M E M O R A N D U M

TO: Board of Trustees

THROUGH: Indra Winquest
District General Manager

FROM: Brad Underwood, P.E.
Director of Public Works

SUBJECT: Review and discuss – Effluent Pipeline Project Update

STRATEGIC PLAN: Long Range Principle 5 – Assets and Infrastructure

DATE: March 1, 2022

I. RECOMMENDATION

This memo is provided for Effluent Pipeline Project informational update purposes only.

II. District Strategic Plan

Long Range Principle 5 – Assets and Infrastructure – The District will practice perpetual asset renewal, replacement, and improvement to provide safe and superior long term utility services and recreation venues, facilities and services.

- Maintain, renew, expand, and enhance District infrastructure to meet the capacity needs and desires of the community for future generations.
- Maintain, procure, and construct District assets to ensure safe and accessible operations for the public and the District's workforce.

III. BACKGROUND

The Effluent Export Pipeline (EEP) provides conveyance from the IVGID Wastewater Resource Recovery Facility (WRRF) to the District's wetlands facility in Carson Valley. The existing pipeline is comprised of four critical segment lengths:

- Segment 1 carries the treated effluent from the WRRF to the Spooner Pump Station (SPS) via gravity flow;

- Segment 2 conveys the effluent from the SPS to the north end of Spooner Meadows under pressure flow;
- Segment 3 conveys effluent to the Spooner Summit under pressure flow;
- Segment 4 starts at Spooner Summit, where the EEP transitions from pressure flow back to gravity flow on the downhill run to the District's wetlands facility.

The EEP Project (Project) proposes to replace the entire Segment 2 portion of the effluent pipeline. There are approximately 29,650 lineal feet (LF) of 16-inch pipeline to be replaced as part of the Project. Pipeline segments 1 and 3 have been previously replaced, and segment 4 does not require replacement at this time.

In 2015 and 2018, pipeline surveys were completed to provide a condition assessment of the Segment 2 portion of the EEP. These surveys revealed there are multiple locations along the EEP identified as deficient, although these surveys were unable to provide a condition assessment of the pipeline joints due to limitations in the technology. IVGID has completed multiple emergency repairs along Segment 2 since these inspections, and field observations of the failed sections of pipeline indicate corrosion-related failures typically located at the pipeline joints.

IVGID has entered into an agreement with HDR Engineering to complete evaluations of rehabilitation methods and prepare a Basis of Design Report and subsequent 30% Design submittal. HDR is currently in progress with these services and a summary of the progress to date is below.

Existing Operations Review:
HDR reviewed the existing EEP to verify operating parameters within the pipeline system to advise on appropriate materials for replacement of the existing pipeline.

Average flows from the WRRF are nearly one million gallons per day (1 MGD). The peak flow observed in recent years is 1.62 MGD. The plant has a maximum allowable discharge volume of 2.60 MGD.

Flow pressure varies along Segment 2 as the effluent travels further from the pump station and as the vertical elevation of the pipeline changes. The maximum pressure zone of approximately 440 psi is expected immediately downstream of the SPS. The pressure where Segment 2 ends and joins Segment 3 (~30,000 LF from SPS) is in the range of 50 psi.

Construction Methodologies:
Many available materials and installation technologies/methods available for pipeline replacement were reviewed by HDR and Granite Construction (CMAR). A large majority of the applications were eliminated from consideration due to

existing operating pressures, vertical/horizontal pipe alignment (i.e. bends, fittings, etc.), and other practical/physical limitations (construction durations, SR28 road space, ground conditions, etc.).

Following technical and practical construction methodology reviews with the CMAR team, the following technologies are currently being evaluated:

- Open Cut, Remove, and Replace
  - This is standard trenching completed by excavation equipment opening a trench, removing the existing pipeline, and installing new pipeline, then backfilling for road restoration.

- Cured-in-place-pipeline (CIPP)
  - This method is intended to greatly reduce the quantity of excavation/trenching required by installing a flexible liner material in the existing pipeline, expanding by pressurization to full pipe diameter and curing the liner in place (with steam or ultraviolet light) until hardened.

- Slip-lining
  - Slip-lining involves inserting a new pipe into the existing pipeline and typically requires filing the annular gap between the new pipe and the existing pipe with grout material. This method is similar to CIPP in that it can greatly reduce the amount of earthwork required to complete the work.

The CMAR team is assessing the use of each of these options, as their suitability varies depending on location along the Segment 2 pipeline. For example, some sections are difficult to use open-cut trenching because of existing curb and gutter, guardrail, or depth to existing pipe. Likewise, certain areas are incompatible with trenchless technologies (CIPP or slip-lining) because bends and directional changes in the existing EEP alignment exceed the trenchless installation capability.

The construction duration, cost, and associated risk profile for each application is being considered as part of the next steps in design development and construction stage planning.

Pipeline Materials:
The available pipeline materials also vary greatly; however, for the criteria specific to the IVGD EEP Project, the most suitable materials are narrowed down to steel, ductile iron, or high density polyethylene (HDPE):

- Steel Pipe

  - Steel pipe is proposed for the high pressure zones (>350psi) located immediately downstream of the SPS. Steel pipe requires welded joints and is suitable for the Project conditions. Steel pipe requires a protective lining both on the interior and exterior of the pipe to minimize corrosion. The duration of construction would be considerably higher than other pipe installations due to the welding time required.

- Ductile Iron Pipe (DIP)
  - DIP is typically used in pipeline where the pressures are below 350 psi. DIP also requires protective lining for the interior and exterior of the pipe to limit corrosion of the pipe walls. The installation of DIP is straightforward and requires no welding; therefore, it can yield higher production rates for installation on a project. The CMAR team are currently investigating available DIP for suitability for the high pressure zones (>350 psi).

- HDPE Pipe
  - HDPE is typically used in pipelines where pressures are below 335 psi. HDPE pipe is corrosion resistant and does not require either interior or exterior lining.

Preliminary Design Report:
HDR completed the Preliminary Design Report and submitted to IVGID staff on February 22, 2022. The report provides technical and background information summarized herein, in addition to specific considerations for use in developing the 30% design documents.

Next Steps:
The CMAR team will continue to develop the preliminary design information for input into the 30% design documents. The anticipated submittal date of the 30% design is in March 2022.

The 30% design will outline high level details necessary to advance the regulatory permitting and approval processes. This level of design will also provide a basis for the CMAR to use in further design development and construction-phase planning.

A 60% design level suite of documents will follow the 30% review process. However, contract amendments for HDR (Design Consultant) and Granite (Head Contractor) will be required to move into the next phase.

Required Storage Volume:
The effluent pipeline project requires approximately six million gallons of effluent storage. This allows the effluent pipeline to be taken offline for up to four days while the effluent pipeline replacement construction is completed, one section at a time.

The lining design for permanent effluent storage within Pond 2 was independently developed for compliance with the NDEP discharge permit. The design required a large earth bench 15 feet wide and approximately 25 feet tall, placed against the upstream face of Dam 2. This is prohibited by Nevada Division of Water Resources without an approved dam permit. Pond 1 is now being investigated for the location of the permanent effluent storage to meet the discharge permit requirements.

However, a liner can be placed over the existing dam provided that grading/earthworks do not alter the existing dam face, as minor maintenance grading is permissible. The CMAR team is currently investigating the feasibility of utilizing Pond 2 with a temporary liner placed over the entire dam face and anchored with concrete barriers on the existing access road on the crest of the dam. The remaining three sides can be conventionally anchored and keyed/buried into the ground. There are technical challenges to overcome and these are currently being assessed against constructability and cost implications.

The temporary lining of Pond 2 provides the six-million-gallon storage requirement, enabling the effluent pipeline replacement project to proceed with a 4-day work week. The lining would be removed upon completion of the EEP project.

IV. BID RESULTS

There are no bid results associated with this item.

V. FINANCIAL IMPACT AND BUDGET

A contract amendment with HDR to advance the EEP design is needed and will be brought to the Board for approval.

Funding exists within the FY 2021-22 CIP Budget for the Effluent Pipeline Pond Lining Project 2524SS1010 (see attached data sheet – Attachment B) in the amount of $2,000,000.

The following is a summary of the HDR contract amounts to date:

Contract	Amount	Total Amount
Original Agreement	$115,614	$115,614
ASA #1 (scope change)	$0	$115,614

Engineering Staff time will also be billed to the project to manage the design and bidding phase of the project.

VI. ALTERNATIVES

At this time there are no available alternatives for effluent pipeline replacement or rehabilitation design.

Continued maintenance and emergency repairs will be required indefinitely to keep the WRRF and effluent pipeline operational.

VII. BUSINESS IMPACT

This item is not a "rule" within the meaning of Nevada Revised Statutes, Chapter 237, and does not require a Business Impact Statement.

Attachments

- Preliminary Design Report
- CIP Data Sheet
- Presentation

ATTACHMENT A

Export Pipeline Preliminary Design Report

Incline Village General Improvement District

Effluent Export Pipeline Project, Phase 1

Incline Village, NV

February 22, 2022

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1. Background

The purpose of this report is to summarize the preliminary design of the rehabilitation and replacement of Segment 2 of the Incline Village General Improvement District (IVGID) effluent pipeline. The existing Effluent Export Pipeline alignment is shown in Figure 1. From the water resource recovery facility (WRRF) the effluent pipeline leaves a storage tank and flows by gravity to the Spooner Pump Station, from which the effluent is pumped south along State Highway 28, turns east along State Highway 50 to Spooner Summit and then continues east to IVGID's wetlands facility. The portion of the pipeline within Highways 28 and 50 is within Nevada Department of Transportation (NDOT) right-of-way. Segments of the effluent line were replaced between 2006 and 2010 (delineated on Figure 1) and a critical repair project replaced approximately 1,200 feet total over 13 separate repairs in 2017-2018. Installation year, material, and location of each effluent pipeline segment are provided in Table 1.

Table 1: Existing Effluent Export Pipeline Segment Summary

Segment	Stationing (STA)	Year	Material
1	-23+63 – 0+00	1970	Steel
1 Lakeshore	0+00 – 16+00	2010	DIP
1	16+00 – 144+15	2006	HDPE
1 Sand Harbor	144+15 – 179+84	2010	DIP
2	200+00 – 497+21	1970	Steel
3 North	497+21 – 562+82	2007	DIP
3 South	562+82 – 601+24	2008	DIP
4	601+24 – XXX+XX	1970	Asbestos Cement
5	XXX+XX – 1009+60	1970	Asbestos Cement
5 Carson Valley	1009+60 – 1021+60	2010	HDPE

Note: The break in stationing between Segment 1 Sand Harbor and Segment 2 is caused by stationing disparities between the original 1970 record drawings and the 2010 Segment 1 replacement drawings.

This project is focused on the rehabilitation and replacement of Segment 2. The existing effluent pipeline in Segment 2 consists of nominal 16" diameter steel pipe (spiral weld AWWA C200) with cement mortar lining (CML) and spiral wrapped asphalt coating. At STA 373+38 the pipe joints change from welded joints to push-on joints. Existing 16" diameter steel pipe wall types in Segment 2 include the following (note that dimensions may vary +/- 5.7% based on stated manufacturing tolerance):

- 12GA – 0.1045" net weight tolerance (NWT)
- 10GA – 0.1345" NWT
- 8GA – 0.164" NWT
- 3/16" – 0.1875" NWT
- 7/32" – 0.21875" NWT
- 1/4" – 0.250" NWT

Over the years, several leaks have occurred along all segments of the pipeline. Investigations determined that the pipeline's interior lining system is deteriorating, and that progressive corrosion is causing leakage at the pipe joints. Because of the deterioration and leakage, IVGID initiated the effort to replace Segment 2. Following a previous HDR Preliminary Design Report for Segment 2 completed in 2012, the decision was made to begin a condition assessment effort to target specific areas of concern.

