BIG SKY ECONOMIC DEVELOPMENT

YELLOWSTONE COUNTY MONTANA

Lockwood TEDD Infrastructure Master Plan

Submitted: November 2017

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engineers ▪ surveyors ▪ planners ▪ scientists

KLJ

TABLE OF CONTENTS

Introduction

This plan documents the infrastructure needs of the Lockwood Targeted Economic Development District (TEDD), and addresses those needs while optimizing the potential of the Lockwood TEDD area for development. This plan attempts to realize the goal of Yellowstone County and their economic development organization, Big Sky Economic Development Association (BSEDA), by planning for an industrial park or other industrial development inside the Lockwood TEDD area.

While areas adjacent to the TEDD are not considered to be included in the TEDD itself, these areas were also analyzed in order to better plan for comprehensive infrastructure needs both for the TEDD and these surrounding properties.

Public Involvement

Steering Committee Meetings

To facilitate input needed for the Infrastructure Plan, a steering committee was set up for guidance with planning efforts. Five Steering Committee meetings were held throughout the course of the Infrastructure Plan. These meetings provided regular updates on the progress of the plan and invited comment and input from committee members. This input was used to address issues identified during the study effort and to move the plan forward. Steering Committee membership included the following:

- Allison Corbyn, Big Sky Economic Development
- Bob Riehl, Committee Chair
- Chief John Staley, Lockwood Fire Department
- Cory Moore, Hardy Construction
- Dianne Lehm, Big Sky Economic Development
- Katy Easton, Big Sky Economic Development
- Kevin Gustainis, Montana Peterbilt
- Marshall Knick, Pacific Steel and Recycling
- Mike Aritizia, Lockwood Water & Sewer District
- Nic Talmark, Trane Inc.
- Robin Rude,. Montana Department of Revenue
- Scott Walker, City of Billings
- Steve Arveschoug, Big Sky Economic Development
- Teery Seiffert, Property Owner
- Tim Miller, Yellowstone County
- Tobin Novasio, Lockwood School District
- Vu Pham, Weave Management
- Woody Woods, Lockwood Water and Sewer District

Five meetings were conducted in person and via GoToMeeting on the following dates:

- June 6th, 2017
- July 27th, 2017
- August 16th, 2017
- September 19th, 2017

- October 11th, 2017

Stakeholder Input

Area stakeholders were approached and asked for input and information regarding the Lockwood TEDD and the Infrastructure Plan. These stakeholders were identified from area land owners, government officials, and other jurisdictions as well as real estate interests.

Public Meetings

Public open houses were held on July 26th and October 10th. Both meetings were held in Lockwood, MT. The intent of the meetings was to share information on planning and analysis to support development of the Lockwood TEDD.

Background

Lockwood TEDD History

The Lockwood TEDD has been the subject of various recent studies. Viability of an industrial park was initially looked at with regard to the Trailhead Commerce Park, the genesis of which would later transform into the TEDD area. Other studies investigated the need for industrial land in the Billings, MT area, the needs and availability of local infrastructure to serve industrial needs, and eventually the capacity to serve an industrial park. This plan combines and summarizes previous work and identifies new issues and needs in the dynamic environment that is the Lockwood TEDD. The plan further explores how the Lockwood TEDD should access the forthcoming MDT Bypass. Figure 1 shows existing road and rail infrastructure within the Lockwood TEDD and Study Area.

Previous Studies

- Yellowstone County Industrial Park Feasibility Analysis – KLJ 2014
- The Economic Impact of Trailhead Commerce Park – University of Montana 2015
- Lockwood TEDD Comprehensive Development Plan – Big Sky Economic Development/Sanderson Stewart 2016

What is a TEDD

TEDD stands for Targeted Economic Development District. A Targeted Economic Development District (TEDD) is a district created by local government to support value-adding economic development projects. The purpose of a TEDD is to develop infrastructure to encourage the development of secondary value-adding industries by providing a funding mechanism to support infrastructure improvements.

Study Scope & Approach

Site Analysis

KLJ analyzed the multitude of recently completed planning efforts and reports developed to support the Lockwood TEDD. While much of this analysis is relatively fresh, it was orchestrated and summarized to support development of the Infrastructure Master Plan. The following elements were part of the Phase I site analysis:

- Previous Study Review
- Land Use & Zoning
- Jurisdictional Understanding

- Market Analysis
- Floodplain Analysis
- Transportation/Billings Bypass Analysis/Multiuse Trail Connection
- Additional Stakeholder Engagement

Future Systems and Full Build Implementation Plan

Inputs from the steering committee meetings were utilized to develop the full-build out of the Lockwood TEDD. The goal was a concise plan for implementation of infrastructure in key targeted areas of the Lockwood TEDD over the next 5 to 20 years. This plan includes preparation of maps detailing development of streets, rail, utilities, and other infrastructure layouts.

Plan Development and Organization

The Lockwood TEDD Infrastructure Master Plan was developed and organized to give users of this plan a valuable resource to assist with future project development and funding efforts. The remainder of the report includes the following major chapters:

- TEDD Market Identification
- Projected Conditions – Full Build Systems
- Transportation Systems
- Trip Generation
- Flood Plain
- Water and Wastewater
- Private Utilities
- Implementation, Programming, and Funding

Vision & Objectives

As part of developing the Lockwood TEDD Infrastructure Master Plan, the TEDD Steering Committee established an overarching vision for development of a Lockwood Industrial Park. The Vision is meant to provide a clear recognition of the efforts needed to secure the anticipated industrial development. The vision and objectives build upon work started earlier through the Comprehensive Development Strategy. The following vision statement and objectives guided the development of the Lockwood TEDD Infrastructure Master Plan.

Vision Statement:

Establish a long-range strategy for the Lockwood Industrial Park which meets both the short term and long term industrial development needs for the greater Yellowstone County economy.

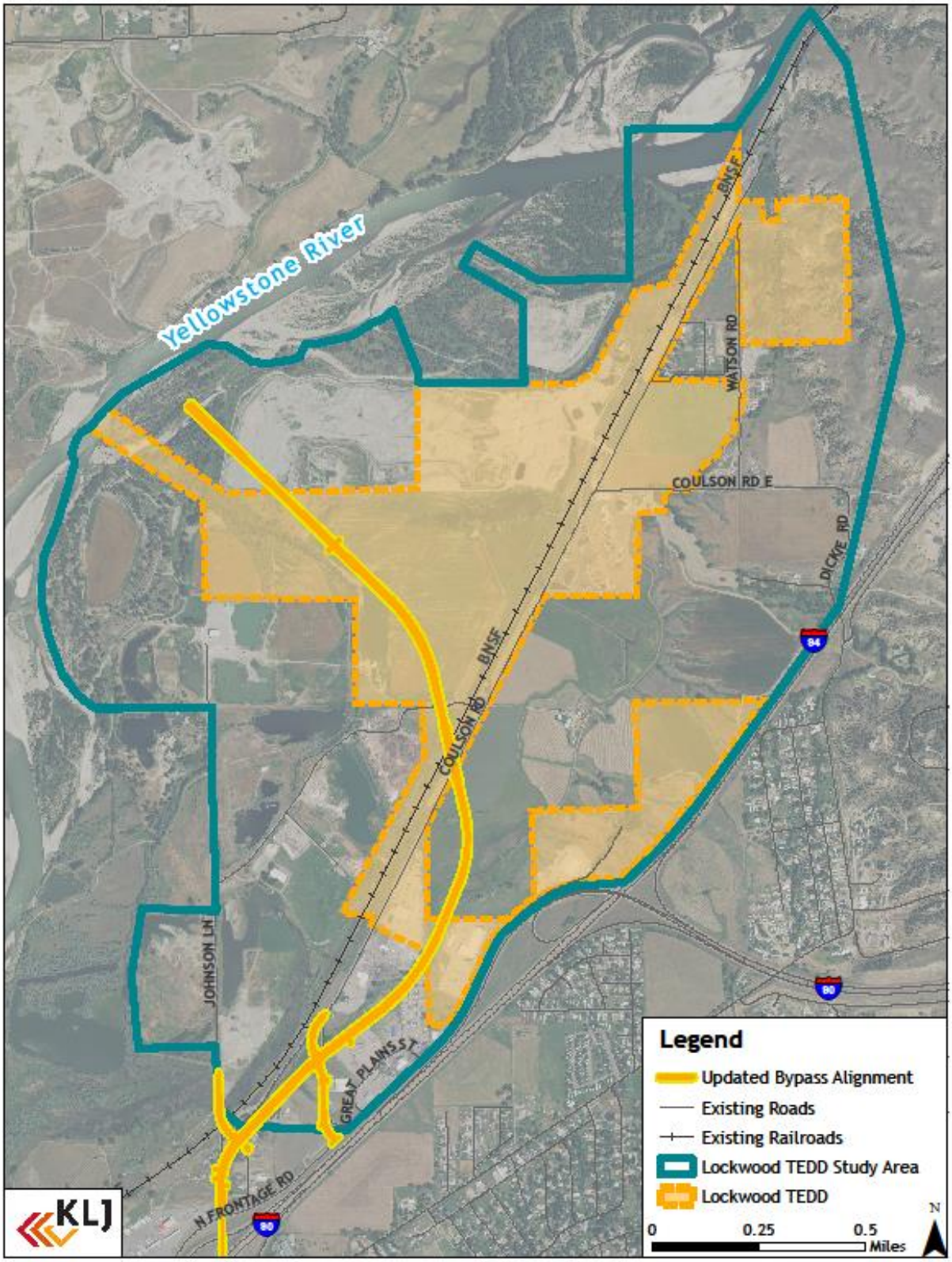
Objectives

Develop a forward-thinking infrastructure plan which addresses projected needs through the development of shovel-ready industrial land.

Ensure coordination and symmetry of the Lockwood Industrial Park with the City of Billings, Yellowstone County, the community infrastructure of Lockwood and the Montana Department of Transportation (MDT).

Outline overall infrastructure needs to assist with securing the appropriate mix of both public and private investments to facilitate the timely and efficient buildout of the Lockwood Industrial Park.

Figure 1: Existing Road and Rail in TEDD and Study Area



TEDD Market Identification

TEDD Industrial Park Need

Previous analysis pointed out the need for an industrial park in the Billings area as there was a dearth of immediately developable land for "shovel-ready" projects, especially in the 10-acre size range. While other cities in Montana have successfully completed industrial park projects including Missoula and Great Falls, the demand for industrial land in the Billings region is great and the Lockwood TEDD area is one of the few locations in the region that is best poised to take advantage of rail and road opportunities.

The Lockwood TEDD straddles the BNSF mainline running through that portion of Lockwood, which is operated by Montana Rail Link (MRL). The TEDD abuts the I-90 and I-94 interchange area and will be the site of a future bypass. MDT had completed plans for the bypass alignment and has conducted flood plain analysis that will be used in conjunction with infrastructure planning.

Market Potential

During steering committee meetings, initial market potential was developed for the Lockwood TEDD for a 20-year period. Assuming an industrial park would capture 25% of industrial market share in the Billings/Yellowstone County area, 957,521 Sq. ft. were calculated to be developed by 2030; this equates to approximately 16 acres per year. See Table 1.

Table 1: Developed Acreage by Year

Year	Total New Industrial Sq. Ft. (Yellowstone County)	Lockwood TEDD 25% Capture	Total Acres (Assume .15 FAR)	Acres/Yr.	Untapped Potential	Acres/Yr.
Year 1-5	1,302,807	325,702	65	13.0	25%	**16.2**
Year 6-10	1,253,815	313,454	62	12.5		**15.6**
Year 11-15	1,273,459	318,365	63	12.7		**15.8**
	3,830,081	**957,520**	**191**			

Source: Lockwood TEDD Strategic Plan, 2016 (Sanderson/Stewart)

Real Estate Assessment

Meetings with real estate professionals were conducted to assess the viability of site development within the TEDD and to come up with site sizes. Allowing for infrastructure and other needs, site sizes were developed using the available land in the TEDD.

Assumed site developments are shown in Table 2.

Table 2: Assumed Site Developments by Area

Assumed Site Development by Area				
Site Size (acres)	Number of Sites			
	TEDD (533 acres)	Remaining Study Area (470 acres)	Total	% Share of Total Lots
≤2	21	19	40	25%
2-5	45	39	84	53%
5-10	13	12	25	16%
10-40	5	5	10	6%
Total	84	75	159	100%

Existing Zoning/Land Use

To integrate into the TEDD, interested properties must be zoned. This was an issue for some of the properties in the TEDD as they were on the outskirts of Yellowstone County's planned areas. Some properties became zoned in order to join the TEDD, others adjacent to the TEDD remain unzoned. Should the TEDD ever expand, joining properties will need to be zoned as a pre-requisite. Current land use in the TEDD and Study Area varies from commercial and heavy industry (notably the neighboring, though not included, Exxon refinery) to gravel pits, agriculture, residential, and unused. Existing zoning can be seen in Figure 2.

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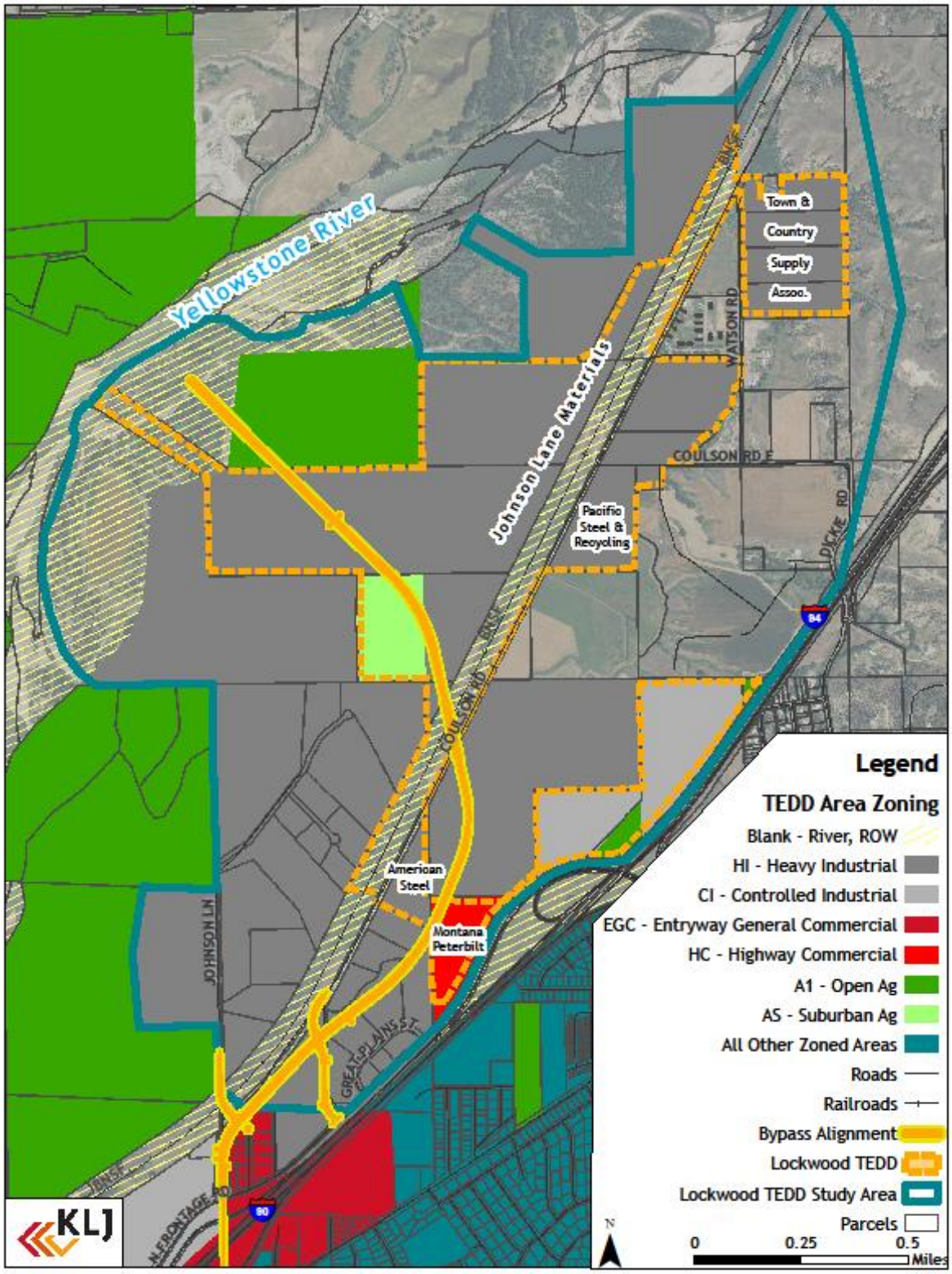
Figure 2: Lockwood TEDD Area Zoning



Projected Conditions – Full Build Systems

TEDD Buildout and Infrastructure Phasing

Infrastructure Phasing Areas

Most of the significant infrastructure for the Lockwood TEDD assumed a planning area which included the entire TEDD Study Area. The Study Area was initially developed through earlier planning efforts, and was again used as a planning tool for the Infrastructure Master Plan. The Infrastructure Master Plan is premised on finding possible efficiencies in the coordinated delivery of future infrastructure planning and investment both within the TEDD, and throughout the TEDD Study Area.

In order to phase infrastructure needs for the Lockwood TEDD area, surrounding properties were grouped into three phasing areas: Group A, B, and C. **These groups were included assuming they were not going to become part of the TEDD, but rather are included for infrastructure planning needs only.** However, Group A had at one time considered inclusion in the TEDD or showed interest in joining.

