

Managing Bridge Data using DataHub

Bridging Big Data | Omaha, Nebraska | 30 November 2016

Lucas Laughery and Santiago Pujol

Lyles School of Civil Engineering, Purdue University

Challenges

Hundreds of thousands of bridges

Different decks, superstructures, substructures, sites

Different traffic volumes

Different inspection intervals

Different maintenance histories

...

Large amount of data over time

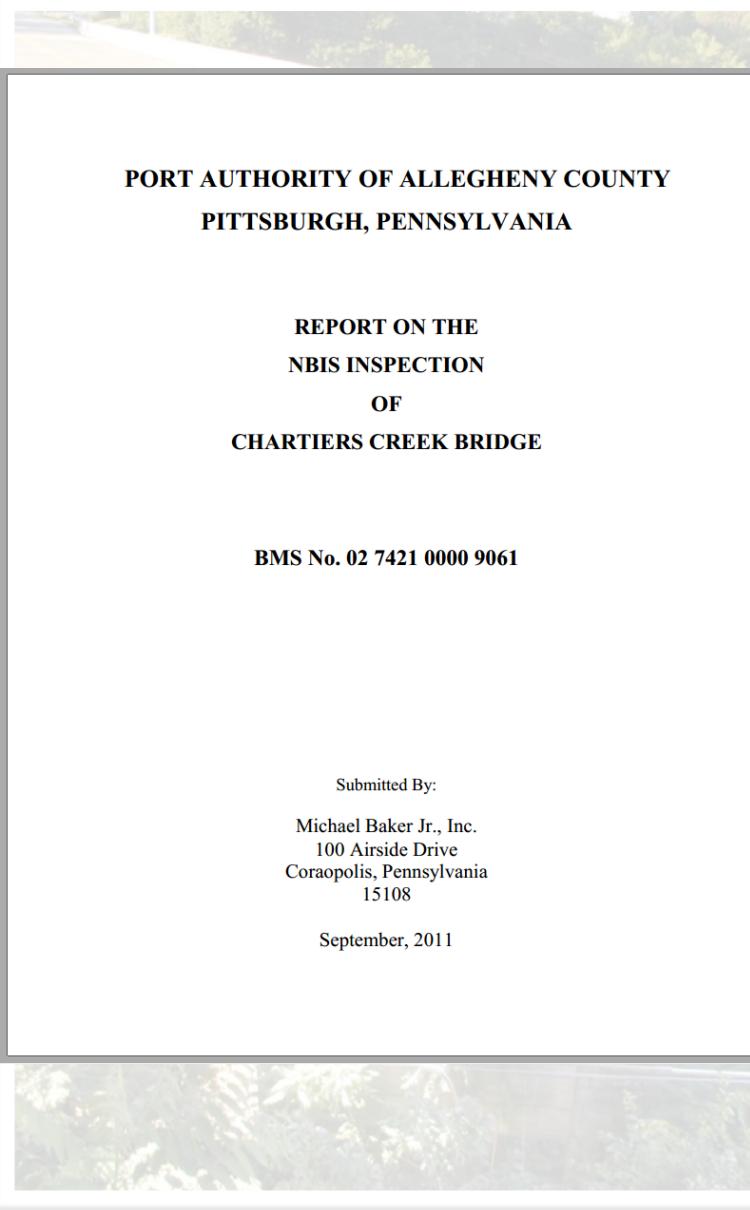
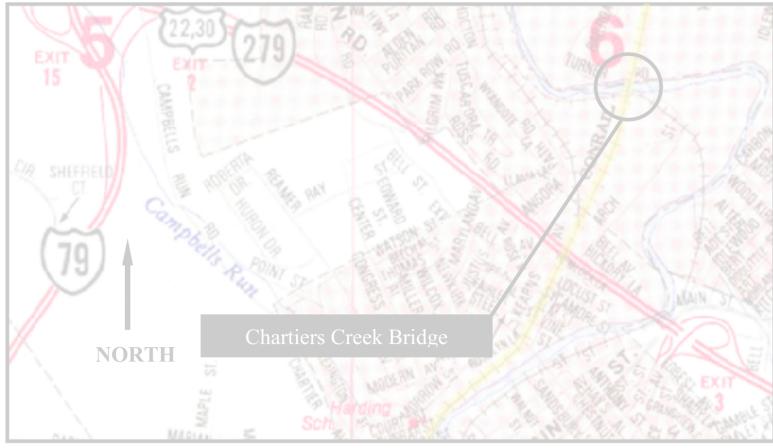
Big Data in a Small Format