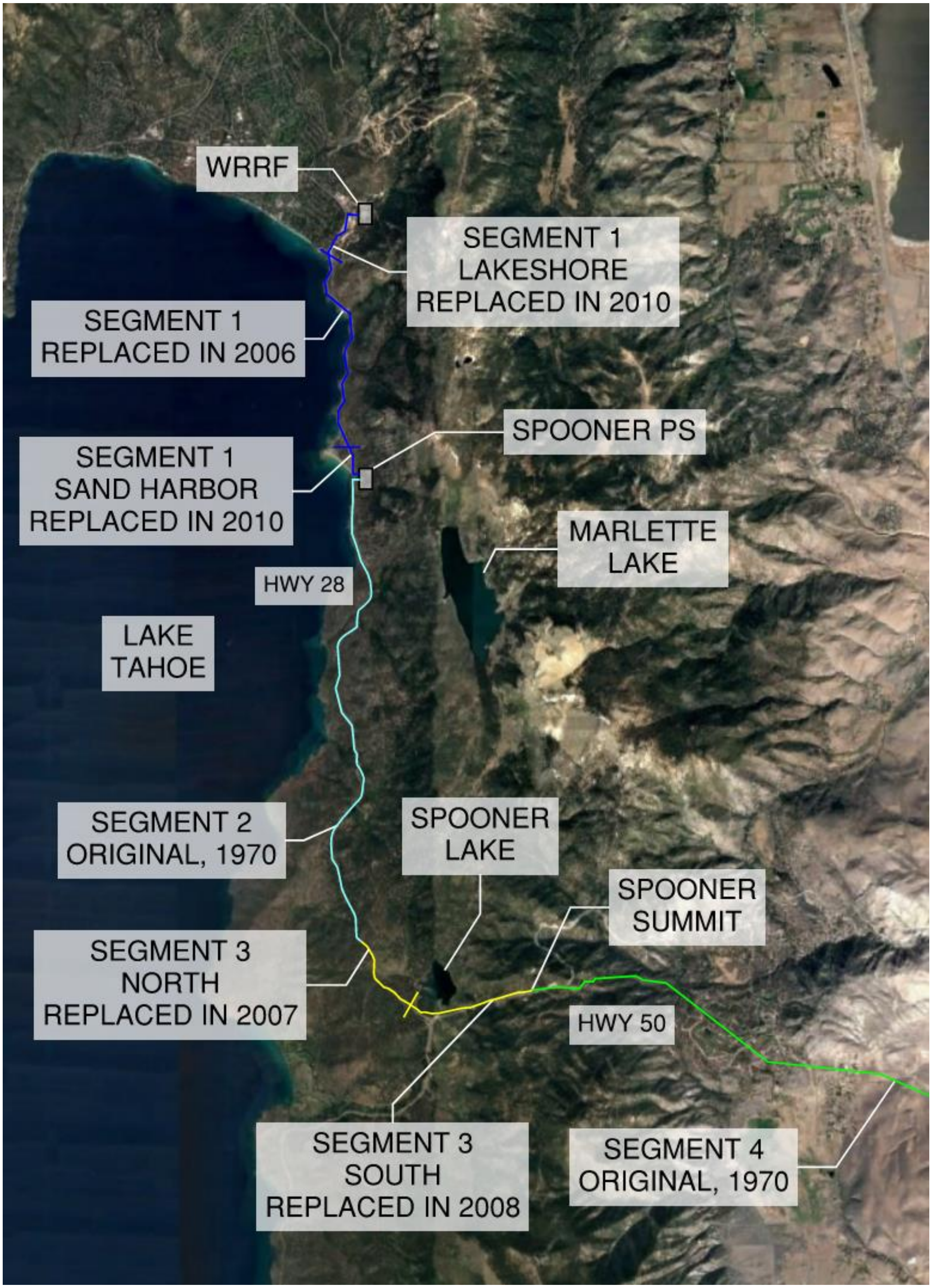


Figure 1: Existing Effluent Export Pipeline Location

The cost estimate and restrictions from NDOT identified in the 2012 Preliminary Design Report brought IVGID to make the decision that the cost to replace the entire pipeline was higher than the cost to inspect the pipeline and replace the sections that needed it the most. In 2015, HDR coordinated a condition assessment of the Segment 2 pipeline between Spooner Pump Station and Highway 50 with the "See-Snake" internal inspection tool from Pipeline Inspection and Condition Assessment Corporation (PICA). PICA's condition assessment results showed significant corrosion pit defect occurrences in the original pipeline sections. HDR reviewed the inspection results and identified corrosion defects where leakage may be currently occurring or may soon be occurring. The repair project was undertaken in 2017-2018 to address the most critical defects by replacing approximately 1,200 feet total with 16" ductile iron pipe at 13 separate repair locations.

In 2018, PICA conducted a second inspection focused on the Segment 2 pipeline to assess the condition of the remaining original sections and confirm the results of the first inspection with better location data. Similarly to 2015, HDR analyzed the PICA results to estimate defects in danger of causing leakage and how much time remains, given an assumed rate of corrosion, before additional minor detected defects become deficient. Figure 2 shows the locations of those defects along the effluent pipeline. This analysis can be found in the *IVGID Condition Assessment Technical Memorandum* (HDR, July 2020).

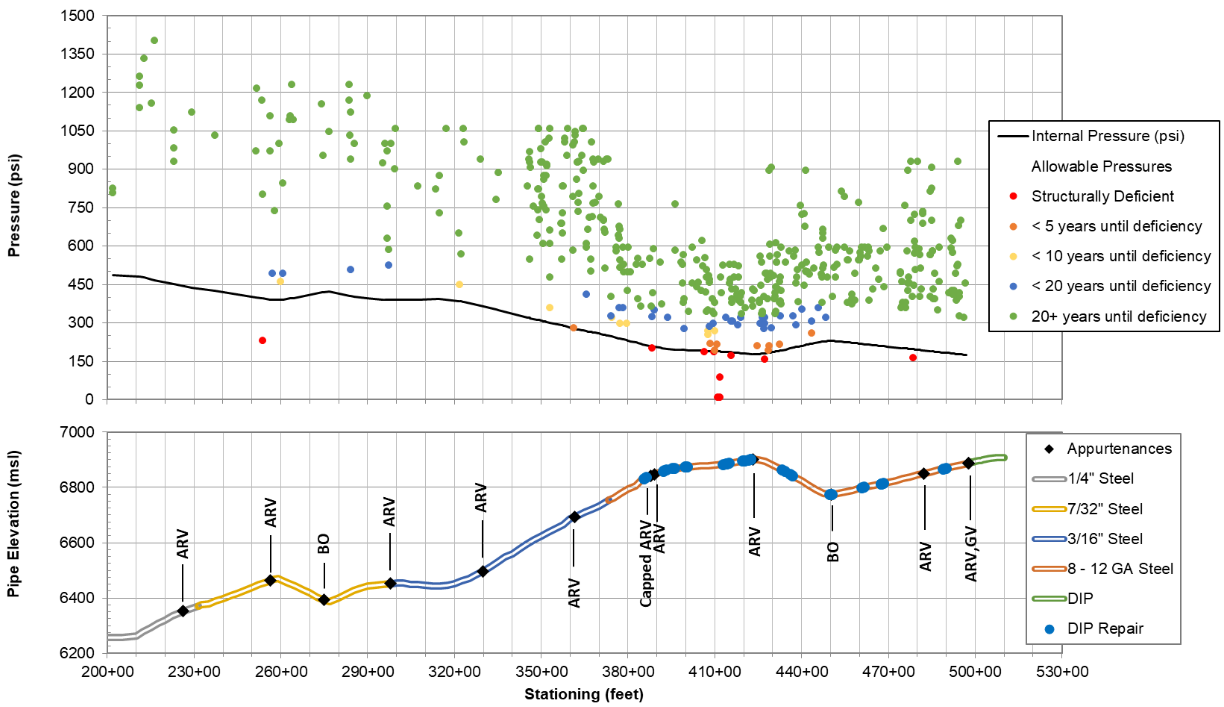


Figure 2: Segment 2 Condition Assessment Summary

The report recommended 16 additional repairs to be made between STA 253+68 and STA 486+45 that the analysis showed as currently deficient or will be deficient within 5 years of construction occurring.

In 2020, IVGID decided to move forward with replacement of the entire Segment 2 section from downstream of the Spooner Pump Station to the beginning of Segment 3. For this project, HDR serves as the Design Engineer in a Construction Manager at Risk (CMAR) approach in which Granite Construction is the construction firm. The CMAR team, including HDR, Granite, and IVGID staff, are working collaboratively to design this pipeline with a strong focus on cost, schedule, and constructability.

2. Operations Review

HDR reviewed the pipeline profile, location and sizing of air and vacuum valves, pump setpoints and operational data, and IVGID's standard operating procedures (SOPs) to provide design criteria related to normal operating and transient conditions. Transient conditions that could result from an unplanned pump station shutdown were analyzed. This analysis did not recommend a design of transient control systems or sizing or locating equipment.

Figure 3 illustrates the minimum and maximum pressures seen in the Segment 2 section of pipeline created from the operations review. From the results of the hydraulic analysis, the existing Spooner Pump Station surge control equipment allows for an estimated additional pressure, due to transient pressures, of about 13 psi above normal operating pressures. The 13 psi transient pressure represents a "worst case" surge scenario. This analysis will be used to provide a pressure envelope to facilitate the selection of pipe material and acceptable rehabilitation methods.

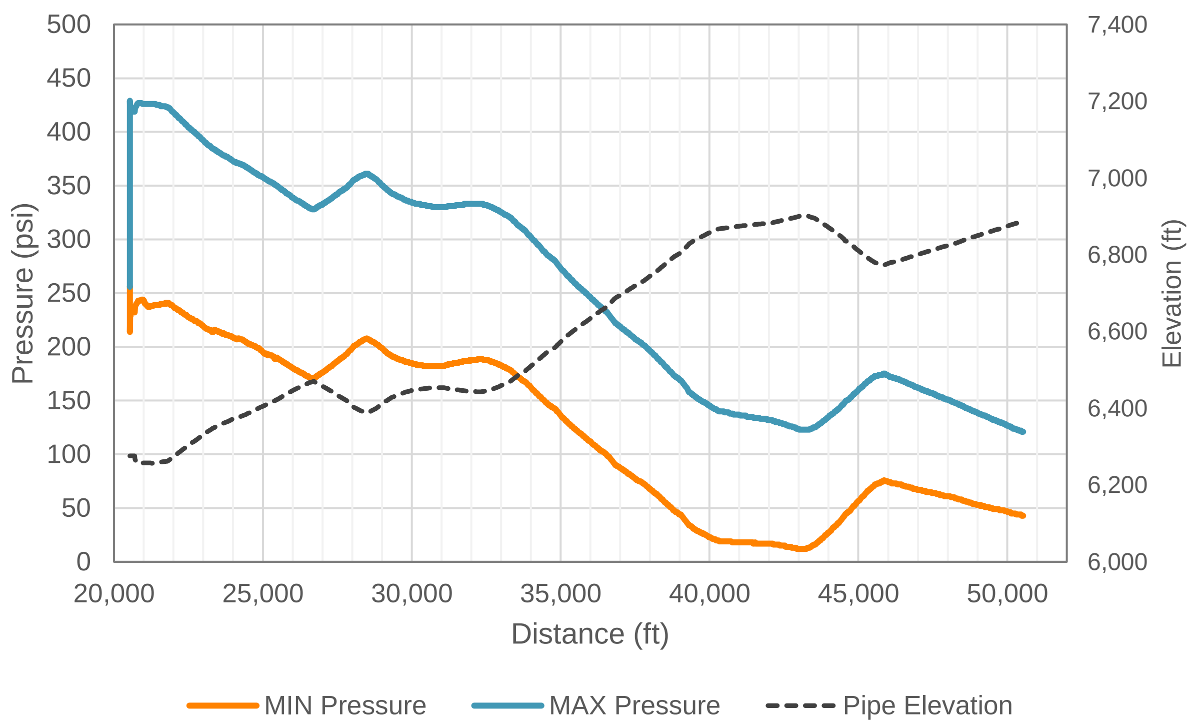


Figure 3: Minimum and Maximum Pressure in the Effluent Pipeline following the Operations Review

Based on daily flow totals from 2020-2021 and daily flow totals during the peak month from 2018-2021, the flow information provided in Table 2 was calculated. The max permitted flow allowed to leave the plant is 2.6 MGD.

