Alan Buehrig PE
Idaho Transportation Department
alan.buehrig@itd.Idaho.gov

AASHTOWare Load Rating Tool for Automated Permitting

Outline

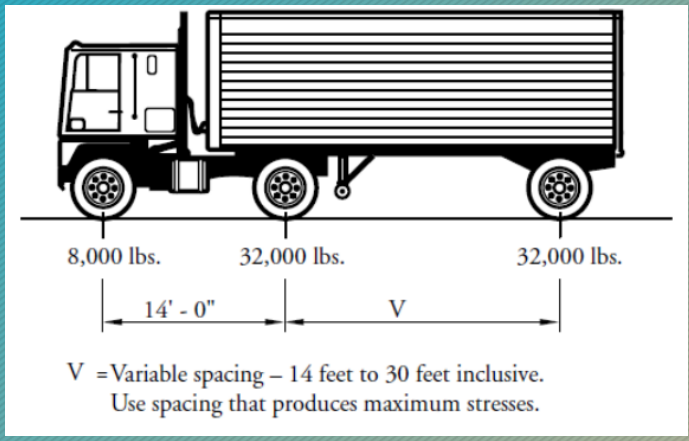
- Idaho Permit Background
- Automated Permitting Types
- BrR Rating Tool
  - Organizing the Data
  - Optimizing the Program
  - Managing the Data
- Idaho Permit Process

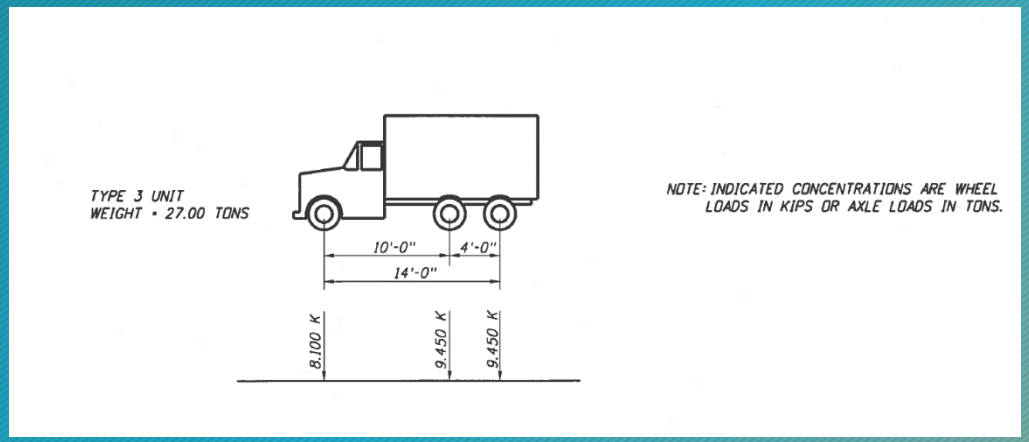
Types of Loads

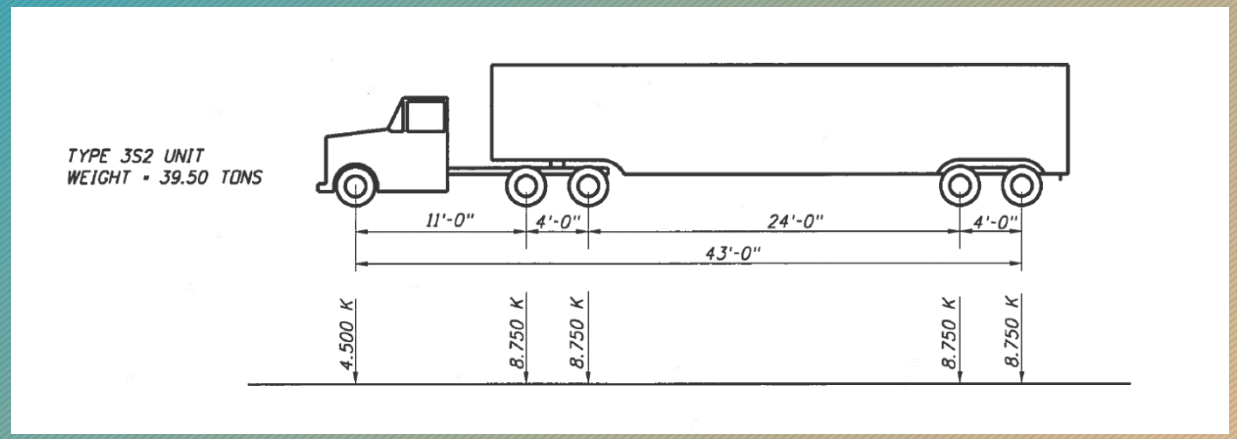
- Legal Loads
- Divisible Over Legal Loads – Annual Permits
- Indivisible Over Legal Loads – Single Trip Permits

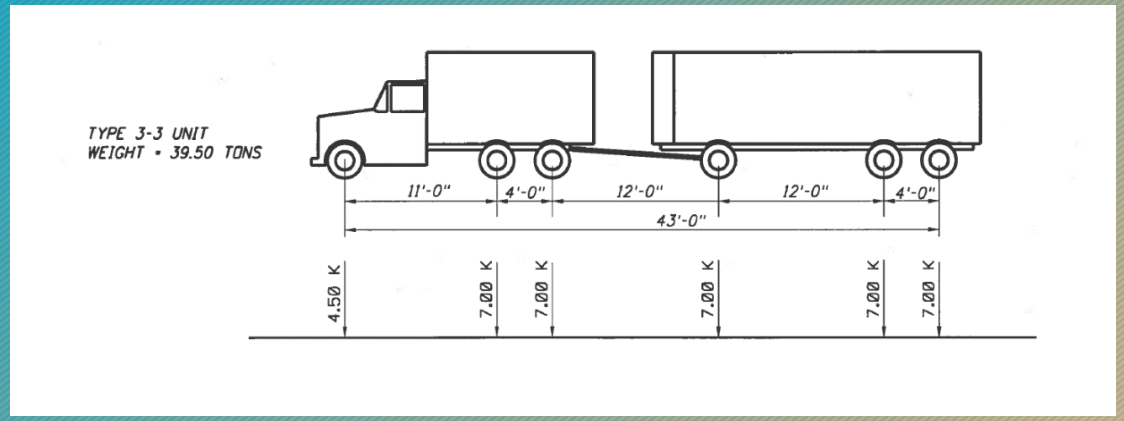
Potential Bridge Loads

Bridge Design and Rating Loads









ITD Over-legal Permitting Journey

Since we built bridge to 1990's:

- **Check heavy trucks over trouble bridges.**

ITD Over-legal Permitting Journey

1990's to 2021 – DMV screens by factor to determine which permits need bridge analysis.

Weekly Average 4 years ago:

- **200 permits.**
- **20 w/bridge analysis.**
- **4 over 250k.**
- **Around 160 models run.**
- **Bridge Hours 60-80 a week.**

ITD Over-legal Permitting Journey

2021- Current. Full bridge analysis and self issue permits takes about 5 minutes.

Current weekly average:

- 450 permits/week
- 48 w/bridge requirements
- 9 over 250k
- Only around 140 per week by bridge
- **Bridge hours 20-30 hours.**

Outline

- Idaho Permit Background
- Automated Permitting Types
- BrR Rating Tool
  - Organizing the Files
  - Optimizing the Program
  - Managing the Data
- Idaho Permit Process

