Condition Assessment and Rehabilitation of Large Sewers: Chambers Creek Interceptor Tunnel

Ohio Water Environment Association

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CDM Smith

April 25, 2013

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Agenda

- Project Background
- Condition Assessment
- Rehabilitation Options
- Project Design
- Construction Challenges
- Conclusions
- Q&A

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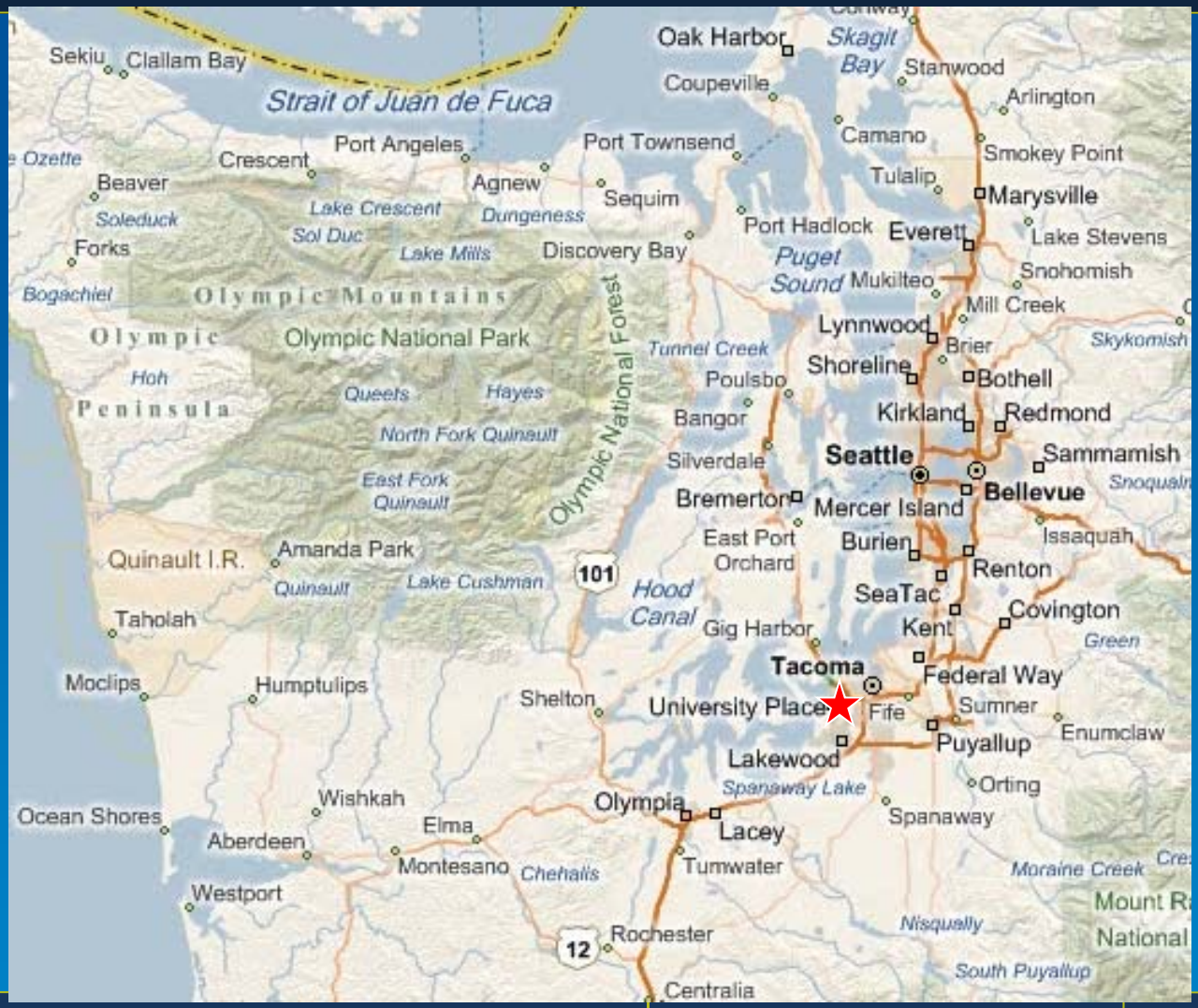
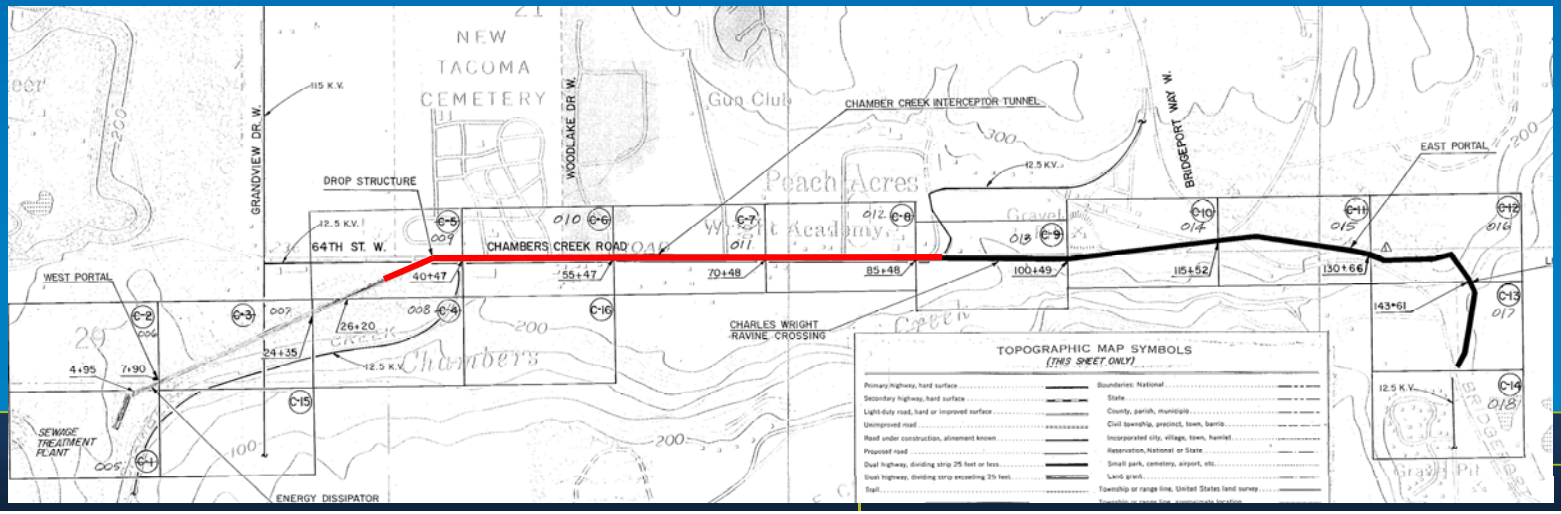
PROJECT BACKGROUND