317 NKA-MF-00214200000000450000Mirage Flats Canal Lembke Rd
Approx 16 miles
southwest999900051170000000000004228037910252188007302690919900200000502010
50050000000050000000000A1510100000200009990004900010700000005000509990N0000N
000006646N232723274NN487381000000031224N N N
052200000000522002010 0 0 ON3 0000018001501Y8000082030 NY
1 06251

317 NKA-MF-01014100470001610000Mirage Flats Canal 470 Lane
12 miles east-northeast
0999900220430000000000004231001910244005300130269091990020000050201050049000
000005N000000000A1510100000100000490007600007600000004900499990N0000N00000077
67N5327532763N577381000000031224N N N 037200000000372002010
0 0 ON2 0000018001501Y80000102030 NY
2 08552

317 NKA-RW-00214800000001450000Red Willow Canal County Road 720
7.2 miles north east of
M99990000000000000000000000000004015478810030582800132169091955020000005201050062010
00000400000000000A15702000002000005900070000140002002005900629990N0000N00000045
55N2381226354N577 200000031224N N N 000000000000506002010
0 0 ON2 000008700150 Y8000062030 NY
1 07611





PITTSBURGH, PENNSYLVANIA

**REPORT ON THE
NBIS INSPECTION
OF
CHARTERS CREEK BRIDGE**

BMS No. 02 7421 0000 9061

Submitted By

Michael Baker Jr., Inc.
100 Airside Drive
Coraopolis, Pennsylvania
15108

September, 2011

IV. STRUCTURAL ANALYSIS

V. RECOMMENDATIONS AND COST ESTIMATE:

Repairs

Item	Estimated Quantity	Unit Cost	Total Cost
Drain junction boxes, and conduits filled with water. Repair bent conduits, and broken couplers/adapters.	N/A	Lump Sum	\$7,500.00
Paint locations requiring final paint coat between girders 3 & 4 in span 2.	20 SF	Lump Sum	\$1,500.00