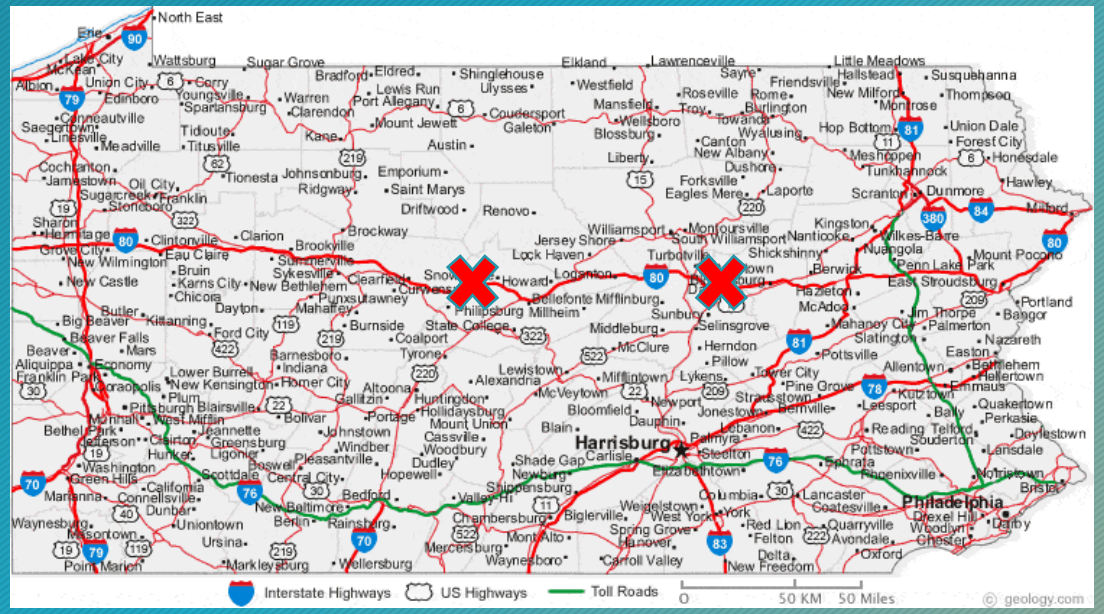
Routing or Rating

Pennsylvania

Idaho

Routing or Rating

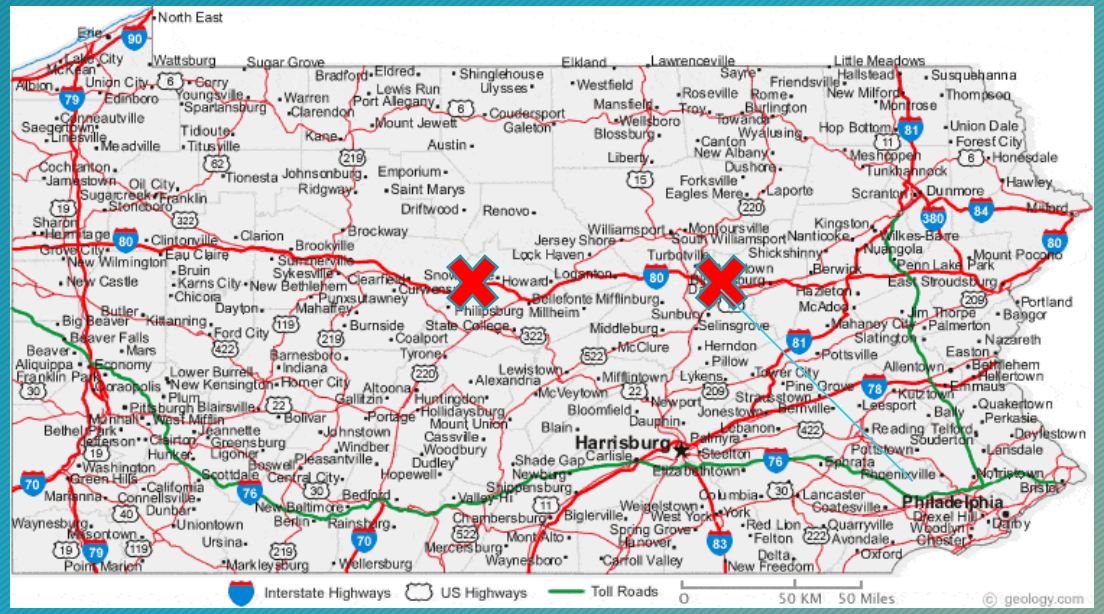
Pennsylvania



Idaho

Routing or Rating

Pennsylvania



Idaho

What type of permitting does your Agency need?

Rule Based

- Faster
- Conservative
- Set it and forget it

Analysis Based

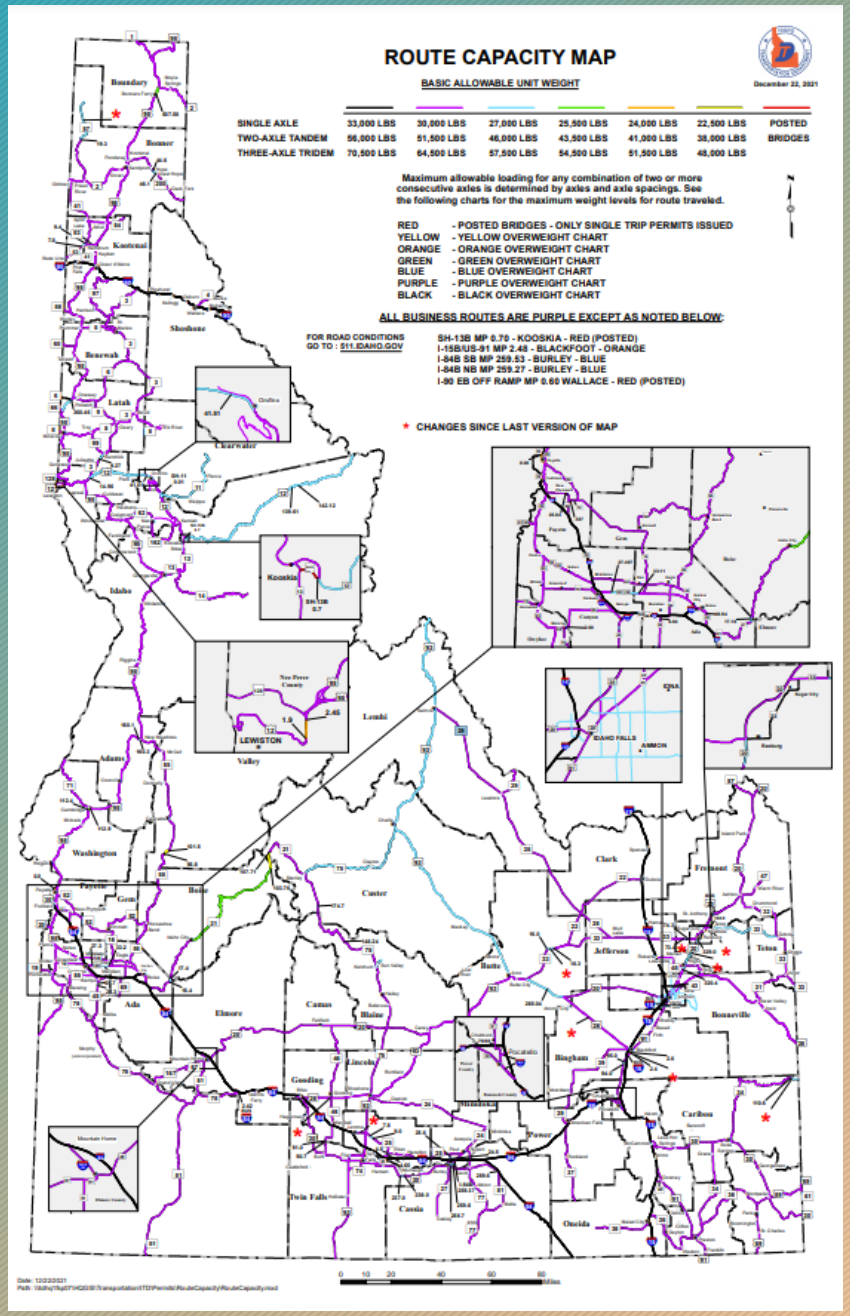
- Slower
- More effort on data
- Less restrictions

ROUTE CAPACITY MAP

BASIC ALLOWABLE UNIT WEIGHT

SINGLE AXLE	33,000 LBS	30,000 LBS	27,000 LBS	25,500 LBS	24,000 LBS	22,500 LBS
TWO-AXLE TANDEM	56,000 LBS	51,500 LBS	46,000 LBS	43,500 LBS	41,000 LBS	38,000 LBS
THREE-AXLE TRIDEM	70,500 LBS	64,500 LBS	57,500 LBS	54,500 LBS	51,500 LBS	48,000 LBS

129 kip Routes



Truck Factors / Bridge Factors

- Quick screening tool for Bridge Capacity and Truck Loads
  - Combines axle weights and spacing
- At ITD the truck factor is based on Federal Formula B

$$w = 500\left(\frac{\ell n}{n-1} + 12n + 36\right)$$

- w = the maximum weight in pounds that can be carried on a group of two or more axles to the nearest 500 pounds (230 kg).
- ℓ = spacing in feet between the outer axles of any two or more consecutive axles.
- n = number of axles being considered.

- Factor developed for all axle groupings use highest

Bridge Factors

Bridge Factor is based on
Rating Factors for Legal trucks

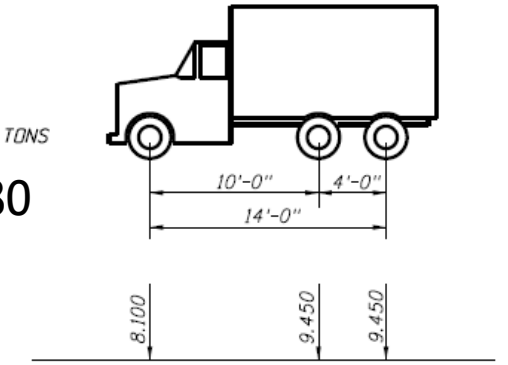
HS-20	Truck	36	U11	Gusset	Fastener Resistance	1.76	63
Idaho - Type 3	Truck	27	U11	Gusset	Fastener Resistance	2.04	55
Idaho - Type 3S2	Truck	39.5	G2 - Int. Gir.	1.5	Flexural - Steel Strength	2.10	83
Idaho - Type 3-3	Truck	39.5	G2 - Int. Gir.	1.5	Flexural - Steel Strength	2.04	81
Idaho - 121k	Truck	60.5	G2 - Int. Gir.	1.5	Flexural - Steel Strength	1.63	99
CALTRANS P13	Truck	157	G2 - Int. Gir.	1.5	Flexural - Steel Strength	0.84	132