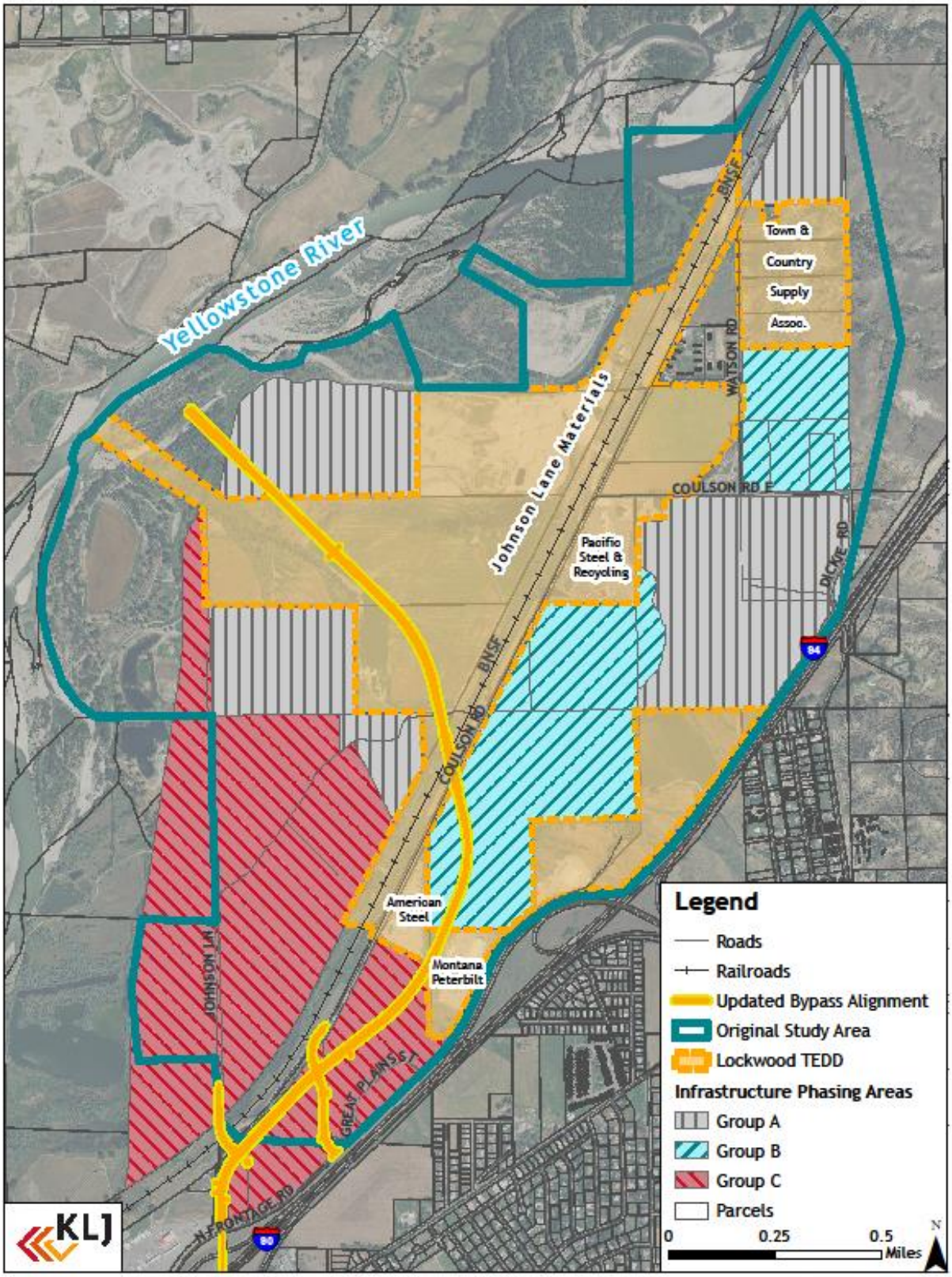
TEDD Buildout Potential

The Lockwood TEDD is planned to develop in phases with development starting in the TEDD itself and radiating out along planned road and rail infrastructure improvements and along the new bypass when that is constructed. Table 3 shows totals acreages by group. Figure 3 shows Group A, B, and C in relation to the existing TEDD.

Table 3: Developable Acres by Group

Group	Acres
Existing Lockwood TEDD	558.1
Group A	268.1
Group B	213.8
Group C	399.7
Total	**1439.8**

Figure 3: Lockwood TEDD and Surrounding Infrastructure Phasing Areas



TEDD Study Area - Buildout Phasing

The Lockwood TEDD and surrounding study area is assumed to develop in phases with development concentrating in the existing TEDD around initial infrastructure development. Infrastructure phasing areas will develop along a 20-year timetable as shown in Table 4. Figure 4 shows a potential 20-year development for the existing TEDD along with Groups A, B, and C. Group B is not likely to develop as property owners have expressed no interest in selling or developing.

Growth Assumptions

TEDD

- Immediate development
- Focus of future development in the Study Area

Group A

- Expressed interest in joining TEDD
- Served by proposed future proposed infrastructure
- Portion outside of existing floodplains

Group B

- Not interested in the development at this time
- Well situated for development based on existing and future infrastructure for development
- All on "dry" side of tracks

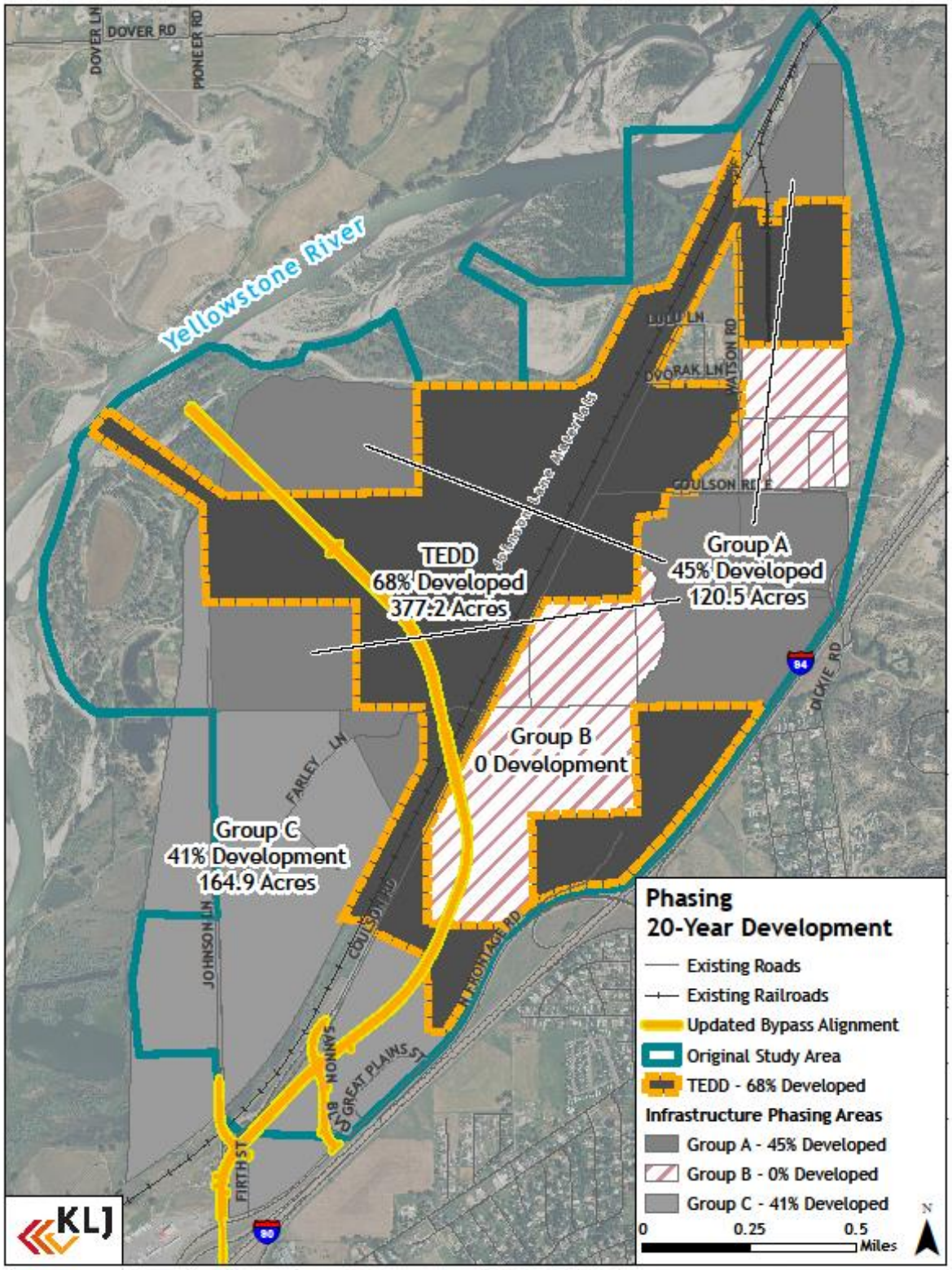
Group C

- Portions along Johnson Lane
- Some already developed (along Frontage Road, Farley Lane)
- Positioned along bypass and interstate access

Table 4: Year 20 Development by Infrastructure Phasing Area

Group	Total Acres	Develop = Y20	% Y20
TEDD	558.1	377.2	68%
Group A	268.1	120.5	45%
Group B	213.8	0.0	0%
Group C	399.7	164.9	41%
Total	**1439.8**	**662.6**	**46%**

Figure 4: Lockwood TEDD Area Development Phasing



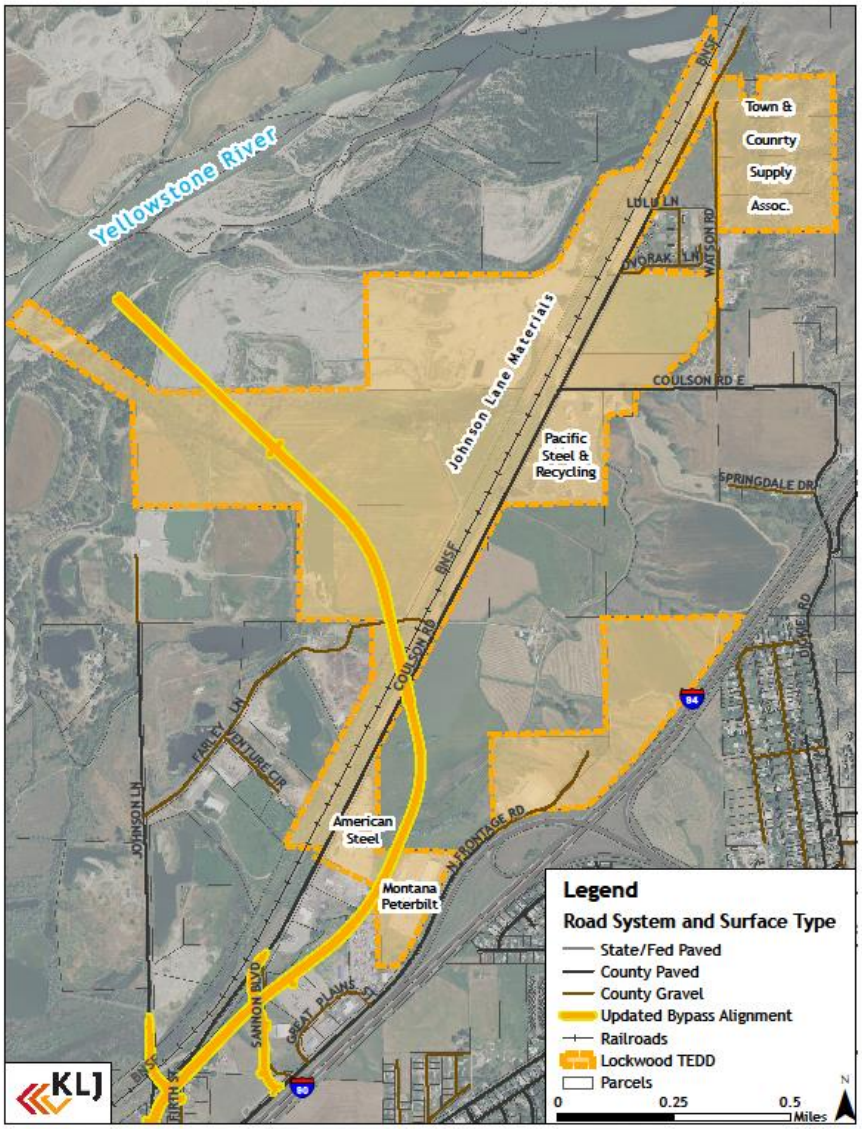
Transportation Systems

Existing System

Roads

Currently, the TEDD is served by a few county roads west of the I-94/I-90 area. Access is provided via the interchange at Johnson Lane and the underpass at Dickie Road. Within the TEDD, Coulson Road parallels the mainline railroad. Other roads include Coulson Road East, Farley Lane, Watson Road, and the Frontage Road. Existing roads can be seen in Figure 5.

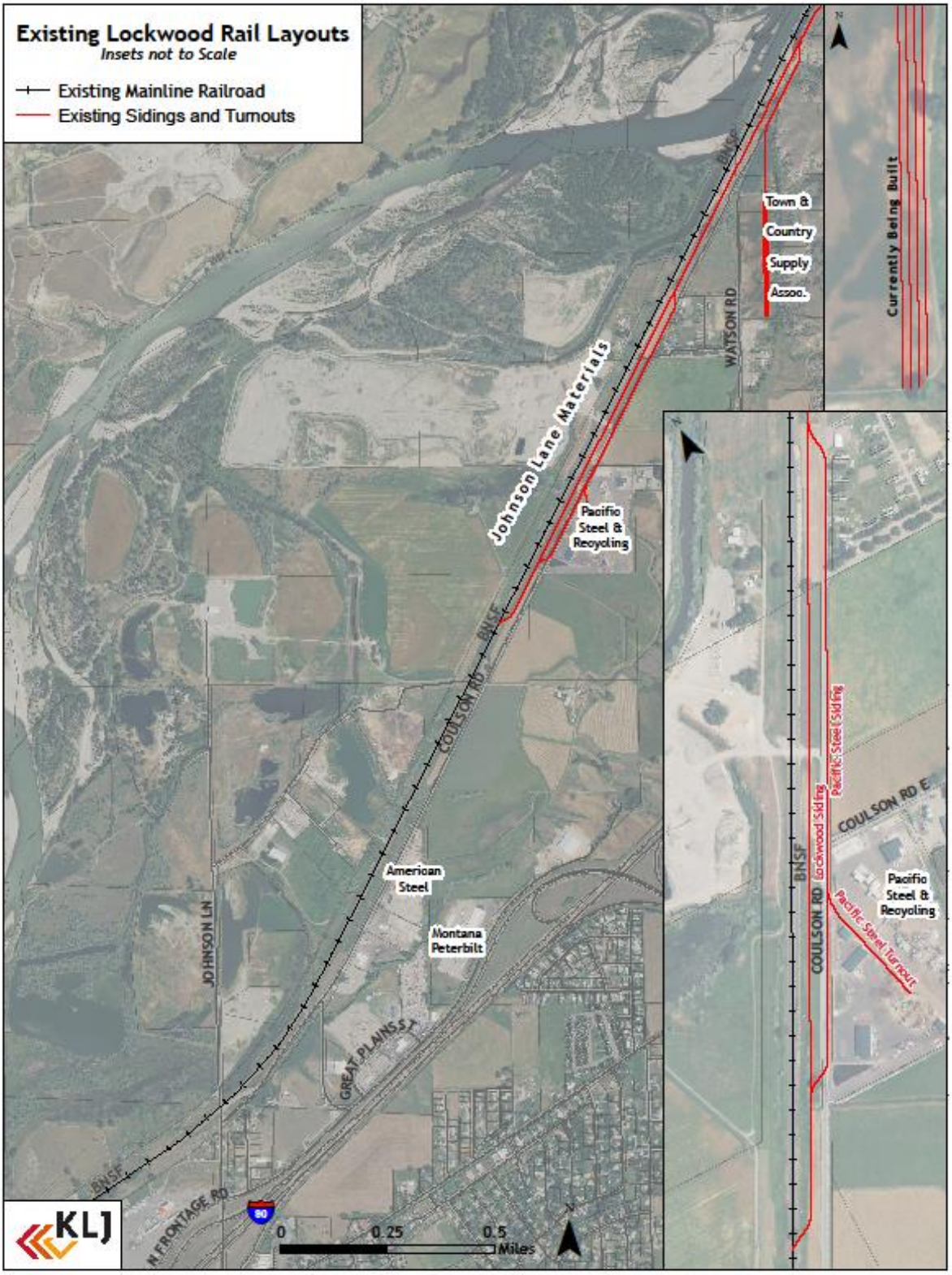
Figure 5: Existing Road Infrastructure



Rail

Rail serves the TEDD area via the mainline BNSF tracks, the Lockwood Siding, the Pacific Steel Siding, and the spurs for Pacific Steel and the recently constructed Town and Country Association Facility. A diagram of existing rail infrastructure can be seen in Figure 6.

Figure 6: Existing Rail Infrastructure



MDT Bypass

KLJ reviewed the preliminary alignment and design layout for the proposed Billings Bypass. KLJ has incorporated the preliminary Bypass layouts and assumptions into ongoing planning within the Lockwood TEDD Study Area. The Lockwood TEDD infrastructure planning has been adjusted to accommodate and tie into MDT's proposed bypass. Discussion regarding needed elements of coordination with MDT on continued design and development of the Bypass are integrated throughout this section.

