Tempe Town Lake Dam Replacement

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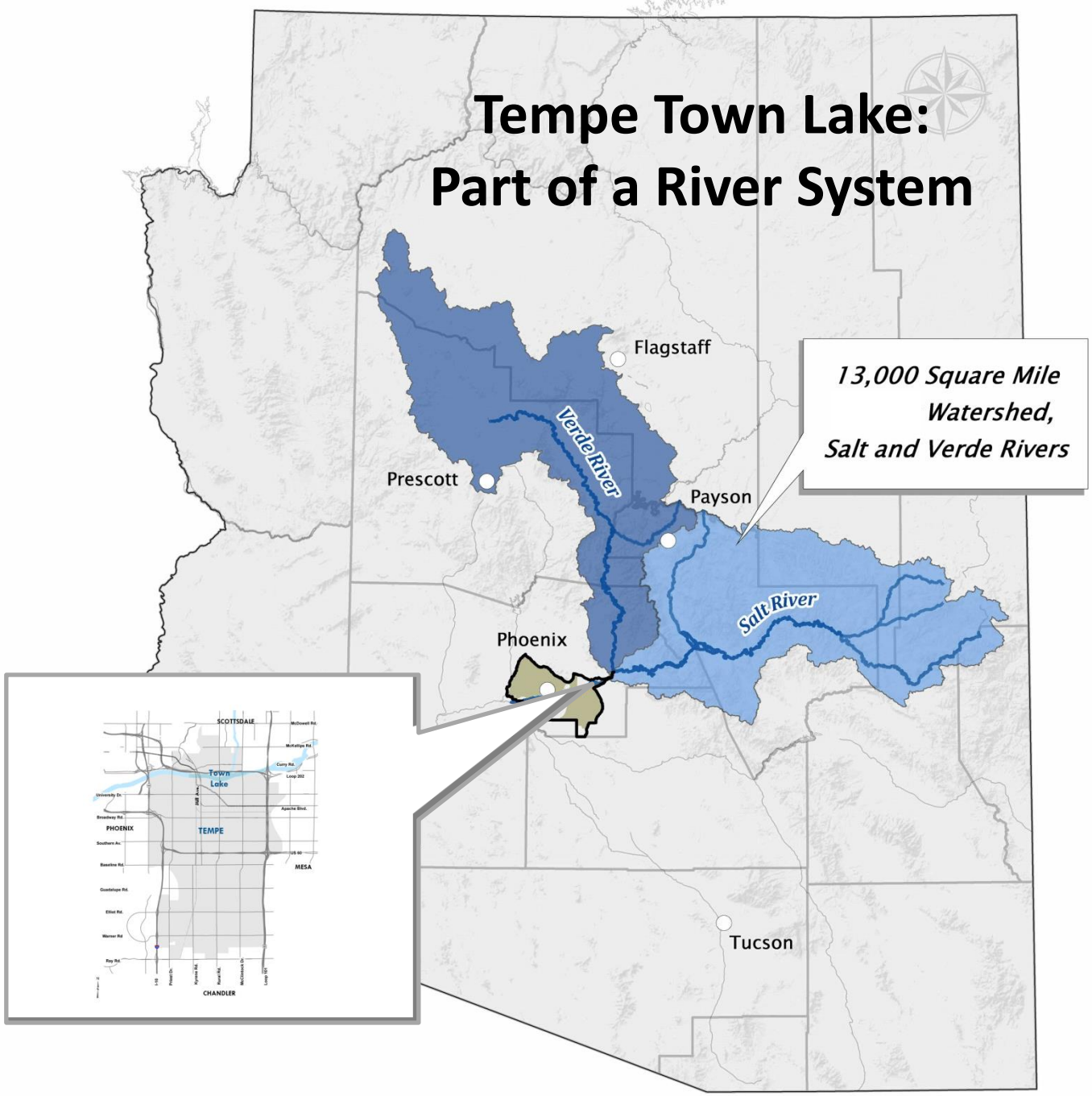
September 9, 2016

2016 ANNUAL ASCE/ASHE
ASCE STATE CONFERENCE ASHE Phoenix Sonoran

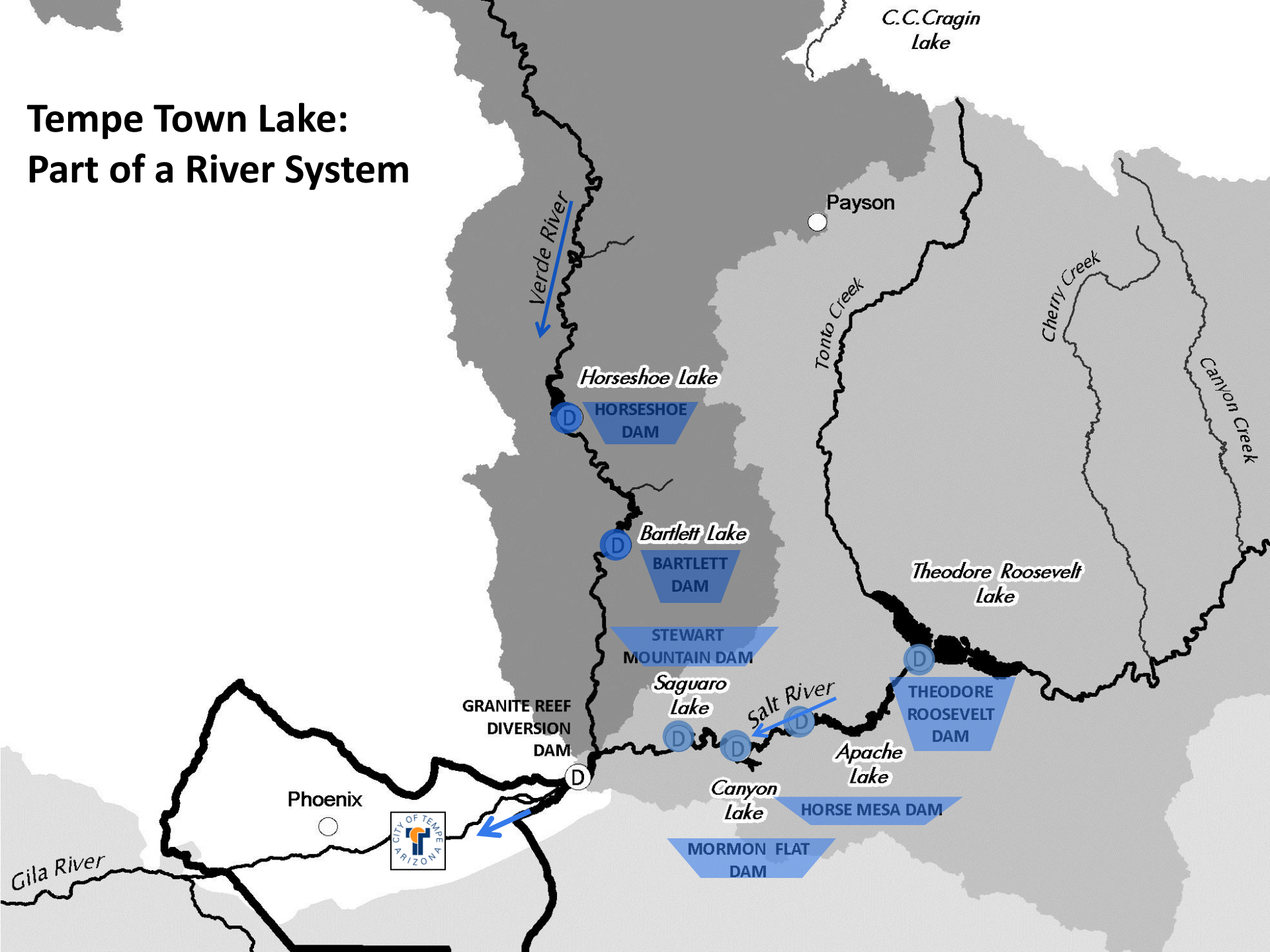
Outline

- Bits of history
- The most important five years
- Replacement dam design & construction
- Operation and Maintenance