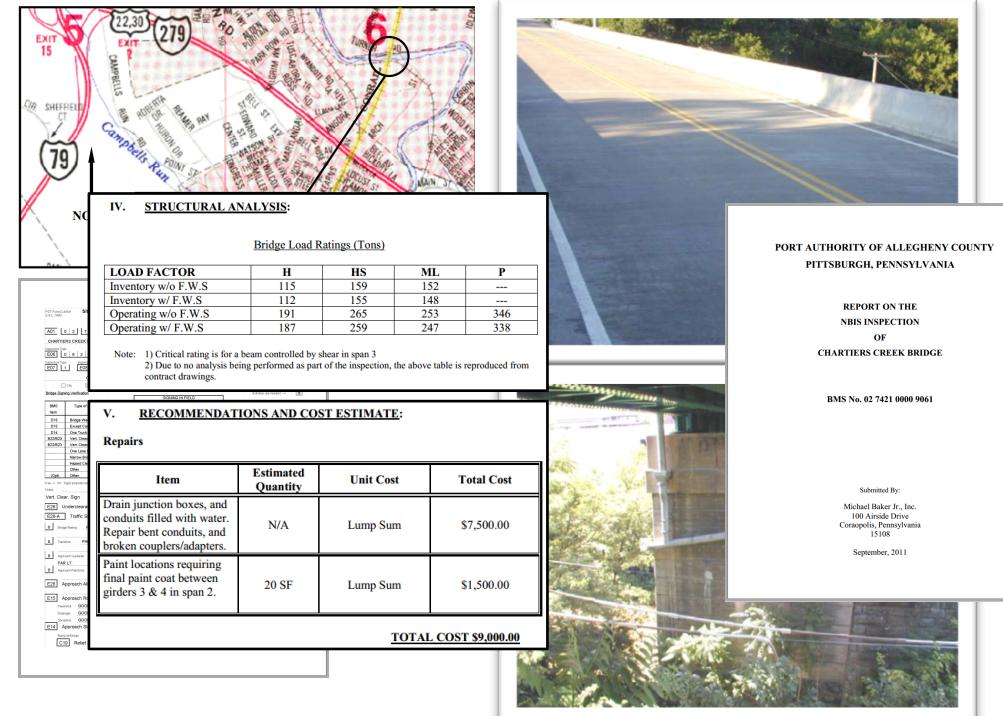
TOTAL COST \$9,000.00

317 NKA-MF-
002142000000004500000Mirage
Flats Canal Lembke Rd

Approx 16 miles
southwest9999000511700000000000
04228037910252188000730269091990
0200000050201050050000000050000
000000A15101000020009990004900
010700000005000509990N0000N0000
006646N232723274NN48738100000003

1224N N N
052200000000522002010 0 0
0N3 0000018001501Y8000082030
NY
1 06251

Information for
Many Bridges
Required by FHWA for NBI.



Files for Each Bridge
Managed by bridge owners.
Different from state-to-state.



datacenterhub.org

How?

- Human-readable organization
- Links
- Parameters
- Exploration tools

How?

- Data are organized in a **table**
- Each **row** corresponds to one **case**
- Each **column** contains information/files for that case
 - **Information** that describes
what, when, where, who?

Use search boxes above columns to filter data [i](#)

Show 10 entries		First	Previous	1	2	3	4	5	Next	Last	Search:
ID	Title	Experiment or Case ID	Keywords	Report(s)		Parameters	Data	Photos, Videos, etc.			
	Search Title	Search Experiment ID	Search Keywords	Search Report(s)	Search Parameters	Search Data	Search Photos, Videos				
8942	I-465 Over I-69 Bridge	I-465, I-69 Intersection IN	I-465 I-69 IN	View 1 report(s)	-	View 4 file(s)	View 3 media				
8943	US-41 White River Bridge	US-41 White River IN	Structural Engineering Steel Bridge Data	View 1 report(s)	-	View 3 file(s)	View 1 media				
8944	US-421 Madison Bridge	US-421 Madison Milton IN	Structural Engineering Steel Bridge Data	View 2 report(s)	-	View 4 file(s)	View 1 media				
8945	Silver Bridge	US-35 Point Pleasant WV	Structural Engineering Steel Bridge Data	-	-	View 2 file(s)	-				
8946	I-95 Yellow Mill Pond Bridge	I-95 Yellow Mill Pond CT	Structural Engineering Steel Bridge Data	-	-	View 4 file(s)	-				
8947	I-91 Quinnipiac River Bridge	I-91 Quinnipiac River CT	Structural Engineering Steel Bridge Data	-	-	View 3 file(s)	View 2 media				
8948	Chicago Dan Ryan Bent Bridge	Chicago CTA Dan Ryan IL	Structural Engineering Steel Bridge Data	-	-	View 4 file(s)	View 1 media				
8949	I-79 Neville Island Bridge	I-79 Neville Island PA	Structural Engineering Steel Bridge Data	-	-	View 4 file(s)	-				

Every column is searchable or interactive.