Table 2: Plant Outflows

Average	Peak Month	Max	Permit Max
0.98 MGD	1.12 MGD	1.62 MGD	2.60 MGD

Based on discussions with IVGID, construction of an effluent storage tank is being considered to handle emergency storage. The construction of an effluent storage tank could change the operational strategy and hydraulics by allowing flow equalization utilizing the tank storage volume to stabilize the typical diurnal nature of the daily sewer flows. This would reduce the required design flow rate and may allow for smaller diameter piping.

3. Rehabilitation Technology Review

A list of the current industry available rehabilitation technologies is shown below. Each method is appropriate only for specific pipe materials, diameters, and installation lengths. The criteria for each method are shown in Appendix A.

Rehabilitation technology includes:

- Open-Cut, Remove, and Replace
- Cured-in-Place
- Sliplining
- Pipe Bursting, Pipe Reaming
- Close-Fit Lining, Die-Draw Lining, Roll-Down Lining, Fold-and-Form Lining
- Spiral Wound Lining
- Geopolymer Lining
- Centrifugally Cast Concrete Pipe Lining (CCCPL)
- Manufactured In-Place Composite Pipe (MICP)
- Spray-Applied Polymer Lining
- Spot Repairs
- Chemical Grouting
- Cement Mortar Lining
- Crown Spraying

The following rehabilitation technologies are not considered appropriate for the existing pipe diameter and were therefore excluded from further consideration:

- Centrifugally Cast Concrete Pipe Lining (CCCPL)
- Geopolymer Lining
- Manufactured In-Place Composite Pipe (MICP)
- Crown Spraying

Also excluded, were technologies that do not provide full structural rehabilitation, including:

- Spray-Applied Polymer Lining
- Chemical Grouting
- Cement Mortar Lining

Close-Fit Lining, Die-Draw Lining, Roll-Down Lining, and Fold-and-Form Lining are not considered possible because of the higher cost compared to other lining methods like sliplining. Pipe Bursting and Pipe Reaming are not considered possible technologies because of the geotechnical conditions with unknown burst conditions and lack of suitability for a host pipe. Pipe bursting has a short range and a large footprint not suitable for this project. Spiral Wound Lining is suitable for gravity lines but not pressure pipe. Spot repairs are not considered because the entire pipeline was identified as needing to be rehabilitated or replaced.

In addition, Spiral Wound Lining, Geopolymer Lining, CCCPL, MICP, Spray-Applied Polymer Lining, spot repairs, chemical grouting, cement mortar lining, and crown spraying are considered incompatible with the current Segment 3 replacement.

Based on existing pipe material, size, and hydraulics the following technologies are considered possible and will be analyzed for incorporation into the design:

- Open-Cut, Remove, and Replace
- Cured-in-Place
- Sliplining

3.1. Open-Cut, Remove, and Replace

Removing and replacing the pipeline is assumed to occur in the same alignment of the existing pipeline. The pipe materials expected to be used are described herein in Section 5 – Design Criteria. The preliminary trench section assumes:

- 54” wide trench
- 7” thick asphalt replacement with 7’-6” wide t-patch
- 12” thick aggregate base under asphalt
- Intermediate backfill (below the aggregate base and above the slurry cement cap)
- 6” thick slurry cement cap, located 12” above top of pipe
- 4” minimum pipe bedding below pipe

Removing and replacing the pipe in its current location allows for utilizing the existing trench and avoids unknown ground conditions that may be encountered with construction of pipe in a parallel trench. While a parallel pipe provides minimal operational interruptions, there are many rocky locations where excavation is difficult or where a parallel alignment may need to be within the roadway instead of in the shoulder. Also, construction of a parallel pipe increases the surface loading not normally seen on top of the existing pipe from construction equipment.

There are locations where the existing pipe is underneath the NDOT metal guard rail that has been constructed since the original pipe installation. Where the pipe is under the guard rail, a parallel pipe or trenchless rehabilitation would avoid guard rail replacement. A parallel pipe would also avoid conflict with the pipe in the future when the guard rail is replaced. Dormant pipe left in the ground remains IVGID’s responsibility and becomes a liability if not maintained.

3.2. Cured-in-Place

Several standards have been published on CIPP rehabilitation of pipeline infrastructure, and these will be used wherever practical and appropriate. Table 3 lists the standards that are expected to apply to the design and construction of the effluent piping rehabilitation.

Table 3: CIPP Applicable Standards

Standard	Description
ASTM F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM F2019	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM F2994	Standard Practice for Utilization of Mobile, Automated Cured-In-Place Pipe (CIPP) Impregnation Systems
ASTM F3240	Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines
ASCE MOP 120	Trenchless Renewal of Culverts and Storm Sewers
ASCE MOP 132	Renewal of Potable Water Pipes
ASTM D5813	Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems

CIPP Liner Installation Procedure

The CIPP installation procedure includes:

1. Pipeline is shutoff, drained, and cleaned
2. Access to the pipe is created on either end of the installation – open cut pit
3. Pipe section is cut out inside access pits
4. Liner is pulled in place through the pipe, or pushed through using water pressure
5. The liner ends on both sides are sealed off (see Figure 4)
6. The liner is inflated (with compressed air or water) and calibrated to the host pipe
7. The curing process is completed using hot water or UV (see Figure 5)
8. Seals are removed
9. Welded flanges are added to existing pipe (if couplings are not used)

10. The liner is cut back and sealed at the ends to the existing pipe
11. Pipes are reconnected with the flanged pipe section and sealed off
12. Open cut pit is backfilled and repaved (see Figure 6)

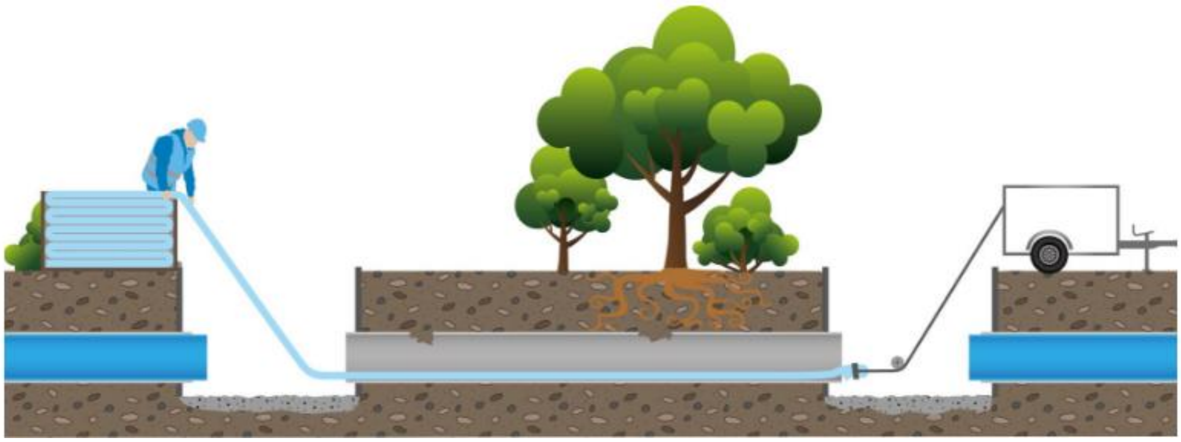


Figure 4: The liner is pulled in place between pits, and both ends of the liner are sealed (Saertex multiCom®)

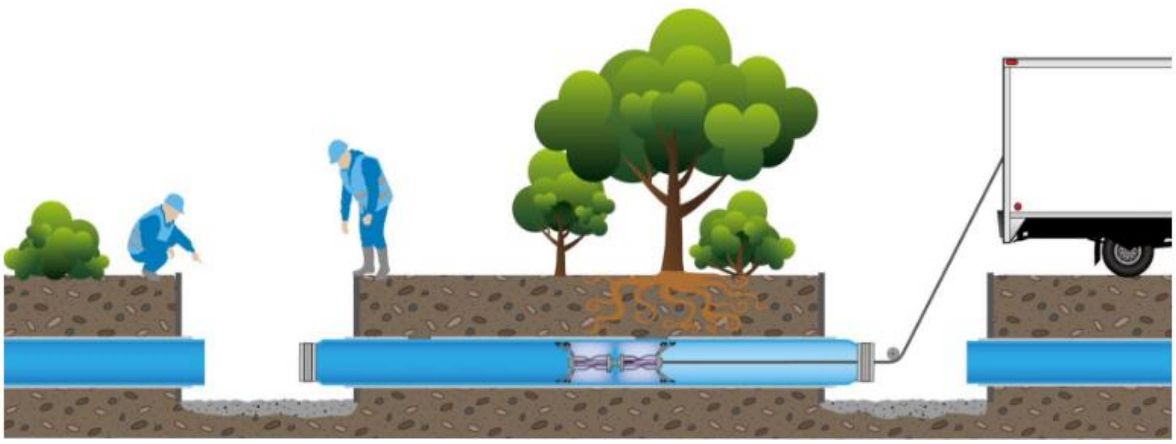


Figure 5: Liner is inflated, and the curing process begins, UV train shown (Saertex multiCom®)

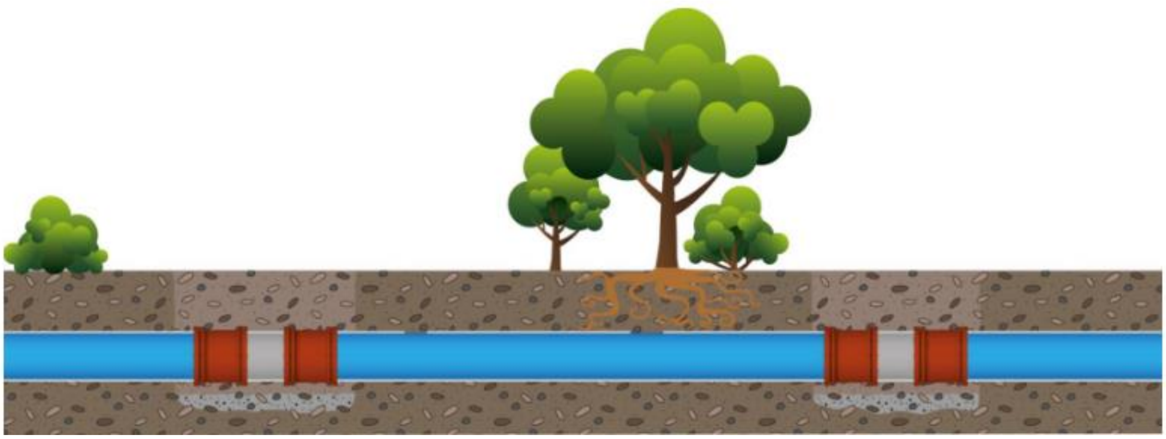


Figure 6: After curing, seals are removed, the pipe is reconnected, and pits backfilled (Saertex multiCom®)

Liner Material and Resin Selection

CIPP liner materials are available in two primary types: felt pipe liners, and glass-fiber reinforced pipe (GRP) liners. Felt liners are the older, more established technology, and are primarily used with vinyl ester or poly ester resins, cured with steam or hot water. GRP liners are a newer technology and are typically used with epoxy resins and cured with UV light. GRP liners offer a thinner liner wall for equivalent strength, maximizing lined pipe diameter, but are relatively more expensive.

Cure Water Treatment

If vinyl ester or polyester resins are used, it is possible that the cure water could contain styrene that may be harmful to wastewater treatment plant processes. The likelihood of styrene contamination will be determined based on the resins allowed for the project and provisions required for treatment and testing of cure water prior to discharge to the plant will be specified.

Rehabilitation Details

As the design progresses, we will develop appropriate details for the work. Currently, we anticipate details to include:

- Access shafts
- Lining contractor layout areas and limitations, considering other work expected to be happening simultaneously
- Liner termination details at each end of each lined segment
- Pipe replacement for portions removed to facilitate lining

CIPP Use Considerations

The locations and frequency of installation of CIPP is determined based on some its limitations and risks.

- CIPP installation requires significant cleaning of the pipe interior, time for curing, and time for installation resulting in similar shutdown periods as remove and replace.
- Assumptions regarding cleaning of the pipe are a risk as exact effort required is not known until the pipe is exposed and drained.
- Using a CIPP liner reduces the internal diameter of the pipeline, increasing the head loss through that section and reducing the Spooner Pump Station maximum flow rate. Once the appropriate liner is selected, the effect on the maximum flow rate will be evaluated.
- CIPP cannot be installed at significant angle points, or where there are significant grade changes.
- Elevation differences within a CIPP section affect the ability to water-cure as pressure differences across the liner may not fit into the required curing conditions.