Proposed Transportation Infrastructure

Roads

The TEDD Study Area includes some existing roads – notably Coulson Rd, Watson Rd, Dickie Rd, the I-90 frontage road and Johnson Ln. The implementation of an overall transportation network in the TEDD Study Area integrates these existing roads where possible within the context of the new bypass and potential land use.

A preliminary layout of potential road alignments can be seen in Figure 7. This graphic shows the Bypass alignment in relation to existing and potential future local roadways within the TEDD Study Area. A proposed intersection along the bypass north of the proposed BNSF overpass bridge is recommended. This intersection is assumed to be the primary access to the core of TEDD. This intersection will connect into additional local roadway systems tied directly with Johnson Lane to the west, and to the Dickey Road/I-94 underpass to the east.

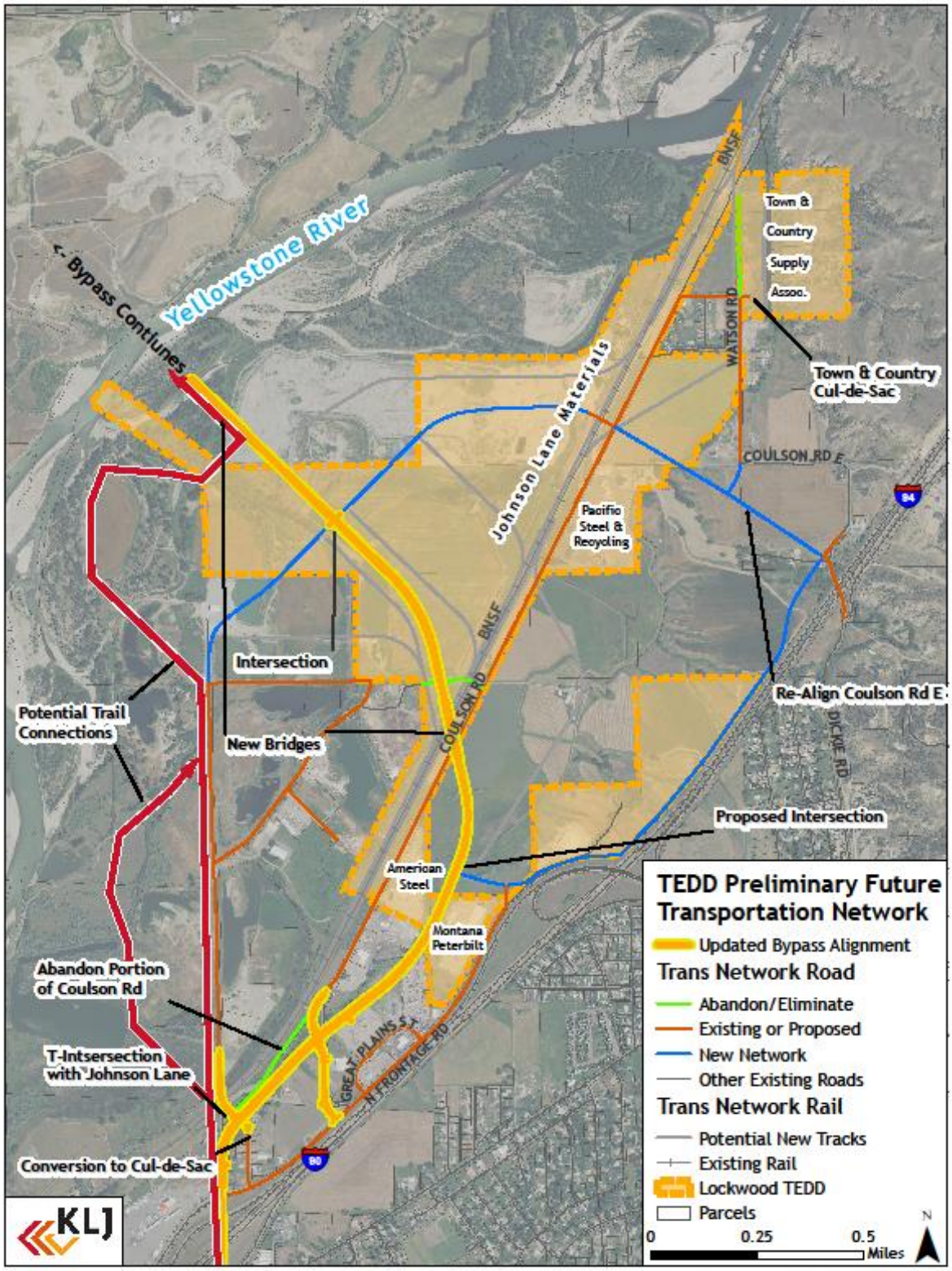
In addition, a potential new bypass intersection north of American Steel, east of Coulson Road would provide additional access for future potential development on the east side of the Lockwood TEDD Study Area. Without this new bypass intersection, all east side development from the Lockwood TEDD would intersect the bypass at Johnson Lane and near the I-90 interchange, possibly creating a significant traffic congestion issue. This intersection will need to go through additional MDT Systems Impact Evaluation as part of the future design work of Phase 4 of the Bypass.

Trail Connection

In addition to road and rail improvements, a trail connection has been identified along Johnson Lane to connect with the Bypass and across the Yellowstone River into the Heights. See Figure *13*. At this point, a final alignment and layout concepts have not been finalized for the Johnson Lane segment of the trail.

Programming of funds to build the trail across the Yellowstone River in tandem with Phase 2 of the Bypass has been secured. MDT will need additional guidance on where to end the proposed trail which is proposed to cross the Yellowstone River Bridge and temporarily terminate at east end of Phase 2 of the Bypass. Future programming needs for the continuation of the trail south of the Bypass and along Johnson Lane should be a future short term consideration. Preliminary costs for the Johnson Lane trail extension should be assumed at between $300,000 to $350,000 per mile. For planning purposes, the Johnson Lane trail extension should be assumed to cost $500,000 until more refined information is developed. The TEDD Advisory Board should work through the Metropolitan Planning Organization (MPO) or the Lockwood Pedestrian Safety District to do a more detailed assessment of project feasibility and cost estimating, including right-of-way.

Figure 7: Potential Future Transportation Network - Roads



Trip Generation

MDT Assumptions

For 2040 traffic projections, MDT's Preliminary Traffic Report for the bypass assumes Industrial Park land use. It appears that approximately 50 acres of future development is assumed in the general Lockwood TEDD, referred to in previous reports as Trailhead Commerce Park. MDT produced traffic projections for the planned Trailhead Commerce Park Development. Table 5 shows those projections.

Table 5: MDT Traffic Projections

Land Use	ITE Code	Units (ac)	Daily	Weekday AM Peak Hour			Weekday PM Peak Hour		
				Total	In	Out	Total	In	Out
Industrial Park	130	12	1,094	117	97	20	128	27	101
		40	2,433	298	247	51	304	64	240
	TOTAL	52	3,527	415	344	70	431	91	341

Assumptions and Traffic Analysis Update

Significantly higher acreages are being planned for the TEDD than those assumed in MDT's calculations. Additional knowledge about land development opportunities is available now, which also lends itself to a more detailed analysis. As shown in Table 6, over 450 acres of development in the Lockwood TEDD Study Area over the 20-year planning horizon were assumed. Therefore, the TEDD study included a new analysis of traffic generated by the TEDD and surrounding developable properties (refer to Figure 3). The assumptions used in that analysis follow. The ITE Trip Generation Manual, 9th Edition was used to estimate future traffic generated by the TEDD and surrounding properties. To accomplish this, the study area was divided into four quadrants, as shown in Figure 8. Table 6 shows that for both the TEDD and for development areas A, B, and C; assumptions were made regarding developable areas, and percent developed within each of the four quadrants over the next 20. A reduction of 30% was made to account for some of the developable land being used for road and rail right-of-way.

The Trip Generation Manual has data for 9 types of industrial development. The Industrial Park land use was chosen for analysis because it represented a mix of land uses likely to be present within the TEDD and surrounding land. Further, the Industrial Park land use resulted in the highest number of trips generated in comparison to other land uses. Therefore, estimated traffic generated within the TEDD area is assumed to be a conservatively high value. Once the number of generated trips within each quadrant was estimated, the distributions of these trips were estimated assuming that much of the industrial traffic will be heading to the Johnson Lane Interchange. Once percentages of traffic were assigned to turning movements, Average Daily Traffic and Peak Hour Traffic estimates were prepared for critical locations entering and leaving the studied quadrants. Traffic projections are shown in Table 6.

Traffic Analysis Summary

The analysis indicates that in the next 20 years, all planned corridors should operate satisfactorily as two-lane facilities with turn lanes. This region will generate heavy truck traffic, so existing and future pavements will need to be built up to handle the anticipated truck traffic. Truck turning radii should ideally be designed to handle the standard WB-67 truck. The traffic volumes on the bypass were not evaluated. However, the projected turning movements from this effort should provide MDT the information needed to continue their designs of turn lanes and intersections along the bypass. It is assumed that all side streets will stop for bypass traffic until such time as traffic signals or some other form of traffic control is warranted and installed.