2.04 * 580 = 1183
2.10 * 552 = 1159
2.04 * 494 = 1007

Bridge Factor is 1007

TYPE 3 UNIT
WEIGHT = 27.00 TONS

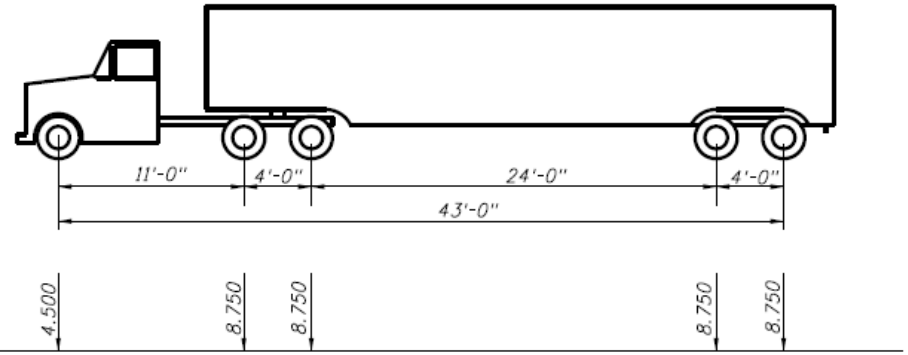
Factor 580



NOTE: INDICATED CONCENTRATIONS ARE WHEEL LOADS IN KIPS OR AXLE LOADS IN TONS.

TYPE 3S2 UNIT
WEIGHT = 39.50 TONS

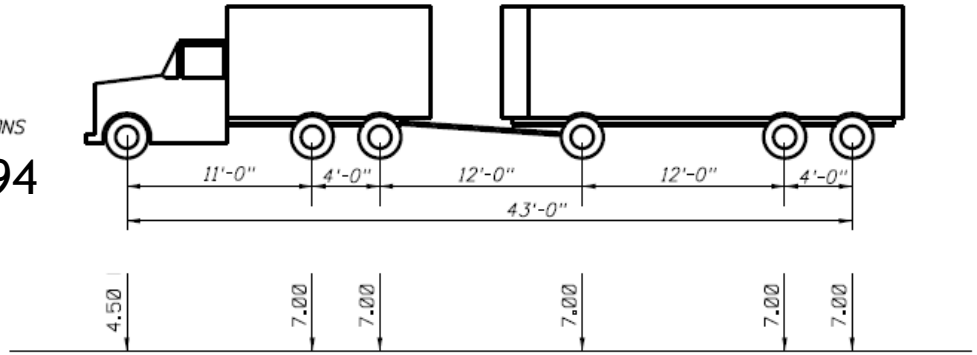
Factor 552



Truck Factors

TYPE 3-3 UNIT
WEIGHT = 39.50 TONS

Factor 494



Outline

- Idaho Permit Background
- Automated Permitting Types
- BrR Rating Tool
  - Organizing the Data
  - Optimizing the Program
  - Managing the Data
- Idaho Permit Process

History of Load Rating Tool

- AASHTOWare BrR
  - Too slow for permitting – ratings take 5+ minutes for each bridge
- Load Rating Tool
  - Uses pre-processed influence lines to quickly determine rating – 100 ratings / second
  - Began upgrade to BrR 10 years ago
  - First included in 6.8.2 with limited capabilities
  - 7.2 includes LRFR

Know Your Inventory

- Bridges not Load Rated in AASHTOWare BrR
  - Tables
  - Rules
  - Excel sheets
  - Engineering Judgement (no plans)

- Bridges Load Rated in AASHTOWare BrR
  - Load Rating Tool
  - LFD Member Alternative
  - LRFR
  - 3D FEM
  - Check out to run

  - Of our bridges only 66 out of 1800 not using the load rating tool

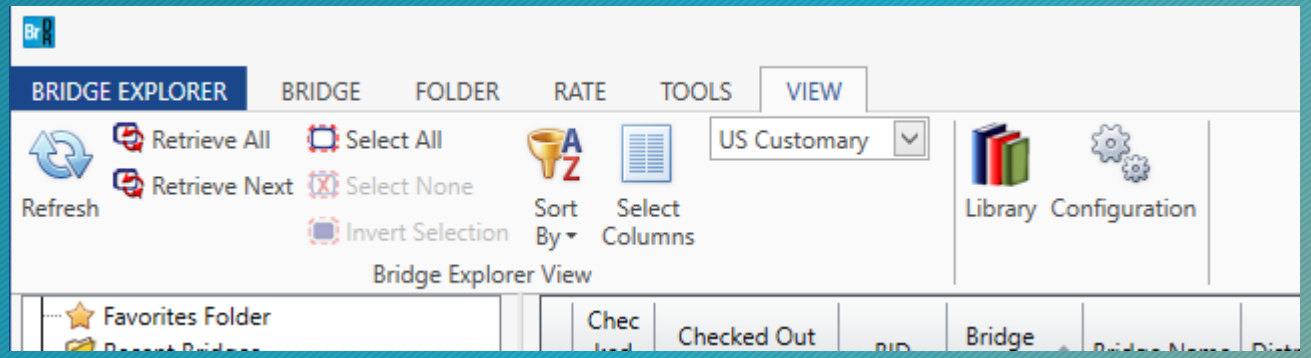
Tables, Rules, Excel, Engineering Judgement

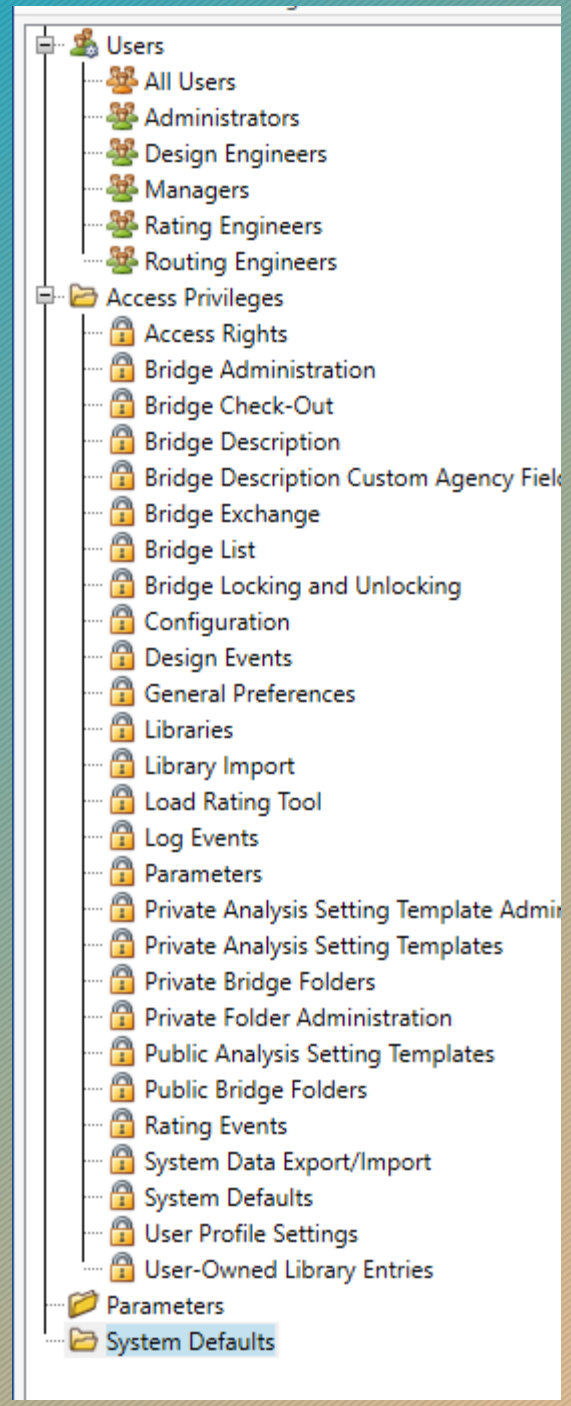
Truck Length (ft)	VW_{none} (kips)	VW_{5mph} (kips)	$VW_{OnlySmphCL}$ (kips)
100	250	250	250
110	250	250	250
120	250	250	272
130	250	250	294
140	250	250	317
150	250	250	340
160	250	250	362
170	250	260	385
180	250	275	408
190	254	291	430
200	267	306	453
210	281	321	475
220	294	337	498
230	307	352	500
240	321	367	500
250	334	382	500

Weight (kips)	Requirement
225 to <250	Slow to 45 mph
250 to <275	Slow to 5 mph
275 to <325	Slow to 5 mph Only vehicle on the bridge in the direction of travel (centered in travelway)
325 to <400	Slow to 5 mph Only vehicle on the bridge in the direction of travel (centered in travelway) Trailer axles must be a minimum of 16 feet wide
400 to <600	Slow to 5 mph Only vehicle on the bridge in the direction of travel (centered in travelway) Only one lane of traffic allowed in the opposing direction Trailer axles must be a minimum of 16 feet wide