3.3. Sliplining

Sliplining involves the insertion of a new smaller pipe into an existing host pipe. The inserted liner pipe can be designed to provide a fully structural new pipe inside the existing pipe. The smaller diameter liner pipe leaves a gap or annular space which can be filled by grouting.

There are two versions of sliplining; (1) continuous, using long strings of HDPE or PVC pipe butt-fusion welded together, and (2) segmented, using individual pipe segments that are jacked together in place. While there are more material options for segmental sliplining, continuous sliplining is more suited for this pipeline due to the associated pressures and allowable downtime.

Sliplining Installation Procedure

The process of continuous sliplining includes the following steps:

1. Pipeline is shutoff, drained, and cleaned
2. Access to the pipe is created on either end of the installation – open cut pit (reception pit is a small excavation, or insertion pit for next liner section)
3. Pipe section is cut out inside access pits
4. Liner pipe is pulled into the host pipe via a cable attached to the lead end of the liner pipe. The cable is attached to a winch at a receiving pit and pulled into the host pipe.
5. Connections are made on either end of the liner
6. Branch and valve connections are made by excavating down to the host pipe
7. Annular space is grouted by drilling of access ports from road surface or insertion of grout tubes during insertion
8. Open cut pit is backfilled and repaved

Rehabilitation Details

As the design progresses, we will develop appropriate details for the work. Currently, we anticipate details to include:

- Access shafts
- Lining contractor layout areas and limitations, considering other work expected to be happening simultaneously
- Liner termination details at each end of each lined segment

Sliplining Use Considerations

The use of sliplining is determined based on some of its risks and limitations.

- Liner pipe is designed to be fully structural, so high pressure areas require low DR HDPE.
- Significant reduction in inside diameter, especially in high pressure areas, increases system pressure.
- Grouting must be carefully planned and implemented. It reduces potential for point loads on liner pipe, provides lateral support, and minimizes potential for loss of subgrade into annular space. Sufficient annular space must be provided to allow for grouting.
- Only minor deflections can be sliplined, more insertion and receptions pits will be needed around bends.
- The length of the access pit must accommodate the maximum allowable bending radius of the liner pipe.
- Large laydown area for fused piping would need to be approved by NDOT.

4. Utility Research

Most of the utilities along Highway 28 are NDOT owned highway drainage culverts and catch basins. These culverts convey storm water and snow melt beneath the highway, generally from the east side to the west side, and range in diameter from 14 to 30 inches.

The following separation is recommended between the effluent pipeline and other utilities:

- For drainage culverts and other perpendicular utility crossings, NDOT typically requests that other utilities cross below their culverts, with a minimum clearance of 3-feet.
  - It is assumed that the replaced pipeline will follow the same vertical and horizontal alignment as the existing, so the pipeline will stay above some culverts.
  - When there is less than 3-feet of clearance between the pipeline and NDOT culvert, a slurry cement backfill will be used to protect NDOT's culvert at the intersection.
- The replaced pipeline will maintain a 10-foot horizontal clearance and 1-foot vertical clearance from potable water lines or provide slurry cement backfill where that clearance cannot be met.

As of 2012, there were 47 NDOT culvert crossings along the pipeline alignment. Information has been requested from NDOT to confirm the locations and depths of their existing utilities.

5. Design Criteria

5.1 Pipe Design

The following pipe materials were evaluated for suitability with the project based on the expected pressure conditions and diameter of the existing pipe:

- Ductile Iron Pipe (DIP)
- Steel Pipe
- High Density Polyethylene (HDPE) Pipe
- Fiberglass Pipe
- Polyvinyl Chloride (PVC) Pipe

Fiberglass pipe was determined to be unsuitable. The material loses strength over time and experiences creep when subjected to stress. There are also concerns about making future field repairs with this pipe material. PVC was also determined to be unsuitable due to its failures being catastrophic in nature. Given the pipeline's high pressures and proximity to Lake Tahoe, PVC is not considered suitable under these conditions.

Table 4 summarizes the suitable pipe materials for the different pressure ranges along Segment 2.

Table 4: Possible Pipe Materials and Sizes

Pressure (psi)	Material	Min. Thickness or SDR	Pressure Class (psi)
> 350	Steel	0.168 in	450
350 – 300	Steel	0.134 in	350
	DIP	0.34 in	350
	HDPE	SDR 7	335
300 – 250	DIP	0.32 in	300
	HDPE	SDR 7	335
250 – 200	DIP	0.30 in	250
	HDPE	SDR 9	250
200 – 150	DIP	0.30 in	250
	HDPE	SDR 11	200
< 150	DIP	0.30 in	250
	HDPE	SDR 13.5	160

Ductile iron or HDPE are to be used for most of the pipeline following discussions with IVGID as the most cost-effective materials for the system pressures and diameters. When ductile iron or HDPE pipe are not feasible (at pressures above 350 psi for DIP and 335 psi for HDPE) steel pipe will be utilized. These pipe materials are discussed below.

Ductile Iron Pipe

Ductile iron pipe for this project should comply with the following AWWA Standards:

- C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- C105/A21.5 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110/A21.10 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water
- C111/A21.11 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C115/A21.15 – American National Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
- C150/A21.50 – American National Standard for the Thickness Design of Ductile-Iron Pipe
- C151/A21.51 – American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- C153/A21.53 American National Standard for Ductile-Iron Compact Fittings, 3 In. (76 mm) Through 64 In. (1,600 mm), for Water Service

FITTINGS

Fittings shall be ductile iron in accordance with AWWA C110 and AWWA C153. Any required restraint shall be achieved with restrained fittings.

JOINTS

Ductile iron pipe is available with unrestrained and restrained push-on type joints. US Pipe's Tyton or American Cast Iron Pipe Company's Fastite are unrestrained and allows for a maximum deflection of approximately 5 degrees for 16-inch diameter pipe. When thrust force resistance is required, restrained joints such as US Pipe's TR-Flex or American Cast Iron Pipe

Company's Flex-Ring can be utilized and allows for a maximum deflection of approximately 3 degrees in all directions. Restrained mechanical joints such as US Pipe's MJ Harness Lok will be used for direct buried valve connections while for exposed valve connections, flanged joints will be used. Note that a flanged joint is generally considered as a rigid connection and should not be used for direct burial. Differential settlement or stress on either side of the flanged joint may induce detrimental stress that could lead to failure of the joint. For flanged valves, a dismantling joint should be used for easy removal in the future.

PIPE LINING

The interior of ductile iron pipes shall be lined with cement mortar with 3/32-inch minimum thickness in accordance with AWWA C104. The exterior of ductile iron pipes shall be coated with asphalt.

An alternative lining material is an epoxy lining like the Protecto 401™ designed to be applied at a 40-mil nominal thickness. Epoxy linings are not a calcium-based lining material, so it should not be subject to leaching of calcium or inorganic lining material into the pipeline. During installation, the pipe lining manufacturer's instructions should be followed to ensure that the epoxy lining is not damaged. Special care must be taken when assembling pipe joints, and mandrel testing should not be allowed.

Steel Pipe

Steel pipe should comply with the following standards:

- C200 – AWWA Standard for Steel Water Pipe–6 In. (150 mm) and Larger
- C203 – AWWA Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines–Enamel and Tape–Hot-Applied
- C205 – AWWA Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe–4 In. (100 mm) and Larger–Shop Applied
- C206 – AWWA Standard for Field Welding of Steel Water Pipe
- C208 – AWWA Standard for Dimensions for Fabricated Steel Water Pipe Fittings
- C222 – AWWA Standard for Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

FITTINGS

Fittings shall be steel in accordance with AWWA C208 and AWWA C222. Where thrust restraint is required, restrained fittings should be used.

JOINTS

Welded type joints are usually used for steel pipes in this pressure range above 350 psi. Welded joints are either lap joints or butt-welded joints. Lap joints would allow angular deflection of up to approximately 3.5 degree for 16-inch diameter pipes, while butt-welded joints allow for very minimal deflection. Design should allow for no more than about half of the allowable maximum deflection, or about 1.5 to 1.75 degrees. Detailed design will determine the type of welded joint needed in this pressure range.

PIPE LINING

Cement mortar lining will be used for the lining and coating material for steel pipe. Lining thickness for steel pipe shall be a nominal 5/16-inch per AWWA C205. Other lining options that provide good protection include epoxy and polyurethane. Epoxy and polyurethane linings are not a calcium-based lining materials, so they should not be subject to leaching of calcium or inorganic lining material into the pipeline. However, epoxy lining is more difficult to apply than polyurethane lining during the pipe manufacturing process. Fusion-bonded epoxy could be an alternative to epoxy but may not be cost competitive with polyurethane lining material. Epoxy lining may also prove more difficult than the cement mortar lining in the future for IVGID maintenance teams if repairs need to be made.

One challenge using either epoxy or polyurethane lining is that neither material can withstand the heat of pipe joint welding. Normally the lining is held back for several inches at the joint, and the lining is then field applied after the joint is welded. Since man entry into a 16-inch diameter steel pipe is not possible, 4 to 6-inch diameter handhole openings with flanged ends are required for field lining application at the welds. Harnessed joints can be used as an alternative joint restraining mechanism to avoid field welding and allow some degree of flexibility at the joints. However, harnessed joints are typically more expensive than welded joints. Because the lining options provide similar protection to the pipe, the decision to use epoxy lining would be based on cost and the ability of maintenance crews to repair epoxy linings.

High Density Polyethylene

HDPE pipe should comply with the following standards:

- C901 – AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 2 In. (76 mm), for Water Service
- C906 – AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

FITTINGS

Fittings shall be ductile iron in accordance with AWWA C110 and AWWA C153. Any required restraint shall be achieved with restrained fittings.

JOINTS

Joints between sections of HDPE pipe shall be made by thermal fusion. Fused joints are considered fully restrained. Connections between HDPE pipe and other pipe materials shall be made by mechanical methods.

PIPE LINING

HDPE pipe is corrosion resistant and does not require lining or cathodic protection.

Restraints

Where the pipeline has fittings and the hydraulic thrust forces that need to be balanced, restrained joints should be used. Welded joints and harnessed joints are usually used for restrained joint types for buried applications. One difficulty of welded joints is the field application of lining material inside the welded joint. Additionally, field quality control of welding and lining application is critical, particularly on smaller diameter pipelines, like this project.

Additionally, flanged joints are another type of restrained rigid joint. Whereas harnessed joints can be used where both joint restraint and joint flexibility are needed.

5.2 Air Relief and Blowoff Valves

To provide for the removal and introduction of air necessary for proper operation of the system, air/vacuum relief valves (ARV) will be installed at high points (11 locations) along the pipeline. The ARVs will be installed in the road shoulder in vaults as shown in Figure 7 in the same location or adjacent to the existing ARVs.