Figure 8: Future Traffic Percentages by Quadrant

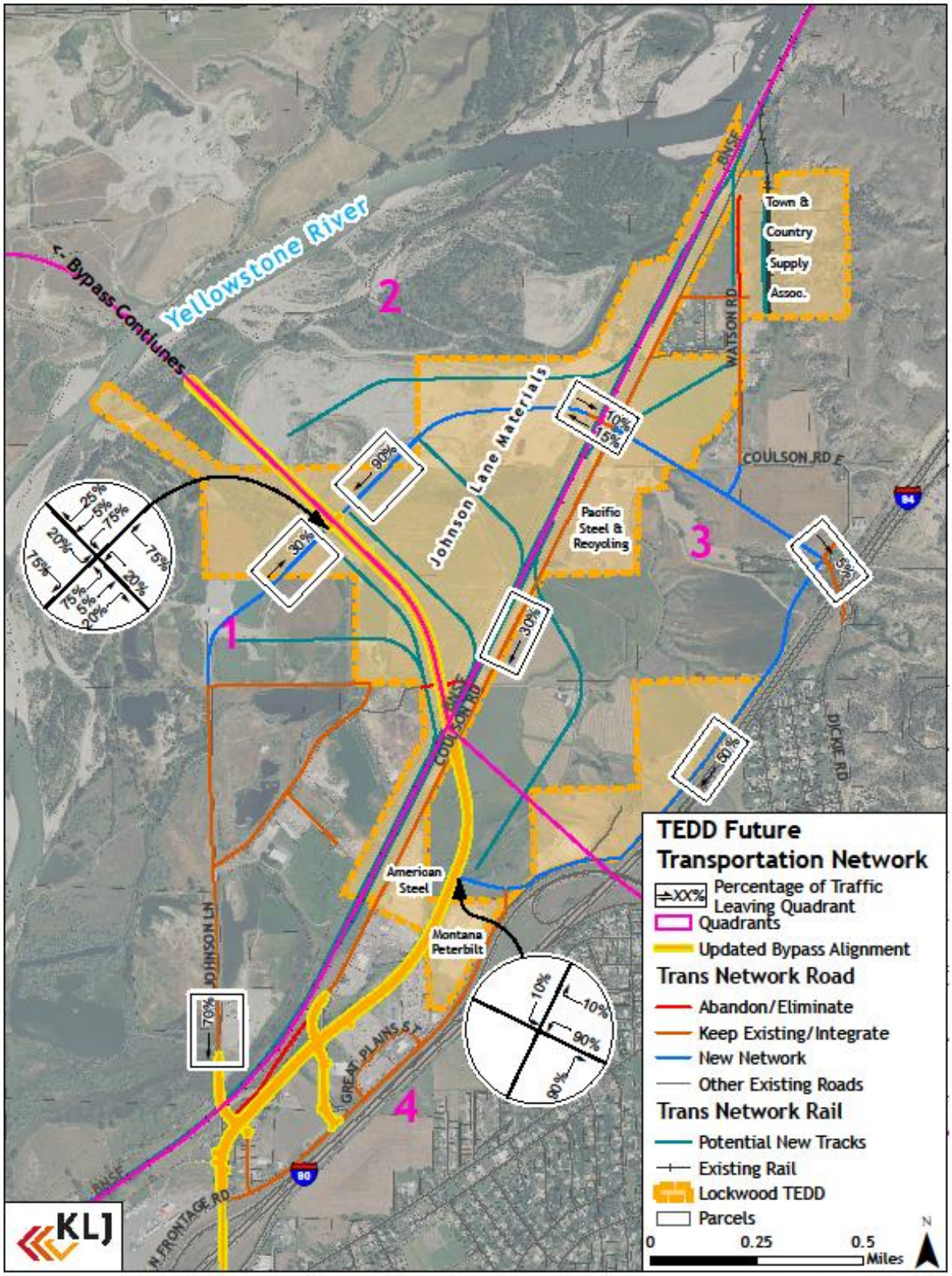


Figure 9: Projected Future Peak Hour Traffic Volume

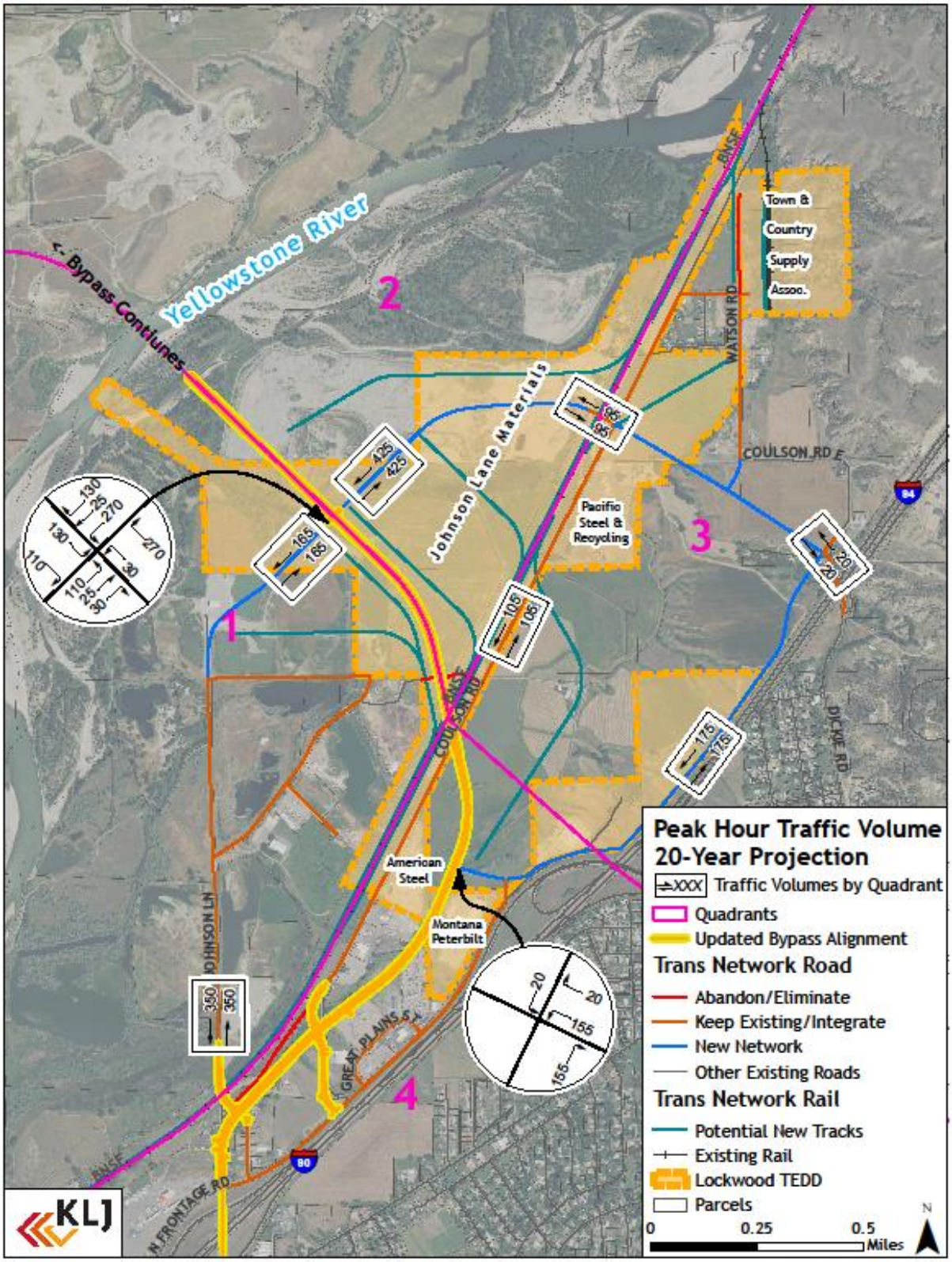


Figure 10: Projected Future Daily Traffic Volume

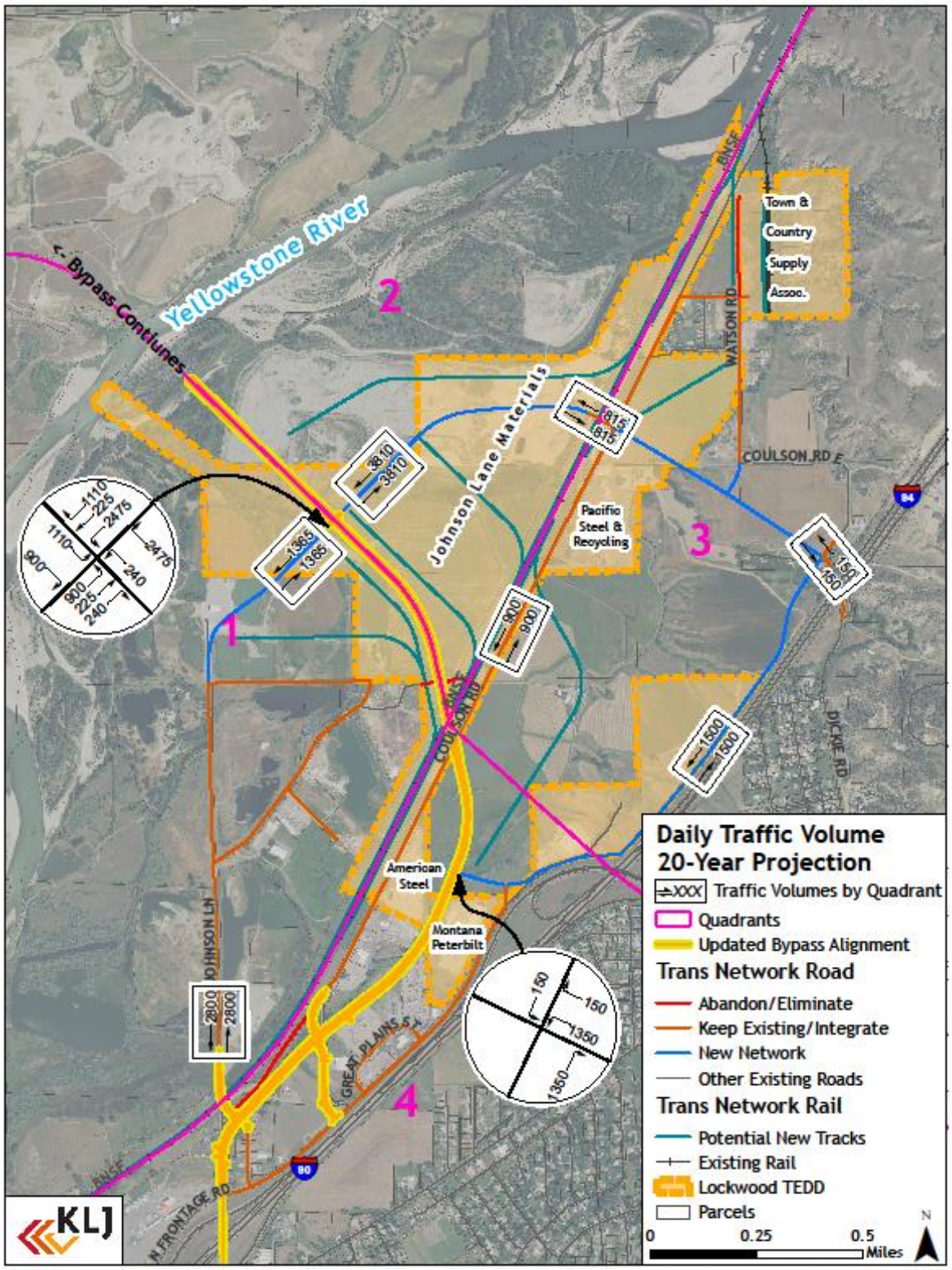


Table 6: Traffic Projections by Quadrant

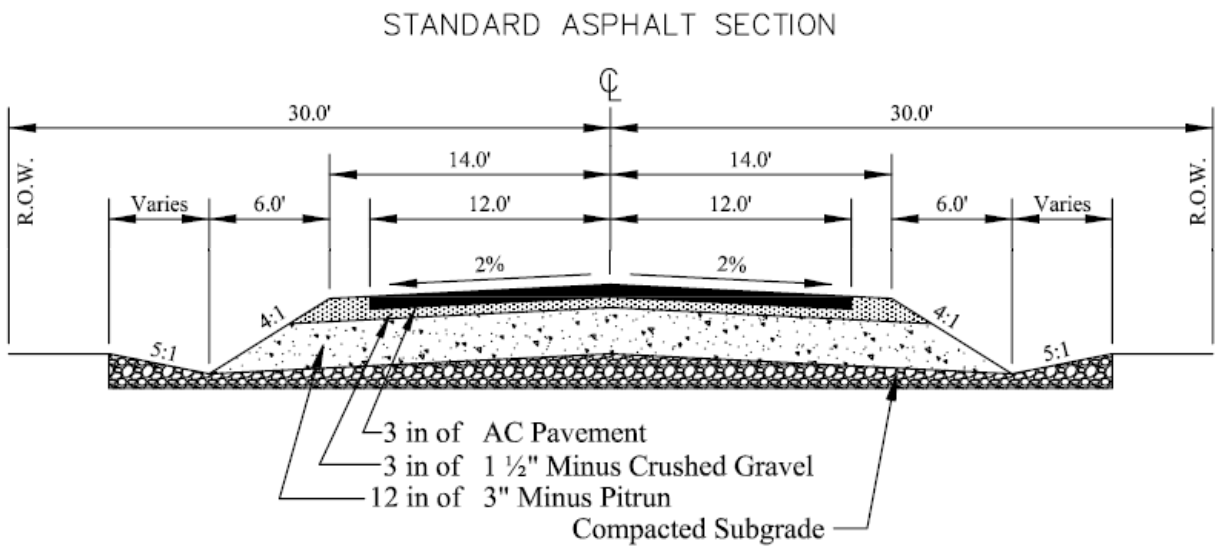
						ITE Industrial Park - Land Use 130					
Quadrant 1						AM Peak Hour		PM Peak Hour		Weekday Trips	
Group	Total Acres	Developable Acres W/ Flood Protection	30% Reduction for ROW	% Developed in 20 Years	Developed Acres in 20 Years	Trips/Acre	Trips*	Trips/Acre	Trips*	Trips/Acre	Trips*
TEDD	99.6	92.7	64.9	75%	48.7	8.00	331.3	8.39	350.7	61.17	2847.8
Group A	60.3	60.3	42.2	75%	31.7	8.00	248.4	8.39	269.8	61.17	2034.8
Group B	0.0	0.0	0.0	0%	0.0	8.00	0.0	8.39	0.0	61.17	0.0
Group C	313.1	313.1	219.2	25%	54.8	8.00	358.7	8.39	377.0	61.17	3140.7
					Subtotals		938.4		997.5		8023.3
Quadrant 2											
TEDD	205.9	202.1	141.5	75%	106.1	8.00	558.4	8.39	564.1	61.17	5593.5
Group A	69.1	46.6	32.6	75%	24.5	8.00	208.9	8.39	230.5	61.17	1690.0
Group B	0.0	0.0	0.0	0%	0.0						
Group C	0.0	0.0	0.0	0%	0.0						
					Subtotals		767.4		794.6		7283.5
Quadrant 3											
TEDD	214.3	214.3	150.0	50%	75.0	8.00	442.7	8.39	456.6	61.17	4107.1
Group A	161.2	161.2	112.8	25%	28.2	8.00	229.9	8.39	251.4	61.17	1868.9
Group B	167.8	167.8	117.4	0%	0.0	8.00	0.0	8.39	0.0	61.17	0.0
Group C	0.0	0.0	0.0	0%	0.0						
					Subtotals		672.5		708.0		5976.0
Quadrant 4											
TEDD	49.0	49.0	34.3	100%	34.3	8.00	262.0	8.39	283.2	61.17	2159.4
Group A	0.0	0.0	0.0	0%	0.0	8.00	0.0	8.39	0.0	61.17	0.0
Group B	46.1	46.1	32.3	0%	0.0	8.00	0.0	8.39	0.0	61.17	0.0
Group C	86.6	86.6	60.6	100%	60.6	8.00	383.8	8.39	401.0	61.17	3419.3
					Subtotals		645.8		684.1		5578.7
					Totals		3024.1		3184.3		26861.5

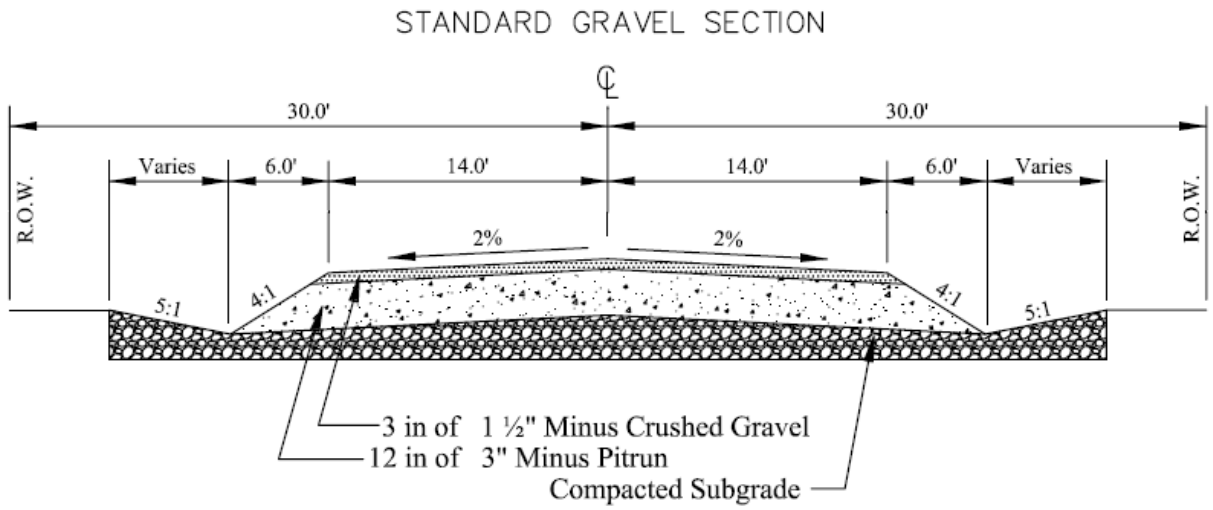
Trips* Calculated using fitted equation

Potential Road Improvement Phasing

Lockwood TEDD road improvements were studied and proposed in order to best serve the immediate development needs of the TEDD and the 20-year development of the TEDD and surrounding infrastructure phasing areas. See Figure 12 for a guide to road improvements by segment. The Yellowstone County typical sections for paved and gravel road segments are shown in Figure 11.

Figure 11: Typical Sections





Phase I

Phase I is scheduled to be implemented first. It extends segments from bypass intersections to feed TEDD properties (segments 1 & 8) and extends the Frontage Road (segment 5) roughly parallel to the interstate.

Phase II

Phase II is planned to improve portions of Coulson Road (where needed) (segment 4), realigns Coulson Road East to connect with Dickie Road at the underpass (segment 2), and extends Watson Road (segment 3) to intersect with the realigned Coulson Road. Phase III also improves Johnson Lane and Farley Lane triangle of roads (segments 6 & 7).

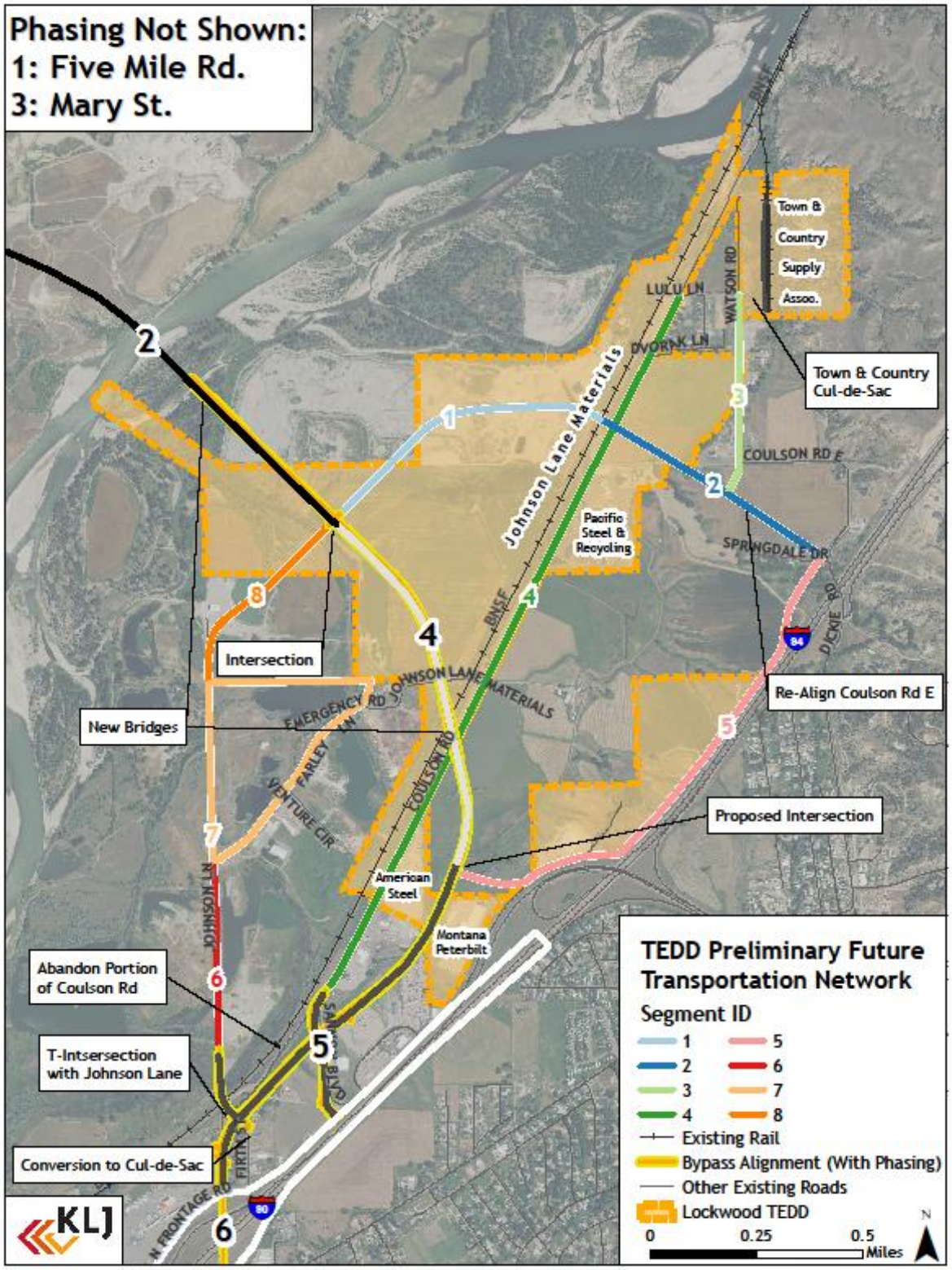
Costs by Segment

Assuming a paved cost of $206 per linear foot and a gravel cost of $113 per linear foot, costs for road segments are presented in Table 7. This assumes a 20 percent contingency.

Table 7: Proposed Roads - Cost by Segment

Segment ID	Linear Feet	Gravel Cost	Paved Cost
1	3,854	$ 522,610	$ 952,722
5	6,637	$ 899,974	$ 1,640,661
8	2,678	$ 363,112	$ 661,956
Subtotal	13,169	$ 1,785,696	$ 3,255,339
2	3,230	$ 438,001	$ 798,480
3	2,475	$ 335,602	$ 611,805
4	9,626	$ 1,305,257	$ 2,379,496
6	2,324	$ 315,131	$ 574,487
7	7,243	$ 982,199	$ 1,790,558
Subtotal	24,898	$ 3,376,191	$ 6,154,825
Total	38,067	$ 5,161,886	$ 9,410,164

Figure 12: Potential Transportation Network Segments



Rail

A number of potential rail options are desirable within the Lockwood TEDD Study Area. Potential rail options include the following:

- Extend the Lockwood and Pacific Steel sidings southward down to approximately where the MRL mainline curves westward;
- Create an additional siding on the west side of the MRL mainline;
- Create spurs off MRL mainline or sidings where applicable.

Costs for various TEDD rail improvements are listed in Table 8.

