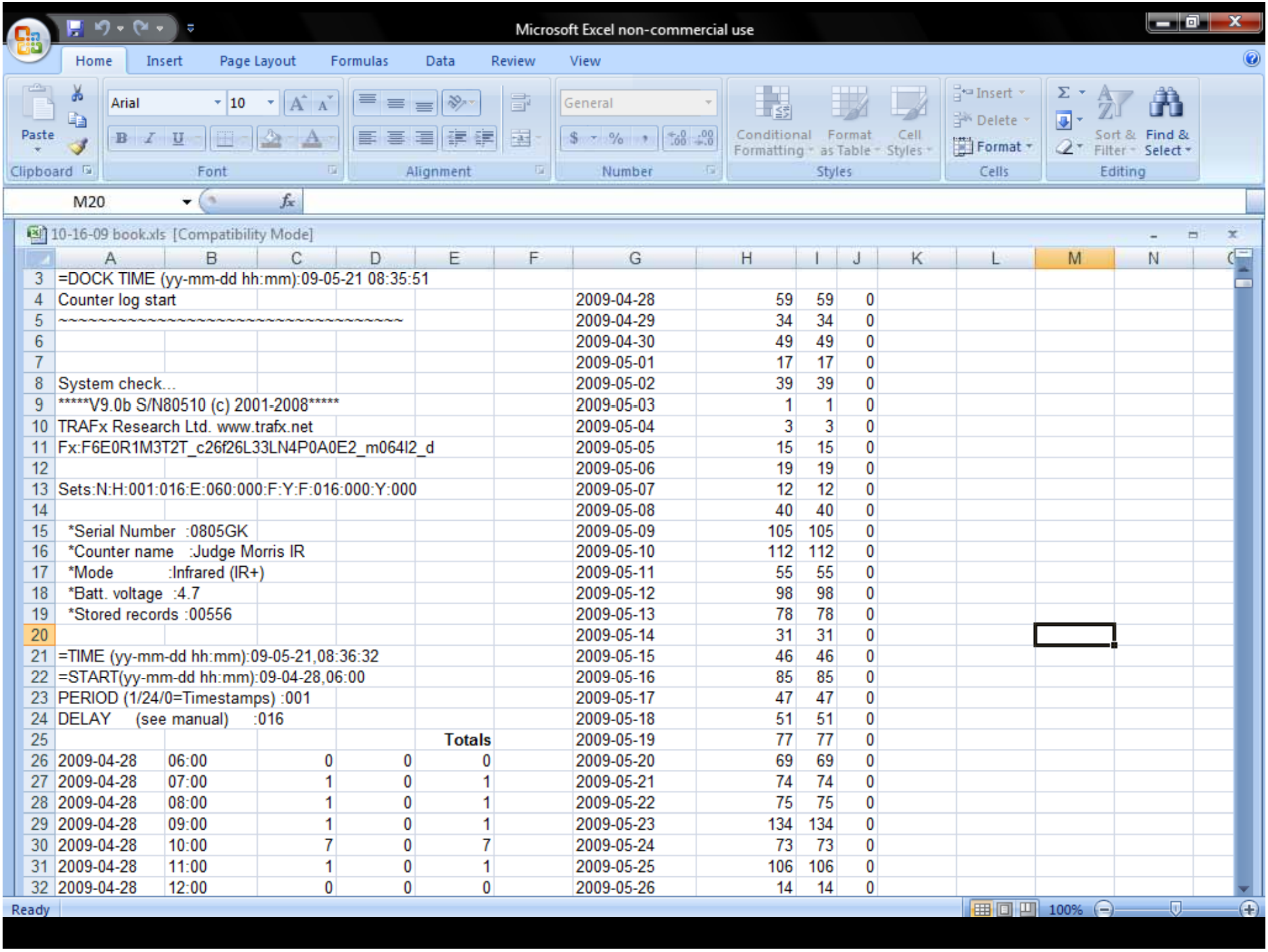
Trail Counters

- Provide real numbers
- Can distinguish type of use
- Useful in planning and resource management
- Relatively inexpensive