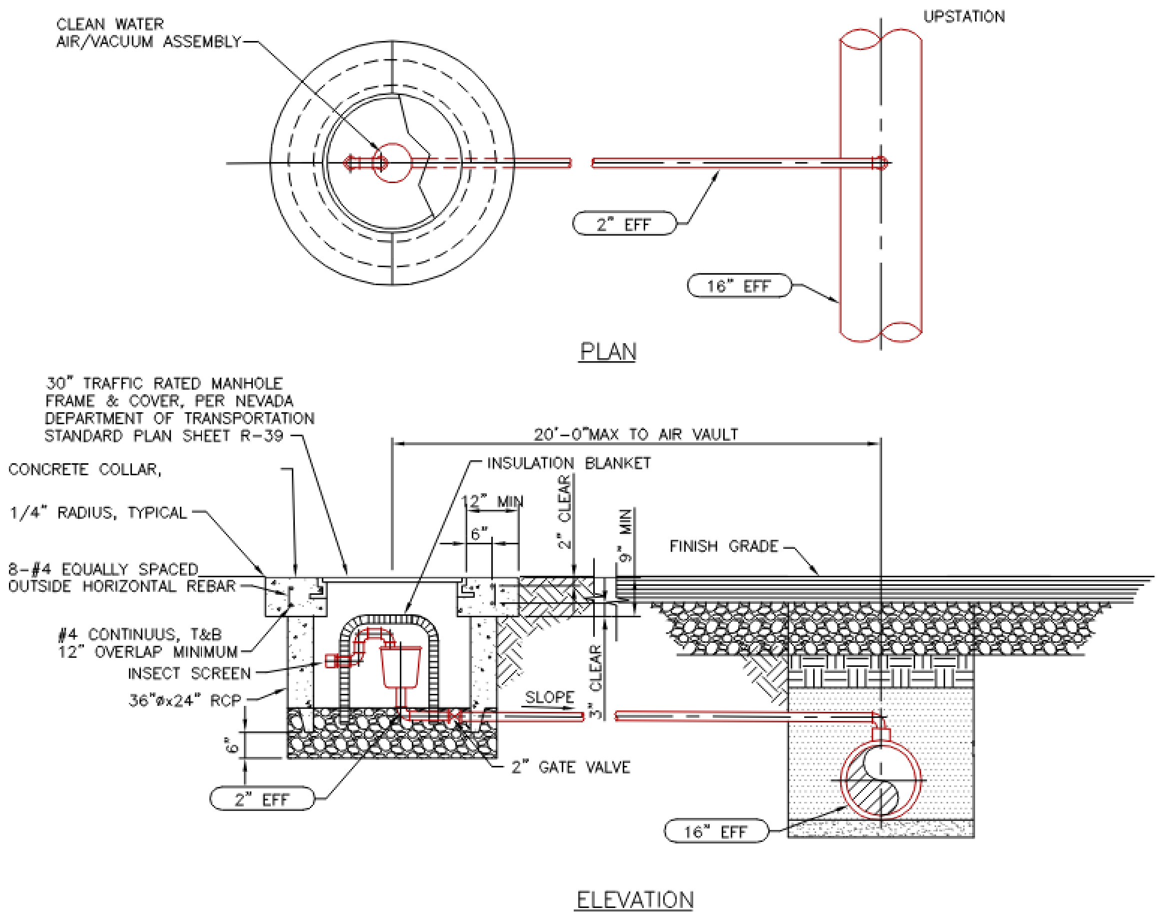


Figure 7: 2-inch Air/Vacuum Relief Valve Assembly

Blowoff manholes will be installed along the pipeline at low points (5 locations) to allow draining of the pipe. Like the ARVs, the blowoff manholes will be located on the roadway shoulder. A detail of the blowoff manhole is shown in Figure 8.

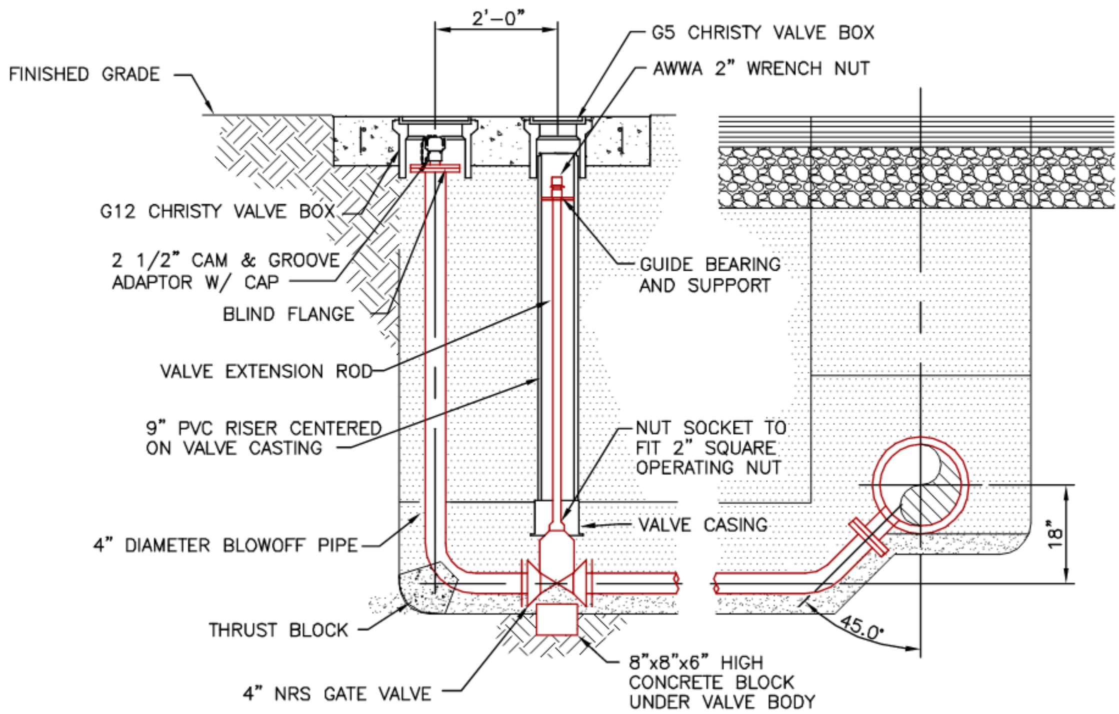


Figure 8: Blowoff Valve Assembly

NDOT standards require that surface access locations for pipeline appurtenances be placed outside the travel lanes of the highway, however, this may not be possible for all locations. Narrow shoulders with steep side slopes are common along the alignment and could require that appurtenances be placed within the traveled way. Even if sufficient shoulder space was available for placement of surface features outside the right-of-way, vehicles and equipment needed for maintenance and operation of the appurtenances would still require lane closures.

5.3 Cathodic Protection

Ductile Iron Pipe

Standard ductile iron pipe coating is a layer of 1-mil thick asphalt. Ductile iron pipe is also usually wrapped with 8-mil thick polyethylene sheets or tubes for extra cathodic protection. Due to the concern that the polyethylene film may be punctured by the sharp edges of the granular backfill material, two layers of polyethylene film can be used to mitigate the film being punctured. Under most circumstances, the standard asphaltic coating and the polyethylene tube provide good corrosion protection to the pipe. Because the native soil is particularly corrosive, with pH levels of approximately 5 to 6, and resistivity of less than 2,000 ohm-cm, the standard asphaltic coating and polyethylene sheets/tubes may not be sufficient for this project. An alternative cathodic protection method could be tape wrapping the pipe with a corrosion resistance tape. This will be evaluated during detailed design.

To allow IVGID to monitor the pipe's condition and allow easy installation of future cathodic protection (if it becomes necessary), the ductile iron pipe segments should be electronically connected by using jumper cables across joints, valves, etc. Corrosion monitoring/test stations should be installed along the pipeline and the oxidation-reduction potential monitored. If the redox potential becomes high and corrosion becomes a concern, then the anodes can be installed to protect the pipe from corrosion. Installation of the bonding jumper cables should take into consideration the possibility of damage to the pipe lining.

Steel Pipe

Cement mortar coating is the standard for buried applications of steel pipe. Because the native soil is corrosive, an additional dielectric layer can be added to the bare steel pipe cylinder exterior surface to enhance the protection to the steel and can be wrapped in polyurethane, epoxy, polyolefin, or tape coating. Cement mortar coating can then be applied outside of the dielectric layer. In this case, the cement mortar coating will not only serve as a protective coating to the steel but will also serve as a protection to the dielectric layer for possible damages during transportation and trench backfilling.

To allow IVGID to continuously monitor the pipe's performance and corrosion potential, it is recommended that the steel pipes be electrically bonded. Welded joints are electronically continuous; however, jumper cables should be used to bond non-welded joints, and corrosion monitoring stations installed along the pipeline. If IVGID finds the redox potential becomes high and there are pipe corrosion concerns, sacrificial anodes could be easily connected to the pipeline to control pipe corrosion.

6. Pipeline Alignment

The existing pipeline alignment is along Nevada State Highway 28. The Project alignment, which is delineated as Segment 2 in Figure 1, begins at IVGID's Spooner Pump Station and follows Nevada State Highway 28 south for approximately 30,000 feet. Segment 2 connects to Segment 3, approximately one mile north of Nevada State Highway 50.

At locations where open cut remove and replace is to be utilized, alignment of the new pipeline will follow the existing alignment in the roadway shoulder. At locations where the existing alignment is underneath the guard rail, the new alignment will be parallel to the existing pipeline and possibly in the travel lane pending NDOT's approval.

Current pipeline pressures were evaluated and in areas found to be conducive to CIPP, areas were selected and evaluated for installation procedures and cost. Table 5 summarizes possible CIPP rehabilitation candidates due to their straight nature (deflection is less than 2.5 degree) and their pressure is less than 175 psi (upper limit for the water cured CIPP liner).

Table 5: Sections Possible for CIPP Rehabilitation

#	STA	Length (ft)	Considerations
1	386+50 – 392+00	550	Air valve and capped air valve present.
2	408+00 – 423+00	1,500	Air valve present. Includes 3 previously replaced DIP sections
3	425+00 – 433+00	800	About 1 degree deflection
4	462+00 – 475+00	1,300	Includes a previously replaced DIP section

The final decision to use CIPP or open cut in these sections will be determined pending the updated hydraulics review and evaluation of reducing the design flow. If the pipe can be reduced in diameter, CIPP is no longer suitable. Consideration will also be given to the need for IVGID to be able to repair and maintain this pipe material in the future. The cost of each section for remove and replace with ductile iron and CIPP was provided by Granite, shown in Table 6. The assumptions used for determining these costs are provided with the cost estimate.

Table 6: CIPP Section Cost vs. Remove and Replace

#	STA	CIPP Cost	Remove and Replace Cost
1	386+50 – 392+00	$472,361	$531,747
2	408+00 – 423+00	$971,557	$1,168,829
3	425+00 – 433+00	$596,214	$611,221
4	462+00 – 475+00	$936,053	$993,279

7. Project Implementation

7.1 Construction Phasing

This project follows construction of an effluent storage pond at the WWRF that increases effluent storage capacity to up to 4 days from 8 hours. Therefore, construction will be phased to allow for the following:

- Shutdown of the effluent pipeline and routing the effluent to the storage pond
- Draining of the section of pipeline to be constructed
- Cutting and replacing pipe section
- Test pipe section for leaks
- Return the effluent pipeline in service
- Refill the effluent pipeline
- Drain the effluent storage pond
- Export the effluent out of the basin
- Repeat this procedure

Per correspondence with NDOT, a pavement preservation project is planned for SR 28 from US 50/Spooner (Milepost Douglas 0.00) to Ponderosa Ranch Road (Milepost Washoe County 5.217). The timeframe for the preservation project is estimated to be Spring 2025. Construction will be phased so that the Segment 2 replacement will be completed prior to the start of the pavement preservation project.

7.2 Cost Estimate

An Estimate of Probable Construction Cost has been prepared by Granite and HDR assuming that the entire alignment will be replaced by open cut methods. The estimate is $45,564,998 and includes a 20% construction contingency, 8% design costs, 2% administrative costs, and

8% construction management costs. The summary of the design elements and estimate breakdown are shown in Appendix B.

7.3 NDOT Standards

Areas where exemptions are requested to NDOT standards were included in a letter to NDOT from IVGID dated December 3, 2020. The questions posed in the letter include:

- Leaving the pipeline in its existing alignment (if CIPP rehabilitation) under a guardrail
- Leave pipe dormant “as is” if required instead of filling with slurry cement or foam backfill
- Locating ARVs or blowoffs in limits of roadway where space is limited
- Pavement section includes 7-inch of NDOT Type 2 over 12-inch of NDOT Type 1 Aggregate Base (7-inch AC / 12-inch AB)
- 2-inch depth T-patch instead of full lane width patch
- No open-grade paving
- Removal of a 6-inch slurry cement backfill cap over entire width of pipe trench
- Stay above NDOT culverts where the existing pipe is above culverts
- Where existing pipe is within 3 feet of NDOT culvert, slurry cement backfill within intersection point
- Work performed between May 1 and October 15, with no work stoppage in July and August as well as possible work between October 15 and May 1, with approval from Tahoe Regional Planning Agency (TRPA)
- Standard work week includes Sunday 8 PM to Friday 3 PM during the shoulder season, and off the road at noon during the peak season
- Single lane closure for 24 hours a day during work week
- Saturday work during shoulder season when no events are scheduled
- A 3,000-foot single lane closure from flagger to flagger, following the 20-30 rule with documentation (delay restrictions of 20 minutes stopped and 30-minute total delay)
- NDOT consideration for alternate methods to protect work zone such as tighter barrel or cone spacing, or attenuation trucks instead of temporary portable precast barrier rail
- Use of the NDOT maintenance fill slope located 2,400 feet east of Spooner Summit Sand Shed for borrow

A follow-up meeting was requested to discuss these items.