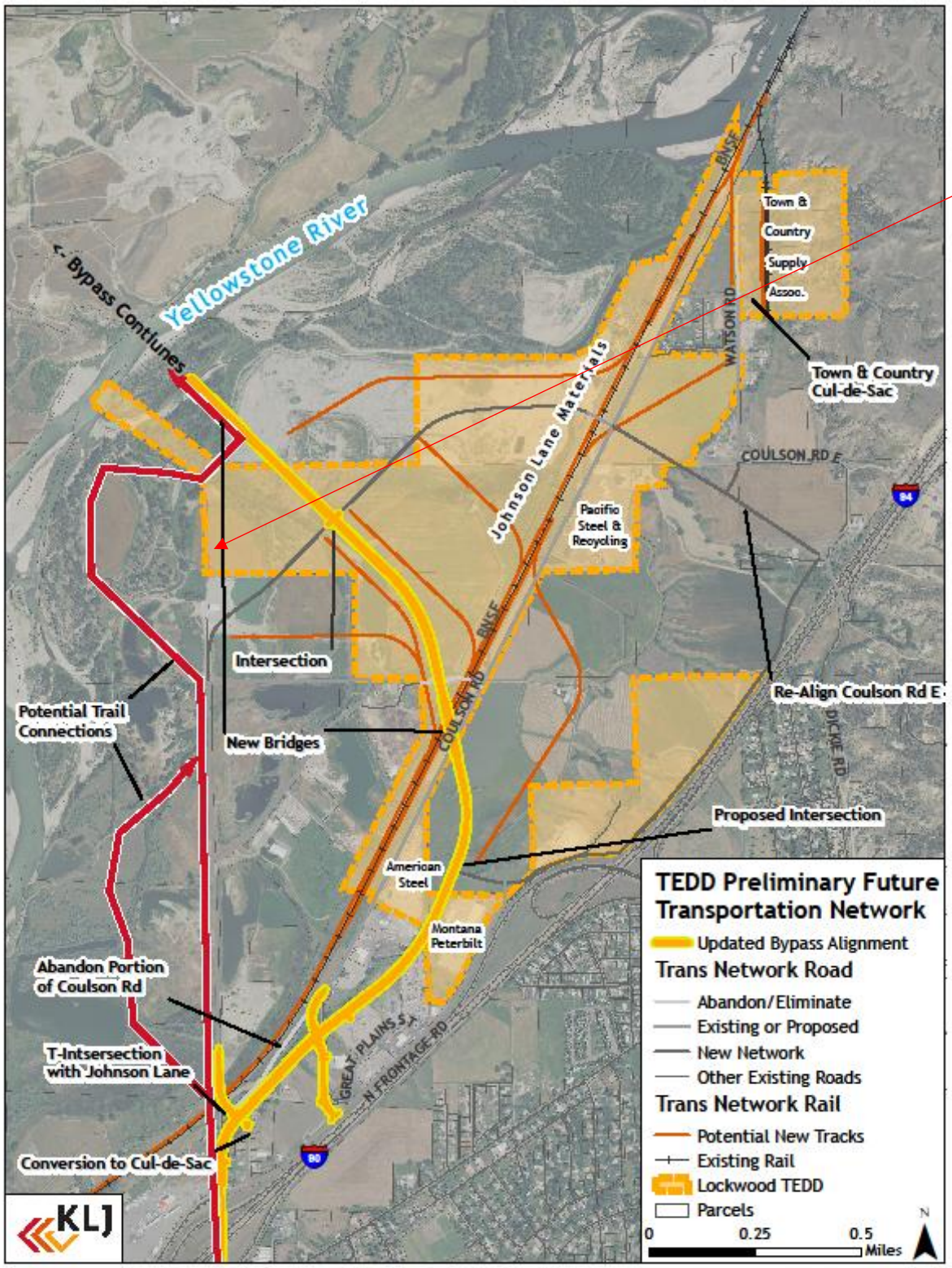
Table 8: Costs for Rail Improvements

Segment	Length	Cost/LF	Total Cost
West Siding	14,000	$ 650.00	$ 9,100,000
Lockwood Extension	4,850	$ 600.00	$ 2,910,000
Pacific/T&C Extension	8,900	$ 615.00	$ 5,473,500
Total	27,750	$ 1,865.00	$ 17,483,500

While developing future rail alignments, care was taken to avoid new at-grade intersections with the proposed road network. Other potential rail spurs are proposed as shown in Figure *13* to provide accessibility between future industrial sites and the BNSF railway.

A full build rail network within the Lockwood TEDD Study Area will require some consideration of the current layouts for bridges along the Bypass within the Lockwood TEDD Study Area. These are discussed in the Bridge Structural Considerations chapter.

Figure 13: Potential Future Transportation Network - Rail



Bridge Structural Considerations

Coulson Road / Railroad Bridge

The current alignment and design for the Bypass assume only one (1) additional rail line underneath the Coulson Road/MRL Railroad Bridge. Based on initial layout for future rail needs in the Lockwood TEDD Study Area, MDT was asked to consider the future need for three (3) rail lines under this structure, making for a total of four lines. This would account for the extension of the current Lockwood Siding and Pacific Steel Siding, and one potential additional siding on the west side of the current MRL mainline. Vertical clearance for two additional tracks (beyond the one currently proposed) exists with the current bypass bridge design over Coulson Rd and the MRL mainline. See Appendix A.

Yellowstone Bridge

The overall rail network within the TEDD Study Area initially considered the potential for a long track loop on the west side of the Lockwood TEDD Study Area. The current Yellowstone Bridge doesn't accommodate this loop track. To accommodate the potential new railroad near the southern end of Yellowstone bridge, that bridge would have to be extended by approximately 500 feet. Assuming a cost of $200 per square foot of bridge, this additional span of bridge would cost $6.6 million. This may not be cost feasible.

If a loop track is warranted in the Lockwood TEDD Study Area, and to avoid impacts to the Yellowstone River bridge it may be better to consider a separate structure to cross a future potential long track loop as shown in Appendix B. It is understood that this cost would likely need to be borne by local partners, and are estimated at between $1.5 to $2.0 million. This potential new structure would need to be about 475' south of the current Yellowstone River abutment.

MDT has significant concerns with the option due to short term decision being made on both the Yellowstone structure and the road grade itself for the Bypass. Concerns have been raised by MDT's consultant regarding the uncertainty of the long track loop, and regarding the high cost and impacts on structure design. Even if a separate structure is provided along the bypass for the rail to pass under, the Yellowstone Bridge grade would need to be designed significantly higher than has been planned to date.

In coordination with the TEDD Steering Committee and MDT it was determined that a loop track system crossing the proposed Bypass was not cost feasible, nor is it needed to support future industrial development. Therefore, that option is not considered in this report.

Flood Plain

Existing Conditions

The Lockwood TEDD was planned with close consideration for existing FEMA floodplain and regulatory floodway along the course of the Yellowstone River. Lockwood TEDD infrastructure concepts were developed in order to make best use of existing property within the TEDD boundary and outside of the floodway. For purposes of planning, it was assumed land falling within the 1% annual chance floodplain or the 0.5% annual chance floodplain could be developed with flood mitigation.

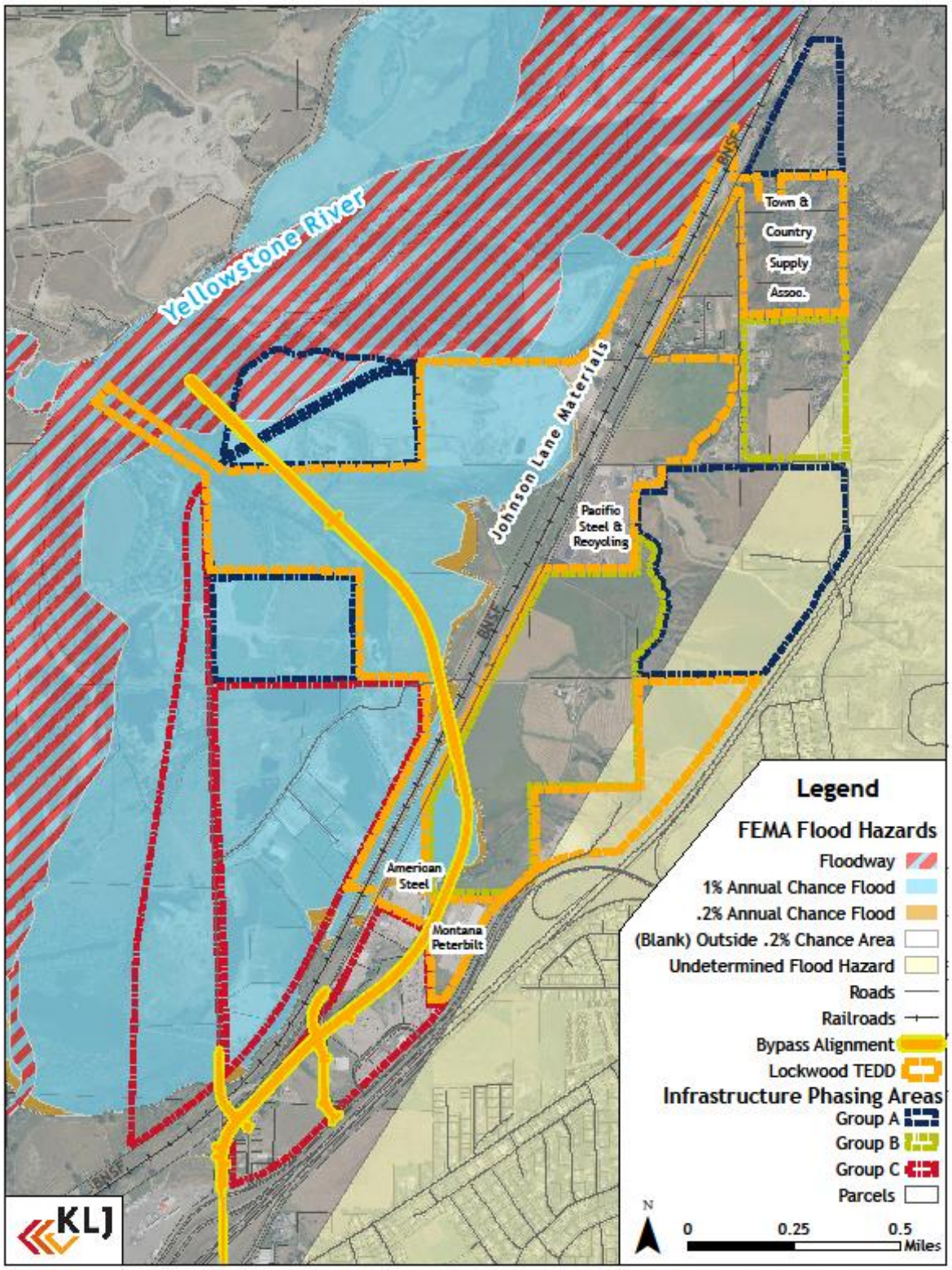
Possible Developable Area

Using FEMA floodplain data, an initial estimate of developable acres was developed for the Lockwood TEDD and Study areas. Much of the TEDD lies within the existing 1% annual chance floodplain and a fringe within the 0.5% chance annual floodplain. These floodplain areas lie mostly on the west side of the MRL mainline track, creating a "wet" side and a "dry" side. Floodplain areas in relation to the TEDD can be seen in Figure *14*. The developable acreage for each group is presented in Table 9.

Table 9: Floodplain Developable Acres by Group

Group	Total Acres	Inside Floodway	Inside 1% Floodplain	Outside 1% Floodplain	Developable with Flood Protection
TEDD	568.7	10.6	230.86	327.22	558.1
Group A	290.6	22.5	106.92	161.16	268.1
Group B	213.9	0.0	0.00	213.85	213.9
Group C	399.7	0.0	301.2	98.5	399.7
Totals	1472.9	33.1	638.98	800.73	**1439.8**

Figure 14: FEMA Floodplain Areas



Flood Area Mitigation Options

Three main flood mitigation options were developed to secure developable land within the TEDD and Study Area. While some options may be better suited to individual properties, larger efforts like mass fill and a levee present certain advantages. The options' pros and cons are presented below.

Option 1: Incremental Fill

In this option sites would be filled as they develop on an individual basis. This option encourages a piecemeal approach to development, where sites are chosen and laid out based on the ease of the development and not necessarily planned ahead of time. The following are the pros and cons of the incremental fill option:

- Pros
  - Developer driven
  - Can be built to suit
  - Lowest initial cost to property owners
  - Unregulated uses do not require fill
- Cons
  - Limits developable area
  - Requires large initial investment for individual sites and most industrial uses
  - Permitting is incremental and rules may change in the future further limiting developable area
  - Burden is completely on development
  - Large borrow volumes are needed
  - Modelling would have to be reproduced on a case by case basis

Option 2: Mass Fill with Map Revision

This option includes a mass fill of a selected area to encourage and plan development in that area. The option allows the risk and cost of development to be equally spread over the filled area and creates "shovel-ready" sites, but there are costs associated with making the land fit development rather than developing based on usable land. The pros and cons of the mass fill options are as follows:

- Pros
  - Opens more "shovel-ready" sites
  - Single permitting process completed upfront
  - More efficient construction than incremental fill because it's all done at once
  - May be coordinated with other infrastructure
  - Allows maximum flexibility of filled area
  - May be combined with incremental fill for more flexibility
  - Unregulated uses could utilize areas outside of fill
  - Value added towards future development
  - Existing flood modelling is already completed as part of MDT Billings Bypass project
- Cons
  - Large initial investment
  - Large borrow volumes are needed
  - Spending is based on speculation that development will take place

Option 3: Levee System

This option includes construction of a levee along the floodway boundary to protect the flood fringe areas. This option allows for the maximum buildable area, and allows development to be planned and "shovel-ready" once the levee is built. However, there are considerable costs associated with levees for both construction and on-going maintenance.

The levee option includes a 15,600-foot-long levee with a top width of 30 feet and average height of 5.5' and 4 to 1 side slopes. The levee option also includes a drainage system to ensure water does not seep under the levee and both seepage and storm water pumping stations, which are not necessary in the other 2 options. Another considerable cost is the ongoing maintenance.

The following is a list of pros and cons for the levee system option:

- Pros
  - Maximum developable area
  - May be coordinated with other infrastructure
  - Allows maximum flexibility
  - Single permitting process completed upfront
  - Greater value added towards future development
  - Existing flood modelling is already completed as part of MDT Billings Bypass project
- Cons
  - Large initial investment
  - On-going maintenance costs
  - Requires buy-in from properties not included in TEDD
  - Requires a public entity to administer maintenance and certification
  - Requires additional stormwater infrastructure
  - Requires additional infrastructure to mitigate effects of groundwater

It was determined not to be cost feasible to construct a separate levee system to support flood protections needs of the TEDD Study Area.

Updated Floodplain Information

With updated floodplain analysis completed as part of the MDT bypass construction near and over the Yellowstone River, flood mitigation options can be more precisely assessed. Three main options have been analyzed regarding their effectiveness and feasibility. Areas which could benefit from either incremental fill, mass fill, or the levee option were calculated in acres.

Developable Area

Tables 10, 11, and 12 refer to areas for each option. Flood option areas can be seen in Figure *15*. A guide to understanding each column is below:

- *Shovel Ready*: areas not currently mapped in the regulated flood area, and are assumed to develop fully.
- *Shovel Ready with Remap*: areas that should be removed from the regulated flood area with a Letter of Map Amendment (LOMA), assumed to develop fully.
- *Zone X (<1 ft. of flooding)*: areas with less than one foot of flood depth and thus not subject to regulations. It's possible to remove such areas from the regulated flood area via LOMA, but less likely than shovel-ready areas, therefore 50% development is projected.

- *Previously Filled* (Incremental and Mass Fill only): areas that have already been developed and are either above the flood elevation or nearly so. This assumes 50% development under the incremental fill option because burden is entirely on developer while 100% development in the mass fill option as burden is spread out.
- *Shallow Fills (<4 feet)*: areas that are able to be filled because of relatively shallow depths. This assumes 10% development in the incremental option and 25% in the mass fill option – again due to the distribution of the burden.
- *Deep Fills (>4 feet)*: these areas are assumed to be undevelopable unless a mass fill option is pursued to tie the previously mentioned areas together.
- For the Levee Option, 25% of area was assumed to be developable because of the presence of ponds and wet areas, which would require additional improvements.
- All options assume 25% building coverage.