18770	
Requirement	Factor
Normal Travel	< 659
45mph	< 700
25mph	< 783
5mph	< 785
OV	< 1009
OV 5 mph	< 1359
Manual	>= 1359

Load Rating Tool Rules





System Defaults ×

General | Bridge workspace | Superstructure analysis | Specifications | Substructure analysis | Tolerance | Custom agency fields | Rating tool

Load rating tool repository: Browse

\\ITDHQ1FSP08\AssetManagement\Load Rating\LR ITD\BrR Prec\D305AE19-0435-4585-BE4D-7622AFAFBE99-7.0.0.3001

Processing order	Code	Description	Pass condition	% impact (%)	One lane restriction
1	1	OK		100.00	☐
2	2	45 mph	45 mph	69.20	☐
3	2	25 mph	25 mph	38.50	☐
4	4	5 mph	5 mph	0.00	☐
5	5	single lane	single lane	100.00	☑
6	6	single lane, 45 mph	single lane, 45 mph	69.20	☑
7	7	single lane, 25 mph	single lane, 25 mph	38.50	☑
8	8	single lane, 5 mph	single lane, 5 mph	0.00	☑

Load Rating Tool

Permit application number:

Application date: 3/13/2022

Requested by:

Minimum allowable rating factor: 1.00

Comment:

Bridges | Vehicles | Rating results

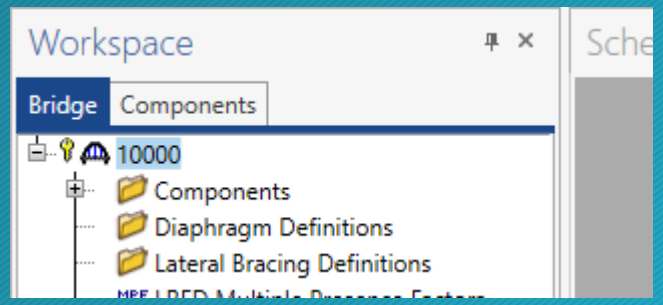
Filter results: Pass Fail Exceptions

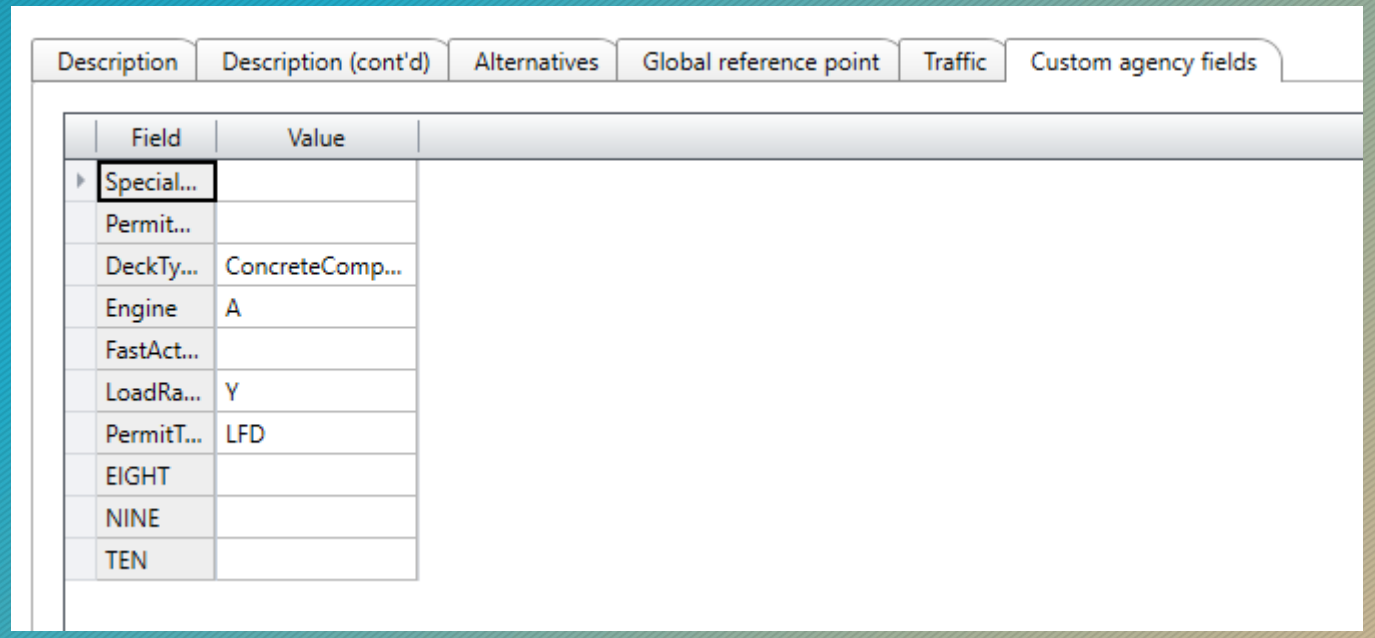
Vehicle	Rating level	BID	Bridge ID	Route number	Code	Description	Inventory rating factor	Operating rating factor	Controlling impact	Pass conditions	Analysis warnings
240k Test Truck (Do not dele...	Oper...	1740	15790_o...	00084	1	OK	0.759	1.267	1.000		
240k Test Truck (Do not dele...	Oper...	1741	15795_o...	00084	1	OK	0.803	1.342	1.000		
240k Test Truck (Do not dele...	Oper...	1825	26220	00000	1	OK	1.645	2.748	1.000		
240k Test Truck (Do not dele...	Oper...	1858	33435	00000	1	OK	1.330	2.221	1.000		
240k Test Truck (Do not dele...	Oper...	1916	26261	00000	1	OK	1.119	1.873	1.000		
240k Test Truck (Do not dele...	Oper...	1917	26280	00055	1	OK	0.734	1.604	1.000		
240k Test Truck (Do not dele...	Oper...	1930	21600	07433		Denied	0.575	0.959	1.000		
240k Test Truck (Do not dele...	Oper...	1930	21600	07433	2	45 mph	0.619	1.032	0.692	45 mph	
240k Test Truck (Do not dele...	Oper...	2061	33415	07023		Denied	0.502	0.839	1.000		
240k Test Truck (Do not dele...	Oper...	2061	33415	07023		Denied	0.541	0.903	0.692		
240k Test Truck (Do not dele...	Oper...	2061	33415	07023		Denied	0.585	0.978	0.385		
240k Test Truck (Do not dele...	Oper...	2061	33415	07023	4	5 mph	0.653	1.091	0.000	5 mph	
240k Test Truck (Do not dele...	Oper...	2063	34015	00016	1	OK	0.709	1.296	1.000		
240k Test Truck (Do not dele...	Oper...	2125	21451	07553	1	OK	7.058	11.786	1.000		
240k Test Truck (Do not dele...	Oper...	2130	25866	00000	1	OK	1.325	2.212	1.000		
240k Test Truck (Do not dele...	Oper...	2168	25876	00000	1	OK	1.339	2.237	1.000		
240k Test Truck (Do not dele...	Oper...	2172	25836	09273	1	OK	1.408	2.351	1.000		
240k Test Truck (Do not dele...	Oper...	2175	34020	00016	1	OK	0.882	1.472	1.000		

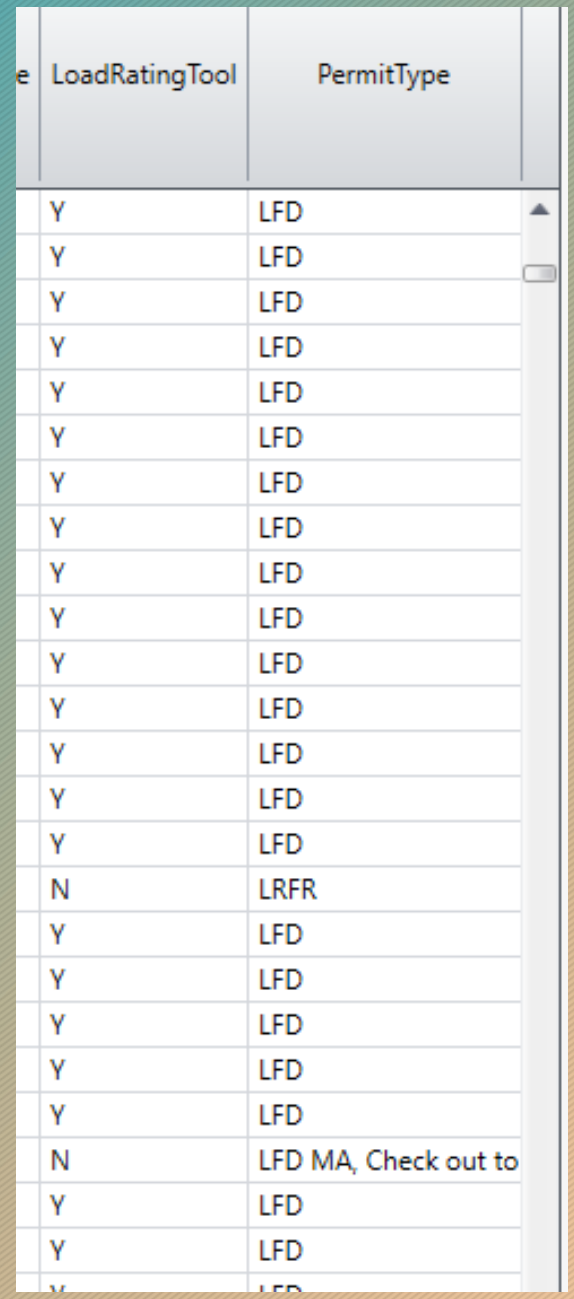
Create rating results file... View rating results file...