Data Shuttle

Magnetic Counter

Infrared Counter


Microsoft Excel non-commercial use
Home
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Page Layout
Formulas
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View
Paste
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10
General
Conditional Formatting
Format as Table
Cell Styles
Insert
Delete
Format
Sort & Filter
Find & Select
Clipboard
Font
Alignment
Number
Styles
Cells
Editing
M20
10-16-09 book.xls [Compatibility Mode]
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Counter log start
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System check...
*****V9.0b S/N80510 (c) 2001-2008*****
TRAFx Research Ltd. www.trafx.net
Fx:F6E0R1M3T2T_c26f26L33LN4P0A0E2_m064I2_d
Sets:N:H:001:016:E:060:000:F:Y:F:016:000:Y:000
*Serial Number :0805GK
*Counter name :Judge Morris IR
*Mode :Infrared (IR+)
*Batt. voltage :4.7
*Stored records :00556
=TIME (yy-mm-dd hh:mm):09-05-21,08:36:32
=START(yy-mm-dd hh:mm):09-04-28,06:00
PERIOD (1/24/0=Timestamps) :001
DELAY (see manual) :016
Totals
2009-04-28 06:00 0 0 0
2009-04-28 07:00 1 0 1
2009-04-28 08:00 1 0 1
2009-04-28 09:00 1 0 1
2009-04-28 10:00 7 0 7
2009-04-28 11:00 1 0 1
2009-04-28 12:00 0 0 0
2009-04-28 59 59 0
2009-04-29 34 34 0
2009-04-30 49 49 0
2009-05-01 17 17 0
2009-05-02 39 39 0
2009-05-03 1 1 0
2009-05-04 3 3 0
2009-05-05 15 15 0
2009-05-06 19 19 0
2009-05-07 12 12 0
2009-05-08 40 40 0
2009-05-09 105 105 0
2009-05-10 112 112 0
2009-05-11 55 55 0
2009-05-12 98 98 0
2009-05-13 78 78 0
2009-05-14 31 31 0
2009-05-15 46 46 0
2009-05-16 85 85 0
2009-05-17 47 47 0
2009-05-18 51 51 0
2009-05-19 77 77 0
2009-05-20 69 69 0
2009-05-21 74 74 0
2009-05-22 75 75 0
2009-05-23 134 134 0
2009-05-24 73 73 0
2009-05-25 106 106 0
2009-05-26 14 14 0
Ready
100%
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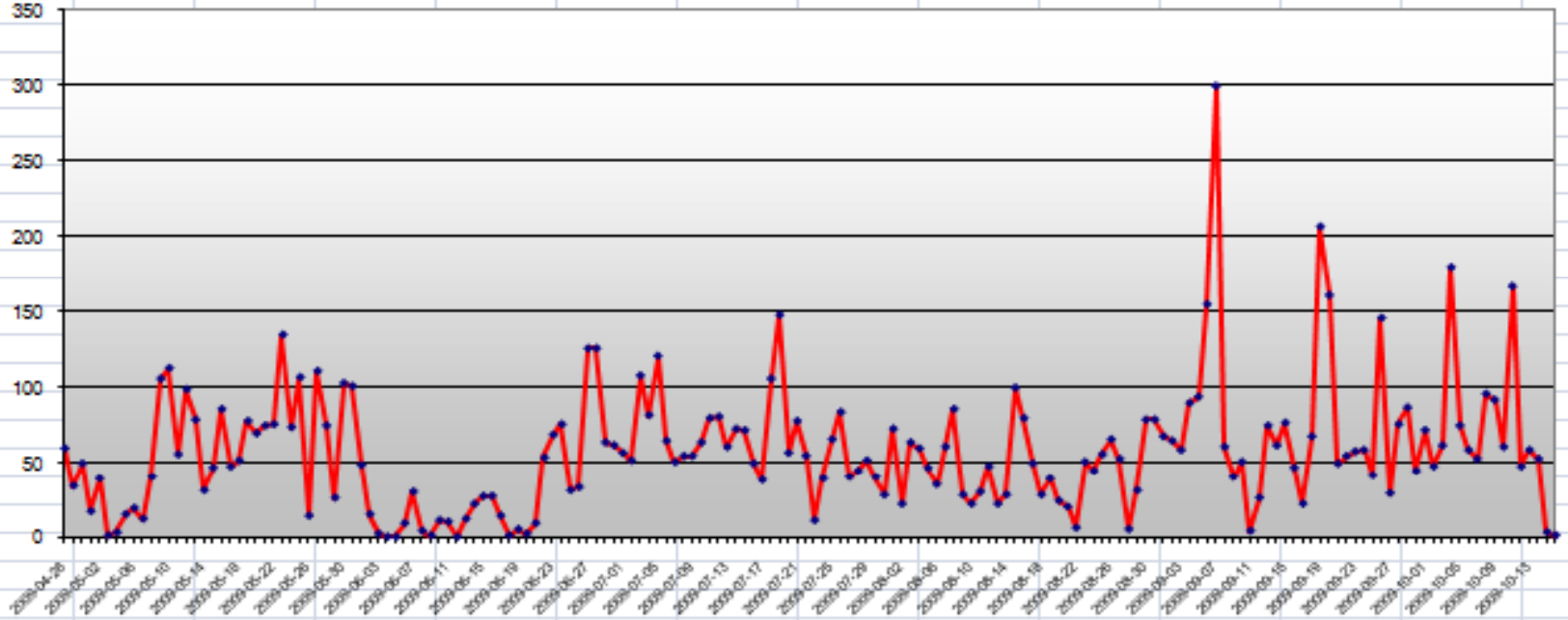
3	Project:		Start:	2009-04-28	Location:		
4	Counter:	judge morris IR 10-16-09	Finish:	2009-10-16	Comment:		