Appendix A – Summary of Available Rehabilitation Technologies

Method	Description	Advantages	Limitations	Size	Maximum Installation Length	Construction Time	Consumer Disruption	Overall Cost
Open Cut Remove and Replace	Traditional method of excavating trench, installing bedding, laying pipe, backfilling, and replacing pavement	• Proven approach • Built to current standards • Sequencing work may avoid bypass • Numerous experienced contractors result in competitive pricing	• Significant surface, socioeconomic and environmental costs • Potential community disruptions, including traffic, noise, and dust • Significant geotechnical requirements • Often requires new alignment • Parallel pipes are difficult to add in congested corridors and increase O&M costs	All sizes	No limitation	High	Extreme	$$$
Cured-in-Place	Inserting a felt liner impregnated with a thermosetting resin inside an existing pipe to form a new structural pipe inside the host pipe. Fiberglass reinforcement may be used to reduce thickness of liner in gravity pipes. Fiberglass, polyester, or carbon fibers can be used for pressure pipe applications. Class III and Class IV.[1]	• Provides a fully structural replacement pipe with proper design • Small reduction in cross-sectional area • Smooth interior with no joints typically improves flow capacity • Installed from maintenance holes, therefore no entrance or exit pits are needed. • Liners can be cured with hot water, steam, or ultraviolet light (which may also provide strength and environmental advantages) • Grouting not required due to tight fit or very small annulus • Accommodate bends, deformations in existing pipe and non-circular conduits • Lateral connections reinstated robotically • Numerous experienced contractors result in competitive pricing	• Requires flow bypass • Relatively high unit costs • Obstruction can inhibit the installation process • Failures may occur due to improper wet-out, delays in transport, equipment failure during curing operations, poor design, lack of cleaning and hydrostatic forces • Styrene may be a byproduct of some liners; can be potential issue for odor complaints and has been identified as potential to interfere with wastewater treatment biological processes • Certified inspectors are highly recommended to monitor and inspect materials, installation and curing operations • 1/4” maximum deviation of internal host pipe diameters	• 4” to 120” for gravity pipes • 6” to 60” for pressure pipes	<1,500’ between access holes	Moderate	Moderate	$$
Sliplining	Placement of a solid continuous or segmented pipe inside an existing pipeline. Typical materials include HDPE, PVC, FRP, steel and VCP. Class III and Class IV.[1]	• Used for non-structural and fully structural rehabilitation • If butt fusion pipe is used, the number of joints is minimized or eliminated • Typically, only one pit is required (to pull pipe into the line) • If segmented pipe is used, sewer flows may not require interruption • Less costly than installing a new pipe, particularly as burial depth increases • Does not require consistent host pipe diameter	• Significant reduction in cross-sectional area of pipe; large annulus • Insertion and reception pits may be needed • Bypassing may be required • Lay down area for butt-fused pipe is required • Generally can’t pass through inflection points depending on material, size, and annular space • Laterals must be reinstated externally (open excavation) • Grouting of annular space may be required • Failures may include separation of pulling head from pipe, joint failure, excessive pulling loads leading to pipe failure and missed laterals	• Up to 60” for HDPE and PVC • Up to 120” for FRP/GRP • Up to 144” for steel	Varies with site conditions and material	Moderate	Moderate	$$

Method	Description	Advantages	Limitations	Size	Maximum Installation Length	Construction Time	Consumer Disruption	Overall Cost
Pipe Bursting Pipe Reaming	Technology that replaces an existing pipe by breaking the old pipe and replacing it by inserting a new pipe of equal or large diameter. Class IV.[1]	• Allows existing pipe to be upsized • Up to 25% less expensive than open cut • Maintains existing pipe alignment • No disposal needed, as existing pipe fragments are left underground • Reduces surface and community disruption • Does not require consistent host pipe diameter	• Needs geotechnical information in pipe zone and trench over the pipe. Insertion and reception pits may be needed • Potential for heaving or settlement depending on soils • Lateral reconnection by open cut is required • Failures may be caused by equipment breakdown, insufficient ground cover, curved pipes, narrow previous trench, and rocky soils • Bursting system components undersized or not compatible with the application • Large footprint	2” to 54”	<2,000’	Moderate	Moderate	$$
Close-Fit Lining Die-Draw Lining Roll-Down Lining Fold-and-Form Lining	Inserting a plastic pipe (HDPE or PVC) inside an existing pipe, either by folding the new pipe (U-shape) or by pulling the new pipe through a reduction die to temporarily reduce the diameter of the new pipe. Class III and Class IV.[1]	• Provides a fully structural replacement pipe • Small reduction in cross-sectional area (can install thin wall liners) • Excavation pit may not be required for smaller diameters • Liner remains in tight contact with the inside of the host pipe; no grouting needed • Adds more competition among lining methods • Requires less downtime than CIPP • Accommodates large radius bends	• Bypass required • Pit excavation may be required for installation • Lay down area for butt-fused pipe is required • May not be suitable for existing pipes with bends more than 22.5 degree (pits must be excavated for larger bends) • Relatively higher cost compared to other lining methods • Infiltration may follow annular space • Failures can result from operator error, equipment failure, improperly sized pipe, and liner slippage in service	3” to 60”	3,000’	Moderate	Moderate	$$
Spiral Wound Lining	Strips of ribbed PVC are spun inside an existing gravity pipe to create a new pipe within the old pipe.	• Adds more competition among lining methods • Can be used for non-circular conduits • Accessible through existing manholes • Can negotiate bends between access points • Improves flow coefficient • Relatively long installation lengths are possible	• Relatively high cost compared to other lining methods • Specialized personnel required to operate winding equipment • Continuous fusion, solvent-welded or mechanical joints are required • Annular space must be grouted • Potential failures caused by equipment breakdown and unexpected obstructions • Better suited when human-entry is possible	6” to 200”	<3,000’	Moderate	Moderate	$$ to $$$

Method	Description	Advantages	Limitations	Size	Maximum Installation Length	Construction Time	Consumer Disruption	Overall Cost
Geopolymer Lining	Cleaning followed by a spin- or spray- applied fly ash-based binder with aluminosilicate, other lime containing minerals, alkalis, and other admixtures along with fine-grained aggregates. Some are fiber-reinforced. Class III.[1]	• True alumina silicate condensations in the lab where highly refined raw materials are used along with high curing temperatures • Accommodates non-circular pipes, bends and deformations in existing pipe • Short curing time shortening bypass time • Products have evolved over the past few years and their short-term mechanical properties approach those of the industry standards • More resistance to direct acid contact than Portland cement-bonded products • Potential use in mild acidic industrial applications where pH <5	• Bypass may be needed • Active infiltration needs to be addressed prior to application • May require confined space entry • Current products offered are hybrids; may compare their properties to simple Portland and sand mortars • Difficult to determined where it is resistant enough for typical municipal applications. One manufacturer suggests corrosion rates of 3" in ten years • Areas with severe MIC can produce acid concentrations nearing 7% with pH near 0. • Autogenous crack healing not well studied	30" to 120"	500'	Moderate	Moderate	$$
Centrifugally Cast Concrete Pipe Lining (CCCPL)	Mechanical cleaning followed by centrifugally applies Portland cement-based binder with a complex formulation or pozzolans, admixtures, crystalline forming mineral, rheological admixtures and reinforcing fibers. The binder is mixed with carefully graded select silica sands.	• Provides a fully structural replacement pipe with proper design • Small reduction in cross-sectional area • No joints and smooth interior • Accommodates non-circular pipes, bends and deformations in existing pipes • Short curing time shortening bypass time • Can be fortified against MIC with an antimicrobial admixture • Crack healing assisted by crystalline forming mineral admixtures • Great short term mechanical properties, including compressive and flexural strengths • Proven method since 1996	• Surface cleaning and preparation needed. Products are not for use against direct acidic conditions • Bypass may be needed • Active infiltration needs to be addressed prior to application • May require confined space entry • Some materials may be costly • Not for certain industrial processes or structures where upstream acidic production occurs in significant quantities	36" to 120"	600'	Moderate	Moderate	$$

Method	Description	Advantages	Limitations	Size	Maximum Installation Length	Construction Time	Consumer Disruption	Overall Cost
Manufactured In-Place Composite Pipe (MICP)	Robotically installed composite system comprised of a closed-cell elastomer, high tensile carbon fiber filament and a high tensile rigid later. Installed using autonomous navigation and control as well as a synergetic matrix of sensor feedback for real-time design validation.	• Reduces long term creep effect and material fatigue • Fills and seals any annular space or other discontinuities • Absorbs and shields rigid layer form strain caused by seismic events • Reports exact liner thickness and fiber pitch, 360 degrees in real-time during installation • Structurally independent (AWWA Class IV) renewal solution • Radial and axial carbon fiber reinforcement • Lining of 0 to 90 degree bends without excavation • Unlimited internal pressure rating • Zero annulus – minimum diameter loss • Autonomous control with auto correct platform eliminates ‘applicator error’ • Significantly reduced environmental and public disruption • Reduced installation times • Utilizes excavated or manway accesses • Does not require confined space entry	• Bypass required • Pit excavation may be required for installation without existing access points • Limited applications to date	48” and up	2,000’	Moderate	Low	$$
Spray-Applied Polymer Lining	Mechanical cleaning followed by spray-applied product, epoxy, polyurethane or polyurea. Class I to Class III.[1]	• Proven method • Relatively low cost • Stops internal corrosion; provides internal corrosion protection • Improves water quality and hydraulics • Small footprint and can be portable	• Thick linings are not proven to serve as fully structural rehabilitation • ANSI/AWWWA Standard C620 exists for 1 mm epoxy lining only	4” to 96”	Depends on equipment	Moderate	Moderate	$ to $$
Spot Repairs	Methods for repairing short sections of pipe. Common methods include internally or externally applied fiber-reinforced polymer and internal seals.	• Minimal surface disruptions • Small reduction in cross-sectional area with internal repairs	• Requires excavation for external repairs • High unit cost due to limited length of pipe repair	6” to 36”	3’ to 20’	Moderate	Moderate	$ to $$
Chemical Grouting	Uses a packer and grouter to stop infiltration, close small voids and/or test the seal of individual gravity pipeline joints. Special shape and size packers can be designed and constructed.	• Proven method • Relatively low cost • Does not require bypassing • Not affected by active infiltration	• Not a structural rehabilitation • Subject to failure when used in area with fluctuating groundwater levels • Failures can result from operator error, equipment failure and improper mixing • Use of grout materials may be restricted in the future	6” to 144”	Depending on packer length space	Low to Moderate	Low	$ to $$

Method	Description	Advantages	Limitations	Size	Maximum Installation Length	Construction Time	Consumer Disruption	Overall Cost
Cement Mortar Lining	Mechanical cleaning followed by spray-applied mortar, per ANSI/AWWA Standard C602. Oldest pipeline rehabilitation method, introduced in the 1960s. Class I.[1]	• Proven method • Relatively low cost • Stops internal corrosion; provides internal corrosion protection • Improves water quality and hydraulics • No work needed to restore services • Medium footprint	• Minimal structural improvement • Only applicable to unlined cast iron and steel water mains • Not recommended for soft water	4" to 144"	Varies	Low	Moderate	$
Crown Spraying	Application of magnesium hydroxide to protect concrete gravity sewers and retard corrosion.	• Low unit cost • Protects corroded concrete pipes • Can be applied quickly	• Temporary (1-2 year expected life) • Only protects the pipe above the flow zone	27" and up	Depends on pipe size and equipment capacity	Low	Low	$

Notes:

1. Structural classification is quantified through type testing which defines the capabilities of the rehabilitation product to provide corrosion protection as well as structural enhancement or replacement of the existing pipe. Manufacturers of the rehabilitation product(s) may provide data to support further classification of the general product categories in this table. Specific type testing recommendations for classification of pressure pipe linings can be found in the AWWA Committee Report – Structural Classifications of Pressure Pipe Linings.