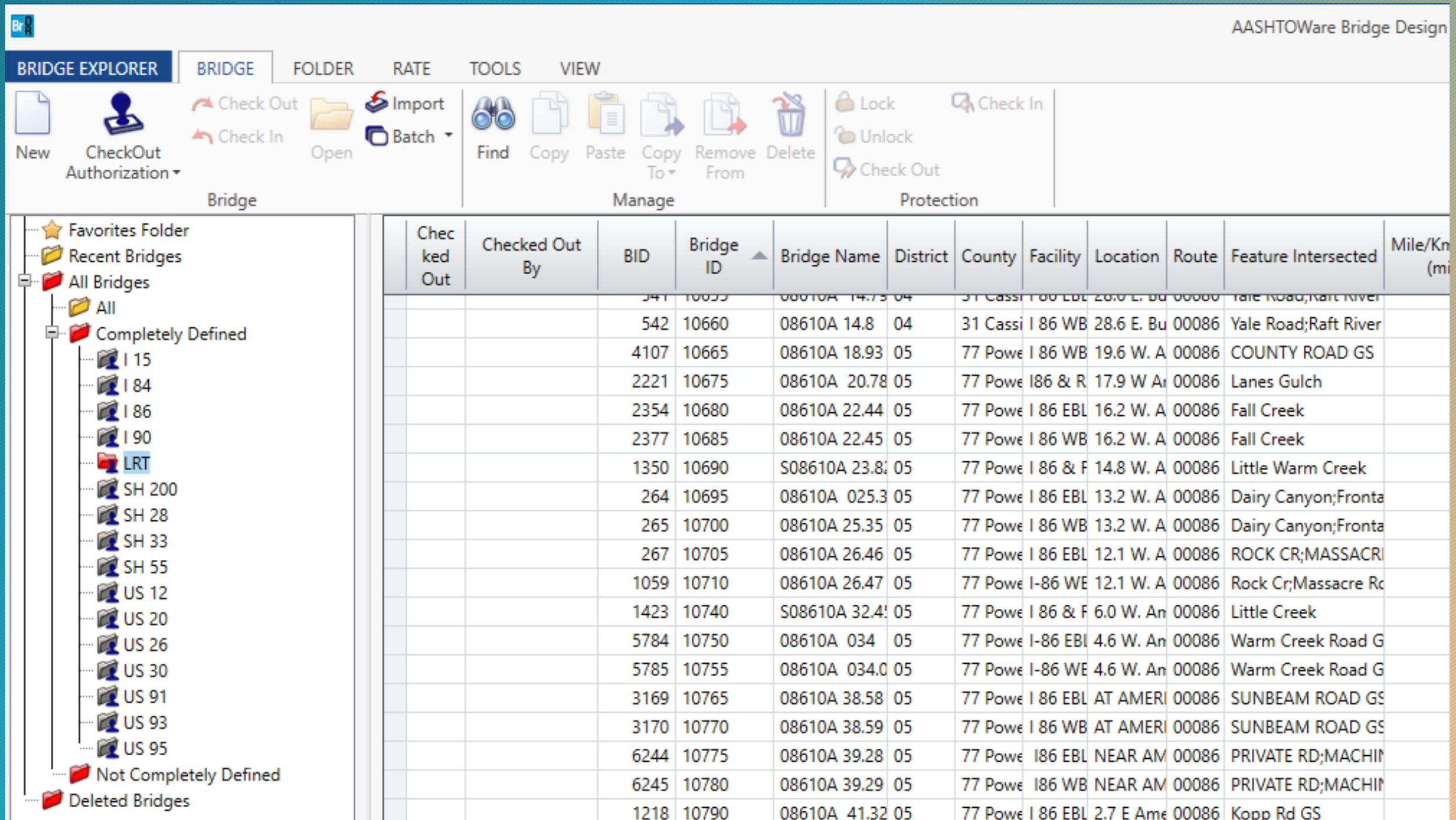
Close

Managing Data





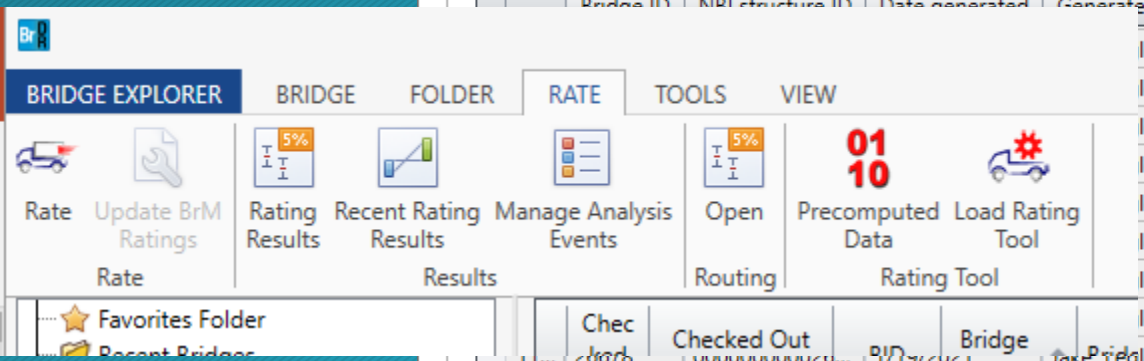



AASHTOWare Bridge Design
BRIDGE EXPLORER
BRIDGE
FOLDER
RATE
TOOLS
VIEW
New
CheckOut Authorization
Check Out
Check In
Open
Import
Batch
Bridge
Find
Copy
Paste
Copy To
Remove From
Delete
Manage
Lock
Unlock
Check Out
Check In
Protection
Favorites Folder
Recent Bridges
All Bridges
All
Completely Defined
I 15
I 84
I 86
I 90
LRT
SH 200
SH 28
SH 33
SH 55
US 12
US 20
US 26
US 30
US 91
US 93
US 95
Not Completely Defined
Deleted Bridges
Checked Out
Checked Out By
BID
Bridge ID
Bridge Name
District
County
Facility
Location
Route
Feature Intersected
Mile/Km (mi
542 10660 08610A 14.8 04 31 Cassi I 86 WB 28.6 E. Bu 00086 Yale Road;Raft River
4107 10665 08610A 18.93 05 77 Powe I 86 WB 19.6 W. A 00086 COUNTY ROAD GS
2221 10675 08610A 20.78 05 77 Powe I86 & R 17.9 W Ar 00086 Lanes Gulch
2354 10680 08610A 22.44 05 77 Powe I 86 EBL 16.2 W. A 00086 Fall Creek
2377 10685 08610A 22.45 05 77 Powe I 86 WB 16.2 W. A 00086 Fall Creek
1350 10690 S08610A 23.8 05 77 Powe I 86 & F 14.8 W. A 00086 Little Warm Creek
264 10695 08610A 025.3 05 77 Powe I 86 EBL 13.2 W. A 00086 Dairy Canyon;Fronta
265 10700 08610A 25.35 05 77 Powe I 86 WB 13.2 W. A 00086 Dairy Canyon;Fronta
267 10705 08610A 26.46 05 77 Powe I 86 EBL 12.1 W. A 00086 ROCK CR;MASSACRI
1059 10710 08610A 26.47 05 77 Powe I-86 WE 12.1 W. A 00086 Rock Cr;Massacre Rc
1423 10740 S08610A 32.4 05 77 Powe I 86 & F 6.0 W. An 00086 Little Creek
5784 10750 08610A 034 05 77 Powe I-86 EBL 4.6 W. An 00086 Warm Creek Road G
5785 10755 08610A 034.0 05 77 Powe I-86 WE 4.6 W. An 00086 Warm Creek Road G
3169 10765 08610A 38.58 05 77 Powe I 86 EBL AT AMERI 00086 SUNBEAM ROAD GS
3170 10770 08610A 38.59 05 77 Powe I 86 WB AT AMERI 00086 SUNBEAM ROAD GS
6244 10775 08610A 39.28 05 77 Powe I86 EBL NEAR AM 00086 PRIVATE RD;MACHIN
6245 10780 08610A 39.29 05 77 Powe I86 WB NEAR AM 00086 PRIVATE RD;MACHIN
1218 10790 08610A 41.32 05 77 Powe I 86 EBL 2.7 E Ame 00086 Kopp Rd GS

Managing Load Rating Tool Files / Data

We review Load Rating Tool files monthly

- Create for new structures
- Update for changed structures
- Delete for structures no longer in inventory