Pierce County, WA

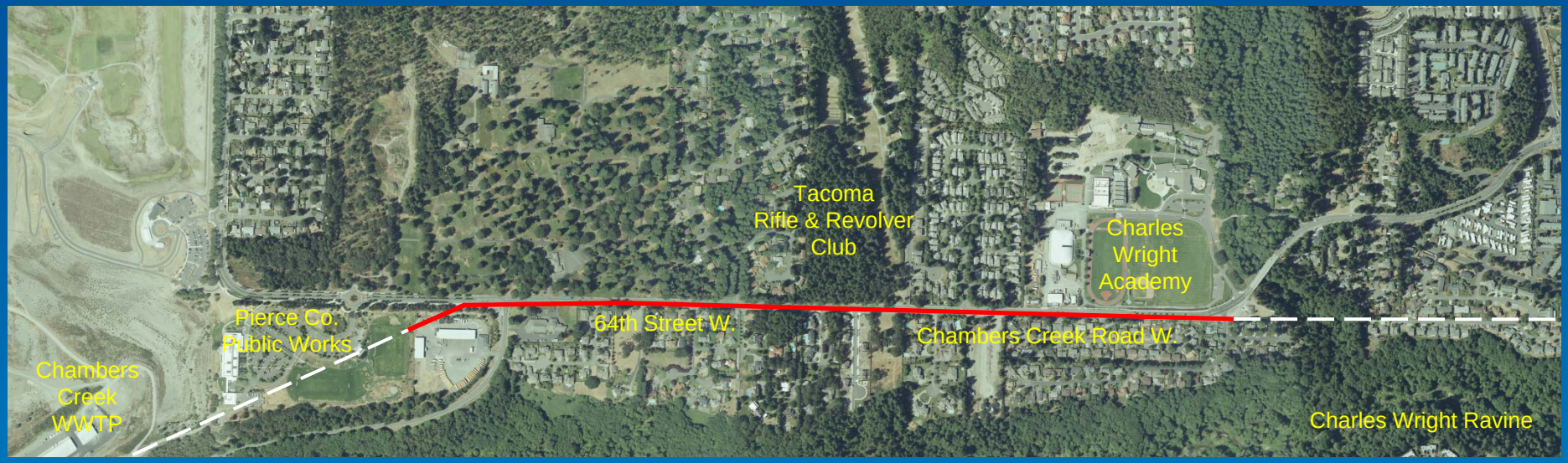


Background

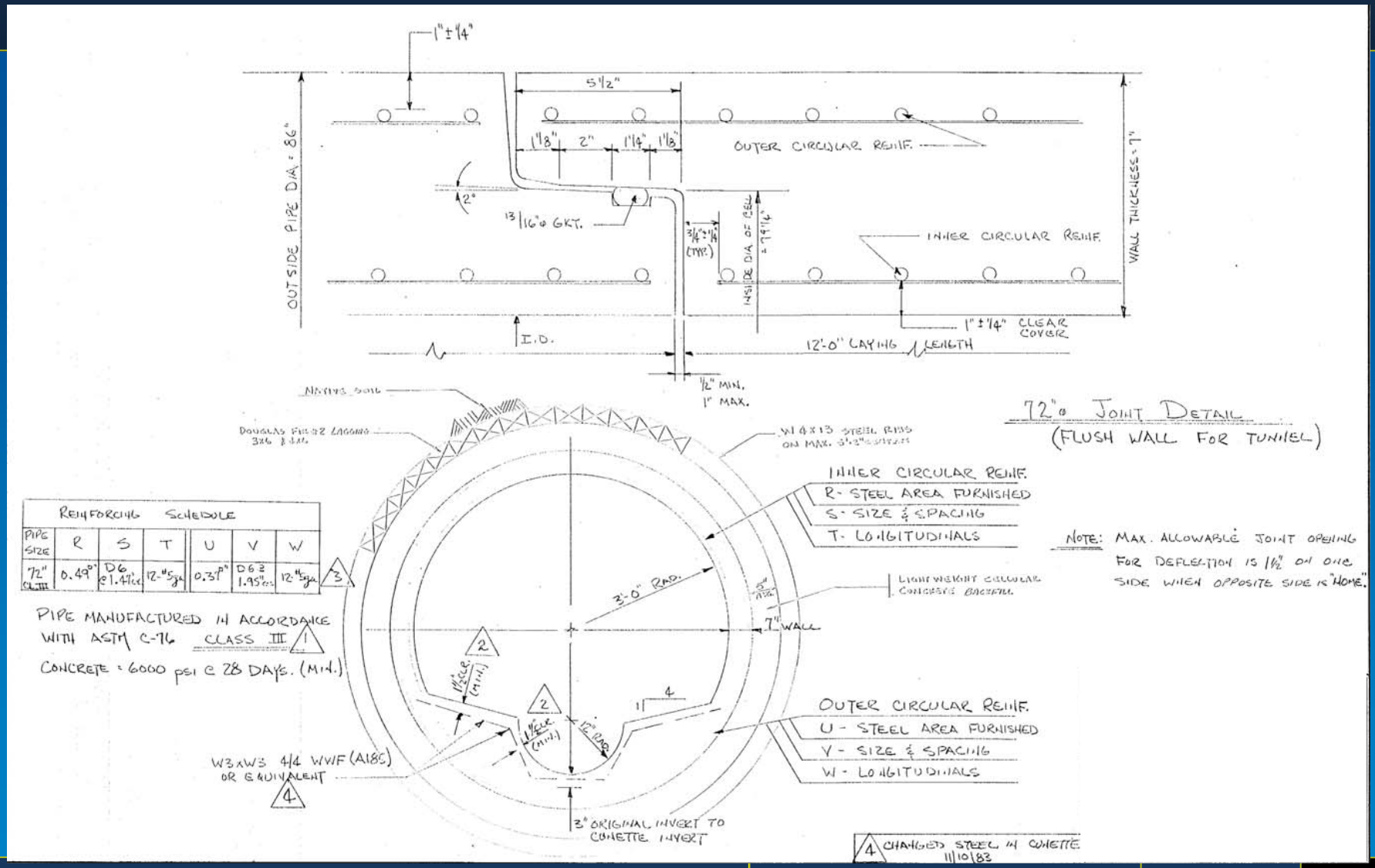
- Constructed in 1983
- Approximately 16,000 LF total Condition Assessment (rehabilitation project 5,500 LF)
- 72-inch diameter RCP with a 24-inch diameter cunette
- Depth ranges from several feet of cover to over 100 ft of cover
- Located in the vicinity of Chambers Creek Road, 64th Street Court, the Charles Wright Ravine



Project Location



Existing Tunnel Cross Section

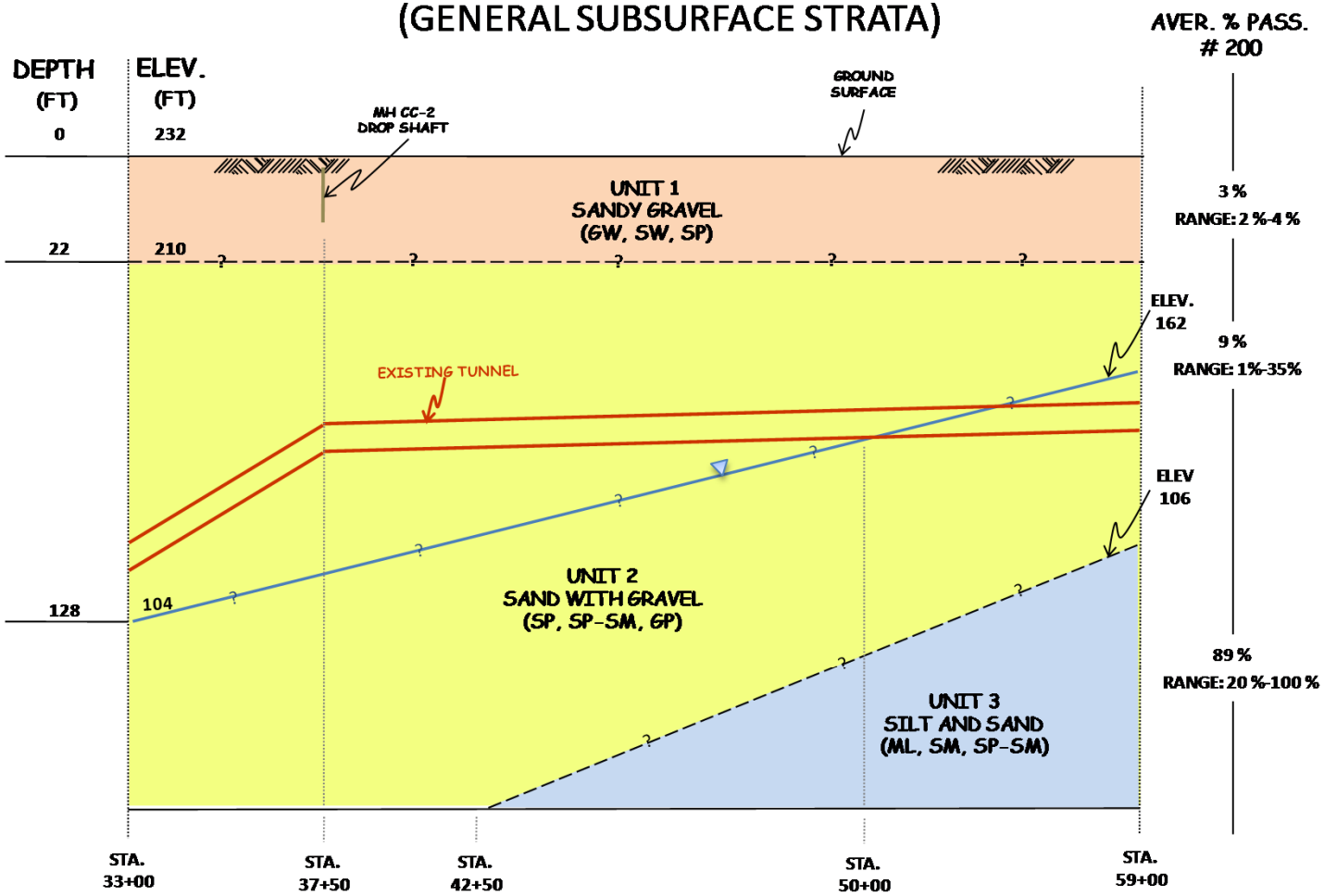


REINFORCING SCHEDULE						
PIPE SIZE	R	S	T	U	V	W
72" CL III	0.49"	D6 @ 1.47"	12-#5 ga	0.37"	D6 @ 1.95"	12-#5 ga

PIPE MANUFACTURED IN ACCORDANCE WITH ASTM C-76 CLASS III

CONCRETE = 6000 psi @ 28 DAYS. (MIN.)