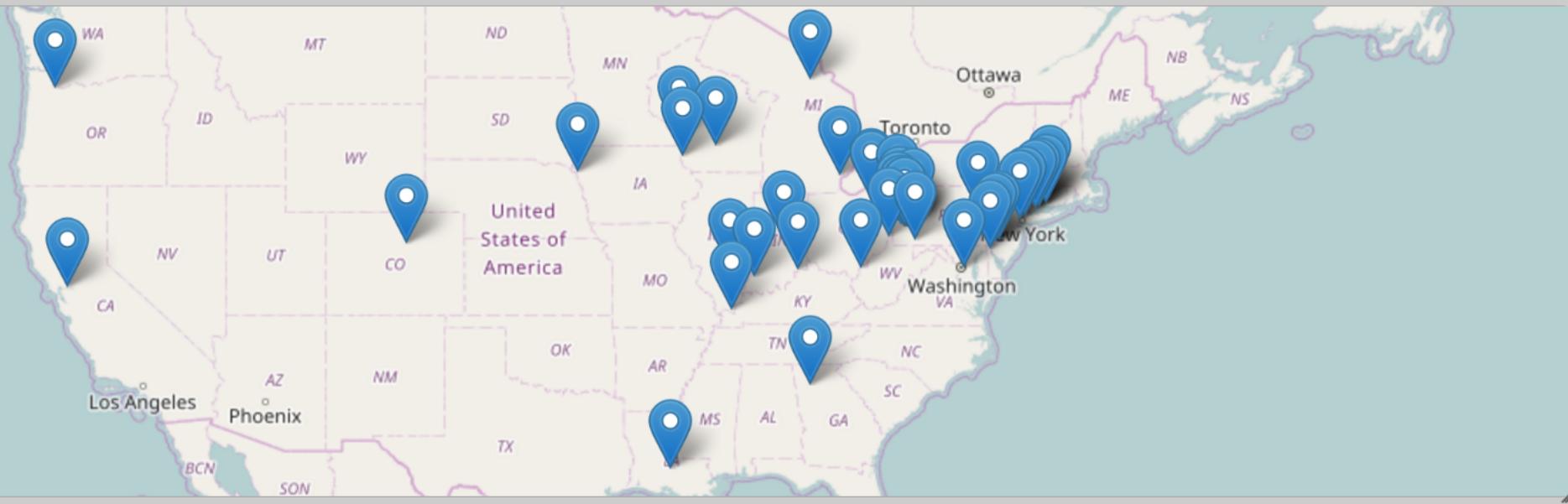
Steel Bridge Database

[Download](#) [Exit Fullscreen](#) [Clear Filters](#) [No-Wrap](#) [Maps](#)

Use search boxes above columns to filter data [i](#)

[Reload Map](#)

[+ KML](#) [+ KMZ](#) [+ SHP](#)



500 km

300 mi

Show 100 ▾ entries

First Previous

1

Next

Last

Search:

Id	Title	Experiment or Case ID	Keywords	Report(s)	Parameters	Data	Photos, Videos, etc.
Search	Search Title <input type="text"/> Search	Search Experiment ID <input type="text"/> Search	Search Keywords <input type="text"/> Search	Search Report(s) <input type="text"/> Search	Search Parameters <input type="text"/> Search	Search Data <input type="text"/> Search	Search Photos, Videos <input type="text"/> Search
8942	I-465 Over I-69 Bridge	I-465, I-69 Intersection IN	Structural Engineering Steel Bridge Data	View 1 report(s) View 1 media	-	View 4 file(s)	View 3 media
8943	US-41 White River Bridge	US-41 White River IN	Structural Engineering Steel Bridge Data	View 1 report(s) View 1 media	-	View 3 file(s)	View 1 media

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 - **File collections** that can be *explored*

Steel Bridge Database

Download Exit Fullscreen Clear Filters No-Wrap Maps

Use search boxes above columns to filter data ⓘ

Show 100 entries

Id

Title

Search

Search Title

8942

I-465 Over I-69 Bridge

8943

US-41 White River Bridge

8944

US-421 Madison Bridge

1 / 3



1 / 2



Photos, etc.