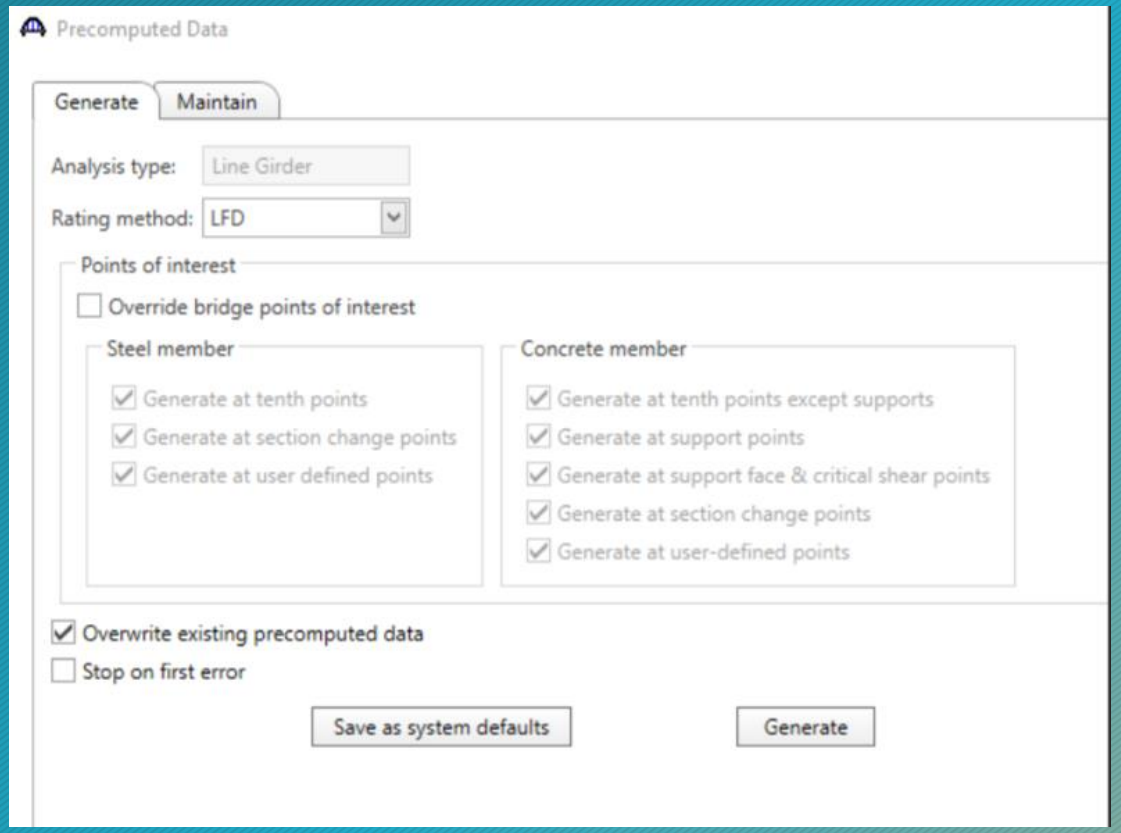
Precomputed Data

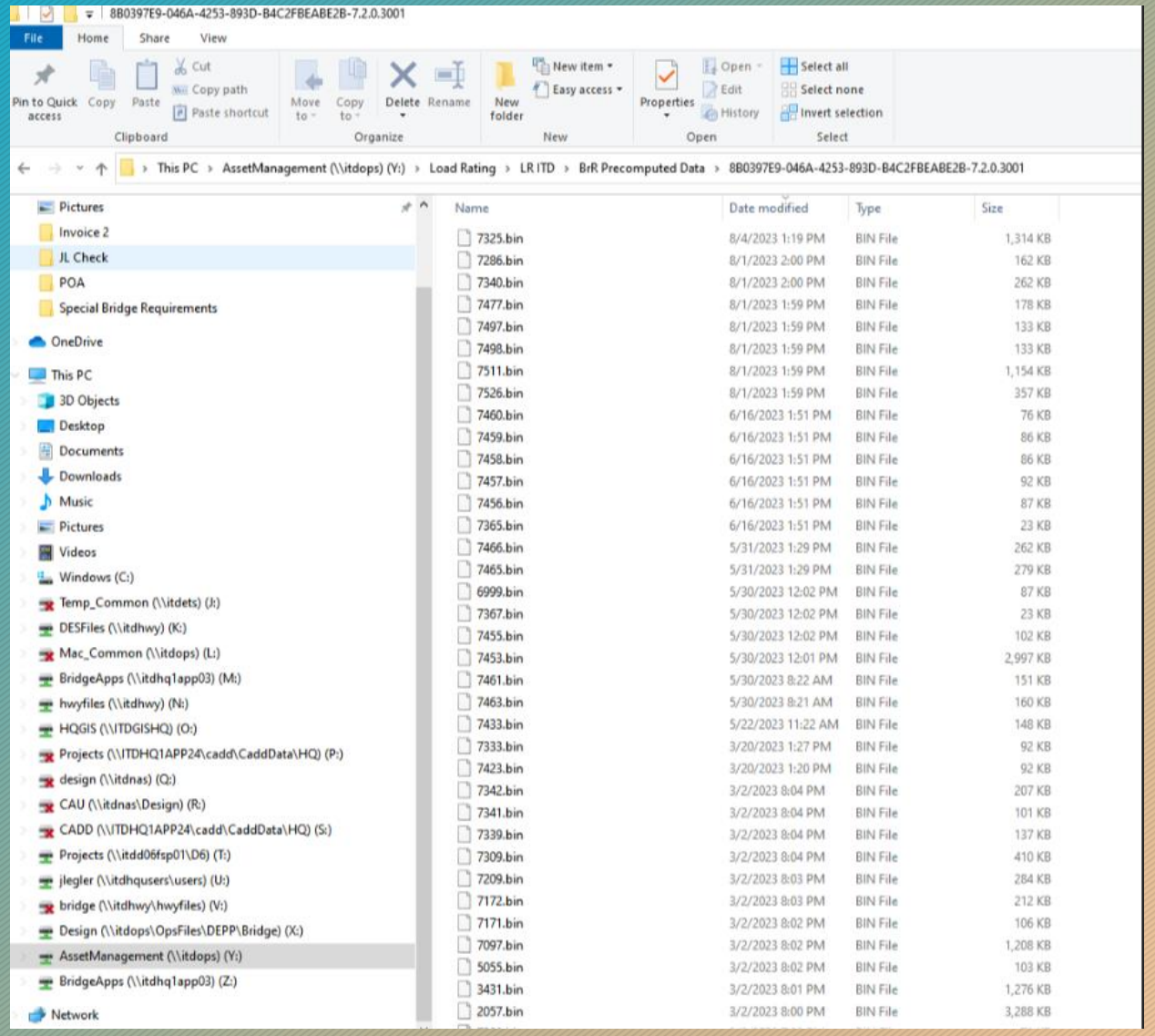
Generate | Maintain

BID	Precomputed data				Bridge database				Select
	Bridge ID	NBI structure ID	Date generated	Generated by	Bridge ID	NBI structure ID	Date last modified	Last modified by	
				ler	18670	000000000018...	2/7/2018	Tisha Hyde	☐
				ler	18675	000000000018...	2/25/2019	Anthony Beauc...	☐
				ler	18735	000000000018...	7/13/2017	Tisha Hyde	☐
				ler	12930	000000000012...	9/4/2017	Tisha Hyde	☐
				ler	12920	000000000012...	2/26/2019	Anthony Beauc...	☐
				ler	12925	000000000012...	1/17/2017	Tisha Hyde	☐
				ler	17690	000000000017...	7/6/2017	Tisha Hyde	☐
				ler	18300	000000000018...	4/15/2019	Tyler Haney	☐
				ler	26678	000000000026...	2/4/2018	Tisha Hyde	☐
11...	29586	000000000029...	1/19/2021	Jake Legler	29586	000000000029...	2/4/2018	Tisha Hyde	☐
11...	31258	000000000031...	1/19/2021	Jake Legler	31258	000000000031...	7/7/2017	Tisha Hyde	☐
11...	10396	000000000010...	1/19/2021	Jake Legler	10396	000000000010...	2/10/2018	Tisha Hyde	☐
11...	13485	000000000013...	1/19/2021	Jake Legler	13485	000000000013...	3/3/2021	Tyler Haney	☑
11...	11050	000000011050	1/19/2021	Jake Legler	11050	000000011050	3/29/2019	Anthony Beauc...	☐
11...	11055	000000011055	1/19/2021	Jake Legler	11055	000000011055	3/29/2019	Anthony Beauc...	☐
11...	11160	000000011160	1/19/2021	Jake Legler	11160	000000011160	6/16/2017	Tisha Hyde	☐
11...	11185	000000000011...	1/19/2021	Jake Legler	11185	000000000011...	2/25/2019	Anthony Beauc...	☐
11...	11190	000000000011...	1/19/2021	Jake Legler	11190	000000000011...	6/25/2017	Tisha Hyde	☐
11...	15680	000000000015...	1/19/2021	Jake Legler	15680	000000000015...	2/26/2019	Anthony Beauc...	☐
11...	15805	000000000015...	1/19/2021	Jake Legler	15805	000000000015...	3/9/2018	Tyler Haney	☐
11...	16520	000000000016...	1/19/2021	Jake Legler	16520	000000000016...	1/31/2014	Tisha Hyde	☐
11...	16525	000000000016...	1/19/2021	Jake Legler	16525	000000000016...	1/31/2014	Tisha Hyde	☐
11...	16865	000000000016...	1/19/2021	Jake Legler	16865	000000000016...	2/10/2018	Tisha Hyde	☐
11...	16870	000000000016...	1/19/2021	Jake Legler	16870	000000000016...	2/10/2018	Tisha Hyde	☐
11...	16920	000000000016...	1/19/2021	Jake Legler	16920	000000000016...	2/10/2018	Tisha Hyde	☐
11...	16925	000000000016...	1/19/2021	Jake Legler	16925	000000000016...	2/10/2018	Tisha Hyde	☐