TYPICAL SECTION
(GENERAL SUBSURFACE STRATA)

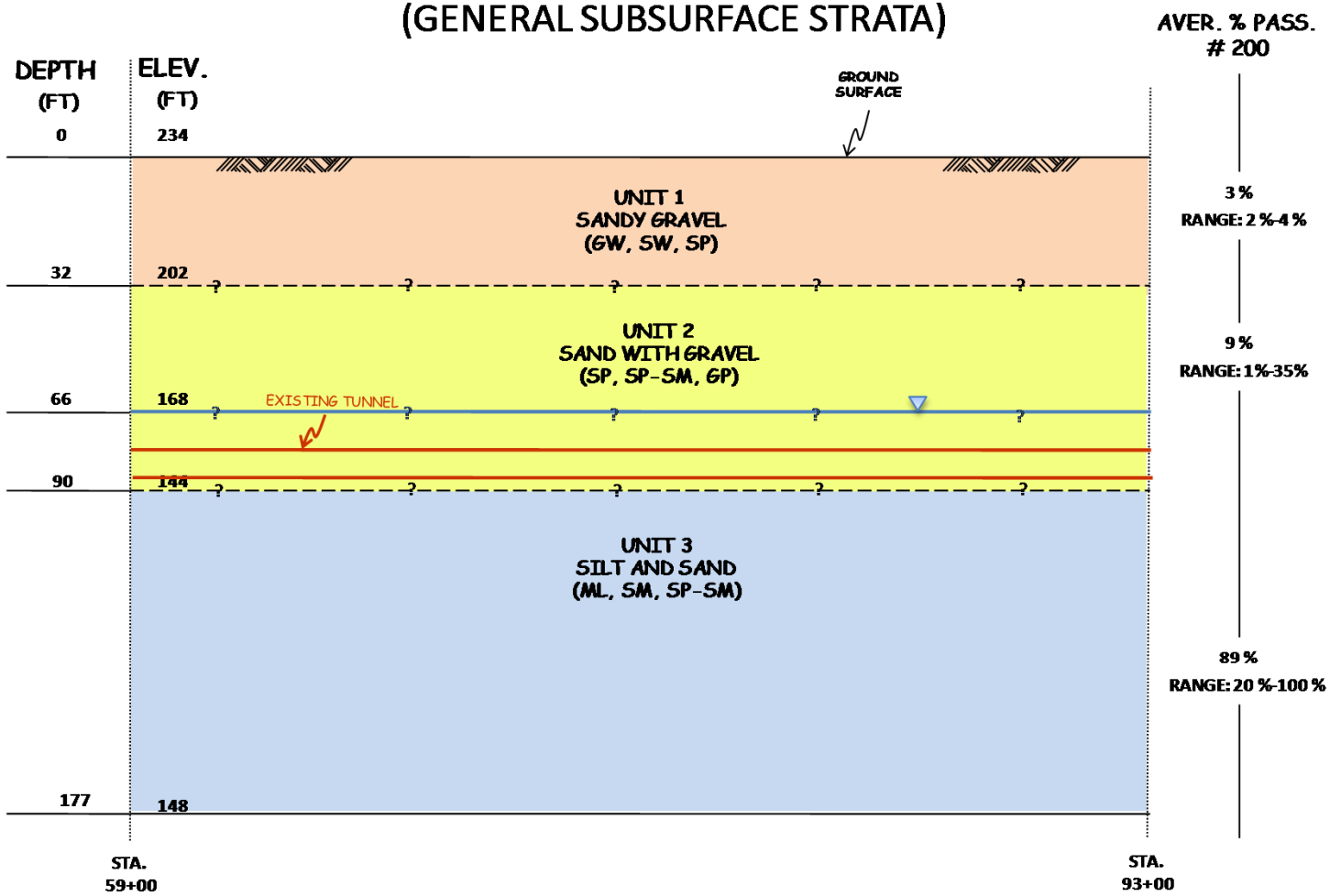


STA. 33+00 – 59+00

NO SCALE

ELEVATIONS AND DEPTHS ARE VARIABLE IN THIS REGION. THOSE NOTED HERE ARE AN AVERAGED REPRESENTATION TO CHARACTERIZE THE STRATA.

TYPICAL SECTION
(GENERAL SUBSURFACE STRATA)



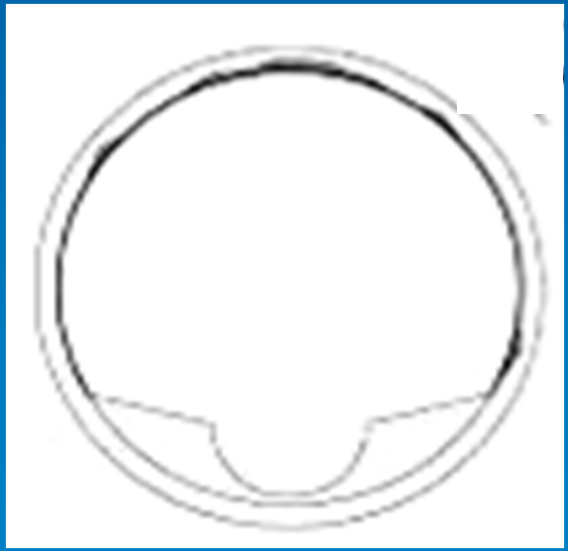
STA. 59+00 – 93+00

NO SCALE

ELEVATIONS AND DEPTHS ARE VARIABLE IN THIS REGION. THOSE NOTED HERE ARE AN AVERAGED REPRESENTATION TO CHARACTERIZE THE STRATA.

Background *(Cont.)*

- Precast RCP laid within 96-inch ID timber-lagging tunnel and grouted in place
- Experienced H_2S corrosion
- Four existing access portals near the alignment being rehabilitated (including three portals and a drop structure)
- Alignment also includes large radius horizontal curves (1,200 ft and 450-ft)
- Previous rehabilitation methods included Linabond for pipe and Raven Coating at the drop structure



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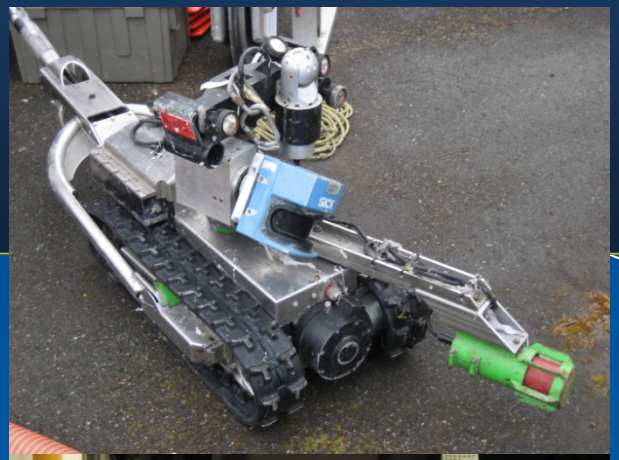
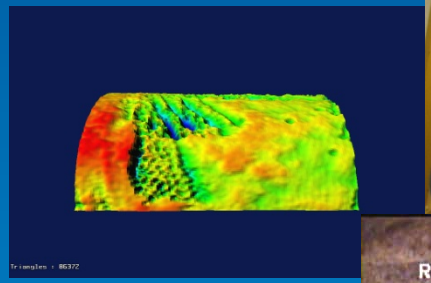
CONDITION ASSESSMENT

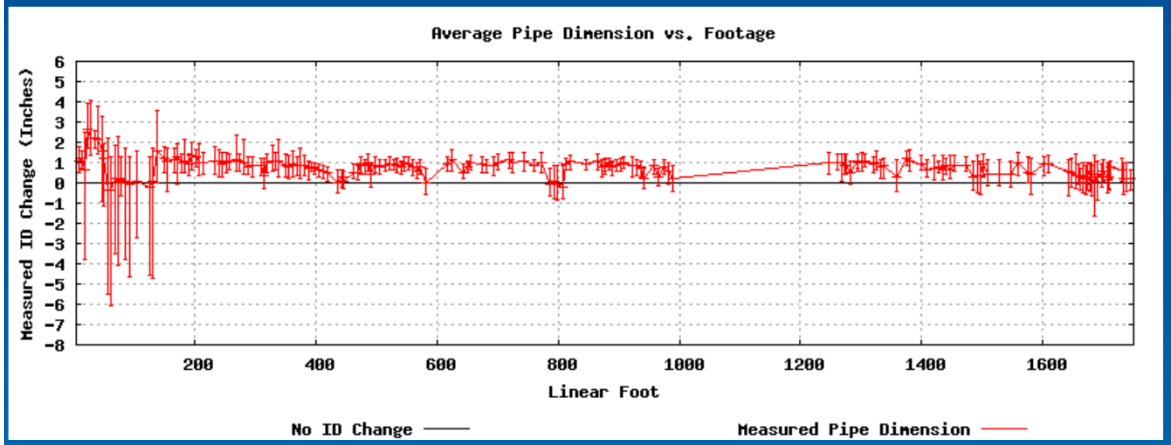
Information Collected

- Sonar
  - Condition under flow
  - Debris Quantity
- Laser
  - Ovality
  - Eccentricity
  - Average ID
- Gas
  - H_2S
- CCTV
  - NASSCO PACP