Tempe Town Lake: Part of a River System

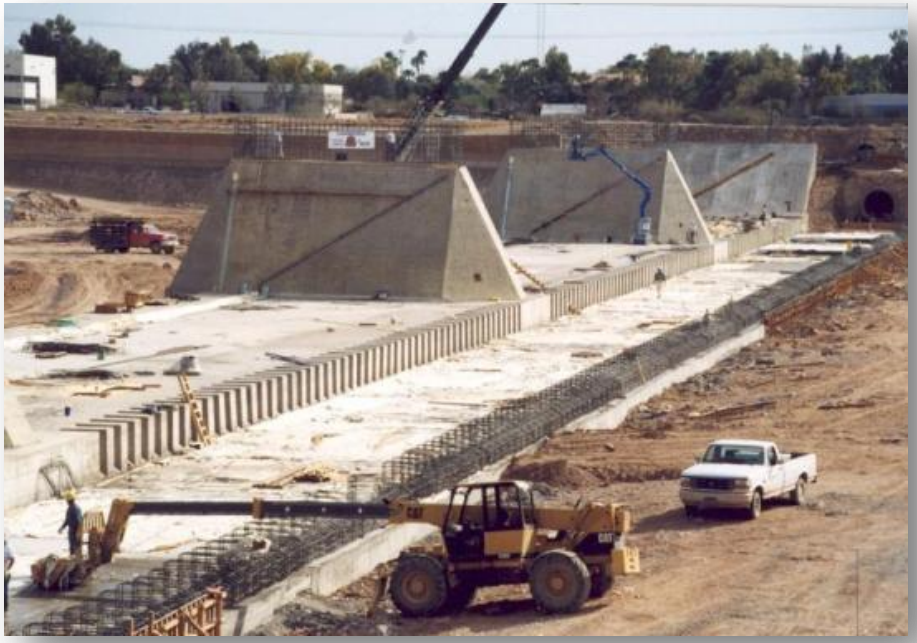


Tempe Town Lake: Part of a River System



Tempe Town Lake

- **Construction Time: 1997 - 1999**



TEMPE TOWN LAKE


26,400 cfs (2/13/05)

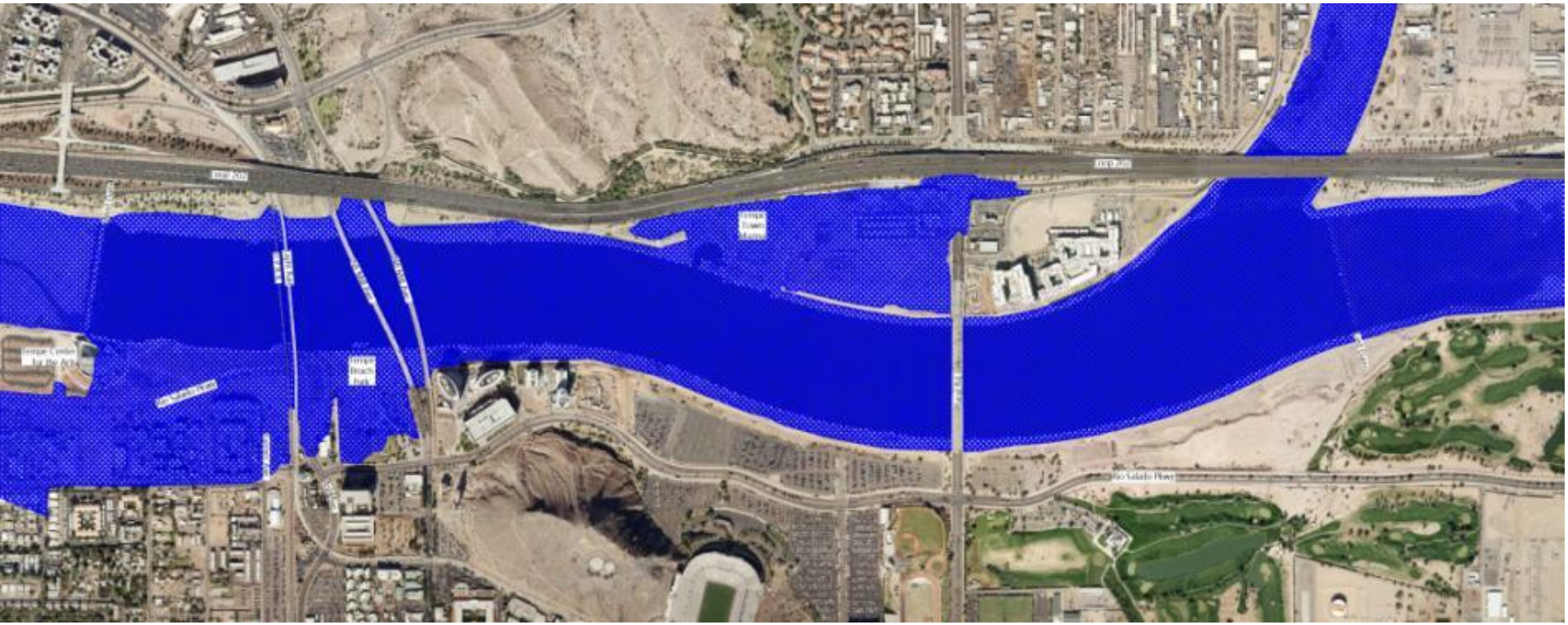
Dam's Timeline: Most Important Five Years

- ✓ Rubber Bladder Dam Replaced - Nov 22nd 2010
- ✓ Alternatives Evaluation – June thru November 2011
- ✓ Phase 1 Validate Concept & Select Dam Technology – Nov. '11
- ✓ Phase 2 Design/Acquire Permits – mid '14
- ✓ Procure Construction Contract by end of 2013 early '14
- ✓ Start Construction by mid 2014
- ✓ Finish Construction mid 2016

Current Level of Flood Protection

Designed to maintain or improve current levels of flood protection
– 210,000 cubic feet per second (cfs.)
This is consistent with the rest of the river system.

Results of Restricted Flow



Alternatives Evaluation

About 20 Dam Options Studied:

- Radial (Tainter) Gates
- Bascule or Bottom-Hinged Leaf Gates
- Inflatable Rubber Dams(water and air-filled)
- Ogee Crest Weirs
- Labyrinth Weirs
- Many Styles of Fuse Plugs
- Several Styles of Pneumatically-Operated Hinged Crest Gates (Obermeyer)
- Hydraulic Hinged Crest Gates
- Dyrhoff Rubber Dams (Sumitomo)
- Vertical Lift Gates
- Swing Gates
- Fusegates (Hydroplus)
- Earth Embankment/Fuseplug
- Several Styles of Mixed-type Spans
- Cable-Operated Hinged Crest Gate
- Others

Dam Design Criteria

1. Span river (875’)
2. Maintain lake’s normal pool (17’ deep at downstream end)
3. Maintain or Improve Current Level of Flood Protection
4. Refill Lake Quickly After Flood Event
5. Raise, Lower and Operate Reliably at Normal Lake Levels
6. Be Cost Efficient – Capital, Lifespan, O&M
7. Have Parts Easily Available
8. Be Compatible with Pedestrian Bridge, Existing Structures
9. Perform Well in this Climate