Select All | Select Outdated | Select Not Found | Clear Selected | Update Selected | Delete Selected

Close


Precomputed Data
Generate
Maintain
Analysis type:
Line Girder
Rating method:
LFD
Points of interest
Override bridge points of interest
Steel member
Generate at tenth points
Generate at section change points
Generate at user defined points
Concrete member
Generate at tenth points except supports
Generate at support points
Generate at support face & critical shear points
Generate at section change points
Generate at user-defined points
Overwrite existing precomputed data
Stop on first error
Save as system defaults
Generate


8B0397E9-046A-4253-893D-B4C2FBEABE2B-7.2.0.3001
File
Home
Share
View
Pin to Quick access
Copy
Paste
Cut
Copy path
Paste shortcut
Clipboard
Move to
Copy to
Delete
Rename
Organize
New folder
New item
Easy access
New
Properties
Open
Edit
History
Open
Select all
Select none
Invert selection
Select
This PC › AssetManagement (\\itdops) (Y:) › Load Rating › LR ITD › BrR Precomputed Data › 8B0397E9-046A-4253-893D-B4C2FBEABE2B-7.2.0.3001
Pictures
Invoice 2
JL Check
POA
Special Bridge Requirements
OneDrive
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Windows (C:)
Temp_Common (\\itdets) (J:)
DESFiles (\\itdhwy) (K:)
Mac_Common (\\itdops) (L:)
BridgeApps (\\itdhq1app03) (M:)
hwyfiles (\\itdhwy) (N:)
HQGIS (\\ITDGISHQ) (O:)
Projects (\\ITDHQ1APP24\cadd\CaddData\HQ) (P:)
design (\\itdnas) (Q:)
CAU (\\itdnas\Design) (R:)
CADD (\\ITDHQ1APP24\cadd\CaddData\HQ) (S:)
Projects (\\itdd06fsp01\D6) (T:)
jlegler (\\itdhqusers\users) (U:)
bridge (\\itdhwy\hwyfiles) (V:)
Design (\\itdops\OpsFiles\DEPP\Bridge) (X:)
AssetManagement (\\itdops) (Y:)
BridgeApps (\\itdhq1app03) (Z:)
Network
Name
Date modified
Type
Size
7325.bin 8/4/2023 1:19 PM BIN File 1,314 KB
7286.bin 8/1/2023 2:00 PM BIN File 162 KB
7340.bin 8/1/2023 2:00 PM BIN File 262 KB
7477.bin 8/1/2023 1:59 PM BIN File 178 KB
7497.bin 8/1/2023 1:59 PM BIN File 133 KB
7498.bin 8/1/2023 1:59 PM BIN File 133 KB
7511.bin 8/1/2023 1:59 PM BIN File 1,154 KB
7526.bin 8/1/2023 1:59 PM BIN File 357 KB
7460.bin 6/16/2023 1:51 PM BIN File 76 KB
7459.bin 6/16/2023 1:51 PM BIN File 86 KB
7458.bin 6/16/2023 1:51 PM BIN File 86 KB
7457.bin 6/16/2023 1:51 PM BIN File 92 KB
7456.bin 6/16/2023 1:51 PM BIN File 87 KB
7365.bin 6/16/2023 1:51 PM BIN File 23 KB
7466.bin 5/31/2023 1:29 PM BIN File 262 KB
7465.bin 5/31/2023 1:29 PM BIN File 279 KB
6999.bin 5/30/2023 12:02 PM BIN File 87 KB
7367.bin 5/30/2023 12:02 PM BIN File 23 KB
7455.bin 5/30/2023 12:02 PM BIN File 102 KB
7453.bin 5/30/2023 12:01 PM BIN File 2,997 KB
7461.bin 5/30/2023 8:22 AM BIN File 151 KB
7463.bin 5/30/2023 8:21 AM BIN File 160 KB
7433.bin 5/22/2023 11:22 AM BIN File 148 KB
7333.bin 3/20/2023 1:27 PM BIN File 92 KB
7423.bin 3/20/2023 1:20 PM BIN File 92 KB
7342.bin 3/2/2023 8:04 PM BIN File 207 KB
7341.bin 3/2/2023 8:04 PM BIN File 101 KB
7339.bin 3/2/2023 8:04 PM BIN File 137 KB
7309.bin 3/2/2023 8:04 PM BIN File 410 KB
7209.bin 3/2/2023 8:03 PM BIN File 284 KB
7172.bin 3/2/2023 8:03 PM BIN File 212 KB
7171.bin 3/2/2023 8:02 PM BIN File 106 KB
7097.bin 3/2/2023 8:02 PM BIN File 1,208 KB
5055.bin 3/2/2023 8:02 PM BIN File 103 KB
3431.bin 3/2/2023 8:01 PM BIN File 1,276 KB
2057.bin 3/2/2023 8:00 PM BIN File 3,288 KB

Data Updates

- ITD updates bridge and load rating information quarterly
  - Backup of BrR database
  - Zip file of Load Rating Tool files
  - Spreadsheet with inventory information
- Able to make emergency changes via 511 restrictions system
- Can update bridge models and inventory information in between but testing is cumbersome

Data Testing

- 1) 121k Test – Run the 121k Truck over all State bridges through system. Match rating method and Operating Rating result.
- 2) 240k Test – Run the 240k Truck over all State bridges through system. Match speed and lane requirements
- 3) Side by Side (QA) - Run permits manually and make sure they match bridges on route, ratings, and requirements.

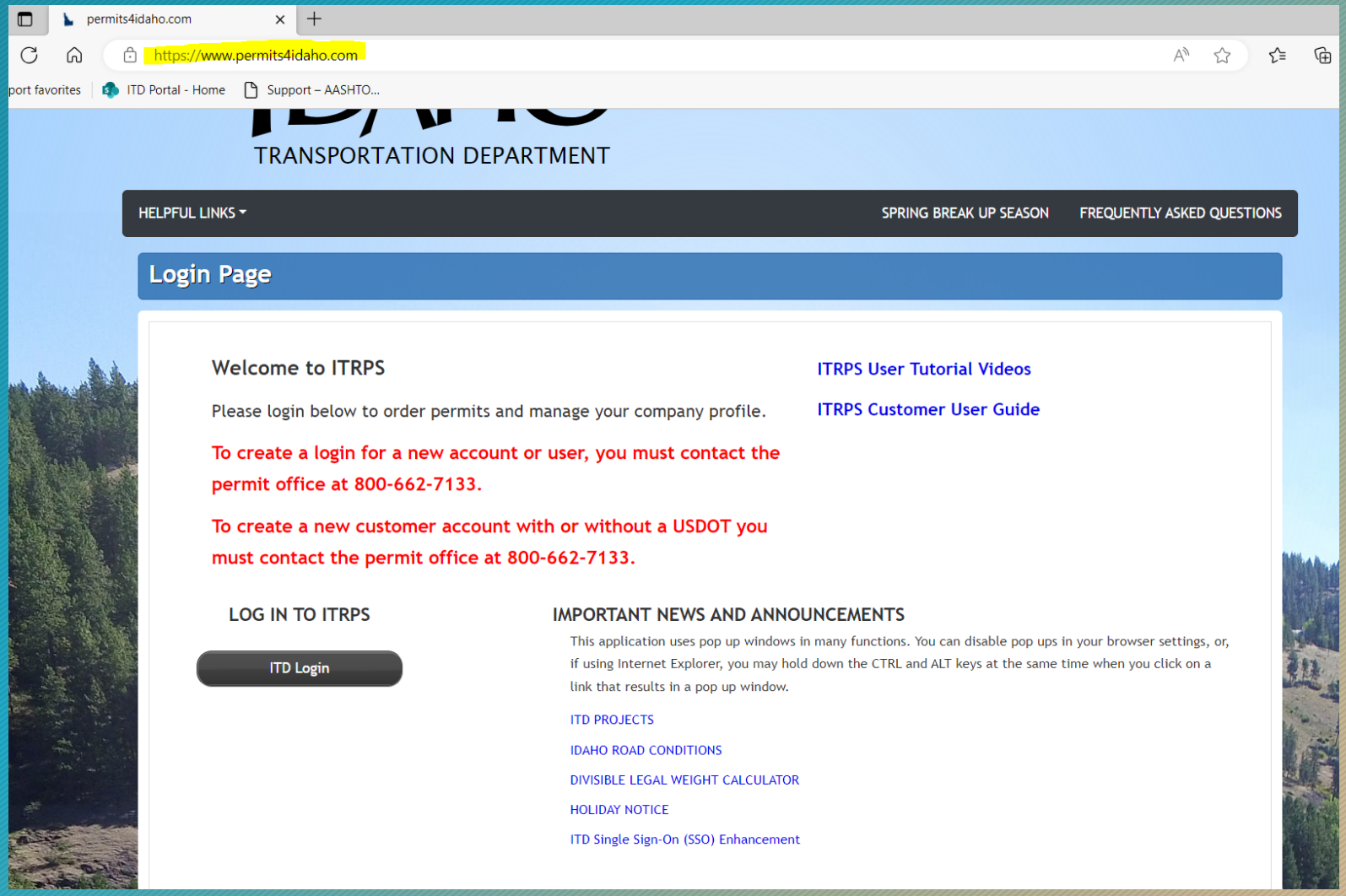
System Monitoring

- Real Time monitoring for error bridges. Bridge where results are expected but system returns none.
- Monitoring of Failed and Manual results for bridges that are causing problems