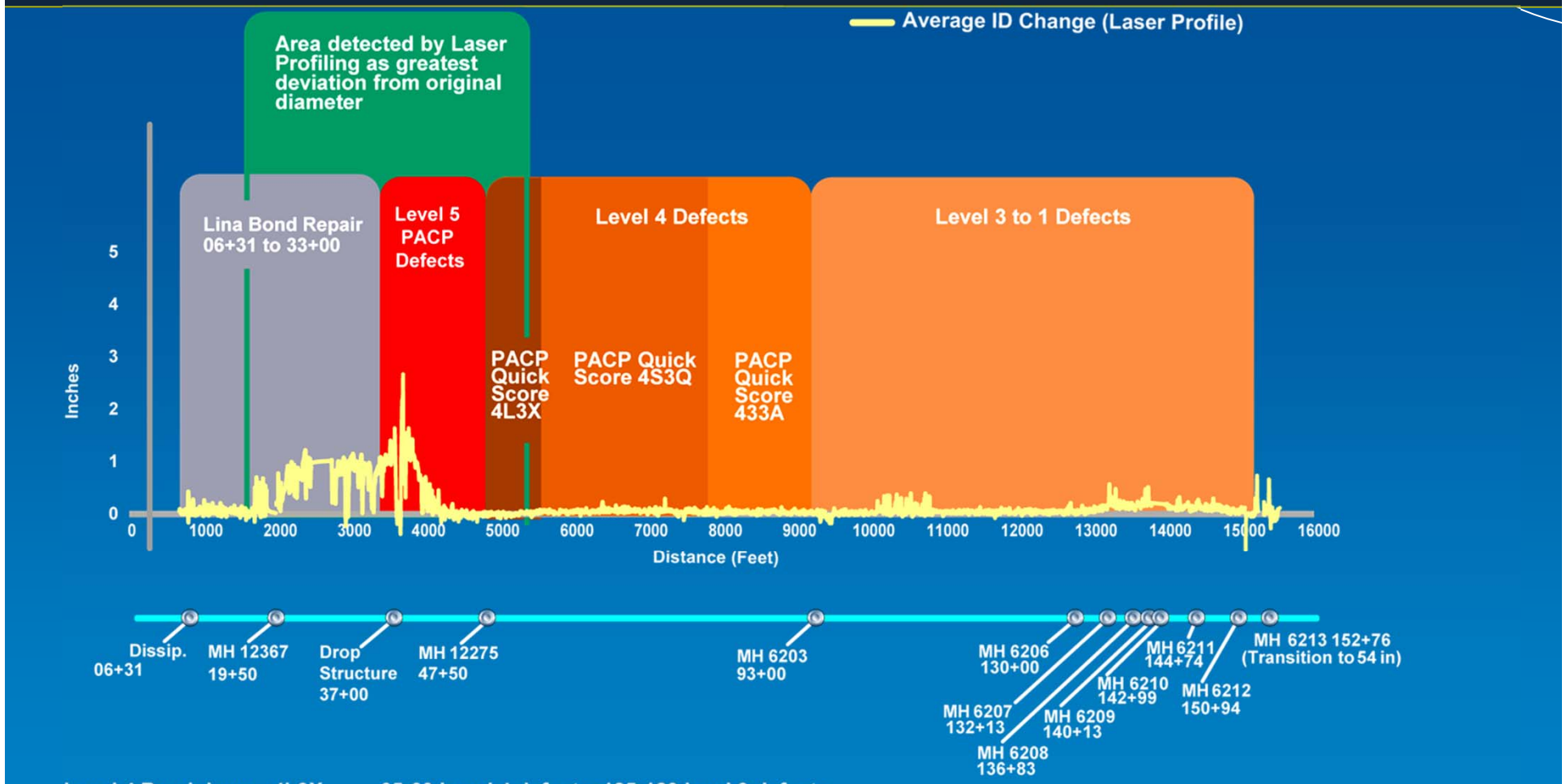




Sample Defects Found



Tunnel Condition Assessment Summary Graph



Level 4 Breakdown		
	4L3X	65-69 Level 4 defects, 125-129 level 3 defects
	4S3Q	100-104 Level 4 defetcs, 90-94 level 3 defects
	433A	3 Level 4 defects, 10-14 level 3 defects

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Accumulated Debris

Upstream MH	Downstream MH	Diam.	Inspection Distance (ft)	Cumulative Sediment Volume (cu. Ft)	Average Sediment Depth (inches)
06203	12275	72	1,800	235.3	1.6
06203	12275	72	2,851	79.4	0.35
12275	06201	72	1,040	10.1	0.16
	Totals		5,691	324.8	

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REHABILITATION OPTIONS

Rehabilitation Options

- Bondstrand® RPMP
- Channeline
- Hobas
- Insituform
- RibLoc
- Sabas
- Sekisui
- Trolining
- Linabond

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Rehabilitation Technologies Allowed

- Bondstrand RPMP
  - Ameron International Water Transmission Group
- Channeline
  - Channeline International
- Sabas
  - SABAS Pipeline Systems LLC

	Design Life (50 years+)	Cost	Availability (Location)	Capacity (MGD)	Risk (L-M-H)
Bondstrand			U.S.		L-M
Channeline			Dubai		L-M
Sabas			U.A.E.		L-M
Sekisui			Japan		M-H

Criteria	Average Weighed Ranking
Capacity	3.5
Implementation Cost	6.1
Availability of Materials and Contractors	7.2
Longevity	7.3
Risk of Cost Increase	12.6
Impact on Community	14.0
Safety	15.0
Construction Duration	16.7
Maximum Use of Existing Assets	22.8
Bypass Requirements	24.4
Ability to Oversee Current Construction	26.4
Flexibility	26.8
Ease of Construction/Scheduling	27.3

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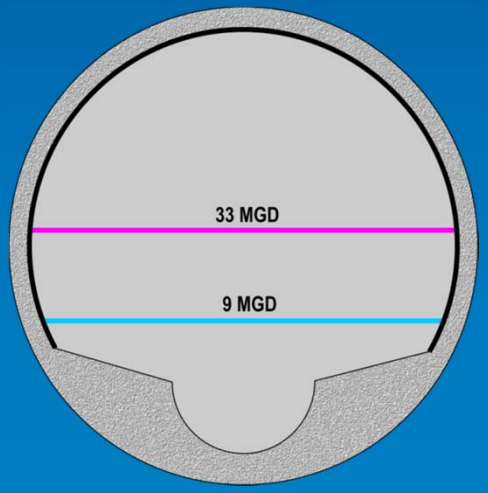
PROJECT DESIGN

Minimum Criteria/Requirements

- Maintain existing capacity
- 50+ years life expectancy
- Existing capacity 73.3 MGD
  - n=0.013 (new pipe)
  - S=0.0010 (minimum)
  - 33 MGD observed after last significant storm in 2008



Slope = 0.0010

(Upstream of Drop Structure)

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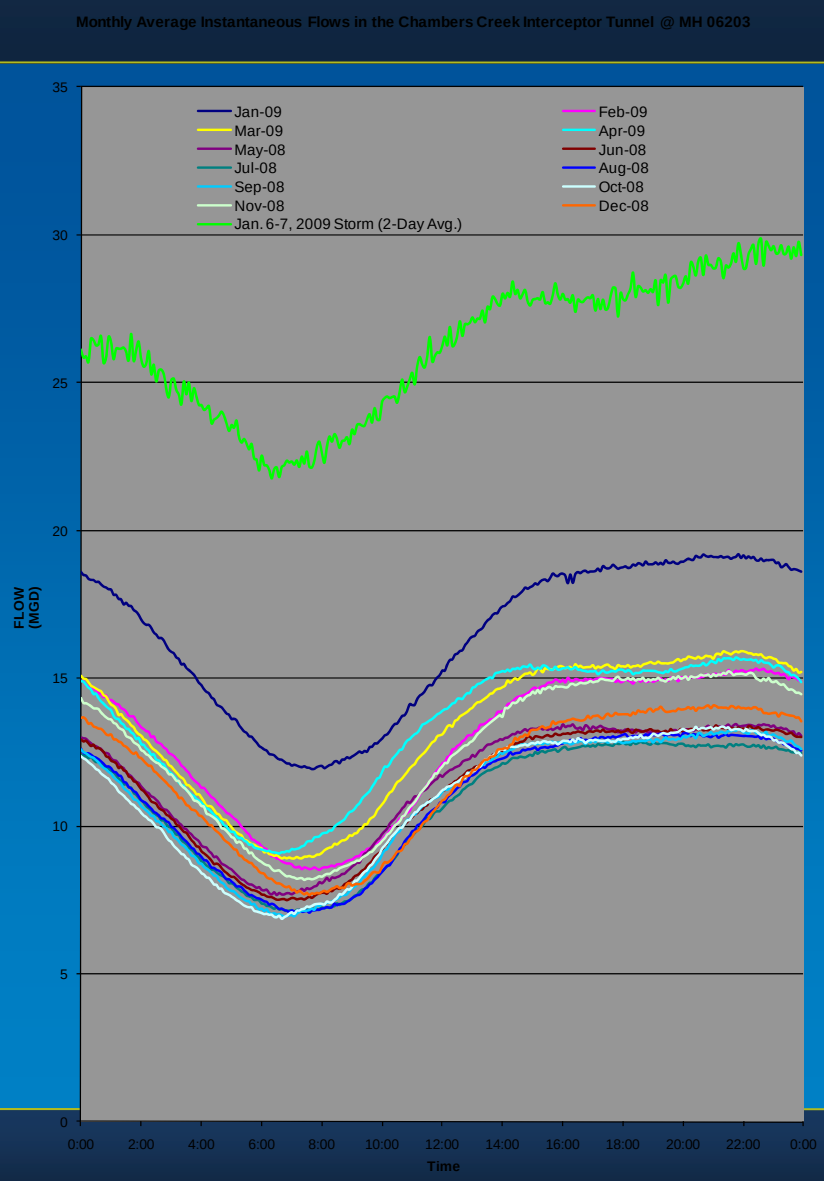
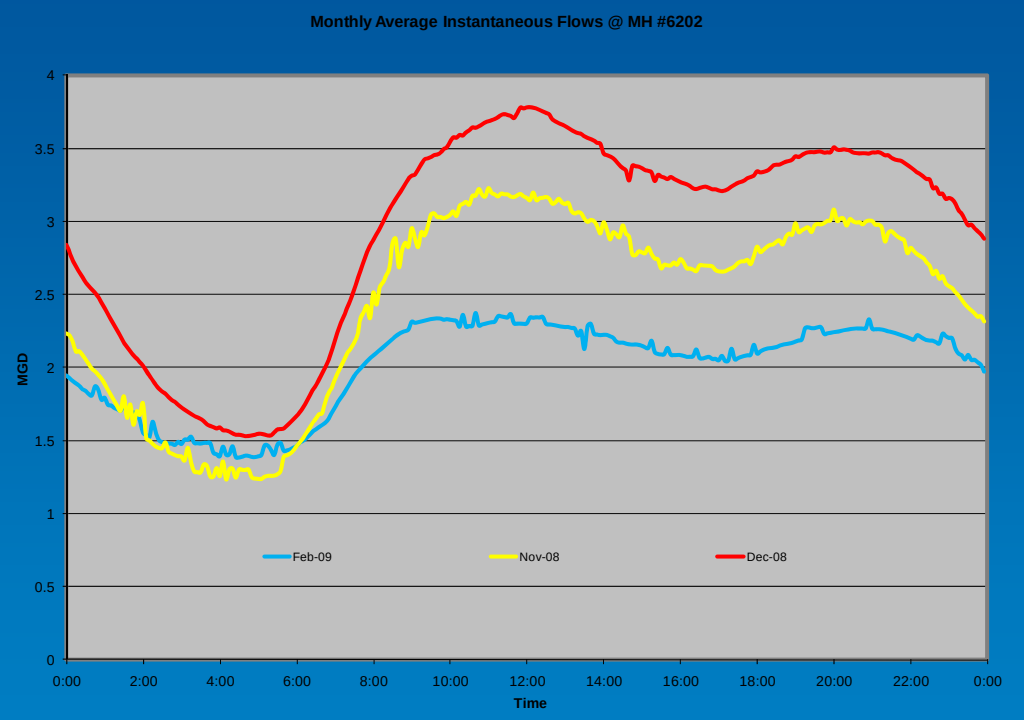
Flow Conditions