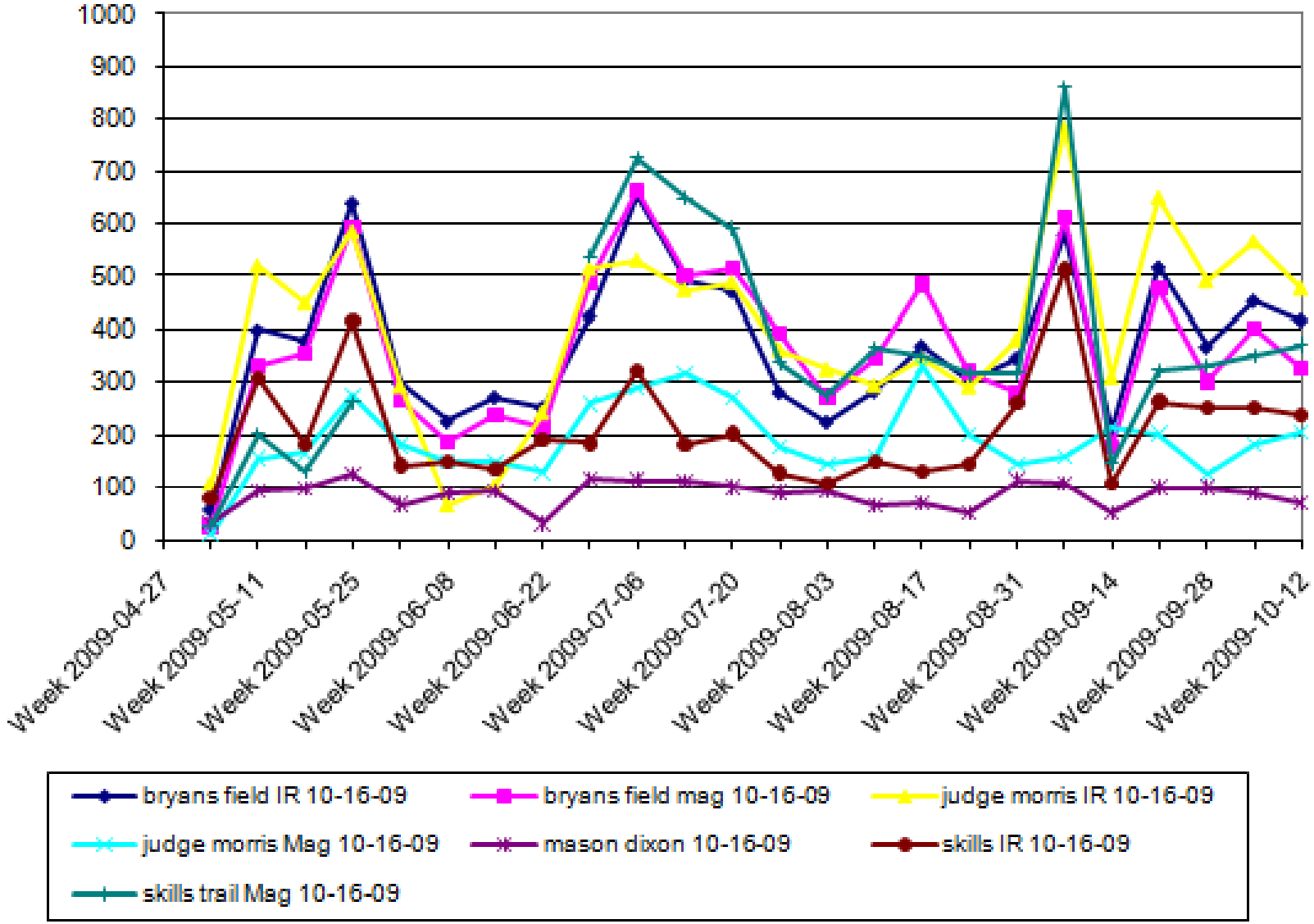
31	**Total Counts:**	**9792**	Daily Mean Weekday:	48.4	Total (1) :		9792
32	**Total Periods:**	**172**	Daily Mean Weekend:	79.1	Total (2) :		0
33	**Period Length:**	**1 day**	Mean Monday	62.1	Percentage (1) :		100.0
34	**Mean:**	**56.9**	Mean Tuesday	52.4	Percentage (2) :		0.0
35	**Mode:**	**22.0**	Mean Wednesday	50.0	Mean (1) :		56.9
36	**Median:**	**52.5**	Mean Thursday	39.1	Mean (2) :		0.0
37	**Standard Deviation:**	**42.0**	Mean Friday	38.8	Max/Min (1) :		299 / 0
38	**Maximum:**	**299**	Mean Saturday	76.1	Max/Min (2) :		0 / 0
39	**Minimum:**	**0**	Mean Sunday	82.0			
40	Total Weekday:	5997					
41	Total Weekend:	3795					
42	Daily Max/Min Weekday:	299 / 0					
43	Daily Max/Min Weekend:	206 / 1					
44							
45	FIVE PEAK PERIODS: 2009-09-07 (299), 2009-09-19 (206), 2009-10-04 (179), 2009-10-11 (166), 2009-09-20 (160)						
46							