Table 10: Incremental Fill Option Flood Areas

Incremental Fill Option						
	Shovel-Ready	Shovel-Ready with Remap	Zone X (<1 ft. of flooding)	Previously Filled	Shallow Fills	Total
Raw Areas (Acres)	321.4	42.2	34.1	0.0	35.9	433.5
Buildable Area (Acres)	321.4	42.2	17.0	0.0	3.6	384.2
Building Area (SF)	3,500,000	460,000	190,000	0	40,000	4,190,000

Table 11: Mass Fill Option Flood Areas

Mass Fill Option							
	Shovel-Ready	Shovel Ready with Remap	Zone X (<1 ft. of flooding)	Previously Filled	Shallow Fills	Deep Fills	Total
Raw Areas (Acres)	321.4	42.2	34.1	0.0	35.9	58.4	491.9
Buildable Area (Acres)	321.4	42.2	34.1	0.0	9.0	5.8	412.4
Building Area (SF)	3,500,000	460,000	370,000	0	100,000	60,000	4,490,000

Additional Square Footage from Incremental: 300,000

Table 12: Levy Option Flood Areas

Levy Option					
	Shovel Ready	Shovel- Ready with Remap	Zone X (<1 ft. of flooding)	Removed from Regulated Area	Total
Raw Areas (Acres)	321.4	42.2	34.1	639.1	1036.8
Buildable Area (Acres)	321.4	42.2	34.1	159.8	557.4
Building Area (SF)	3,500,000	460,000	370,000	1,740,000	6,070,000

Additional Square Footage from Incremental: 1,880,000
Additional Square Footage from Mass Fill: 1,580,000

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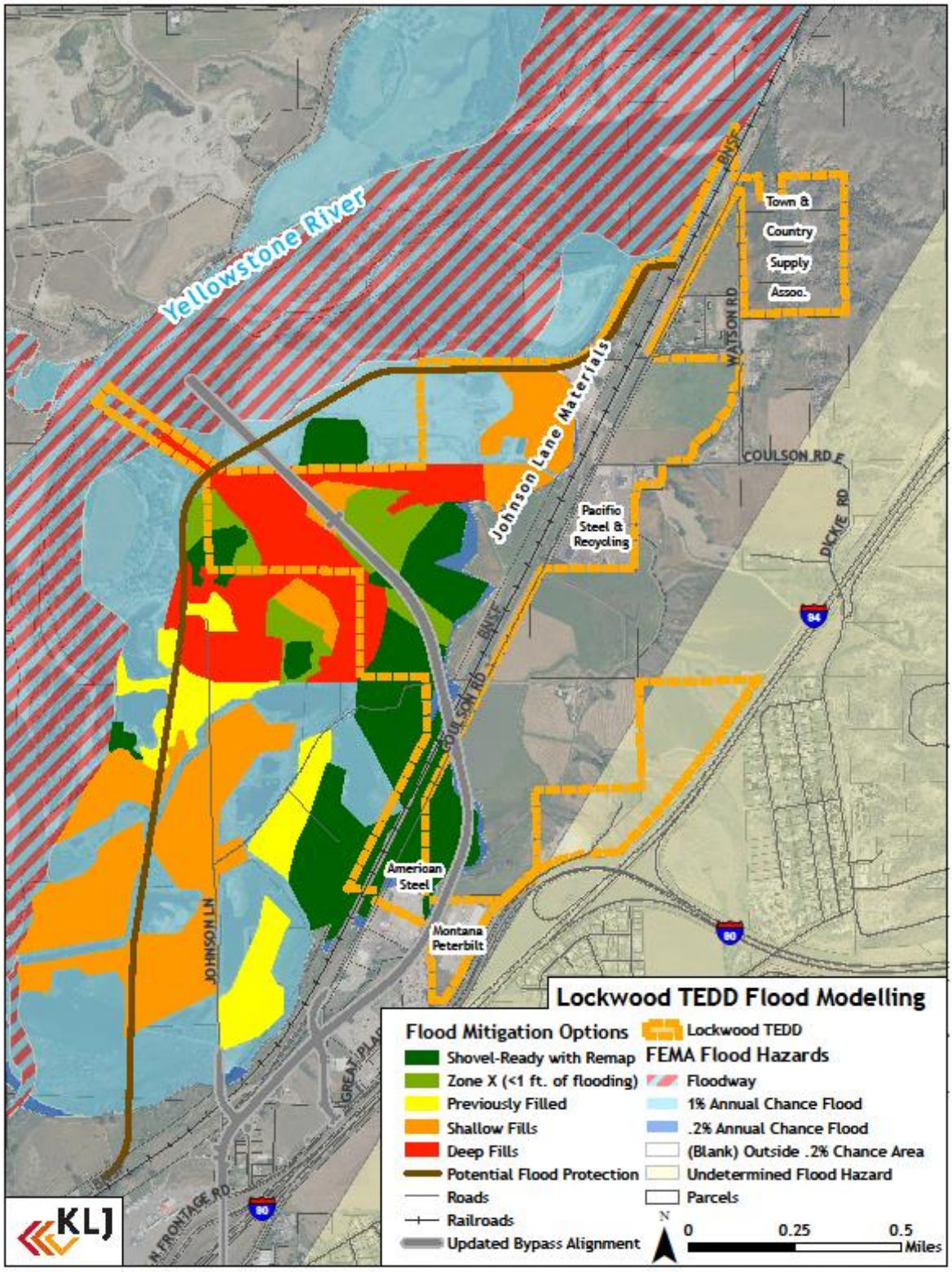
Figure 15: Lockwood TEDD Flood Options



As previously discussed each option has its own set of advantages and challenges and these are borne out by the buildable areas associated with each. The costs associated with each option are summarized below:

Table 13: Flood Option Costs - Incremental Fill

Incremental Fill Option (TEDD Only)					
Opinion of Probable Costs					
Phase 1: Floodplain Modelling and Mapping					
Item	Description	Quantity	Unit	Unit Price	Total
1	Letter Of Map Revision (CLOMR/LOMR)	10	Site	$ 40,000.00	$ 400,000.00
				30% Contingency	$ 120,000.00
				Phase 1 Subtotal	$ 520,000.00
Phase 2: Design & Construction					
Item	Description	Quantity	Unit	Unit Price	Total
1	Mobilization, Taxes, Bonds & Insurance	10	Site	$ 17,000.00	$ 170,000.00
2	Stormwater Management & Erosion Control	10	Site	$ 9,000.00	$ 90,000.00
4	Imported Fill Material	17,000	CY	$ 100.00	$ 1,700,000.00
9	Design & Construction Engineering	10	Site	$ 40,000.00	$ 400,000.00
10	Materials Testing	10	Site	$ 20,000.00	$ 200,000.00
				30% Contingency	$ 770,000.00
				Phase 2 Subtotal	$ 3,330,000.00
				Total Incremental Fill Costs (TEDD Only):	$ 3,850,000.00

The incremental fill option includes 10 sites within the flood fringe area based on the buildable area and the site sizes estimated in Table 2. The fill volume was determined based on an average fill of 1 foot in the Zone X area and 3 feet in the shallow fill area.

Table 14: Flood Option Costs - Mass Fill

Mass Fill Option (TEDD Only)					
Opinion of Probable Costs					
Phase 1: Floodplain Modelling and Mapping					
Item	Description	Quantity	Unit	Unit Price	Total
1	Existing Floodplain Modelling[1]	1	LS	$ -	$ -
2	Letter of Map Revision (CLOMR/LOMR)	1	LS	$ 100,000.00	$ 100,000.00
				30% Contingency	$ 30,000.00
				Phase 1 Subtotal	$ 130,000.00
1. Existing floodplain modelling completed as part of Montana Department of Transportation's Billings Bypass project.					
Phase 2: Design & Construction					
Item	Description	Quantity	Unit	Unit Price	Total
1	Mobilization, Taxes, Bonds & Insurance	1	LS	$ 950,000.00	$ 950,000.00
2	Stormwater Management & Erosion Control	1	LS	$ 475,000.00	$ 475,000.00
4	Imported Fill Material	95,000	CY	$ 100.00	$ 9,500,000.00
9	Design & Construction Engineering	1	LS	$ 2,200,000.00	$ 2,200,000.00
10	Materials Testing	1	LS	$ 1,100,000.00	$ 1,100,000.00
				30% Contingency	$ 4,270,000.00
				Phase 2 Subtotal	$ 18,500,000.00
				Total Incremental Fill Costs (Other Areas):	$ 18,630,000.00

The mass fill option includes the areas assumed to develop in the incremental fill option plus the deep fill areas which tie them together. The advantage of this approach is a single permitting process, but there is additional fill volume included to fill the deep fill areas and average of 5.5 feet.

Table 15: Flood Option Costs - Levee

Levee Flood Protection Option					
Opinion of Probable Costs					
Phase 1: Floodplain Modelling and Mapping					
Item	Description	Quantity	Unit	Unit Price	Total
1	Existing Floodplain Modelling[1]	1	LS	$ -	$ -
2	Internal Drainage Study	1	LS	$ 50,000.00	$ 50,000.00
3	Post-Construction Floodplain Modelling	1	LS	$ 100,000.00	$ 100,000.00
4	Breach Analysis	1	LS	$ 50,000.00	$ 50,000.00
5	FEMA Submittals	1	LS	$ 50,000.00	$ 50,000.00
				30% Contingency	$ 75,000.00
				Phase 1 Subtotal	$ 325,000.00
1. Existing floodplain modelling completed as part of Montana Department of Transportation's Billings Bypass project.					
Phase 2: Design & Construction					
Item	Description	Quantity	Unit	Unit Price	Total
1	Mobilization, Taxes, Bonds & Insurance	1	LS	$ 2,400,000.00	$ 2,400,000.00
2	Stormwater Management & Erosion Control	1	LS	$ 1,200,000.00	$ 1,200,000.00
3	Site Clearing (removal of trees and grubbing)	1	LS	$ 500,000.00	$ 500,000.00
4	Imported Fill Material	190,000	CY	$ 100.00	$ 19,000,000.00
5	Levee Toe Drain	15,600	LF	$ 200.00	$ 3,120,000.00
6	Seepage Pumping Station	1	LS	$ 150,000.00	$ 150,000.00
7	Stormwater Pumping Station	1	LS	$ 750,000.00	$ 750,000.00
8	Planning & Environmental Assessments	1	LS	$ 4,100,000.00	$ 4,100,000.00
9	Design & Construction Engineering	1	LS	$ 5,400,000.00	$ 5,400,000.00
10	Materials Testing	1	LS	$ 1,400,000.00	$ 1,400,000.00
11	Operations & Maintenance Manual	1	LS	$ 50,000.00	$ 50,000.00
				30% Contingency	$ 11,400,000.00
				Phase 2 Subtotal	$ 49,500,000.00
Phase 3: Maintenance					
Item	Description	Quantity	Unit	Unit Price	Total
1	Levee System Maintenance (30 - Years)	30	YR	$ 500,000.00	$ 15,000,000.00
				Total Levee System Costs:	$ 64,825,000.00

Due to the fact that all three options have differing build potential, it's important to do an apples-to-apples comparison. The easiest way to accomplish this is to simply divide the cost of the flood protection improvements by the potential square footage of each option. That comparison is shown in Table 16.

Table 16: Flood Protection Costs by Square Foot

Option	Incremental Fill (TEDD Only)	Mass Fill (TEDD Only)	Levee (All Benefited)
Cost/SF of Building Space	$ 3.41	$ 13.03	$ 15.07

Summary

Given current development practices, and based on funding limitations, the most likely option for future flood protections will involve the Option 1 – incremental fill. However, efforts to do more large-scale fill and protections efforts should be pursued as development becomes imminent.

Water and Wastewater

This element of the Lockwood Infrastructure Master Plan is intended to summarize expected required capital upgrades to the existing Lockwood Water and Sewer District (LWSD) Facilities to accommodate the projected "full build out" flows from the TEDD Study Area.

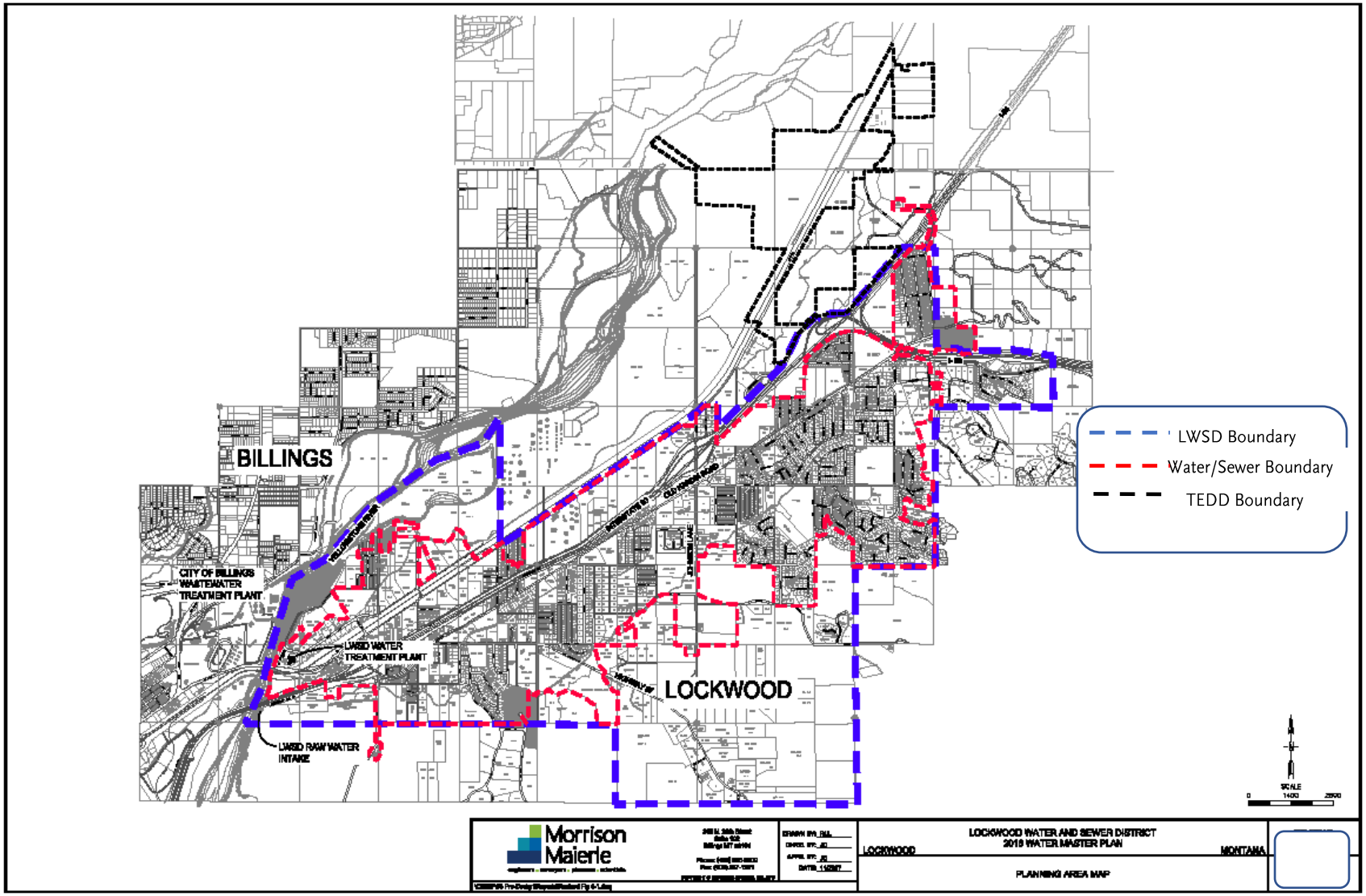
Background

The Study Area is defined as the Targeted Economic Development District (TEDD) plus the three adjacent study areas A, B and C as was shown in Figure 3. Figure 16 shows the current LWSD Boundary in relation to the current TEDD. It should be noted that only infrastructure improvements that are required specifically by the additional industrial development in the Study Area are included herein. Recommendations for upgrades needed for projected growth in the existing LWSD Boundary, as recommended in recent planning reports for the LWSD are not included as costs to accommodate the Study Area, and an assumption is made that LWSD will make these upgrades on a timeline approximately as recommended. Impacts to Operations and Maintenance of the facilities is not included in this memo.

Brief discussion of the LWSD's water rights and their agreement with the City of Billings for wastewater treatment are also included. Each of these topics is both important and complex in the consideration of LWSD's ability to provide water and sewer service to the TEDD. However, extensive investigation of these issues is beyond the scope of this report. These topics warrant specific additional analysis in the future.

All costs provided in this memo are planning level only. It should be noted that the costs for future LWSD customers to connect would be based on a detailed rate study conducted by LWSD's rate consultant, to include both impact fees and user fees. It should also be noted that due to limited scope of this report, in all cases the Study Area was looked at as a whole. No attempt to break out the TEDD, as separate from the additional adjacent areas A, B and C was made. Instead, the entire area was considered as a whole, which in this section will be referred to as the "TEDD Study Area".

Figure 16: Lockwood Water and Sewer District Planning Area



Projected Water/Wastewater Need

Approximate water and wastewater needs were developed for the TEDD Study Area by MMI based on water needs of similar area industries (excluding outliers).

Water Demand and Sewer Flow Projections

It is important to note that all of the analysis summarized in this memo is based on the flow projections included in Appendix C. Estimation of water demand and sewer flows in an undeveloped, future industrial area presents a challenge. At this time, the types of businesses that may locate in this area are not well defined. The category of "industrial users" is very broad, and could include both very low water use customers (such as large warehouses with only a few employees and only domestic facilities) to very large water user customers (such as agricultural processing of food products or other industries which use large volumes of water for industrial processes). Sewer flows, similarly, can be highly variable. Therefore, it is important that as the industries who will locate in this area are better defined, these analyses are updated to reflect any changes to the assumptions used as compared to actual planned development. For purposes of this analysis, we utilized actual demands from select industrial users currently in the LWSD boundary. Those who were believed to be reasonably representative were Loveland Products, Billings Livestock, MAC LLT Mfg., Polar Service Centers, Titan Machinery and Crown Parts.

Three years of actual water use from these facilities was reviewed and averaged. Annual water use was used to calculate an average demand per day per acre. This water use per acre was then applied to the TEDD Study Area, assuming the Study Area development would have similar usage. The total study area was looked at, decreased to consider the area that KLJ determined was developable with flood protection. Total acreage was also reduced by 30% to account for areas that are likely to be dedicated to road, rail and other public uses. Peaking factors that were used in the 2016 LWSD PER were applied to estimate peak day and peak hour water demands. As can be seen in Appendix C, this analysis resulted in a "full build out" peak day water demand of 330 gpm, and a peak hour water demand of 526 gpm. While the projected 20 year demands are also shown in Appendix C, the scope of this study did not allow for analysis of multiple points in time. Only the full build out impacts are included in this plan.

For wastewater flow projections, the same existing LWSD industrial users were analyzed. Winter water use is considered to reflect water usage that will return as sewer flows. By using only winter usage, we can reasonably assume the demand does not include water that would be used outside such as for lawn watering. A peaking factor of 3 was used. Similarly to the difficulty in estimating water usage, it should be understood that industries can have much higher or much lower peaking factors, depending on how they use water. However, as a starting point for planning, we felt 3 was a reasonable peaking factor to use. Peaking factors, along with flow rates, should be reanalyzed when the types of industries that will locate in this area and their probable water and sewer usages are better defined. The average "full build out" wastewater flowrate estimated from the analysis is 141 gpm, with peak wastewater flows of 405 gpm. While the projected 20 year wastewater flowrates are also shown in Appendix C, the scope of this study did not allow for analysis of multiple points in time. Only the full build out impacts are included in this plan.

Water Treatment

Below, each of the LWSD water treatment components are evaluated for capacity to treat the additional peak day demands projected for the Study Area.