Other Criteria

- 2,500(±) LF minimum rehabilitation of existing tunnel
  - 90-100 feet below grade
- Option to rehabilitate up to 5,500 LF under single contract
- Temporary installation/access shafts abandoned in place
  - Upper 15-ft must be removed
- Surface bypassing of the main tunnel flow not permitted
- Interface new rehabilitation with existing Linabond used for previous rehabilitation

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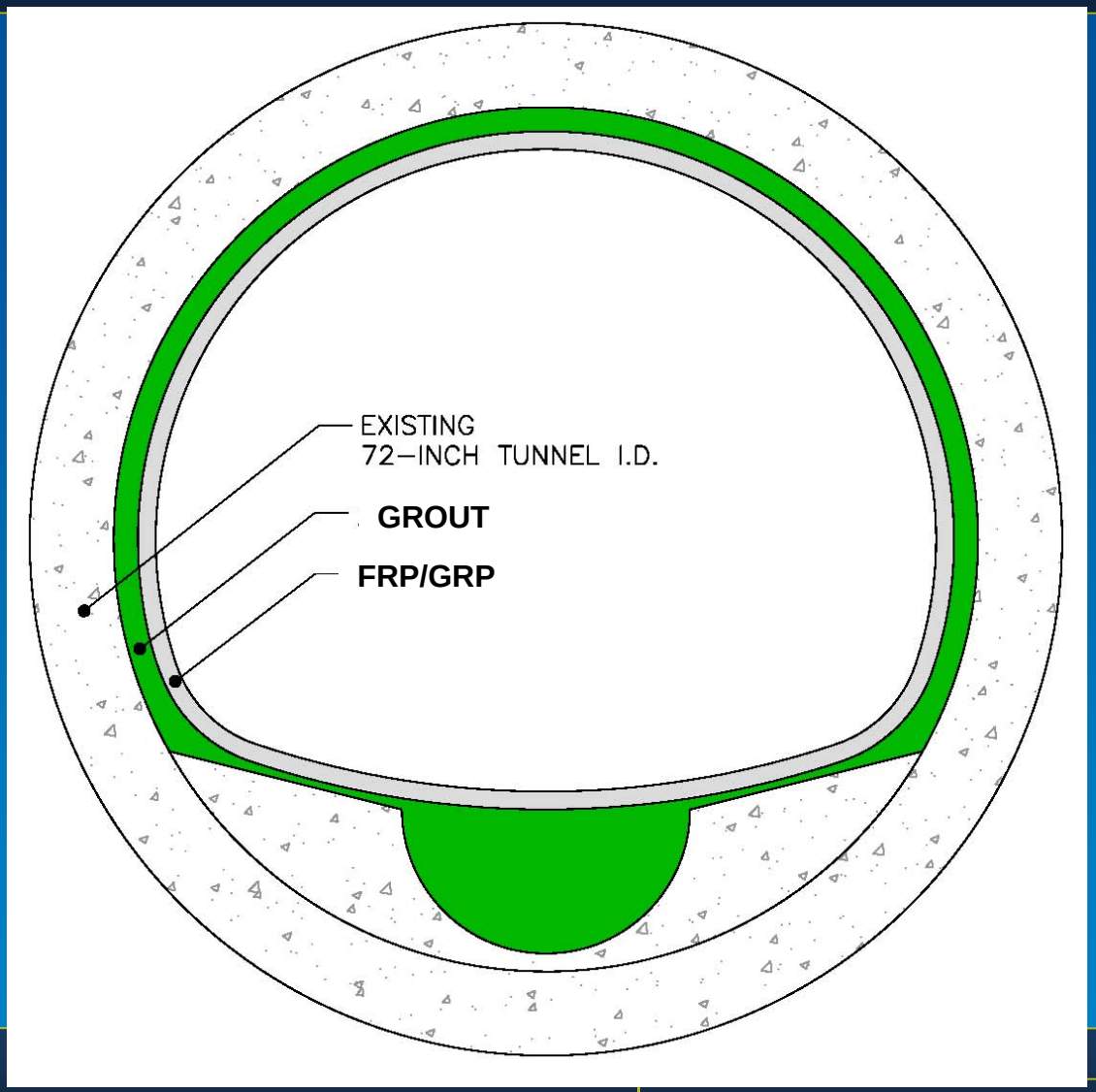
Proposed Tunnel Cross Section after Rehabilitation



Major Scope Items

- Cleaning of existing tunnel
- Pre- and post-rehabilitation CCTV
- Permits
- Construction of new access portals for installation
- Bypass of Tacoma flows only (at drop structure)
- Modifications to drop structure
- Procurement and installation of rehabilitation product
- Grouting of annular space and cunette
- Traffic control
- Temporary erosion and sediment control
- Restoration of existing access portals
- Surface restoration

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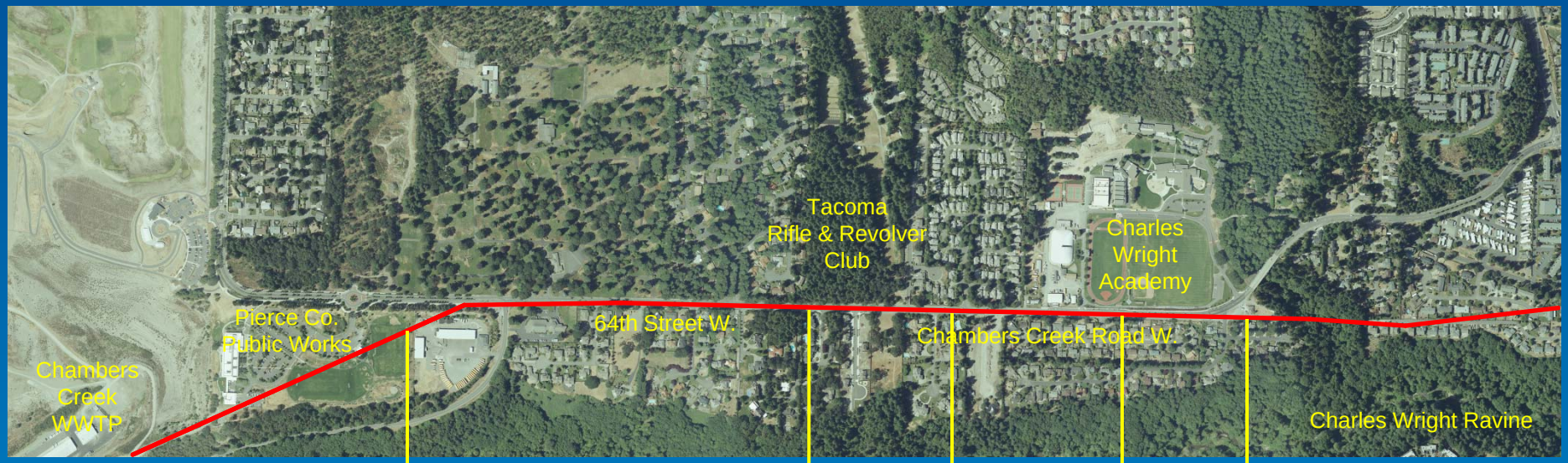
Bidding Alternatives



2,500 LF (±) Base Bid

3,500 LF (Alternative Bid #1)