Alternatives Carried Forward

1. Obermeyer Gates
2. Hinged Steel Gates
3. Inflatable Rubber Dam

1

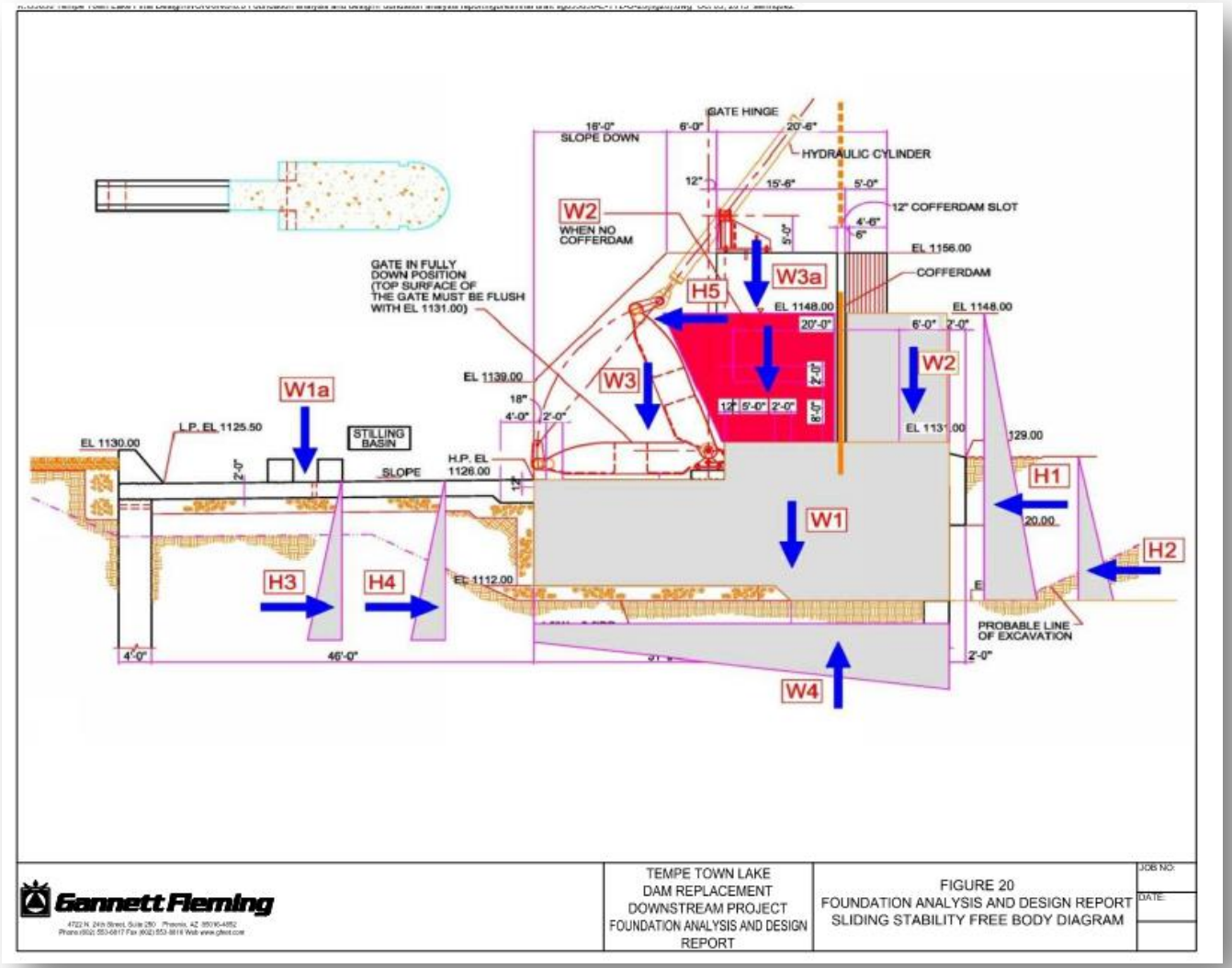
2

3

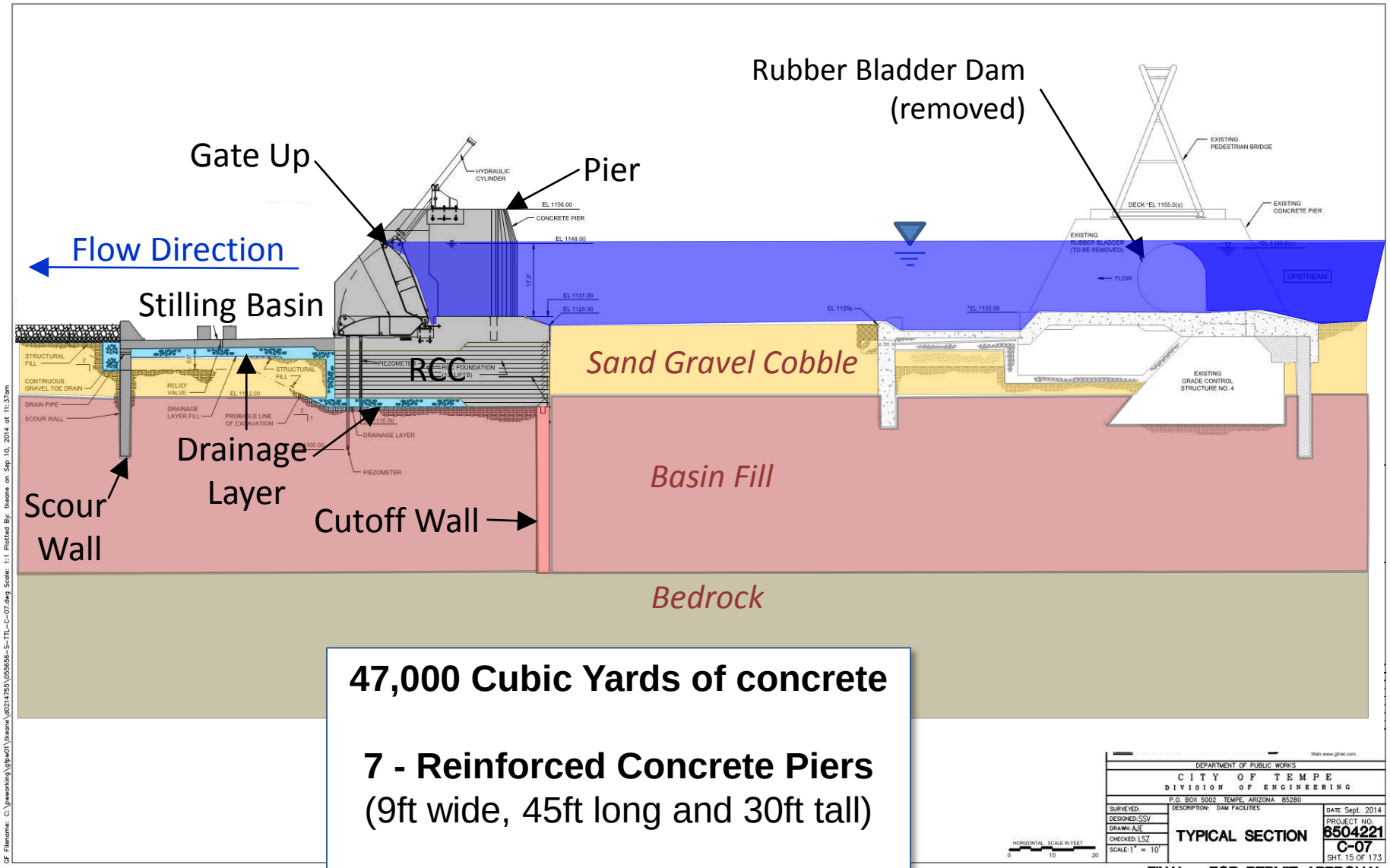
Hydraulically Operated Hinged Steel Gate

- Flood Control
- Safety & Reliability
- Durability
- Value (cost competitive)
- Engineering Requirements
- Regulatory Requirements
- Risk Management
- Parts Readily Available
- Climate

Design


GATE HINGE
18'-0"
SLOPE DOWN
6'-0"
20'-6"
HYDRAULIC CYLINDER
12"
15'-6"
5'-0"
12" COFFERDAM SLOT
4'-6"
6"
W2
WHEN NO
COFFERDAM
5'-0"
EL 1156.00
COFFERDAM
GATE IN FULLY
DOWN POSITION
(TOP SURFACE OF
THE GATE MUST BE FLUSH
WITH EL 1131.00)
H5
W3a
EL 1148.00
EL 1148.00
20'-0"
6'-0"
2'-0"
W2
EL 1139.00
W3
18"
4'-0"
2'-0"
12"
5'-0"
2'-0"
2'-0"
8'-0"
W1a
EL 1130.00
L.P. EL 1125.50
STILLING
BASIN
SLOPE
H.P. EL
1126.00
2'-0"
12"
EL 1131.00
129.00
H1
20.00
H2
W1
H3
H4
EL 1112.00
PROBABLE LINE
OF EXCAVATION
4'-0"
46'-0"
2'-0"
W4
Gannett Fleming
TEMPE TOWN LAKE
DAM REPLACEMENT
DOWNSTREAM PROJECT
FOUNDATION ANALYSIS AND DESIGN
REPORT
FIGURE 20
FOUNDATION ANALYSIS AND DESIGN REPORT
SLIDING STABILITY FREE BODY DIAGRAM
JOB NO:
DATE:

Typical Section



47,000 Cubic Yards of concrete

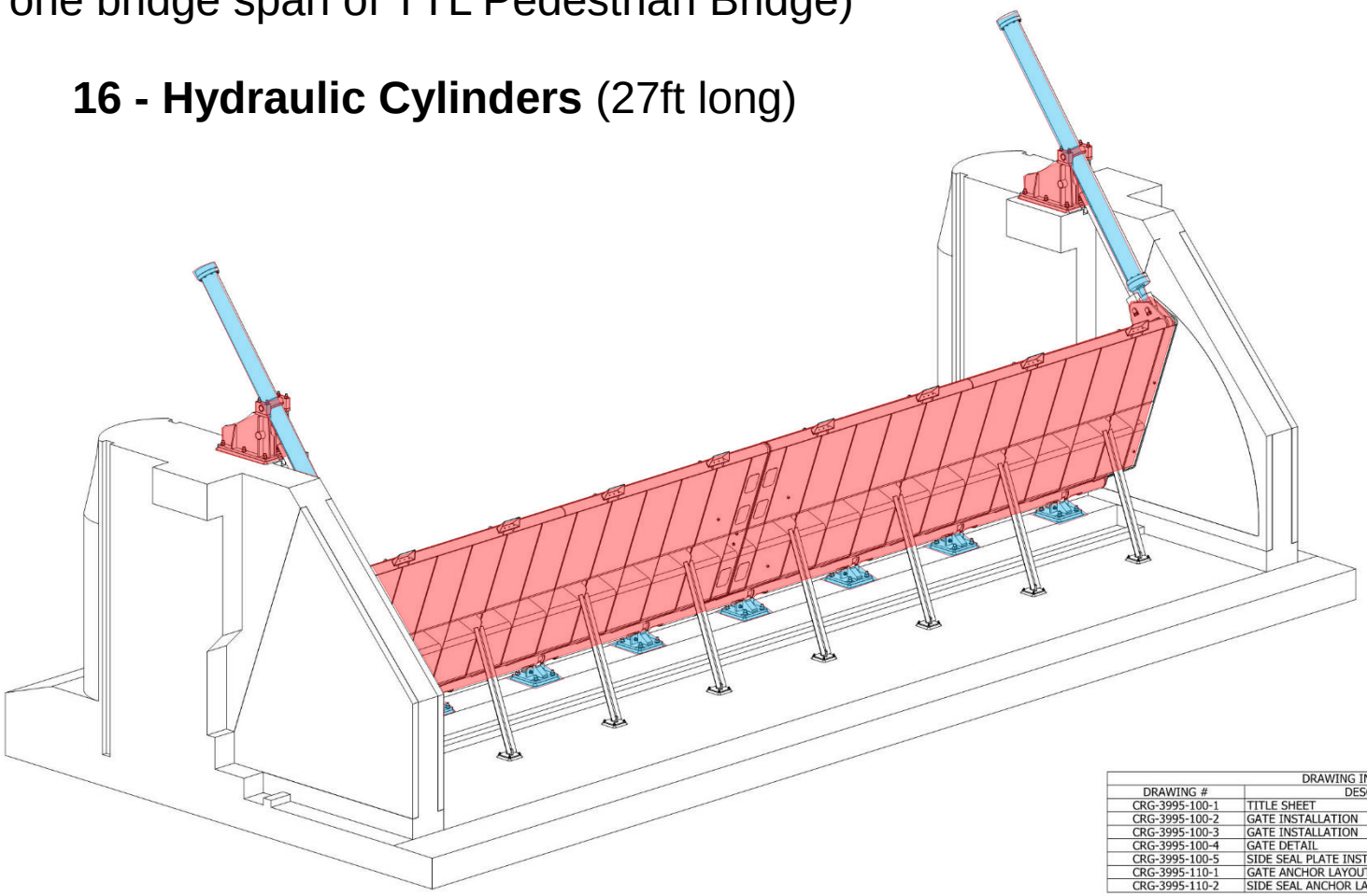
7 - Reinforced Concrete Piers
(9ft wide, 45ft long and 30ft tall)

DEPARTMENT OF PUBLIC WORKS
CITY OF TEMPE
DIVISION OF ENGINEERING
P.O. BOX 5002 TEMPE, ARIZONA 85280
SURVEYED:
DESIGNED: SSV
DRAWN: AJE
CHECKED: LSZ
SCALE: 1" = 10'
DESCRIPTION: DAM FACILITIES
DATE Sept. 2014
TYPICAL SECTION
PROJECT NO. 8504221
C-07
SHT. 15 OF 173
FINAL - FOR PERMIT APPROVAL

Gate

8 - 106 ft long Steel Gates
(260,000 lb. each equivalent to the weight of one bridge span of TTL Pedestrian Bridge)

16 - Hydraulic Cylinders (27ft long)



PART #	QTY
170	4
229	16
409	8
413	4
606	16
607	8
609	8
669	8
674	88
675	88
676	44
677	44
678	88
679	8
684	16
685	24
686	40
687	32
688	32
689	16
690	16
695	16
906	2
998	2
999	2
CRG-3995-200	1
CRG-3995-201	1
CRG-3995-210	1
CRG-3995-211	1
CRG-3995-213	8
CRG-3995-220	4
CRG-3995-305	2
CRG-3995-306	8
CRG-3995-310	1
CRG-3995-311	1

PAINT:

•ALL EXPO
THE REQU
ANGULAR

UPSTREAM PA

•PRIME CO

•SECOND

•FINISH C

•FINISH C

DOWNSTREAM

•PRIME CO

•SECOND

•FINISH C

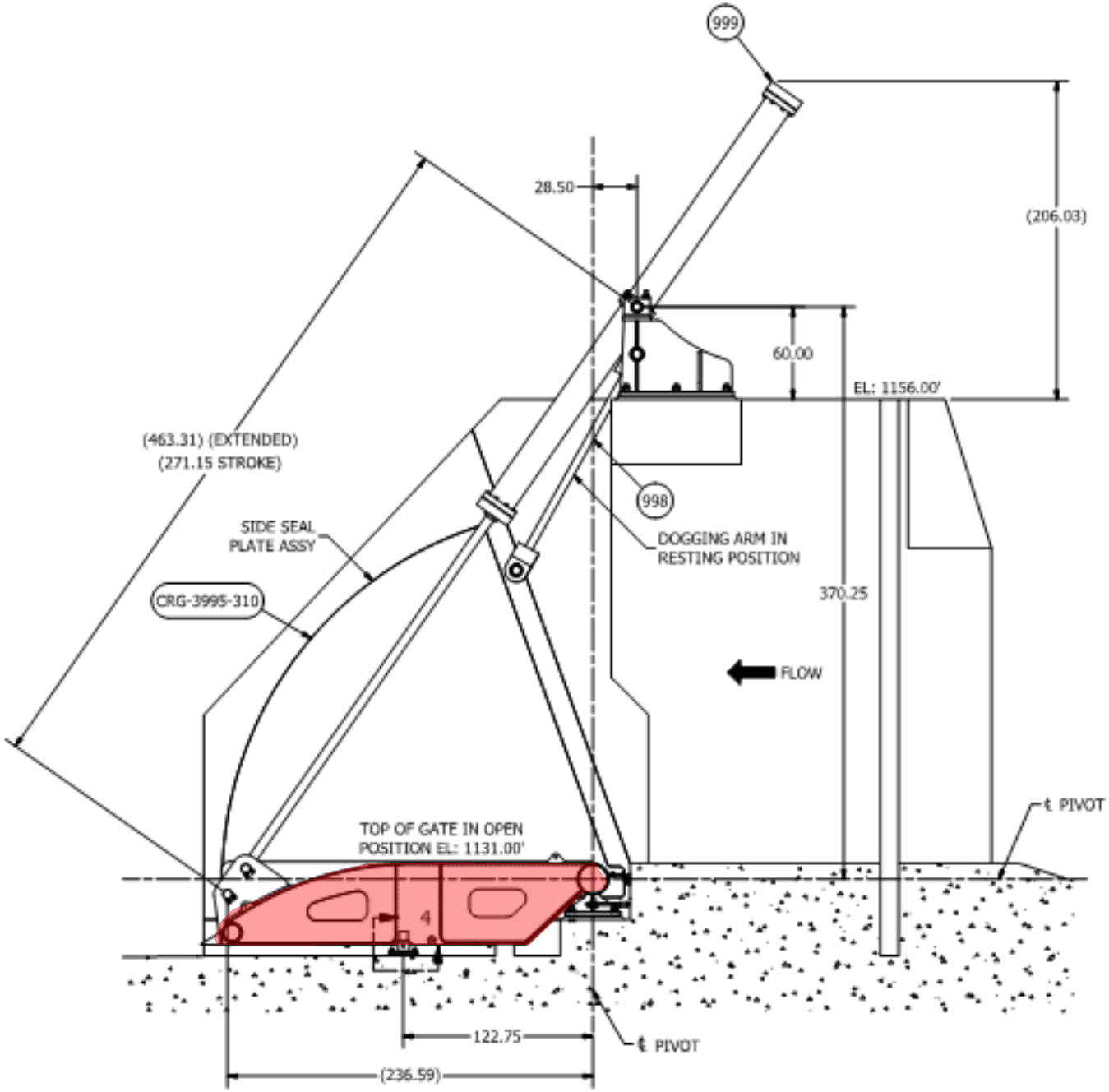
DRAWING INDEX

DRAWING #	DESCRIPTION	REVISION
CRG-3995-100-1	TITLE SHEET	0
CRG-3995-100-2	GATE INSTALLATION	0
CRG-3995-100-3	GATE INSTALLATION	0
CRG-3995-100-4	GATE DETAIL	0
CRG-3995-100-5	SIDE SEAL PLATE INSTALLATION	0
CRG-3995-110-1	GATE ANCHOR LAYOUT	0
CRG-3995-110-2	SIDE SEAL ANCHOR LAYOUT	0

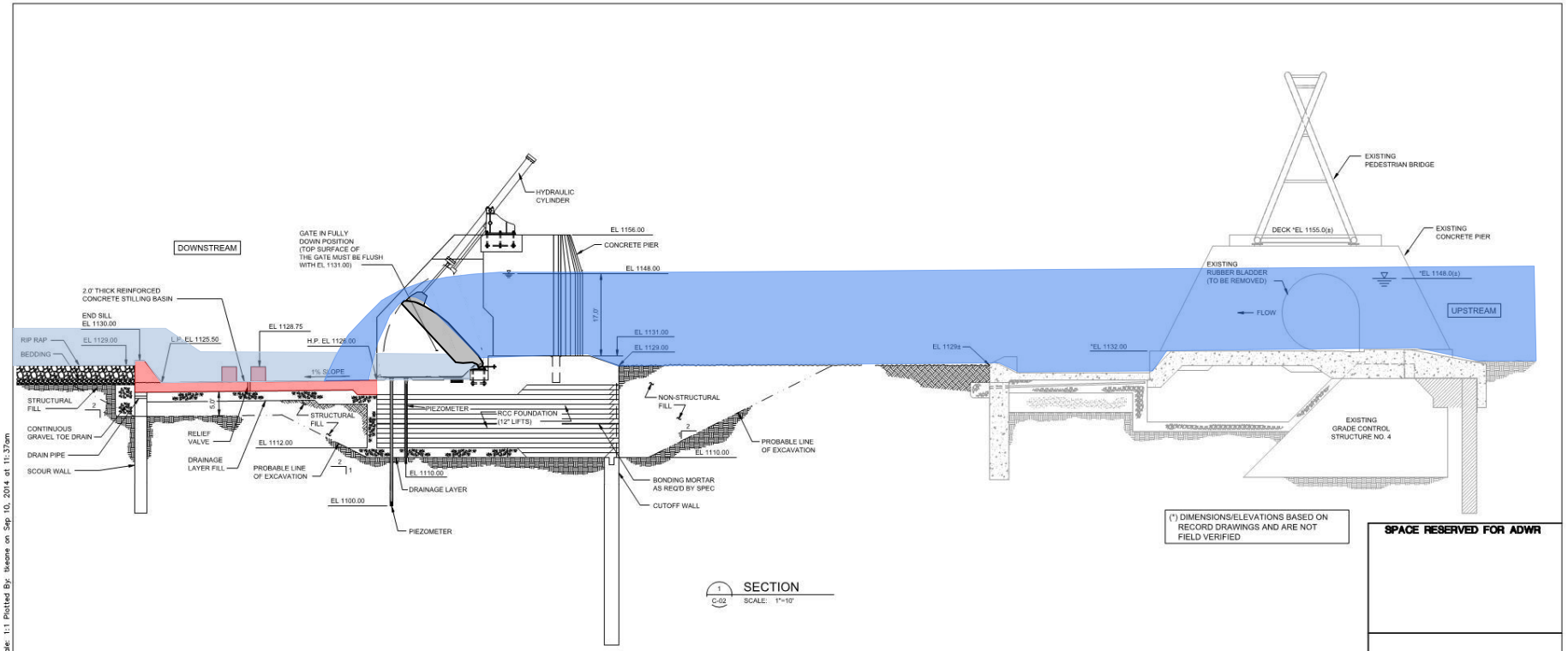
DESIGN PARAMETERS:

- CLEAR WATER WAY WIDTH: 106.0'
- GATE HEIGHT: 17'

Test No.	Element ID, Location or Description	Dia.	Test Load Applied (lbf)	Duration of Load	Observation(s)	Result
1	Cylinder Support Bracket, Pier 4, Row 3, Col 2	2-½ in.	97,000	5 Min.	No cracks, damage, pull out	PASS
2	Cylinder Support Bracket, Pier 4, Row 2, Col 3	2-½ in.	97,000	5 Min.	No cracks, damage, pull out	PASS
3	Cylinder Support Bracket, Pier 4, Row 2, Col 1	2-½ in.	97,000	5 Min.	No cracks, damage, pull out	PASS
4	Gate Hinge, 2nd Grouping N. Of Pier 4, NW Corner	2-½ in.	114,000	5 Min.	No cracks, damage, pull out	PASS
5	Gate Hinge, 6th Grouping N. Of Pier 4, SW Corner	2-½ in.	114,000	5 Min.	No cracks, damage, pull out	PASS
6	Gate Hinge, 2nd Grouping S. Of Pier 4, SW Corner	2-½ in.	114,000	5 Min.	No cracks, damage, pull out	PASS


999
28.50
(206.03)
60.00
EL: 1156.00'
(463.31) (EXTENDED)
(271.15 STROKE)
998
DOGGING ARM IN
RESTING POSITION
SIDE SEAL
PLATE ASSY
CRG-3995-310
370.25
FLOW
℄ PIVOT
TOP OF GATE IN OPEN
POSITION EL: 1131.00'
122.75
(236.59)
℄ PIVOT

Stilling Basin



1 C-02 SECTION
SCALE: 1"=10'

(*) DIMENSIONS/ELEVATIONS BASED ON RECORD DRAWINGS AND ARE NOT FIELD VERIFIED

SPACE RESERVED FOR ADWR

Call at least two full working days before you begin excavation
ARIZONA 811
Blue Stake, Inc.
Dial 8-1-1 or 1-602-263-1100 (1-800-STAKE-IT (782-5348))
In Maricopa County (602) 263-1100

REVISIONS			
REV.	DESCRIPTION	DATE	APR.