Drawings/Diagrams

Videos

Search Drawings/Diagrams

View 2 drawing(s)

View 4 drawing(s)

View 10 drawing(s)

View 11 drawing(s)

View 3 drawing(s)

View 5 drawing(s)

View 6 drawing(s)

View 2 drawing(s)

Reports Explorer

Fullscreen Clear Filters No-Wrap

Use search boxes above columns to filter data ⓘ

Show 10 entries

First Previous

1

Next Last

Search:

File Id

File Name

File Description

File Date & Time

[yyyy-mm-dd hh:mm:ss]

Classification

Size

[KB]

Search File

Search File Name



13380

Thesis_Final.pdf

2015-03-23 13:18:24

4377.04

13381

Milton Madison Chemistry.PDF

2015-03-23 13:19:09

79.24

Go to Page

1

Milton Madison Tensiles and Chemistry.PDF



From 273 total entries

First

Previous

1

Next

Last

View 3 file(s)

How?

- Data are organized in a **table**
- Each **row** corresponds to one **case**
- Each **column** contains information/files for that case
 - **Information** that describes
what, when, where, who?
 - **File collections** that can be *explored*
 - **Parameters** that surface important data and make them **searchable**

Parameters

317 NKA-MF-
0021420000000004500000Mirage
Flats Canal Lembke Rd
Approx 16 miles
southwest999900051170000000000
0042280379102521880007302690919
90020000050201050050000000050
00000000A1510100002000999000
4900010700000005000509990N0000
N000006646N232723274NN48738100
0000031224N N N
052200000000522002010 0 0
0N3 00000018001501Y80000082030
NY
1 06251

NBI ASCII Files

NBI Record Format

With the conversion to metric and the addition of new items it is required to expand the size of the NBI record to 432 characters. The following format will be used to submit data to the FHWA.

ITEM NO	ITEM NAME	ITEM POSITION	ITEM LENGTH/TYPE
1	State Code	1 - 3	3/N
8	Structure Number	4 - 18	15/AN
5	Inventory Route	19 - 27	9/AN
5A	Record Type	19	1/AN
5B	Route Signing Prefix	20	1/N
5C	Designated Level of Service	21	1/N
5D	Route Number	22 - 26	5/AN
5E	Directional Suffix	27	1/N

Nebraska Bridges, 2014

[Download](#) [Exit Fullscreen](#) [Clear Filters](#) [No-Wrap](#) [Maps](#)

Use search boxes above columns to filter data [i](#)

Show 10 ▾ entries

First Previous 1 2 3 4 5 ... 20 Next Last

Search:

Id	Title	Experiment or Case ID	Keywords	Report(s)	Parameters	Data	Photos, Videos, etc.
Search Id <input type="text"/>	Search Title <input type="text"/>	Search Experiment <input type="text"/>	Search Keywords <input type="text"/>	Search Report(s) <input type="text"/>	Search Parameters <input type="text"/>	Search Data <input type="text"/>	Search Photos, Videos, etc. <input type="text"/>
333333540	Sundown Road at THIRTY-TWO MILE CREEK	C000103430	Concrete continuous Slab	-	NBI Parameters <input type="button" value=""/>	-	-
333333444	IRR BIA RTE 805 at OWL CREEK	000000000000B309	Steel Stringer/Multi-beam or Girder	-	NBI Parameters <input type="button" value=""/>	-	-
333333445	IRR BIA RTE 820 at FOX CREEK	000000000000B312	Concrete continuous Culvert (includes frame and walls)	-	NBI Parameters <input type="button" value=""/>	-	-
333333446	IRR BIA RTE 820 at COON CREEK	000000000000B313	Concrete continuous Culvert (includes frame and walls)	-	NBI Parameters <input type="button" value=""/>	-	-
333333447	IRR BIA RTE 815 at ROYS CREEK	000000000000B314	Prestressed concrete continuous *	-	NBI Parameters <input type="button" value=""/>	-	-
333333448	IRR BIA RTE 820 at DEER CREEK	000000000000B315	Concrete continuous Culvert (includes frame and walls)	-	NBI Parameters <input type="button" value=""/>	-	-
333333449	IRR BIA RTE 809 at FOX CREEK	000000000000B316	Concrete continuous Culvert (includes frame and walls)	-	NBI Parameters <input type="button" value=""/>	-	-
333333484	COUNTY ROAD at LITTLE BLUE RIVER	C000101705	Steel Truss - Thru	-	NBI Parameters <input type="button" value=""/>	-	-