4,500 LF (Alternative Bid #2)

5,500 LF (Alternative Bid #3)

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KEY NOTES:

1. EXISTING 72-INCH DIA RCP CHAMBERS CREEK INTERCEPTOR TUNNEL W/ 24-INCH DIA CUNETTE TO BE REHABILITATED BY SEGMENTAL SLIPLINING.
2. TERMINATION OF EXISTING LINABOND REHABILITATION. BEGIN REHABILITATION BY SEGMENTAL SLIPLINING. SEE TRANSITION DETAILS ON DRAWING 08C007.
3. HORIZONTAL BEND IN ALIGNMENT. MINIMUM RADIUS APPROXIMATELY 450 FT PER RECORD DRAWINGS. CONTRACTOR SHALL FIELD VERIFY CURVE RADIUS AND LOCATION PRIOR TO SEGMENTAL SLIPLINING.
4. MODIFY EXISTING DROP STRUCTURE SEE DRAWING 08C008, 08C009 AND 08C010.
5. CONTRACTOR SHALL INSTALL TEMPORARY BYPASS OF FLOWS FROM EXIST MH 09529 TO EXIST DROP STRUCTURE FOR CONSTRUCTION ACTIVITIES RELATED TO THE MODIFICATION OF THE EXISTING DROP STRUCTURE PIPING AND SEGMENTAL SLIPLINING THRU THE DROP STRUCTURE.
6. HORIZONTAL BEND IN ALIGNMENTS. MINIMUM RADIUS APPROXIMATELY 1200 FT PER RECORD DRAWINGS. CONTRACTOR SHALL FIELD VERIFY CURVE RADIUS AND LOCATION PRIOR TO SEGMENTAL SLIPLINING.
7. LAYDOWN AREAS. SEE DRAWING 08C013.

DRAWING NOTES:

1. BASE PROJECT LENGTH OF REHABILITATION IS 2,500 LF FROM STA 33+00 TO STA 58+00.
2. FIRST ORDER OF WORK WILL ENCOMPASS REHABILITATION OF STA 33+00 TO STA 48+00.
3. STORM DRAINS AND OTHER UTILITIES ARE NOT SHOWN ON THESE DRAWINGS FOR CLARITY. EXISTING UTILITY INFORMATION CAN BE FOUND IN THE SUPPLEMENTAL REFERENCE INFORMATION AS DESCRIBED IN SECTION 01800.

NORTH

1" = 50'

25 0 50

VERIFY SCALE
BAR IS ONE INCH
IF PLOTTED FULL SCALE

K:\85598 (Pierce County)\6-26-09 DWG\08C002010020.dwg SAVED: 7/8/09 PRINTED: 7/8/09 BY: HUFFSMITH4

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FILE: 08C002	DATE ISSUED: JULY 2009
CAD FILENAME: 08C002G02.DWG	LAST PLOT DATE: 7/7/09 REV.

RECEIVED PROFESSIONAL ENGINEER STATE OF CALIFORNIA 7/7/09 DATE OF WRITTEN ENTRY NEW ENTRY

NO.	REVISION	DATE	APPD

DATE	SCALE
7/7/09	1" = 50'
DESIGNED	CHECKED
SLD	LRL
DRAWN	APPROVED
XMH	LRL

PIERCE COUNTY PUBLIC WORKS & UTILITIES DEPARTMENT

CHAMBERS CREEK INTERCEPTOR TUNNEL REHABILITATION PROJECT PHASE 2

9401 Chambers Creek Road West
UNIVERSITY PLACE, WASHINGTON 98467-1041

STA 33+00 TO 45+00

DRAWING NO.
08C002

5 OF 17

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KEY NOTES:

1. EXISTING 72-INCH DIA RCP/CHAMBERS CREEK INTERCEPTOR TUNNEL W/ 24-INCH DIA CUNETTE TO BE REHABILITATED BY SEGMENTAL SLIPLINING.
2. REESTABLISH EXISTING PORTAL ACCESS. SEE EXISTING PORTAL CONNECTION DETAILS ON DRAWING 08C011. EXISTING PORTALS ARE ONLY AVAILABLE FOR ACCESS PURPOSES AND SHALL NOT BE DECONSTRUCTED OR OTHERWISE MODIFIED FOR COMPLETING THE WORK.

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1" = 50'

25 0 50

VERIFY SCALE

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FILE: 08C003	DATE ISSUED: JULY 2009
CAD FILENAME 08C0020100S.DWG	LAST PLOT DATE: 7/7/09 REV.

REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA — 7/7/09 — STATE OF WASHINGTON

NO.	REVISION	DATE	APPD

DATE	SCALE
7/7/09	1" = 50'
DESIGNED	CHECKED
SLD	LRL
DRAWN	APPROVED
KMH	LRL

PIERCE COUNTY PUBLIC WORKS & UTILITIES DEPARTMENT

CHAMBERS CREEK INTERCEPTOR TUNNEL REHABILITATION PROJECT PHASE 2

(08) Chambers Creek Road West — TACOMA PLACE, WASHINGTON 98467-1046

STA 45+00 TO 57+00

DRAWING NO. 08C003

6 OF 17

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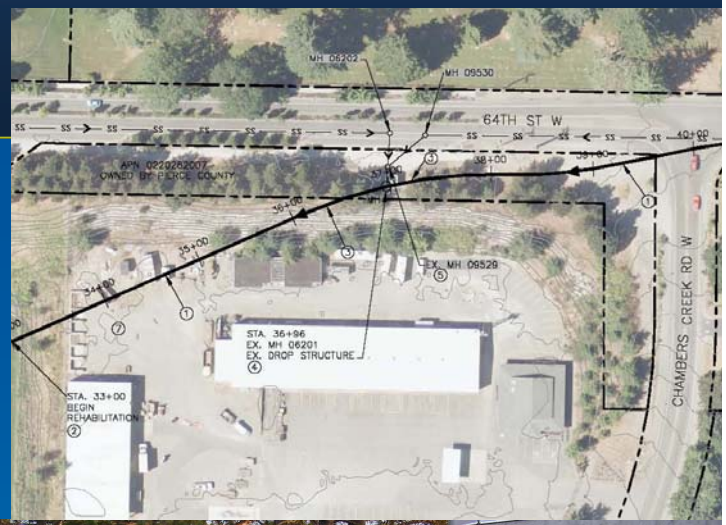
Installation Shafts

- Basis
  - Designed by the contractor
  - Depends on installation equipment and method
  - 24-ft maximum dimension (based on installation equipment)
  - Maximum jacking force NTE 25% of initial axial pipe capacity

Portal #3

Tacoma Flows at Drop Structure

- Existing 30-inch pipe
- Between 2 and 8 MGD
- Connect to drop structure
- Construction Surface Bypass
- Reconnect after rehab