HDR

Appendix B – Cost Estimate

				HDR Project No. 10309311

Computation

Project	IVGID Export Pipeline CMAR Project	Computed	K. Calderwood
Subject	Estimate of Probable Construction Cost - 16 inch Effluent Pipeline	Date	10/21/2021
Task	PreDesign Cost Estimate	Reviewed	
File Name	IVGID Export Pipeline CMAR Pre-Design Cost Estimate_102121 - bbu.xls	Date	

	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
DIVISION 1 - GENERAL REQUIREMENTS				
Mobilization and Demobilization	1	LS	$3,854,828	$3,854,828
Insurance and Bonds	1	LS	$176,818	$176,818
SUBTOTAL				**$4,031,646**
DIVISION 2 - SITE WORK				
Mitigation and Environmental Controls	1	LS	$250,000	$250,000
Asphalt Cutting	59,400	LF	$4.97	$295,218
Repaving - Trench Section	222,750	SF	$10.68	$2,378,970
Asphalt Overlay (1 inch open-graded) and Rotomill	475,200	SF	$1.76	$836,352
Asphalt Stripping	59,400	LF	$1.00	$59,400
Excavation (Soil)	31,185	CY	$105.65	$3,294,695
Excavation (Rocks)	3,465	CY	$320.30	$1,109,840
Hauling and Disposal (Soil and Rocks)	34,650	CY	$76.90	$2,664,585
Shoring	29,700	LF	$12.65	$375,705
Backfill and Compaction (Intermediate)	10,560	CY	$152.88	$1,614,413
Backfill and Compaction (Initial Backfill)	10,311	CY	$148.95	$1,535,834
Bedding Material	1,650	CY	$351.40	$579,810
Aggregate Base	4,950	CY	$149.55	$740,273
Grout Existing Effluent Pipeline	1,536	CY	$293.59	$450,922
Traffic Control	1	LS	$1,921,919.31	$1,921,919
Blow off Valves (Installation and Miscell.)	5	EACH	$2,417.56	$12,088
AVRV manholes	11	EACH	$6,859.25	$75,452
SUBTOTAL				**$18,195,475**
DIVISION 3 - CONCRETE				
Concrete Pipe Cover	2,475	CY	$231.51	$572,987
SUBTOTAL				**$572,987**
DIVISION 15 - MECHANICAL				
PIPES				
8 inch DI (Blowoff)	75	LF	$196.94	$14,771
2 inch HDPE pipe	176	LF	$129.29	$22,755
16-inch DIP Pipe	29,700	LF	$190.71	$5,664,087
FITTINGS				
DIP Fittings (Assume 3.5% of Pipe Cost)	1	LS	$206,616.58	$206,617
VALVES				
2 inch AVRV	11	EACH	$4,058.24	$44,641
2 inch Gate Valve	11	EACH	$757.51	$8,333
8 inch Gate Valve (Blowoff)	5	EACH	$1,888.90	$9,445
16 inch Butterfly Valves	2	EACH	$9,173.81	$18,348
Valve Boxes (Blowoff)	10	EACH	$900.26	$9,003
Valve Extension Rod and Casing (Blowoff)	5	EACH	$2,478.55	$12,393
Tie-in	2	EACH	$10,743.05	$21,486
Pipeline Pressure Testing	29,700	LF	$4.42	$131,274
SUBTOTAL				**$6,163,150**
Subtotal 1 (Division Total)				**$28,963,258**
Contractor Overhead and Profit (14% of Subtotal 1)				$4,054,856
Subtotal 2				**$33,018,115**
Construction Contingencies				$6,603,623
Design				$2,641,449
Administrative Costs				$660,362
Construction Management				$2,641,449
Subtotal 3				**$45,564,998**
TOTAL ESTIMATED PROJECT COST				**$45,564,998**

IVGID SR-28 EFFLUENT EXPORT PIPELINE TRENCHLESS TECHNOLOGY OPTIONS:

OPTION #1 386+50 TO 392+00:

DESCRIPTION	QTY	UNITS	$ / UNIT	TOTAL
Shoring & Plates	0.75	MO	$ 10,000.00	$ 7,500.00
Exc & Pipe Removal	89.14	CY	$ 410.00	$ 36,547.40
Pipeline Draining	0.00	EA	$ 35,000.00	$ -
16" Spools & Couplings	7.00	EA	$ 4,035.00	$ 28,245.00
Liner Sub Mobilization	1.00	LS	$ 26,108.44	$ 26,108.44
Clean & Camera & Support	550.00	LF	$ 73.00	$ 40,150.00
16" CIPP & Support - SAERTEX	550.00	LF	$ 405.00	$ 222,750.00
16" WEKO End Seals & Testing	2.00	SEG	$ 12,500.00	$ 25,000.00
Remove & Replace Spools	14.00	EA	$ 800.00	$ 11,200.00
Backfill	80.00	CY	$ 340.00	$ 27,200.00
AC Patching	22.90	TN	$ 1,400.00	$ 32,060.00
SUBTOTAL				**$ 456,760.84**
FEET				**550.00**
$ / FOOT				**$ 830.47**

SR-28 Pipeline Liner Location - Costs Savings # 1:

	Quantity	Units	$/Unit	Total
Remove Guardrail	335	LF	$ 20.00	$ 6,700.00
Remove AC Curb	345	LF	$ 5.00	$ 1,725.00
Remove Curb & Gutter	205	LF	$ 25.00	$ 5,125.00
Remove Slotted Drain	205	LF	$ 35.00	$ 7,175.00
Remove Guide Posts	10	EA	$ 15.00	$ 150.00
Install/Remove Temp Barrier Rail	335	LF	$ 50.00	$ 16,750.00
New Tri-Beam Guardrail	335	LF	$ 85.00	$ 28,475.00
AC Curb	345	LF	$ 15.00	$ 5,175.00
Concrete Curb & Gutter	205	LF	$ 50.00	$ 10,250.00
Slotted Trench Drain	205	LF	$ 200.00	$ 41,000.00
Guide Posts	10	EA	$ 75.00	$ 750.00
				$ 123,275.00

IVGID SR-28 EFFLUENT EXPORT PIPELINE TRENCHLESS TECHNOLOGY OPTIONS:

OPTION #2 408+00 TO 423+00:

DESCRIPTION	QTY	UNITS	$ / UNIT	TOTAL
Shoring & Plates	0.75	MO	$ 10,000.00	$ 7,500.00
Exc & Pipe Removal	89.14	CY	$ 410.00	$ 36,547.40
Pipeline Draining	0.00	EA	$ 35,000.00	$ -
16" Spools & Couplings	7.00	EA	$ 4,035.00	$ 28,245.00
Liner Sub Mobilization	1.00	LS	$ 71,204.82	$ 71,204.82
Clean & Camera & Support	1500.00	LF	$ 73.00	$ 109,500.00
16" CIPP & Support - SAERTEX	1500.00	LF	$ 405.00	$ 607,500.00
16" WEKO End Seals & testing	2.00	SEG	$ 12,500.00	$ 25,000.00
Remove & Replace Spools	14.00	EA	$ 800.00	$ 11,200.00
Backfill	80.00	CY	$ 340.00	$ 27,200.00
AC Patching	22.90	TN	$ 1,400.00	$ 32,060.00
SUBTOTAL				**$ 955,957.22**
FEET				**1500.00**
$ / FOOT				**$ 637.30**

SR-28 Pipeline Liner Location - Costs Savings #2:

	Quantity	Units	$/Unit	Total
Remove AC Curb	1075	LF	$ 5.00	$ 5,375.00
Remove Curb & Gutter	425	LF	$ 25.00	$ 10,625.00
Remove Guide Posts	16	EA	$ 15.00	$ 240.00
AC Curb	1075	LF	$ 15.00	$ 16,125.00
Concrete Curb & Gutter	425	LF	$ 50.00	$ 21,250.00
Guide Posts	16	EA	$ 75.00	$ 1,200.00
				$ 54,815.00

IVGID SR-28 EFFLUENT EXPORT PIPELINE TRENCHLESS TECHNOLOGY OPTIONS:

OPTION #3 425+00 TO 433+00:

DESCRIPTION	QTY	UNITS	$ / UNIT	TOTAL
Shoring & Plates	0.75	MO	$ 10,000.00	$ 7,500.00
Exc & Pipe Removal	44.58	CY	$ 410.00	$ 18,277.80
Pipeline Draining	2.00	EA	$ 35,000.00	$ 70,000.00
16" Spools & Couplings	4.00	EA	$ 4,035.00	$ 16,140.00
Liner Sub Mobilization	1.00	LS	$ 37,975.90	$ 37,975.90
Clean & Camera & Support	800.00	LF	$ 73.00	$ 58,400.00
16" CIPP & Support - SAERTEX	800.00	LF	$ 405.00	$ 324,000.00
16" WEKO End Seals & testing	1.00	SEG	$ 12,500.00	$ 12,500.00
Remove & Replace Spools	8.00	EA	$ 800.00	$ 6,400.00
Backfill	40.00	CY	$ 340.00	$ 13,600.00
AC Patching	11.30	TN	$ 1,400.00	$ 15,820.00
SUBTOTAL				**$ 580,613.70**
FEET				**800.00**
$ / FOOT				**$ 725.77**

SR-28 Pipeline Liner Location - Costs Savings #3:

	Quantity	Units	$/Unit	Total
Remove AC Curb	800	LF	$ 5.00	$ 4,000.00
Remove Guide Posts	12	EA	$ 15.00	$ 180.00
AC Curb	800	LF	$ 15.00	$ 12,000.00
Guide Posts	12	EA	$ 75.00	$ 900.00
				$ 17,080.00

IVGID SR-28 EFFLUENT EXPORT PIPELINE TRENCHLESS TECHNOLOGY OPTIONS:

OPTION #4 462+00 TO 475+00:

DESCRIPTION	QTY	UNITS	$ / UNIT	TOTAL
Shoring & Plates	0.75	MO	$ 10,000.00	$ 7,500.00
Exc & Pipe Removal	88.14	CY	$ 410.00	$ 36,137.40
Pipeline Draining	2.00	EA	$ 35,000.00	$ 70,000.00
16" Spools & Couplings	7.00	EA	$ 4,035.00	$ 28,245.00
Liner Sub Mobilization	1.00	LS	$ 61,710.84	$ 61,710.84
Clean & Camera & Support	1300.00	LF	$ 73.00	$ 94,900.00
16" CIPP & Support - SAERTEX	1300.00	LF	$ 405.00	$ 526,500.00
16" WEKO End Seals & testing	2.00	SEG	$ 12,500.00	$ 25,000.00
Remove & Replace Spools	14.00	EA	$ 800.00	$ 11,200.00
Backfill	80.00	CY	$ 340.00	$ 27,200.00
AC Patching	22.90	TN	$ 1,400.00	$ 32,060.00
SUBTOTAL				**$ 920,453.24**
FEET				**1300.00**
$ / FOOT				**$ 708.04**

SR-28 Pipeline Liner Location - Costs Savings # 4:

	Quantity	Units	$/Unit	Total
Remove AC Curb	1300	LF	$ 5.00	$ 6,500.00
Remove Guide Posts	20	EA	$ 15.00	$ 300.00
AC Curb	1300	LF	$ 15.00	$ 19,500.00
Guide Posts	20	EA	$ 75.00	$ 1,500.00
				$ 27,800.00

ATTACHMENT B

INCLINE VILLAGE
GENERAL IMPROVEMENT DISTRICT

Project Summary

Project Number:	2524SS1010
Title:	Effluent Pipeline Project
Project Type:	B - Major Projects - Existing Facilities
Division:	24 - Transmission
Budget Year:	2021
Finance Option:	
Asset Type:	SS - Sewer System
Active:	Yes

Project Description

The Effluent Pipeline Project will be a multi-year pipe replacement project. The immediate priority is to replace all of the remaining Segment 3 pipeline (12,385 linear feet) and to make immediate repairs to the Segment 2 pipeline (17,314 linear feet) to extend its life and avoid future leaks. The project timeline is to accomplish this over multiple construction seasons. TRPA and NDOT permits typically prohibit SR 28 traffic control delays from July 1 to September 5. This limits construction to May, June and Sept 6 to Oct 15. The replacement of Segment 3 would occur over two construction seasons. Replacing segment 2 would require 3 construction seasons. Reapirs to segment 2 could be accomplished with a segment 3 construction phase.