Gannett Fleming
4722 N. 24th Street, Suite 250
Phoenix, AZ 85016-4652
Phone (602) 553-8817 Fax (602) 553-8816
Web www.gfnet.com

DEPARTMENT OF PUBLIC WORKS
CITY OF TEMPE
DIVISION OF ENGINEERING
P.O. BOX 5002 TEMPE, ARIZONA 85280

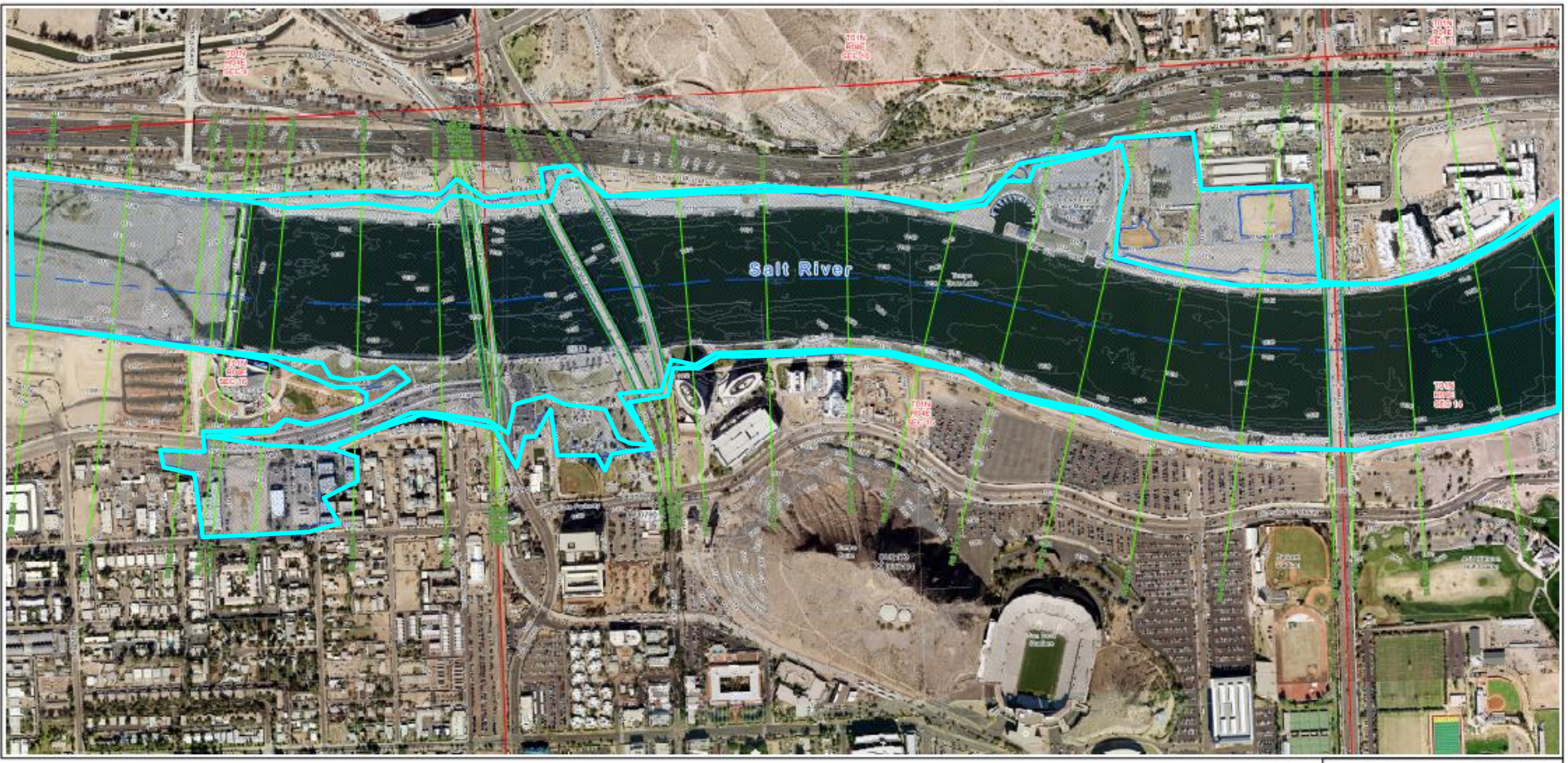
SURVEYED:	DESCRIPTION: DAM FACILITIES	DATE Sept. 2014
DESIGNED: SSV	TYPICAL SECTION	PROJECT NO. 8504221
DRAWN: AJE		C-07
CHECKED: LSZ		SHT. 15 OF 173
SCALE: 1" = 10'		

HORIZONTAL SCALE IN FEET
0 10 20

FINAL - FOR PERMIT APPROVAL

DF Filename: C:\pwworking\gfpw01\tkeane\d0214755\D55656--S--TTL--C--07.dwg Scale: 1:1 Plotted By: tkeane on Sep 10, 2014 at 11:37am

Flood Analysis



300 150 0 300 Feet

Two Gate Failures - 210,000cfs
Inundation Map

Tempe Town Lake
Downstream Dam Replacement

JOB NO:	55656
DRAWN BY:	
CHECKED BY:	
DATE:	