judge morris IR 10-16-09 | **judge morris IR 10-16-0-Daily** | bryans field mag 10-16-09

Ready

Weekly Composite Charts

Partial weeks omitted. See manual for details.

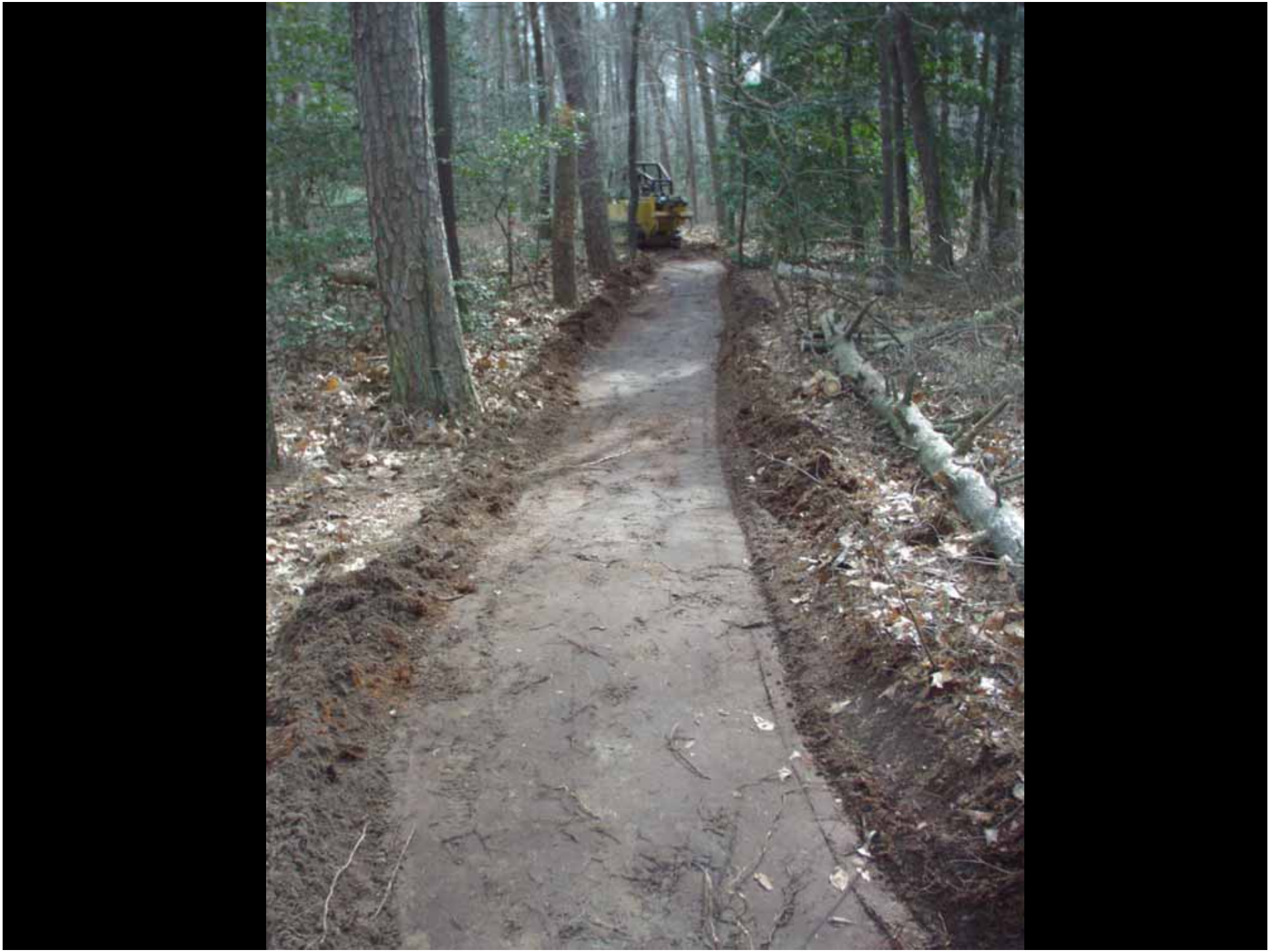


May-Oct. 2009

	Total	Bikers	%	Hikers	%
Judge Morris	9792	4680	48	5112	52
Bryans Field	9052	8894	98	158	2
Skills Trail	6425	4512	70	1913	30
Mason Dixon	2090	0	0	2090	100
Shared Use Only	**25269**	**18086**	**72**	**7183**	**28**
Total	**27359**	**18086**	**66**	**9273**	**34**

Stone Trail Construction

Corridor trench cut below grade



Wet Areas

Goetextile or R4 must be laid down

Stone is brought in using equipment appropriate for the trail width

Tread is compacted

Tread is crowned or outsloped 5-8% to shed water

Recap

- Brief history of trail infrastructure
- Highlight bridge/boardwalk projects
- Helical pile applications and installation
- Alternative decking materials
- Fiberglass bridge construction
- Stone trail construction

Thank You

*Special thanks to volunteers and park staff for their assistance on these and other projects