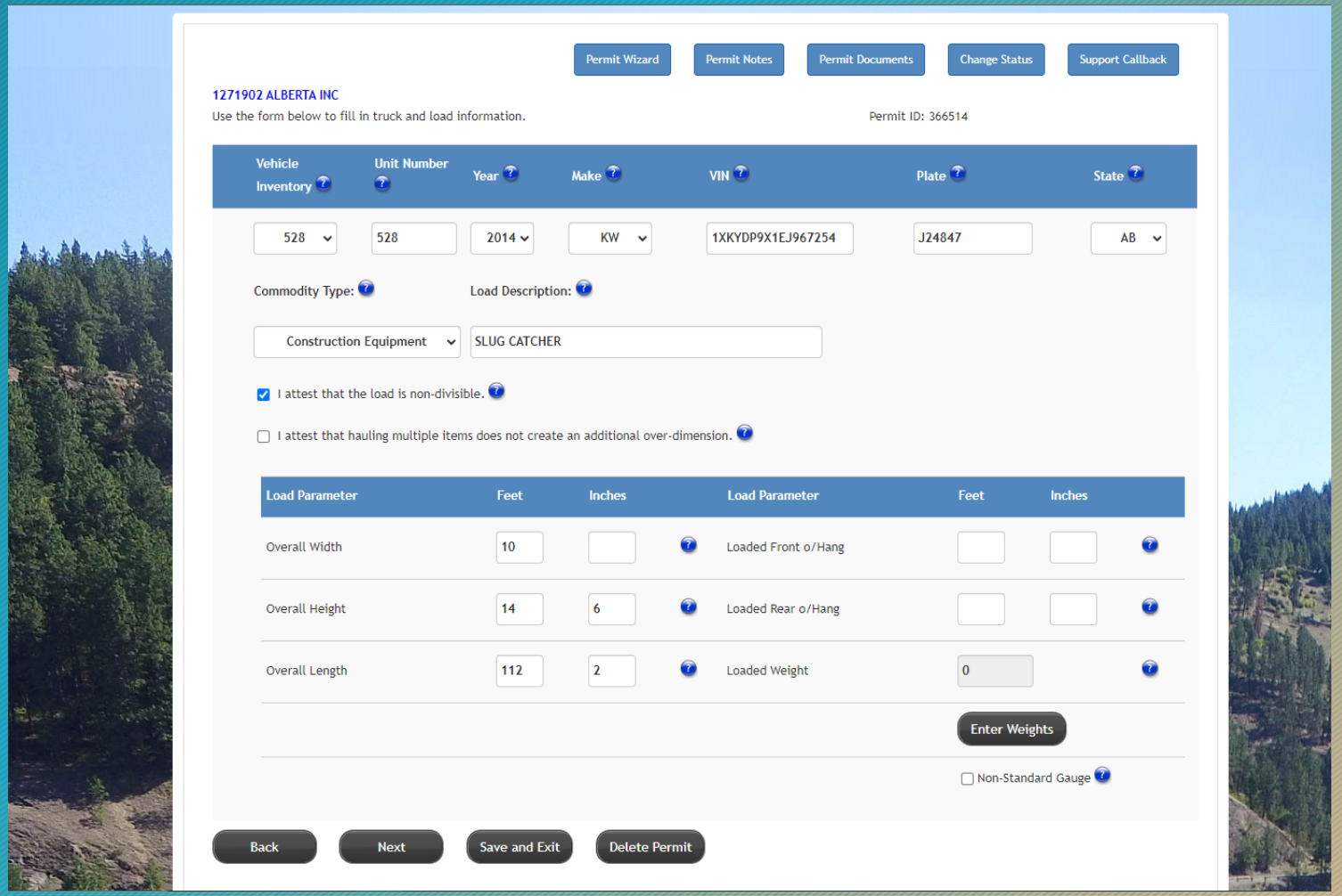
Outline

- Idaho Permit Background
- Automated Permitting Types
- BrR Rating Tool
  - Organizing the Data
  - Optimizing the Program
  - Managing the Data
- Idaho Permit Process

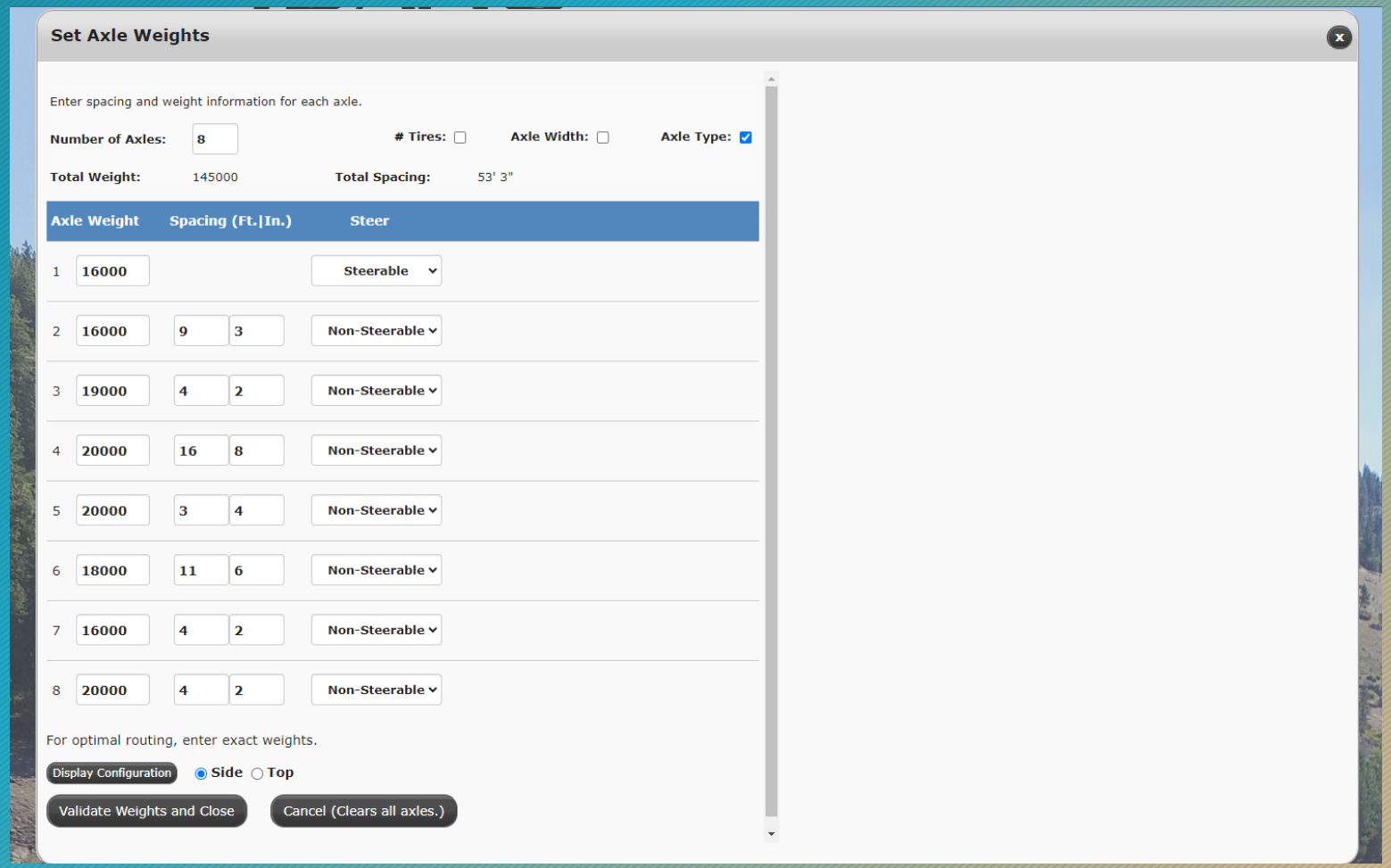
Permit Process



Permit Process



Permit Process



Questions