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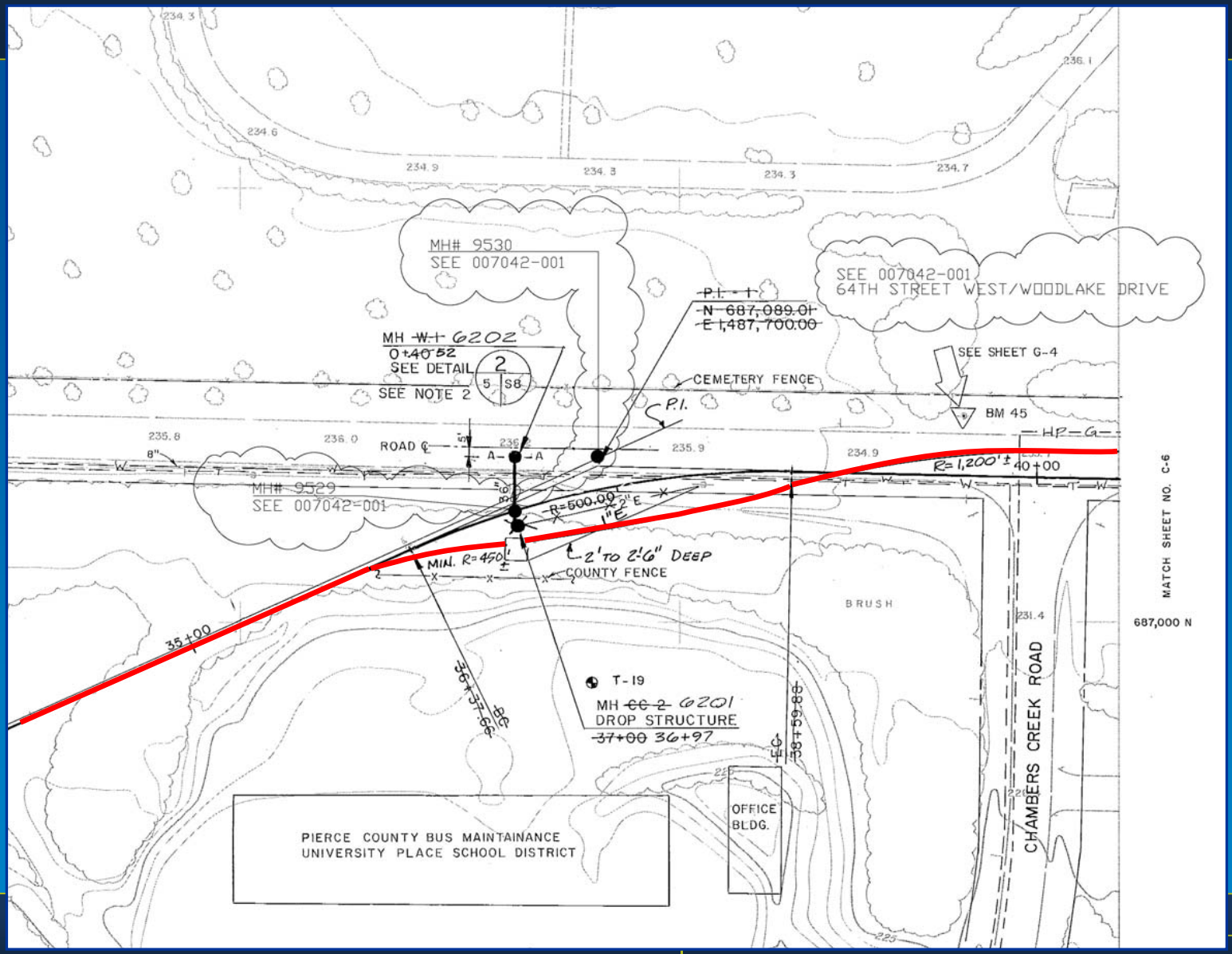
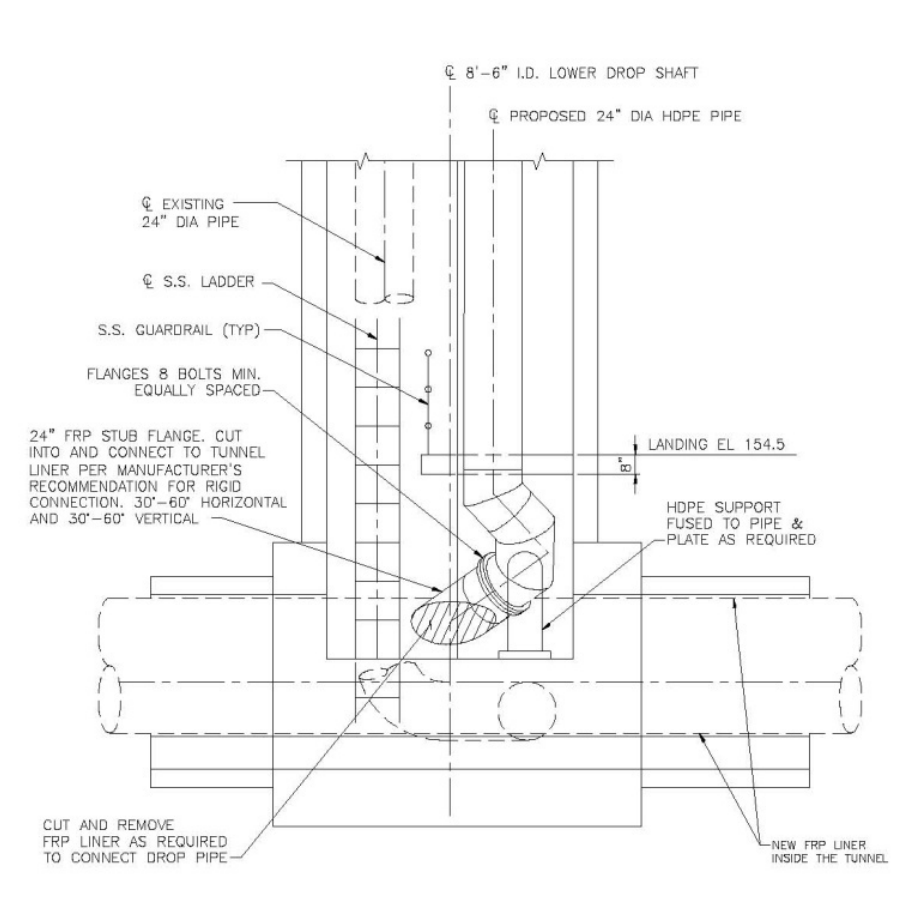
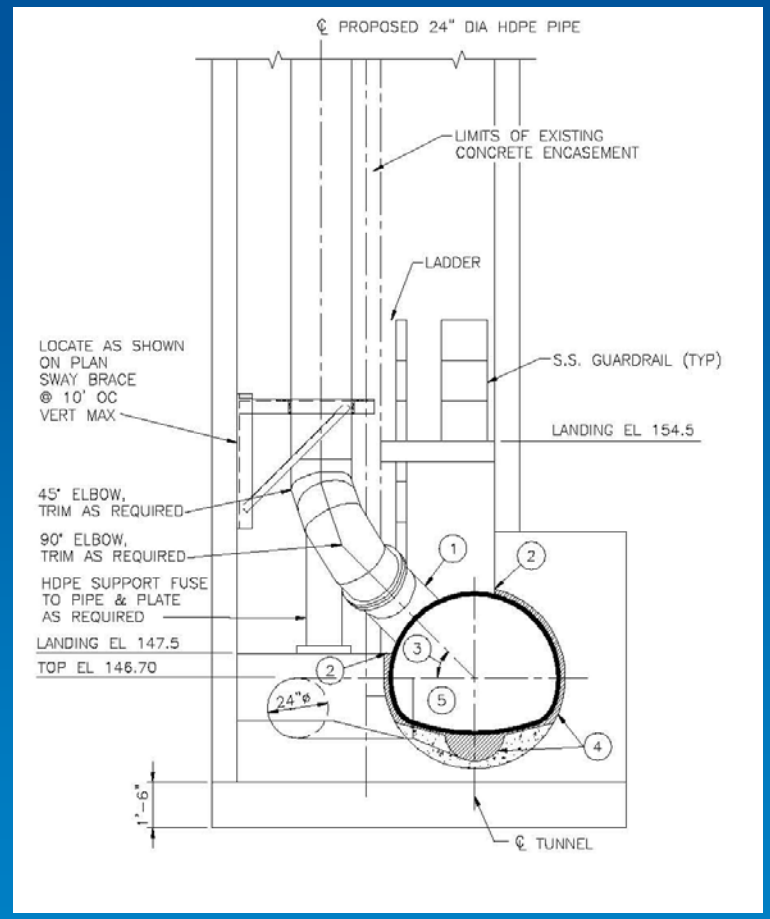
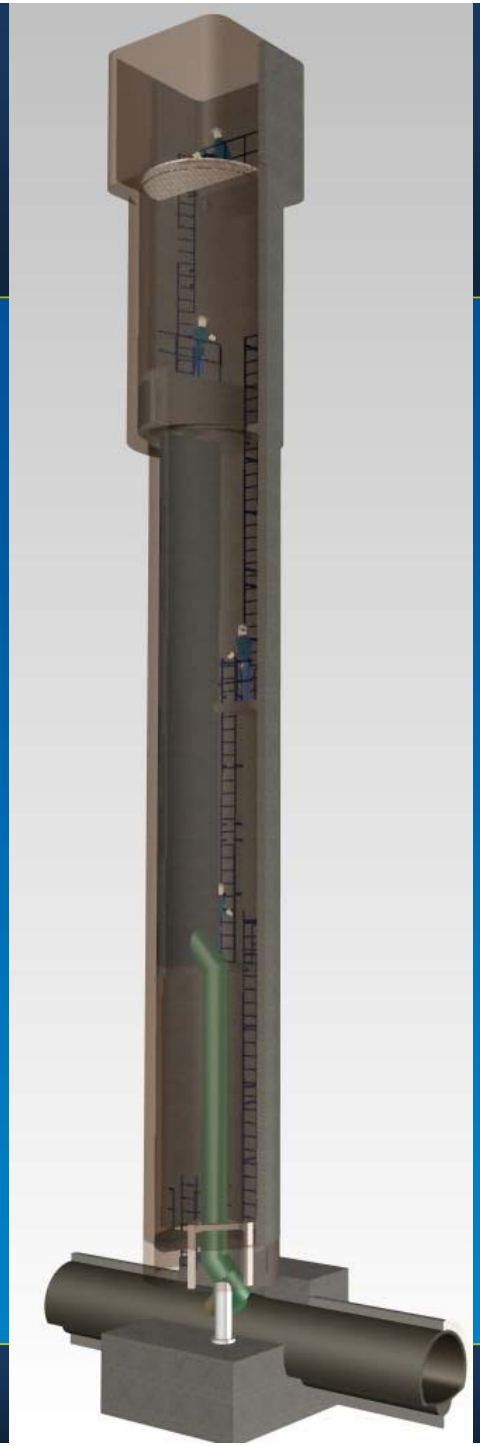
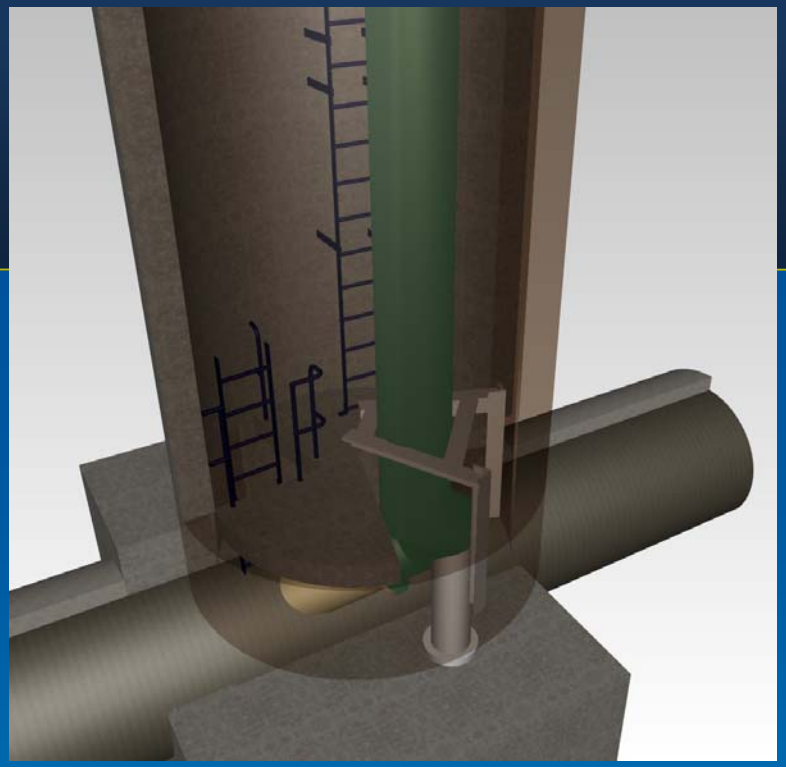
Station 37+00 – Existing Drop Structure