CITY OF TEMPE ARIZONA

Gannett Fleming

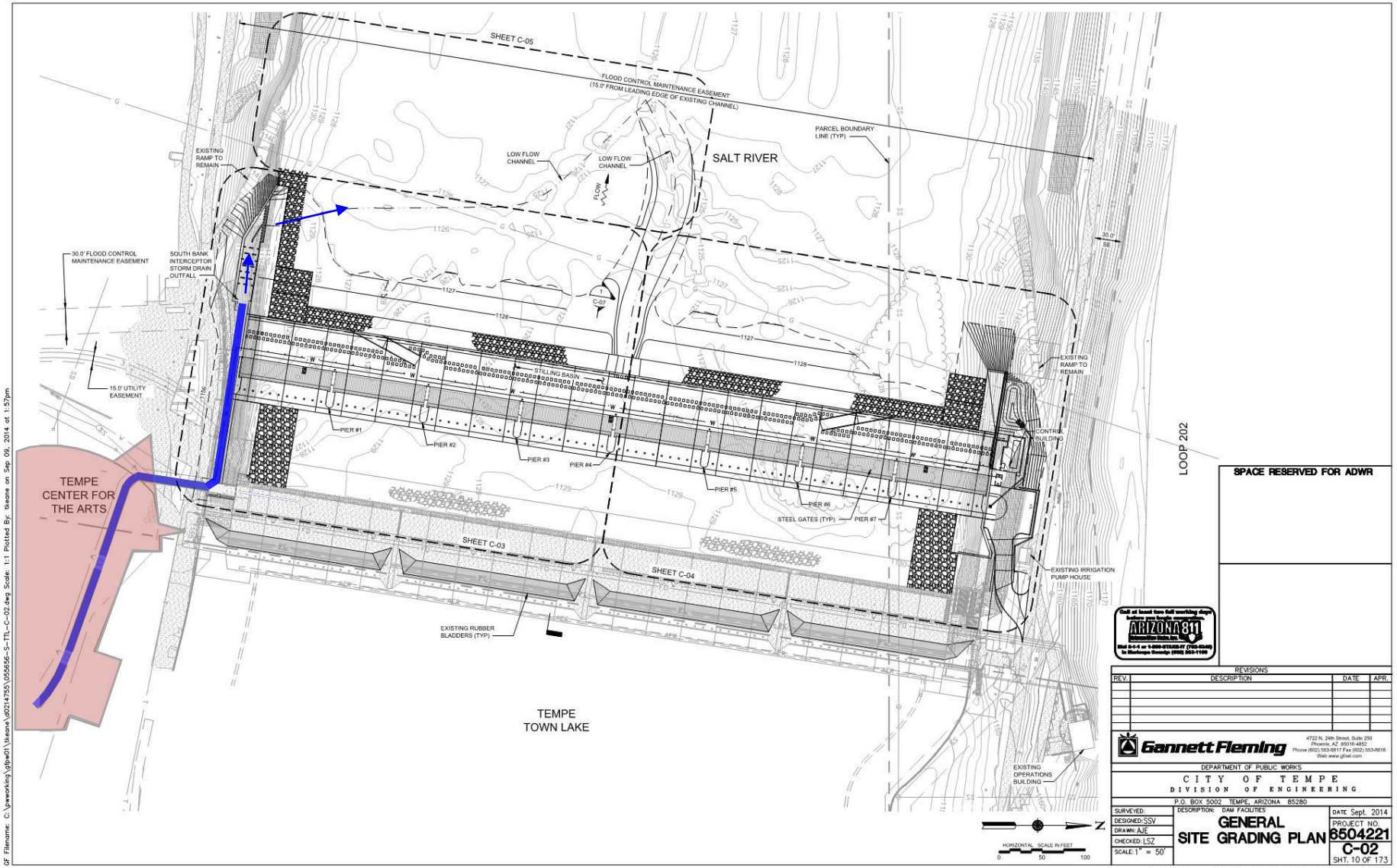
Excellence Delivered As Promised

SCALE: 1" = 300'
ON 22" x 34" SHEET

Exhibit 1

Gate Failure Analysis

South Bank Interceptor

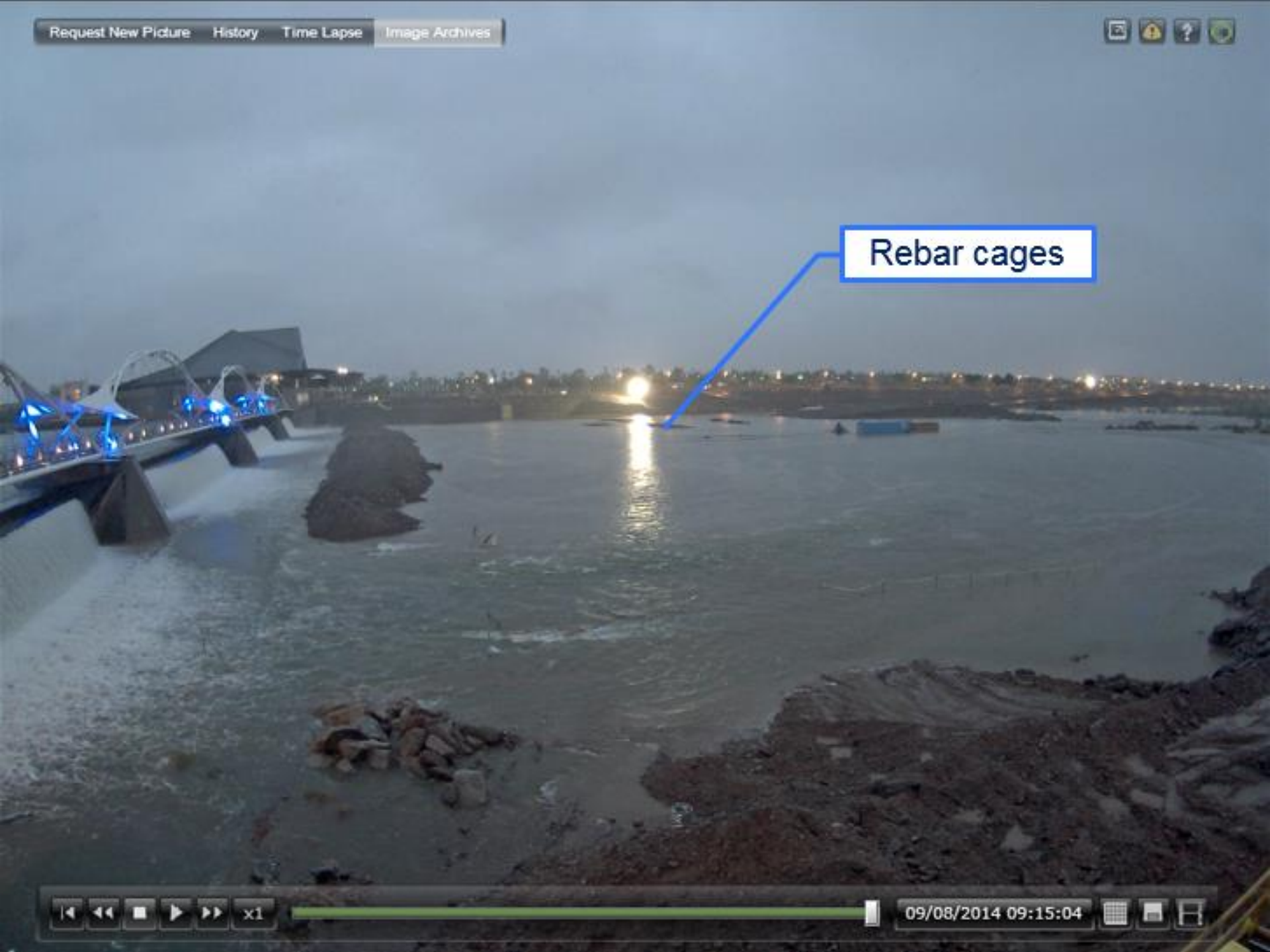


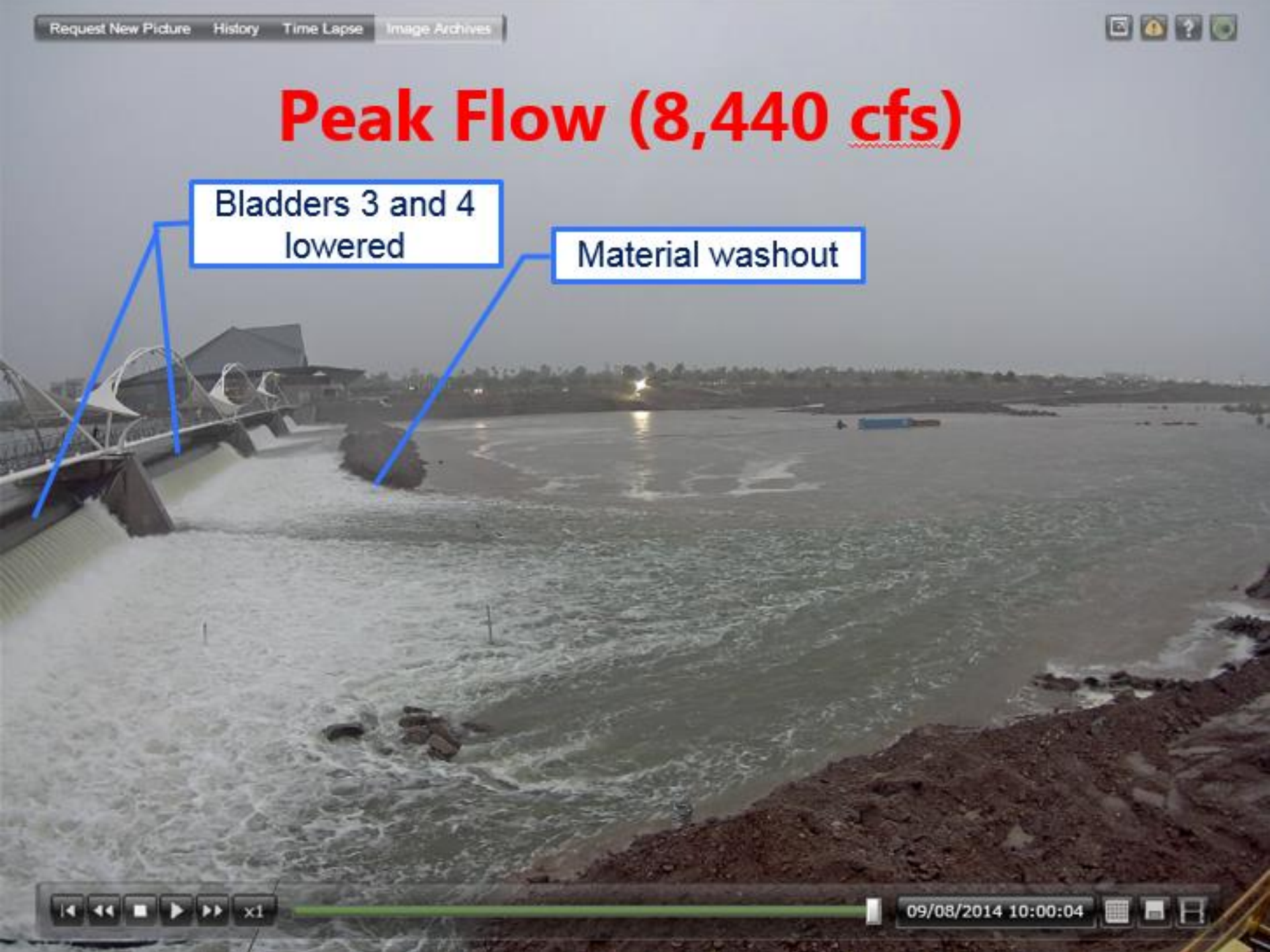
South Bank Interceptor


Construction
Start May 2014

A wet winter may be on the way, and it could provide a big boost to Arizona's parched water supply