Estimated Water Demands are:

Current Peak Day Water Demand for the 20 year planning period (through 2035) from 2016 LWSD

Preliminary Engineering Report (PER) = 2,200 gpm

TEDD Study Area estimated full-build out Peak Day Design = 330 gpm

Total Peak Day Design, including LWSD and TEDD Study Area = 2,530 gpm

Intake

The river intake currently has a firm capacity of 3,150 gpm (4.5 MGD) with the three inclined pumps. Adding the fifth "auxiliary" intake pump in the LID canal increases the firm capacity to 4,650 gpm (6.7 MGD). As noted above, the peak day demand including the TEDD Study area is estimated to be 2,530 gpm.

An upgrade to the Intake is planned for construction over the winter of 2017-2018. This upgrade is includes (3) 2000 gpm pumps and (1) 1500 gpm pump, increasing firm capacity to 5500 gpm, or 7000 gpm with the auxiliary pump.

The intake pumps, both currently and after the upcoming upgrade, have adequate capacity for future needs, including the additional capacity required by the TEDD based on the defined assumptions.

Sand Separator

The current capacity of the Sand Separator in the Pre-Sedimentation (Pre-Sed) building (per 2016 PER) is 2,100 gpm. It is likely that the sand separator capacity is adequate since unit may not be operated during peak day. Therefore, no upgrades are expected to be necessary to this treatment component.

The Pre-sed equipment room does have room for 2nd sand separator if it were determined in the future that it was needed.

Pre-Sedimentation Basin

Montana DEQ Circular DEQ 1 states that 3-hours detention time is the minimum recommended for pre-sedimentation. During the current average raw water production rate of 1,650 gpm, 4-hours detention time is provided in pre-sedimentation. Montana DEQ does not have a redundancy requirement for pre-sedimentation basins. The 20-year (2035) maximum production rate for projected demands from the current LWSD boundary of 2,200 gpm would result in a detention time of 3.0-hours, which is still adequate per Circular DEQ 1. Incorporation of the TEDD would increase the projected maximum day demand to 2,530 gpm, resulting in a detention time of 2.6-hours in the pre-sedimentation basin. It is anticipated that the shorter detention time would still provide benefits to the plant during these peak conditions.

Conventional Treatment – Filter/Clarifier Train

The 2016 PER discussed adding 3rd filter/clarifier "train" for firm capacity of 2,200 gpm to meet current and future water treatment rates. 2 of 3 filters would operate at 1,100 gpm each, which is a loading rate of 4.6 gpm/sf.

With the TEDD Study Area demands added, the required flowrate of 2,530 gpm, still using 2 of the 3 filters (with one on standby, as redundant) would require flow in each filter to be 1,265 gpm. This translates to a loading rate of 5.3 gpm/sf. LWSD's Water Treatment Plant has long history of data showing successful operation of 2 of 2 filters at 1,100 gpm each during peak production. The increased loading rate of 5.3 gpm/sf, while slightly above ideal, would likely operate very well. However, obtaining DEQ approval of this higher loading rate may be difficult.

2016 PER cost for 3rd train = $2,300,000 (2015 dollars)

X 1.03^2 ==> $2,440,000 (2017 dollars)

The cost for the 3rd filter/clarifier train is not attributable solely to the TEDD Study Area, other than difficult DEQ approval for a higher filter loading rate.

If DEQ would not approve this higher loading rate, either a 4th conventional filter/clarifier train would need to be added, or another filtration option would need to be explored. A 4th conventional treatment train would not fit on the site in a logical manner to the south of the existing WTP. Therefore, if DEQ would not approve the 3rd media filter train with higher loading rates as described above, LWSD may have to go with a membrane option, similar to Alternative T3, as described in the 2016 PER. The cost for T3 was $3,500,000 as presented in 2015 dollars in the PER for 2200 gpm. Below, the cost estimate is increased 10% for the additional TEDD Study Area flows that need to be treated, and inflated for 2 years of inflation to 2017 dollars:

2016 PER cost for membrane filtration = $3,500,000 (2015 dollars)

X 1.1 X 1.03^2 ==> $4,085,000 (2017 dollars)

The difference between this membrane cost and the cost for the 3rd media filter is $1,645,000.

The transition to membrane instead of conventional, over the 20 year design period presented in the 2016 PER is due to the additional demand placed on the WTP by the TEDD Study Area. However, if additional capacity was added, this capacity would benefit both the TEDD Study Area and also would allow additional LWSD water demand to be accommodated. The exact allocation of the benefit of this additional treatment would need to be determined through an impact study, which is beyond the scope of the current contract.

Chlorine Contact Basin

The 2016 PER did not identify any upgrades for the LWSD's projected 2035 peak day of 2,200 gpm. To evaluate the impact of the additional TEDD flows, an example calculation is provided for 2,530 gpm for *Giardia* CT: The total effective clearwell volume is 215,000 gallons (215,000 x 0.6 + 215,000 x 0.4). At a production rate of 2,530 gpm, the effective contact time is 85 minutes (215,000 gallons / 2,530 gpm). With a chlorine residual of 1.25 mg/L, the calculated CT value is 106 mg/L-min (85 min x 1.25 mg/L). The required CT for 0.5-log *Giardia* inactivation with a water temperature of 5-deg C and pH of 7.5 is approximately 43 mg/L-min. Therefore, the inactivation ratio provided is 2.5 (106 / 43), where only 1.0 is required. Therefore, no upgrades are expected to be necessary to this treatment component.

High Service Pumps

The Water Treatment Plant includes 1,050, 2,100 and 2,100 gpm high service pumps to pump the water from the plant to the distribution system. Firm capacity is 3,150 gpm. Therefore, no upgrades are expected to be necessary to this treatment component.

Chlorine and Chemical Feed

These systems are sized such that no capacity issues will be caused by the additional demand of the TEDD Study Area. Therefore, no upgrades are expected to be necessary to this treatment component.

Water Distribution and Storage

Water Distribution System Analysis

The existing water mains and proposed future water main extensions were analyzed with the TEDD Study Area served by the Lockwood Water and Sewer District (LWSD). The analysis was based on an estimated 331 gallons per minute (gpm) maximum day demand (MDD) and 527 gpm peak hour

demand. Only analysis of the LWSD existing infrastructure was performed during this analysis and improvement recommendations for needs to extend to and throughout the TEDD Study Area were not made in this section. The existing distribution system piping was evaluated for average velocities above five (5) feet per second (fps) during MDD. The existing distribution system is sufficient for both average velocities and maintaining a minimum of 35 psi in the LWSD. No additional distribution improvements would be required for the LWSD outside the improvements already recommended in the 20 year CIP presented in the 2016 PER. An analysis also occurred on the system for fire flows in the TEDD Study Area. The flows at the edge of the TEDD Study Area are able to deliver the standard industrial 3,500 gpm fire flows (without pipe upgrades). If higher flows are required for a certain industrial application, this analysis would need to be re-evaluated.

Water Storage Analysis

The Low Zone storage was analyzed based on the same criteria utilized in the 2016 PER. The analysis involved evaluating maximum day demands, fire flow requirements, and emergency storage as they relate to reservoir infrastructure. Additional fire storage is not required for the TEDD Study Area, as it is already incorporated into the Low Zone storage. LWSD already has planned upgrades as recommended in the 2016 PER to add Low Zone Storage. In 20 years the Low Zone will be at a deficit of 1.1 MG based on current LWSD boundaries and projected growth. The analysis of the storage in relation to the TEDD Study Area calculated the need for an additional 310,000 gallons for emergency and operational storage. This storage would be in addition to the 1.1 MG deficit discussed in the 2016 PER. It is assumed that LWSD will add another Low Zone Reservoir in the next 5 years, and that this new reservoir could be upsized to accommodate the TEDD Study Area. The costs associated with increasing the size of the new storage reservoir by 310,000 gallons would be approximately $2.50 per gallon $775,000.

Table 19: Storage Analysis

Pressure Zone	Operational Storage (MG)	Emergency Storage (MG)	Additional Recommended Storage (MG)
Low Zone	0.07	0.24	0.31

Pump Station Analysis

The pump stations were analyzed based on each station's firm capacity during MDD. Firm capacity is defined as the available flow from a pump station with the largest pump out of service. Based on 20 year projections in the 2016 PER, the Low Zone has a pumping surplus of 1.6 million gallons per day (MGD). Based on the pumping analysis of the TEDD and surrounding area assuming 331 gpm, the additional pumping requirement in relation to the area would be 0.5 MGD. This still leaves 1.1 MGD surplus on the existing LWSD pump station, so no pumping improvements would be required.

Table 20: Pumping Analysis

Pressure Zone	Additional Pumping Requirement (MGD)
Low Zone	0.5

Wastewater

The following LWSD sewer system components are evaluated for capacity to convey the additional peak flows projected for the TEDD Study. The TEDD Study Area flows are in addition to ultimate capacity flows previously estimated and updated earlier this year for the LWSD existing boundary in a study by Morrison Maierle. System components impacted by the TEDD Study Area and evaluated below are shown on Appendix D. Initial assumptions in this analysis are that the TEDD wastewater flows will be routed to the Firth Lift Station where they will be pumped to the sewer trunk main system beginning at the intersection of Johnson Lane and Old Hardin Road. From this point, wastewater flows will continue east by gravity as they are conveyed through the trunk mains shown on Appendix D ultimately to discharge into the LWSD Main Lift Station located at the Lockwood WTP on Cerise Road. From this lift station, wastewater will be pumped across the East Bridge to discharge into the City of Billings gravity sewer system. It should be noted that the ExxonMobil Refinery is in the planning and design process to discharge 2 million gallons per day (MGD) to the LWSD sewer system at the intersection of Lockwood Road and Reynolds Street and identified as point "C" in Appendix D. The Lockwood wastewater flows used in this analysis in combination with TEDD flows include this 2 MGD flow from ExxonMobil.

All estimates included herein are for planning purposes only. Evaluation of additional O&M costs are not included in this analysis.

Firth Lift Station

The Firth Lift Station located north of the Johnson Lane I-90 Interchange was originally sized for an average daily flow rate of 50 gpm and a peak hourly flow rate of 190 gpm. The Firth Lift Station consists of a duplex submersible pump system in a 24-foot deep wet well. A 6-inch force main pumps wastewater flows under Interstate 90 to a manhole and the subsequent downstream trunk main system located at the intersection of Johnson Lane and Old Hardin Road. Each pump is rated for 250 gpm.

A wastewater flow projection study completed earlier this year projected an updated average daily flow rate of 30 gpm to the Firth Lift Station and a peak hourly flow rate of 110 gpm. Flows estimated for the TEDD Study Area consist of an average daily flow rate of 141 gpm and peak hourly flow rate of 405 gpm.

If the TEDD Study Area wastewater flows were routed to the Firth Lift Station, the combined flows would result in an average daily flow rate of 171 gpm and a peak hourly flow rate of 515 gpm. See Appendix E for a flow estimate summary for this lift station.

Both existing pumps would be required to convey the peak hourly flow from the Firth Lift Station tributary area and the TEDD Study Area, leaving no redundant pump as required by DEQ. This initial analysis of the Firth Lift Station is included in Appendix E. In order to accommodate wastewater flows from the TEDD Study Area, a third pump and additional wet well capacity would be required. No further analysis is completed for this lift station and it is recommended that since a lift station will be needed to pump TEDD Study Area flows to the LWSD system that TEDD flows be pumped directly to the manhole at Johnson Lane and Old Hardin Road. Another alternative would be to pump to the current termination point of the existing trunk main system at the intersection of Old Hardin Road and Wade Drive and identified as point "H" on Figure 1 in Appendix D.

Gravity Trunk Mains

The gravity sewer trunk mains impacted by TEDD Study Area wastewater flows were evaluated using FlowMaster. These trunk mains are shown on Figure 1 in Appendix D and begin at point "H" at the intersection of Old Hardin Road and Wade Drive and terminate at the LWSD Main Lift Station. The size of each of the impacted trunk main and their minimum slopes were taken from record drawings and are summarized in Appendix D. A summary of the wastewater trunk main analysis is included in Appendix F.

The 15-inch sewer main identified as H-G is undersized to receive TEDD Study Area wastewater flows. This trunk main would have to be upsized to an 18-inch sewer main to accommodate additional flows if flows from the TEDD Study Area were to enter the LWSD trunk main system at point "H". The remaining trunk mains are sufficiently sized or nearly sufficiently sized for Lockwood and TEDD flows. Cumulative flows in the two trunk mains immediately preceding the Main Lift Station and identified as C-B and B-A slightly exceed the recommended maximum ¾ design depth. However, there are few if any basements in this area and depths to sewer typically exceed 15 feet. It is recommended that these two trunk mains do not need to be upsized to accommodate ultimate buildout flows from the existing LWSD boundary as estimated in the 2017 Wastewater Flow Projection Study, ExxonMobil (assuming 2 mgd discharged evenly throughout the day), and the TEDD Study Area. If flows from the TEDD Study Area were to enter the LWSD gravity sewer system instead at the Johnson Lane and Old Hardin Road intersection, as has previously been discussed, no improvements to the gravity trunks mains are required.

Main Wastewater Lift Station

A previous study evaluated the impacts to this lift station from discharging 2 MGD from the ExxonMobil Refinery to the LWSD sewer system. This analysis identified that at ultimate build-out capacity for the Lockwood community and with the addition of ExxonMobil flows, the Main Lift Station would require the installation of a fourth pump, installation of a third force main, and expansion of the existing wet well. The cost of these improvements was estimated at $1,855,000 in 2016 dollars.

The analysis for the Main Lift Station is included in Appendix G. The analysis starts with the previous evaluation of improvements required to accommodate the ExxonMobil flows and then builds upon this preliminary evaluation to include wastewater flows from the TEDD Study Area. The analysis determines that the new fourth pump would need to be upsized from a 1,750 gpm pump to a 2,150 gpm, the additional third force main would need to be upsized from a 12-inch main to a 16-inch main, and the wet well size would have to be increased by 128 square feet, rather than the additional 93 square feet that would have been required for LWSD full build out, plus the Exxon flows. These upgrades to accommodate TEDD Study flows result in an estimated increase in sizing of the improvements by a factor of 23%. Translating these improvements to a cost and accounting for the increase in cost from 2016 dollars to 2017 dollars, the estimated cost for improvements to accommodate TEDD flows is 23% of $1,910,650, or $440,000.

LWSD Water Rights

The current permitted annual water volume under LWSD combined rights is 1802 acre-ft. After accounting for treatment losses of 11 percent LWSD has an estimated 1603 acre-ft of water annually to serve to its customers. From an annual volume standpoint, LWSD has adequate water rights to meet projected demand growth within the existing LWSD Boundary, which the TEDD Study Area is outside of, through 2033. After 2033, additional annual volume is expected to need to be secured to meet the needs of the currently defined LWSD Boundary.

However, LWSD does not have annual volumetric water rights adequate to serve the TEDD Study Area and also to meet projected future demands of the LWSD through the year 2033. LWSD also does not have excess in their instantaneous flow right. Therefore, it is very important to understand that additional water rights will need to be obtained to supply full build estimates of TEDD Study Area. LWSD will need to be involved in a discussion regarding how these water rights may need to be secured.

It should be noted that short term water demands of the TEDD may likely fit within the current projected water supply capacity of the LWSD. It is understood that this future demand for the TEDD should be limited, at least initially, to low intensive water users. At such time as more effort is put into water supply options for LWSD, more intensive water users could be considered in the TEDD, served by LWSD.

LWSD Wastewater Agreement with the City of Billings – Sewer Treatment

LWSD has an Agreement with the City of Billings under which the City accepts and treats LWSD's sewer flows. This Agreement has a defined Sewer Service Boundary, shown in blue in Appendix D, of which the TEDD Study Area is not a part. For LWSD to expand their sewer service boundary would require an amendment to their Agreement with the City of Billings.

The LWSD would need to get permission from the City to expand their boundary to encompass the TEDD Study Area. Under this arrangement, it could be that all sewer infrastructure built by the new development is then turned over to LWSD, who would own and operate this area as a part of their sewer system. The timeline and effort required for LWSD to get this permission is unclear at this time. The TEDD Study Area developers would need to work closely with LWSD to complete this process.

Summary

In summary, the items that we expect may require improvements to accommodate the TEDD are shown in the table below, and explained in further detail in the narrative that follows.

Table 18: Summary of Impacts

System	Component	Estimated cost impact, if any*	Notes
Physical Facilities Analysis			
Water Treatment	Membrane filtration	$1,645,000	There is some chance that higher hydraulic loading of planned 3rd filter train could be approved, avoiding this cost
Water Distribution	Storage	$775,000	Assumes a planned additional storage tank in the Low Zone will be upsized to add capacity
Wastewater Pumping	Firth Lift Station	-	No cost was developed, as it was determined upgrades at this lift station are not the best way to provide the pumping needed
Wastewater Pumping	Main Lift Station	$440,000	Assumes this additional capacity is part of another potential expansion
* Note that costs are for the entire TEDD Study Area at full build out. This report did not try to allocate costs to the TEDD versus the additional areas. When customers connect to LWSD, detailed rate study must be connected to determine appropriate impact and user fees. Some of these capital costs may also benefit other users, in which case the full cost of these improvements may not be allocated to the TEDD Study Area. Detailed impact analysis is beyond the scope of this study.			
Legal Considerations			
Water Supply	Water Rights	Undefined	LWSD anticipates bringing the TEDD into its overall water service area boundary. Additional water rights will need to be obtained. The District is currently working on securing additional water rights both for itself and to serve future boundary expansion. LWSD intends to continue to coordinate with the TEDD Advisory Committee as this issue is resolved.
Wastewater Treatment	Wastewater Agreement with the City of Billings	Undefined	LWSD will need to modify their Agreement with the City of Billings for wastewater treatment. LWSD is committed to working with the City of Billings and the TEDD Advisory Committee to bring the TEDD into its Wastewater Service Area boundary.