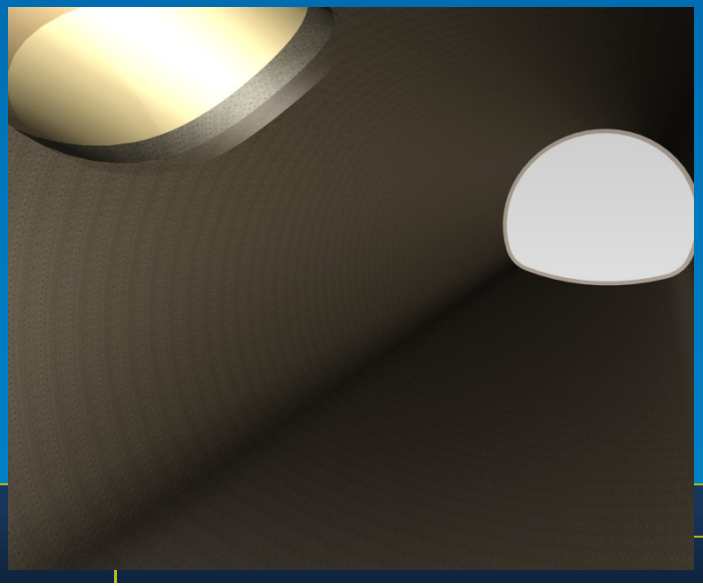



℄ 8'-6" I.D. LOWER DROP SHAFT
℄ PROPOSED 24" DIA HDPE PIPE
℄ EXISTING 24" DIA PIPE
℄ S.S. LADDER
S.S. GUARDRAIL (TYP)
FLANGES 8 BOLTS MIN. EQUALLY SPACED
24" FRP STUB FLANGE. CUT INTO AND CONNECT TO TUNNEL LINER PER MANUFACTURER'S RECOMMENDATION FOR RIGID CONNECTION. 30°-60° HORIZONTAL AND 30°-60° VERTICAL
LANDING EL 154.5
8"
HDPE SUPPORT FUSED TO PIPE & PLATE AS REQUIRED
CUT AND REMOVE FRP LINER AS REQUIRED TO CONNECT DROP PIPE
NEW FRP LINER INSIDE THE TUNNEL


℄ PROPOSED 24" DIA HDPE PIPE
LIMITS OF EXISTING CONCRETE ENCASEMENT
LADDER
S.S. GUARDRAIL (TYP)
LOCATE AS SHOWN ON PLAN SWAY BRACE @ 10' OC VERT MAX
LANDING EL 154.5
45° ELBOW, TRIM AS REQUIRED
90° ELBOW, TRIM AS REQUIRED
HDPE SUPPORT FUSE TO PIPE & PLATE AS REQUIRED
LANDING EL 147.5
TOP EL 146.70
24"ø
1'-6"
℄ TUNNEL
1
2
3
4
5







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Restoration of Installation Shafts

- New shafts constructed for rehab installation
  - Abandon after installation
    - Filled to full depth
    - Capped
- No additional permanent portals (manholes) required
- Restoration paid as part of price for each installation shafts

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Surface Restoration

- Paving
- Striping
- Landscaping
  - Restored to original conditions
  - Keep accurate photo records
- No additional requirements beyond existing conditions

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CONSTRUCTION

Goals for Project Procurement

- Fair
- Manage objectives
- Have mechanism to rehabilitate more than 2,500 ft
- Select qualified contractor

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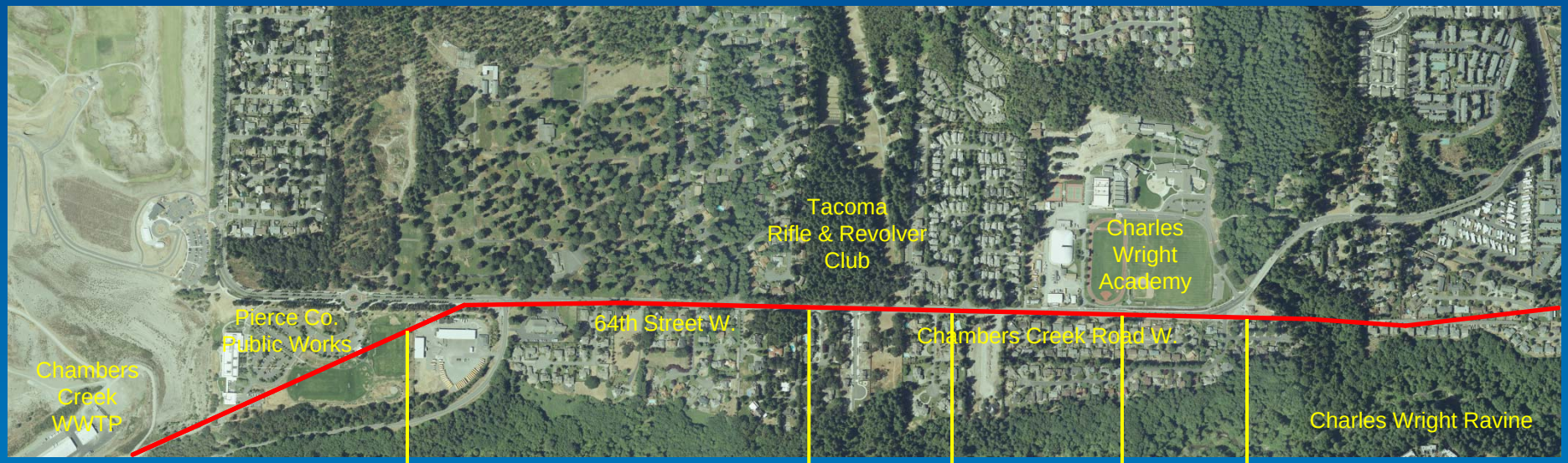
Bidding Alternatives



2,500 LF (±) Base Bid

3,500 LF (Alternative Bid #1)

4,500 LF (Alternative Bid #2)

5,500 LF (Alternative Bid #3)

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Eligibility Requirements

- Corporation Experience
  - Tunneling
  - Rehabilitation of large diameter pipelines ($\geq$ 48-inch)
    - Minimum 5,000 feet of sliplining in last five years
    - 20-ft deep or greater
    - No flow bypass
  - Financial Solvency
  - Insurance
- Superintendent Experience – meet at least three
  - Rehabilitation of large diameter pipelines
  - Minimum 5,000 feet of sliplining or SPR in last five years
  - Installation in flow conditions
  - Deep installations (>20 feet)

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Sabas

- Injection-molded Reinforced (Fiberglass)
  Polymer Mortar Pipe

- Rehabilitation Technology
  - Segmental Sliplining
- Service Life
  - 50-100 years
- Proposed 1.34” thick pipe w/ 2.5” grout

Cut and Jointed Liner Section

Installation Shafts

Installation Shafts

Unforeseen Conditions

- Verification of field clearance inside tunnel
  - Offset joints
  - Lips
- Unsuccessful internal bypass
- Areas with less severe corrosion and smaller annulus

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Mitigation Steps during Construction

- Removed FRP skids
- Installed external bypass
- Perform additional remedial work to remove concrete on sloped benches
- Slipline in the dry by hand-carrying FRP liner
- Joint FRP sections with Sikaflex 221

Construction of New Permanent Access

- Added a saddle manhole
  - 120-inch precast
  - Cast-in-place LW hatch over the interceptor

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Challenges of Modifications to the Drop Structure

- Confined space with limited access
- NFPA classified space
- Measurement, fabrication and fit up of HDPE x FRP fitting
- Specialty fiberglass work to match fitting to liner
- Restraining HDPE pipe at bottom of drop structure

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Finished Product

CONCLUSIONS

Conclusions

- Original contract for 3,500 ft was $9.37M
- Change Orders $4.5M
- Grand Total paid $14.3 M (w/taxes)
- Rehabilitation of tunnel was successful
- Fata flaws are negotiable
  - Bypass pumping
- Complexity of project could benefit by using GC/CM contracting procedure

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THANK YOU

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