Project Internal Staff

The engineering division will support this project. Outside consultants will be used for design and management. The project will be publicly advertised in accordance with NRS 338.

Project Justification

The District currently owns, operates and maintains a 21-mile pipeline that exports treated wastewater effluent out of the Lake Tahoe Basin. This pipeline was installed in 1970 as part of the regional effort to protect Lake Tahoe's water quality by requiring all wastewater effluent to be exported out of the basin. Within the Tahoe Basin, this pipe is divided into three segments. Segment 1 is the low-pressure supply pipe to the pump station near Sand Harbor. Segment 2 is the welded steel high-pressure discharge pipe exiting the pump station. Segment 3 is the remaining low pressure jointed steel transmission pipeline within the Tahoe Basin running south to Spooner Summit. Segment 4 is the pipe that carries the effluent down the east side of the Carson Range from Spooner Summit to Hwy 395. Segment 5 is the pipeline that extends from HWY 395 to the bank of the Carson River. Segment 6 is the pipeline from the Carson River that delivers the effluent to the IVGID Wetlands Disposal Facility and was installed in 1983. A condition assessment completed on Segments 2 and 3 confirmed pipe deficiencies.

Forecast

Budget Year	Total Expense	Total Revenue	Difference
2021			
Internal Services	100,000	0	100,000
Project Design and Construction Costs	1,900,000	0	1,900,000
Year Total	2,000,000	0	2,000,000
2022			
Internal Services	100,000	0	100,000
Project Design and Construction Costs	1,900,000	0	1,900,000
Year Total	2,000,000	0	2,000,000
2023			
Internal Services	100,000	0	100,000
Project Design and Construction Costs	1,900,000	0	1,900,000
Year Total	2,000,000	0	2,000,000
2024			
Internal Services	100,000	0	100,000
Project Design and Construction Costs	1,900,000	0	1,900,000
Year Total	2,000,000	0	2,000,000
2025			
Internal Services	100,000	0	100,000
Project Design and Construction Costs	1,900,000	0	1,900,000
Year Total	2,000,000	0	2,000,000
	10,000,000	**0**	**10,000,000**

Year Identified	Start Date	Est. Completion Date	Manager	Project Partner

2012	Jul 1, 2020	Jun 30, 2025	Engineering Manager	

IVGID – Export Pipeline Replacement – Segment 2

Board of Trustees Update

3/1/2022

Effluent Pipeline Project Team

1 Schedule Update

2 Project Background

3 Design Progress

4 CMAR Process

5 Next Steps

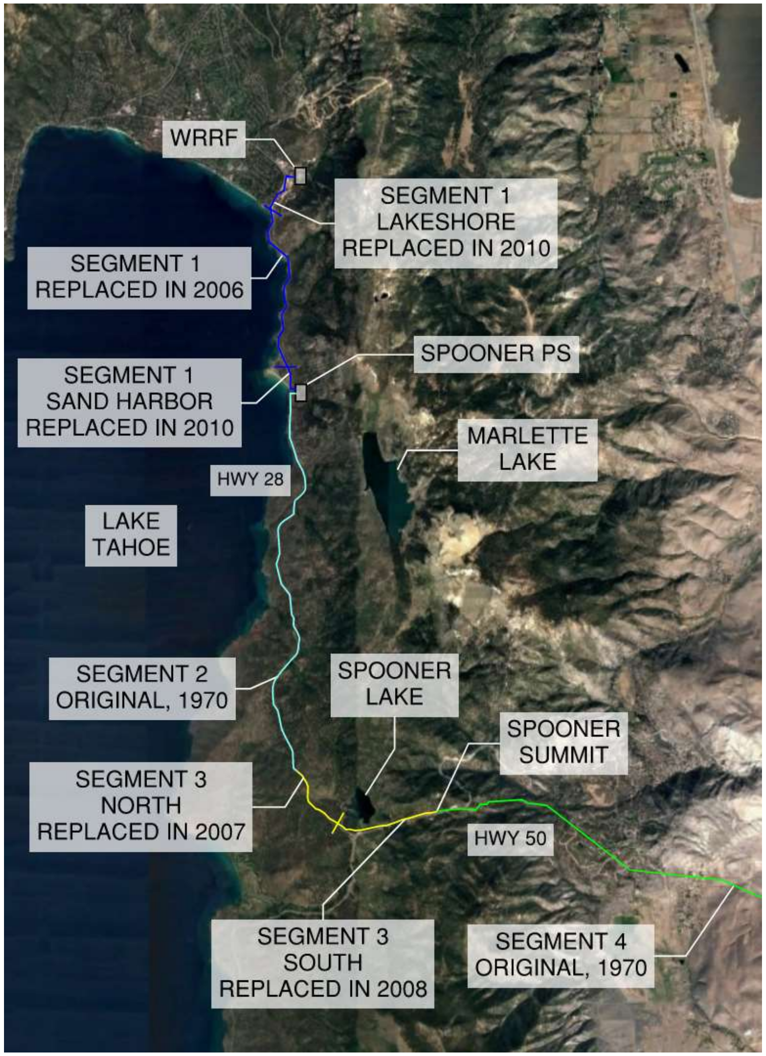
Schedule Update

30% Design

- Draft Preliminary Design Report submitted on 1/3/2022
- Comments received from IVGID and Granite
- Final Preliminary Design Report submitted 2/22/22
- 30% Design Drawings planned to submit in March 2022

Export Pipeline Background

Segment	Stationing (STA)	Year	Material
1	-23+63 – 0+00	1970	Steel
1 Lakeshore	0+00 – 16+00	2010	DIP
1	16+00 – 144+15	2006	HDPE
1 Sand Harbor	144+15 – 179+84	2010	DIP
2	200+00 – 497+21	1970	Steel
3 North	497+21 – 562+82	2007	DIP
3 South	562+82 – 601+24	2008	DIP
4	601+24 – XXX+XX	1970	Asbestos Cement
5	XXX+XX – 1009+60	1970	Asbestos Cement
5 Carson Valley	1009+60 – 1021+60	2010	HDPE



3 Design Progress

- Rehabilitation Tech Review
- Utility Research
- Hydraulic Analysis
- Pipeline Material Selection
- Pipeline Alignment
- NDOT Coordination

Rehabilitation Technology Review

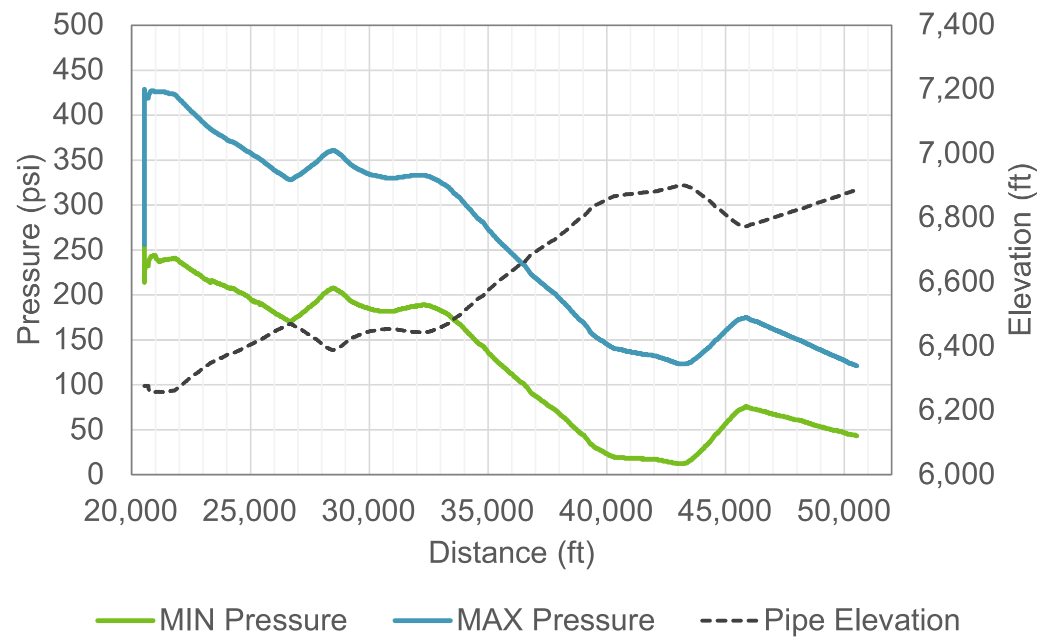
- Open Cut Remove and Replace
- Open Cut Parallel Alignment
- Cured-in-Place
- Sliplining

Utility Research

- NDOT-owned highway drainage culverts and catch basins
- NDOT records were requested for all contracts along Hwy-28

Hydraulic Analysis

- Transient analysis provided understanding of pipeline pressures
- Pipeline pressures inform pipe material and construction method selection.



Pipeline Material Selection

- Steel
  - All range of pressures
  - Expensive
  - High pressures require welding, which requires more shutdown time
- DIP
  - Pressures below 350 psi
  - Material used for emergency repairs
- HDPE
  - Pressures below 335 psi
  - Higher pressure requires thicker wall, which can reduce inside diameter
  - Volatile pricing
  - Corrosion resistant

Pipeline Alignment

Construction Methods

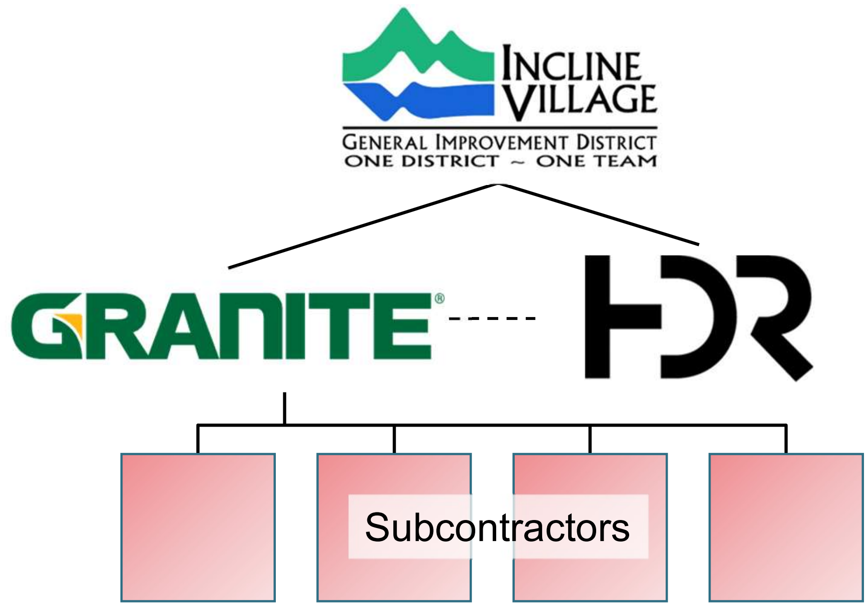
- Open-Cut Remove and Replace
  - Most of the alignment
- Open-Cut Parallel Alignment
  - High-pressure reaches to provide time for welding
- CIPP
  - Where feasible and appropriate (lower-pressure, straight segments)

NDOT Coordination

- NDOT is engaged in project progress meetings
- NDOT records requested
- Letter sent to NDOT in December detailed requested exemptions to NDOT standards
- Pavement preservation project is planned for SR 28 from US 50/Spooner to Ponderosa Ranch Road in Spring 2025.

CMAR Update

- Calibration of Costs – Provided Conceptual Cost Estimate
- Facilitate coordination with 3rd Party stakeholders
- Establish Limitation of Operations
- Develop Construction Schedule
- Pipeline Alignment and Constructability
- Cost Evaluation
  - Materials Selection
  - Replacement vs. Trenchless Options



Next Steps

- Contract amendments for HDR and Granite
- 60% Design
  - Finalize construction methods and pipe materials
  - OPCC
- Environmental documentation
- Pond 2 Temporary Storage
- 100% Design

INCLINE VILLAGE
GENERAL IMPROVEMENT DISTRICT
ONE DISTRICT ~ ONE TEAM

HDR

GRANITE®