Download Exit Fullscreen Clear Filters No-Wrap

Use search boxes above columns to filter data *i*

Show 10 entries First Previous 1 2 3 4 ... 20 Next Last Search:

Id	Title	Experiment or Case ID	1: State Code	8: Structure Number	5A: Record Type	5B: Route Signing Prefix	5C: Des
Search Id	Search Title	Search Experiment	Search 1: State Code	Search 8: Structure Number	Search 5A: Record Type	Search 5B: Route Signing Prefix	Search 5C: Description
333333401	Lembke Rd at Mirage Flats Canal	NKA-MF-002	317	NKA-MF-002	1		
333333402	470 Lane at Mirage Flats Canal	NKA-MF-010	317	NKA-MF-010	1		
333333403	County Road 720 at Red Willow Canal	NKA-RW-002	317	NKA-RW-002	1		4
333333404	COUNTY RECREATIONA at MEDICINE CREEK DAM SPILL	NKA-FCD-001	317	NKA-FCD-001	1		4
333333405	COUNTY ROAD 44B at TRENTON DAM SPILLWAY	NKA-FCD-002	317	NKA-FCD-002	1		4
333333406	STATE HIGHWAY 61 at ENDERS SPILLWAY	NKA-FCD-003	317	NKA-FCD-003	1		3
333333407	South Rd 828 at Mirdan Canal	NKA-MIR-001	317	NKA-MIR-001	1		4
333333408	Field Access at Cambridge Canal	NKA-CAMB-001	317	NKA-CAMB-001	1		8

Sort average daily traffic: descending

29: Average Daily Traffic		32: Approach Roadway Width	33: Bridge Median	34: Skew	35: Structure Flared
Search 29: Average Daily Traffic					
0	3940				
0	3925				
0	2500				
0	2000				
0	1715				
0	1715	2011	2	91	0
0	1500	2012	5	79	0
0	1350	2011	5	73	0

29: Average Daily Traffic

Average daily traffic (ADT) volume for the identified route. Most recent ADT counts available, including trucks counted in ADTT.

2 3 4 5 ... 20 Next Last

Search:

12TH STREET

999900175260

40354949098281106003302020719350200003940201120

0850000000050000000000A151010000010000086000670

000730000000860086999N0000N000005556N0254018

154N568341000073091224N N N

0000660000060000992012 0 0

ON2

00195016000001Y300394020330000NN

0 04920

?

Filter to show only steel bridges

Files

VERTICAL LIFT BRIDGE		Federal Agency	SR	Material	Construction Type	Report(s)	Data	Photos, Videos, etc.	Drawings/Diagrams	
VERTICAL LIFT BRIDGE	Search Federal Agency	Search	steel	Search Construction	Stringer/Multi-beam or Girder	317C000104105P 1410217500400100000LITTLE BLUE RIVER S. SHOWBOAT BLVD. 13075 S. SHOWBOAT BLVD. 999900237060	Search Report(s)	Search Data	Search Photos, Videos	Search Drawings/Diagrams
0	NN	600	Steel continuous	Stringer/Multi-beam or Girder	4025240009820360000630202071966020000103 02011501100000000050000000000A1540200000					
0	NN	603	Steel	Stringer/Multi-beam or Girder	3000007400338000863005005007400889999N00 00N0000006576N1390123654N588					
0	NN	1000	Steel continuous	Stringer/Multi-beam or Girder	000000101224N N N					
0	NN	1000	Steel	Culvert (includes frame culverts)	00000000000000002012 0 0					
0	NN	195	Steel	Girder and Floorbeam System	0N2 00000011000001Y50007602033000NN 0 06000					
0	NN	645	Steel	Stringer/Multi-beam or Girder						
0	NY	341	Steel	Girder and Floorbeam System						
0	NN	970	Steel	Stringer/Multi-beam or						

317 NKA-MF-
002142000000004500000Mirage
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Approx 16 miles
southwest 9999000511700000000000
04228037910252188000730269091990
0200000050201050050000000050000
000000A15101000020009990004900
010700000005000509990N0000N0000
006646N232723274NN48738100000003
1224N N N
052200000000522002010 0 0
0N3 0000018001501Y8000082030