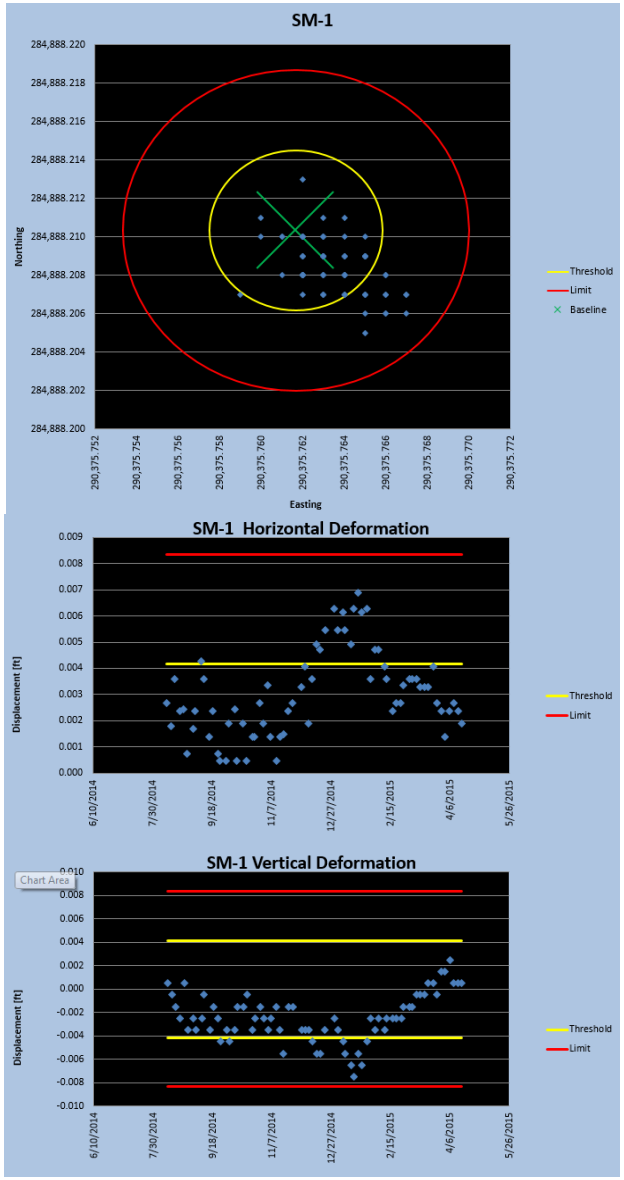
El Niño to the rescue?

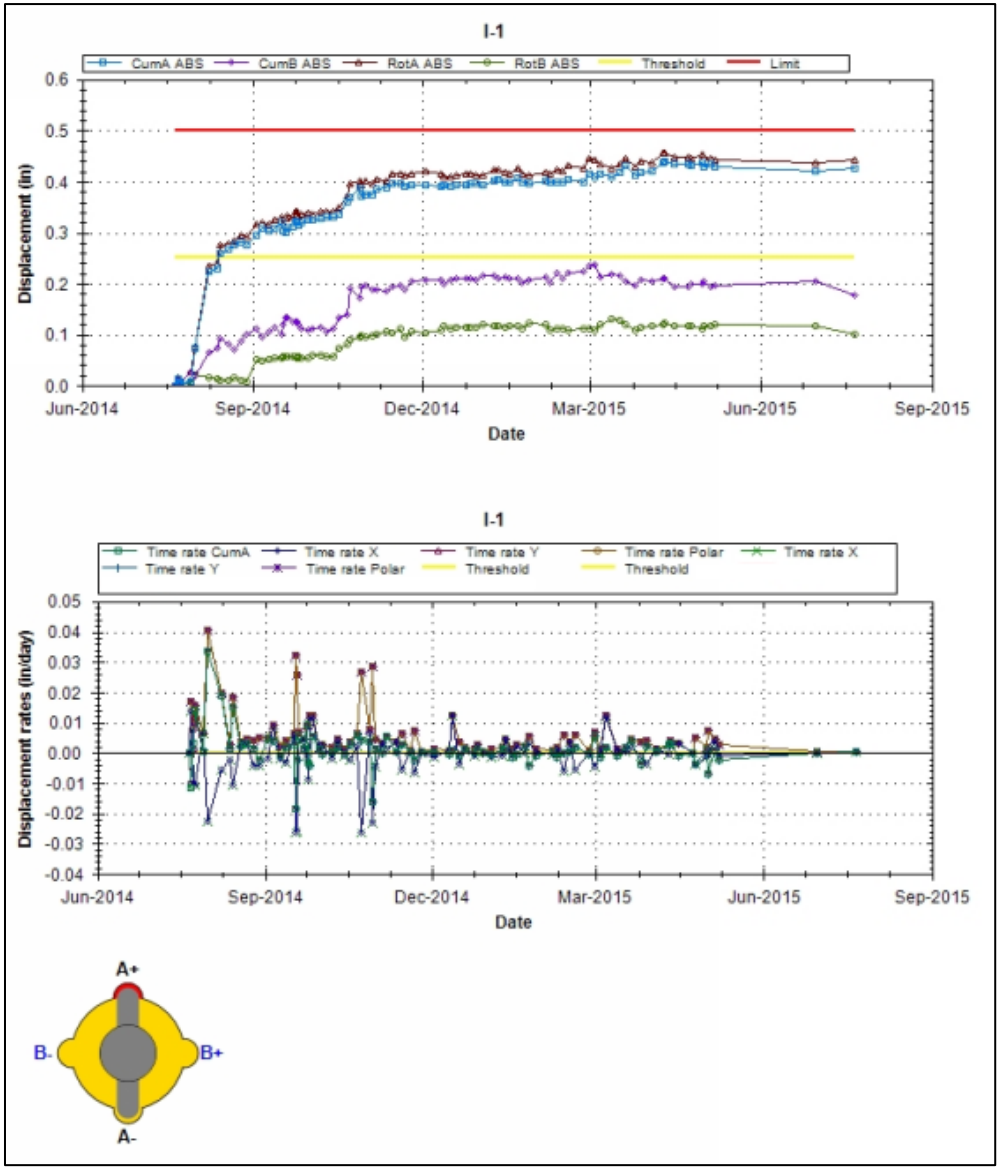

Request New Picture
History
Time Lapse
Image Archives
Rebar cages
x1
09/08/2014 09:15:04


Request New Picture
History
Time Lapse
Image Archives
Peak Flow (8,440 cfs)
Bladders 3 and 4 lowered
Material washout
x1
09/08/2014 10:00:04


MAGNUS
KOMATSU


700
CAT


SM-1
Northing
Easting
284,888.220
284,888.218
284,888.216
284,888.214
284,888.212
284,888.210
284,888.208
284,888.206
284,888.204
284,888.202
284,888.200
290,375.752
290,375.754
290,375.756
290,375.758
290,375.760
290,375.762
290,375.764
290,375.766
290,375.768
290,375.770
290,375.772
Threshold
Limit
Baseline
SM-1 Horizontal Deformation
Displacement [ft]
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
6/10/2014
7/30/2014
9/18/2014
11/7/2014
12/27/2014
2/15/2015
4/6/2015
5/26/2015
Threshold
Limit
SM-1 Vertical Deformation
Chart Area
Displacement [ft]
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
-0.004
-0.006
-0.008
-0.010
6/10/2014
7/30/2014
9/18/2014
11/7/2014
12/27/2014
2/15/2015
4/6/2015
5/26/2015
Threshold
Limit


I-1
CumA ABS
CumB ABS
RotA ABS
RotB ABS
Threshold
Limit
Displacement (in)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jun-2014
Sep-2014
Dec-2014
Mar-2015
Jun-2015
Sep-2015
Date
I-1
Time rate CumA
Time rate X
Time rate Y
Time rate Polar
Time rate X
Time rate Y
Time rate Polar
Threshold
Threshold
Displacement rates (in/day)
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
Jun-2014
Sep-2014
Dec-2014
Mar-2015
Jun-2015
Sep-2015
Date
A+
B-
B+
A-


DEERE


Save | Share
Reset Zoom
HIDE


Dogging Rod


1/8/2016 9:30:25 AM EST


Coffer Dam


Coffer Dam

Tempe Town Lake Operations

Maintain Lake Elevation

Town Lake Operations

- Ensure Water Quality
- Operate Dam
- Maintain all Dam/Lake Infrastructure

New Dam Operations

Manual and Automatic mode

Challenges

- Budget
- Permitting
- Schedule
- Testing
- Beavers


NEW TONIGHT
TEMPE BEAVER RELEASED BACK INTO THE WILD
ANIMAL WAS FOUND SICK IN THE LAKE LAST MONTH
ABC15 ARIZONA
/abc15
abc 15
10:18
65°


More information:
www.tempe.gov/lake
Thank You
CITY OF TEMPE ARIZONA
Gannett Fleming
PCL