NY
1 06251



IV. STRUCTURAL ANALYSIS:				
Bridge Load Ratings (Tons)				
LOAD FACTOR	H	HS	ML	P
Inventory w/o F.W.S.	115	159	152	---
Inventory w/ F.W.S.	112	155	148	---
Operating w/o F.W.S.	191	265	253	346
Operating w/ F.W.S.	187	259	247	338

Note: 1) Critical rating is for a beam controlled by shear in span 3
2) Due to no analysis being performed as part of the inspection, the above table is reproduced from contract drawings.

V. RECOMMENDATIONS AND COST ESTIMATE:			
Repairs			
Item	Estimated Quantity	Unit Cost	Total Cost
Drain junction boxes, and conduits filled with water. Repair bent conduits, and broken couplers/adapters.	N/A	Lump Sum	\$7,500.00
Paint locations requiring final paint coat between girders 3 & 4 in span 2.	20 SF	Lump Sum	\$1,500.00
			TOTAL COST \$9,000.00



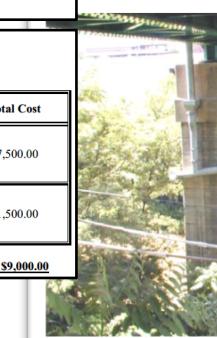
PORT AUTHORITY OF ALLEGHENY COUNTY
PITTSBURGH, PENNSYLVANIA

REPORT ON THE
NBIS INSPECTION
OF
CHARTIERS CREEK BRIDGE

BMS No. 02 7421 0000 9061

Submitted by:
Michael Baker Jr., Inc.
100 Avenue Drive
Corporation, Pennsylvania
15108

September, 2011



Creating

1. Define cases

(one-at-a-time or using spreadsheets)

2. Upload files

(in-browser or server)

3. Define parameters

(using spreadsheets)

An Alternative

Remote site: /db/nees/NEES-2010-0904.groups/Experiment-10/Documentation/Generated_Pics

The screenshot shows a file explorer interface with the following details:

- File Explorer View (Top):** Shows a tree structure of directories:
 - NEES-2010-0904.groups
 - .Generated_Pics
 - Documentation
 - Experiment-1
 - Experiment-10
 - Documentation
 - .Generated_Pics
 - Public
 - Specimen-3283
 - Trial-1
 - Rep-1
 - Converted_Data
 - Corrected_Data
 - Derived_Data
 - Unprocessed_Data
 - Experiment-11
 - Documentation
 - Public
 - Specimen-3284
 - Trial-1
 - Experiment-2
 - Experiment-3
- File List View (Bottom):** Shows a table of files with the following columns: Filename, Filesize, Filetype, Last modified, Permissions, and Owner. The data is as follows:

Filename	Filesize	Filetype	Last modified	Permissions	Owner
..	42,068	PNG File	2014-12-09...	-rwxrwx...	www
display_1674161_Overall.png	69,563	PNG File	2014-12-09...	-rwxrwx...	www
display_1674162_Reinforcement.png	60,014	PNG File	2014-12-09...	-rwxrwx...	www
display_1674163_Strain Gages.png	88,839	PNG File	2014-12-09...	-rwxrwx...	www
display_1674164_Test Setup.png	2,865	PNG File	2014-12-09...	-rwxrwx...	www
thumb_1674161_Overall.png	4,269	PNG File	2014-12-09...	-rwxrwx...	www
thumb_1674162_Reinforcement.png	3,907	PNG File	2014-12-09...	-rwxrwx...	www
thumb_1674163_Strain Gages.png					

- **Organized** differently from owner-to-owner
- Files for each bridge are **disconnected** from parameters
- Exploration & sharing is **more difficult**

DataHub can help you

- **Organize** your bridge health data
- **Annotate** file collections from bridge inspections and **connect** them to the parameters that describe the bridges
- **Explore** and **share** the data easily



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