It will be important for the Lockwood TEDD Study area planners and developers to closely coordinate with LWSD on both any new information about expected water demands and wastewater flows, as well as on timing and decisions about water and wastewater infrastructure needs. As noted in Table 18, several of the costs presented assume that needed improvements to serve the TEDD will be planned for and built concurrently with other projects that are part of Lockwood Water and Sewer District's already planned Capital Improvements Plan (CIP). By completing the work concurrently, it allows, for example, for a single larger storage tank to be built, which takes advantage of an economy of scale. If

instead the TEDD's additional needed infrastructure is built as standalone projects, it is expected that costs may be higher than if coordinated with the planned CIP projects, as presented in Table 18.

Please note that in all cases, the projects, schedule and budget from the LWSD's CIP are based on the 2016 Water Master Plan and other planning completed by LWSD and are for planning purposes only. These plans are subject to change based on funding availability as well as other prioritization considerations. Changes are possible and are at the discretion of the LWSD management and board.

The first two items shown on Table 18, Water Treatment (filtration) and Water Distribution (storage), coincide with a planned LWSD "2020" CIP project as described in the 2016 LWSD Water Master Plan. LWSD may apply for state grants for this project in the spring of 2018. Preliminary planning indicates that design on the project could begin as soon as fall 2018, with construction beginning in either 2019 or 2020. To avoid re-work in design, and associated additional costs, LWSD will need to be notified prior to beginning design if additional capacity for the TEDD Study Area should be included in the design of the treatment and storage upgrades.

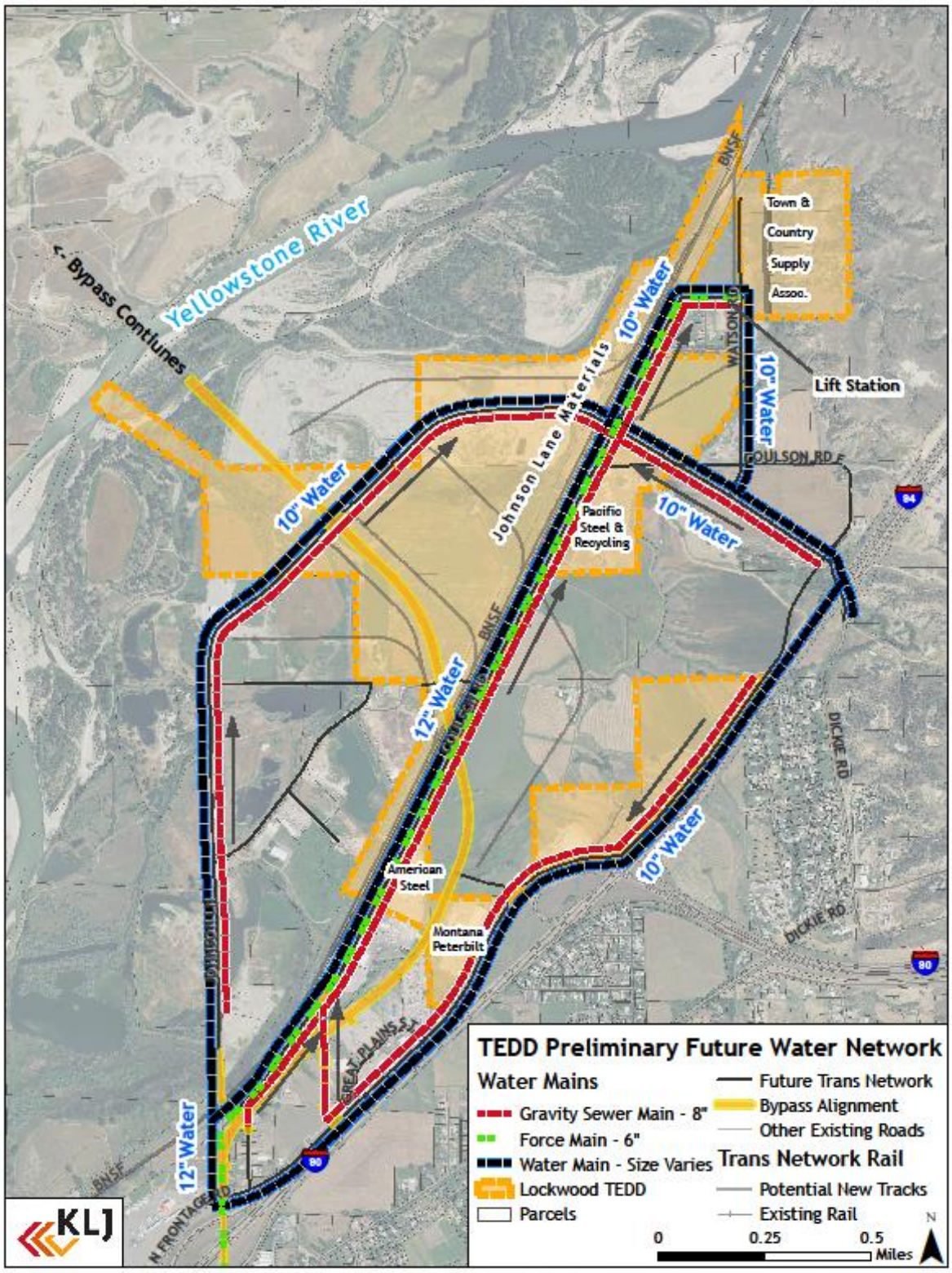
For wastewater pumping needs, no defined timeline is yet set for the main lift station expansion. It is recommended that additional study be conducted on timing of needed improvements be conducted as more information becomes available about probable types of industries, associated wastewater flowrates and timing of development to determine at what point in time it is probable that LWSD's existing wastewater infrastructure will need to be expanded to accommodate the TEDD. At this time, LWSD's sewer system has a significant unused capacity that was built in to accommodate future flows as LWSD customers continue to connect to the new sewer system. In 2016, LWSD conducted a study to analyze the impact of Exxon's connection to the LWSD sewer system. This study noted that for the main sewer lift station would eventually need to be upsized. A date was not defined, but instead the threshold was defined based on when a certain amount of flows are being received, defined as all of the Phase 1, 2 and 3 Sewer Subdistricts as well as Exxon being connected to the LWSD system. When this will actually occur is difficult to predict. Similarly, the rate at which the TEDD actually builds out will affect the timeline in which the wastewater pumping will need to be expanded. Detailed growth rate projections of the TEDD were beyond the scope of this study. In summary, additional study and continued close coordination will be needed to estimate a probable timeline for the sewer lift station expansion.

Distribution Network

To serve the Lockwood TEDD area, a water and sewer network would be constructed along existing and proposed roadways. A force main would run along existing Coulson Road with gravity sewer and water mains running along the proposed roadways. This network can be seen in Figure 17.

Detailed estimates to support development of the water and wastewater connections to the TEDD are shown in Appendix H.

Figure 17: TEDD Proposed Future Water and Sewer



Private Utilities

Communications

Charter Communications was approached to determine existing communications in the Lockwood TEDD area. They currently do not have facilities in the area but could expand. However, it would require equipment upgrades and network expansion.

Concurrently, CenturyLink is serving the Pacific Steel property with fiber. This initial fiber laying could be expanded to serve the rest of the TEDD with fiber lines running alongside roadways and under roadways through conduits after the roadways were built.

Electric

Electricity to the TEDD would be provided by Yellowstone Valley Electric Cooperative (YVEC). YVEC currently has both 69 kV transmission and 7.2/12.5 kV distribution feeders in the area along Coulson Road, East Coulson Road and North Frontage Road serving existing residential, commercial, and industrial customers in this area.

YVEC is in the process of completing a looped 69kV transmission tie into this area which will allow them to provide multi source transmission delivery to this area, this is in accordance with commitment's YVEC have made to these customers to provide the maximum reliability that we can to the area. It should be noted that YVEC has the preeminent service rights to this designated area based on previous Territorial Service Rights discussion with NorthWestern Energy concerning recent industrial development which have been resolved between the parties.

Due to YVEC's ongoing program of distribution and transmission improvements, there are no immediate plans for additional capital improvements in this area except for those dictated by internal analysis of any new loads which may be proposed here. Any new capital upgrades are absorbed by the Cooperative.

Depending on the nature, size and projected loads that may be associated with any proposed new customers in the TEDD Study Area, there would probably be extension costs associated with new service requests. These costs would be subject to review and discussion by the YVEC Manager and Board of Directors during the development of service plans for proposed loads, therefore it is difficult to delineate those costs until more specific information would be provided.

YVEC would consider installation of backbone distribution facilities on a limited scale provided a Master Plan would be filed with the County and adhered to. These backbone facilities would be subject to developer financial contributions, with any specific service requests being the financial responsibility of the new customer making the request. At the very least, YVEC would require specific easement provision in the platting of the development.

Next Steps & Work Program Action Plan

There continues to be regular demand for new shovel ready industrial land in Yellowstone County and more specifically the general Billings-Lockwood-Laurel area. The BOCC and BSED are focused on developing a 21st century industrial park within the Lockwood TEDD Study Area, and more specifically focused on the designated TEDD. What follows highlights critical next steps in the life cycle of the Lockwood TEDD.

Formation of TEDD Advisory Board

An immediate next step following approval of the Lockwood Infrastructure Master Plan should be the formal appointment of the TEDD Advisory Board. The Advisory Board should be created by the Yellowstone Board of County Commission (BOCC), and should request direct appointments from the following key stakeholder groups:

- Yellowstone County Commission;
- Lockwood Water and Sewer District;
- Lockwood Schools;
- Lockwood Fire District;
- Lockwood Pedestrian Safety District;
- TEDD Property Owners;
- Yellowstone County Staff (including representation from the MPO);
- Montana Department of Transportation (MDT) (ex-officio);
- Montana Rail Link (MRL) (Ex-officio).

The Advisory Board should meet no less than quarterly. The focus is a range of pressing items requiring follow up and further study to move forward on opportunities highlighted with in the Infrastructure Master Plan. Based on previous agreements, it is understood that BSED would staff the Advisory Committee meetings for the foreseeable future.

TEDD Advisory Board Work Program

One of the first efforts of the Advisory Board is to develop an updated work program to guide future efforts of TEDD development. It would supplant the 12-month work plan approved agreed to by BSED and the BOCC in March of 2017. Many of those early milestones are complete or in process, most notably the following:

- Development of TEDD Website;
- Reimbursement agreements between the BOCC and BSED;
- Development of an Infrastructure Master Plan.

Additional work program elements for the TEDD Advisory Committee would be entailed with in the following elements outlined below.

Water Supply

LWSD intends to expand its service area to include the TEDD; however, as noted in the body of the report, LWSD is not able to commit to long term water supply needs of both its current service area and the TEDD. However, it is understood that early efforts to attract development to the TEDD will focus on low intensive water users so that as areas of the TEDD become LWSD customers they would not

dramatically impact long term water supply demands. Additionally, LWSD is committed to seeking additional water rights which will meet the long term needs of their current and future service area which is expected to include the TEDD.

LWSD is considering multiple options for obtaining additional water rights. It is assumed LWSD will expand its water service area. Boundary expansion may identify unused water rights available for transfer or sale to potentially meet the long-term supply needs of both LWSD and the TEDD. The Advisory Board will work closely with LWSD on this issue.

TEDD Expansion

Significant discussion took place during the development of the Infrastructure Master Plan regarding the potential addition of properties to the TEDD. The results of this discussion were mixed among key stakeholders, including existing taxing districts in Lockwood. An immediate early step for the TEDD Advisory Board is to outline the policy and procedures to be followed for amending the current TEDD Boundary. The Infrastructure Master Plan provides clear guidance on those properties currently interested in joining the TEDD. The Advisory Board itself would be seated with the requisite stakeholders to logically think through the pros and cons of TEDD boundary adjustments prior to making a final recommendation back to the BOCC. The BOCC makes final decisions on adjustments to the TEDD Boundary.

MDT Coordination

The development of the Infrastructure Master Plan provided an opportunity for coordination and communication with MDT on the development of the Billings Bypass. The TEDD Advisory Board must continue to proactively engage MDT on a very regular basis to ensure future coordination and programming opportunities are not missed. Key points of coordination with MDT will involve the following areas.

Potential to adjust Bypass Phasing

MDT has indicated that Phase 3 (Mary Street) and Phase 4 (Yellowstone River bridge to Coulson Road) could potentially be flip flopped if development trends within the TEDD were to be accelerated. The potential for this change in phasing for the Billings Bypass is also likely incumbent on investment in connecting local road infrastructure within an adjacent to the TEDD.

Coulson Rail Bridge Coordination (Coordination with MRL)

MRL and MDT need to be integrated into several efforts of the TEDD Advisory Board, most specifically efforts regarding future rail investments. The potential to include additional rail lines under the proposed Coulson Road bridge need to be coordinated with MDT and MRL over the coming months. Additional analysis and coordination is needed regarding the potential for expanded rail capacity under this structure. The TEDD Advisory Board should work proactively to keep an open dialogue with both MRL and MDT on this issue.

MRL has expressed a strong interest in seeing the rail capacity within and adjacent to the TEDD expanded in future years. Beyond coordination of the rail implications of the proposed Coulson Road rail bridge, the TEDD Advisory Board should continue to proactively work with MRL on furthering a discussion and analysis of the concepts developed as part of the Infrastructure Master Plan.

Flood Protection and Flood Plain Management

Several key decisions on impacts and mitigation efforts related to the location of the Bypass in the floodplain have not been decided by MDT and relevant permitting agencies. There should be coordination between the TEDD Advisory Board and MDT in the coming months. Focus should be on potential flood plain mitigation issues which may be mutually beneficial to both the Bypass construction and development in the TEDD and adjacent areas. A coordinated decision making process between the TEDD Advisory Board, MDT and relevant permitting agencies may assist in opening more cost-effective flood protection solutions than those outlined earlier in this report.

Map Revisions

With an official submittal of a Letter of Map Revision (CLOMR/LOMR) nearly 80 acres of land in and adjacent to the TEDD could be removed from the flood plain. Moving these forward either on a case by case basis or through a coordinated effort could assist in expediting development efforts. The TEDD Advisory Board should consider options to facilitate and expedite these efforts.

Lockwood Trail Coordination

As noted earlier, funding was secured to add a multiuse trail to Phase 2 of the Billings Bypass (connecting the Heights to the Lockwood TEDD across the Yellowstone River Bridge). MDT needs guidance on how to terminate the multiuse trail so that it will logically connect with a future system developed along Johnson Lane. Additional concept development and programming support is needed for the extension of the trail from the Bypass south along Johnson Lane.

Development & Infrastructure Guidelines

The TEDD Advisory Board needs to develop recommendations to the BOCC on development guidelines to ensure the TEDD can develop as a more complete an integrated industrial park. Considerations and future analysis should look at the development of design guidelines (potentially through zoning tools such as a planned unit development [PUD]) to ensure incremental development efforts in or adjacent to the TEDD don't compromise long term build out potential.

The TEDD needs to be able to realistically assess for the costs of future needed infrastructure as development occurs. More creative tools should be explored that allow for incremental development of needed infrastructure in the TEDD through development impact studies. This will be especially important for future projects which may require turn lane or other improvements to the Bypass (I.e. turn lanes, etc.).

Funding & Programming

The completion of the Lockwood Infrastructure Master Plan clarifies the significant opportunities available to developing the needed infrastructure to support development of the TEDD, and additional development within the larger Study Area. Table 21 is a general list of the minimum investments to bring about development within the TEDD over the next 5 to 8 years.

The projects listed in Table 21 represent the overall short to mid-term set of infrastructure needs to serve projected development within both the TEDD and the TEDD Study Area. The independent order of priority of each must be determined iteratively based on the interest of individual properties and larger market forces. The coordinated implementation of elements listed in Table 21 depend on adjacent and complimentary infrastructure. Nowhere is this more important than continued coordination of TEDD infrastructure with the infrastructure planning for the Billings Bypass (MDT), LWSD and Montana Rail Link (MRL). The TEDD Advisory Board must monitor and guide these efforts.

Table 21: Prioritized List of Short to Mid Term Infrastructure Needs

Transportation		Justification
Roadway Segment 1	$952,722	Create key Bypass connection.
Roadway Segment 8	$661,956	
Roadway Segment 5	$1,640,661	Facilitates development on eastside of the TEDD.
Johnson Lane Multiuse Trail	$500,000	Connects new trail alignment with Bypass.
subtotal	**$3,755,339**	
Rail		**Justification**
Lockwood Extension	$2,910,000	Facilitates incremental rail infrastructure built to support TEDD development
50% of West Siding	$4,550,000	
subtotal	**$7,460,000**	
Water & Sewer		**Justification**
Water Treatment (50% assumed for TEDD)	$822,500	Assumes anticipated coordination with LWSD to support TEDD.
Distribution	$775,000	
Wastewater Pumping (Main Lift Station)	$440,000	
Subtotal	**$2,037,500**	
TEDD Water & Waste Water Connection & Distribution		**Justification**
Connection to TEDD (Assume 50% Build)	$5,675,000	Facilitates development on eastside of the TEDD.
Subtotal	***$5,675,000***	
Flood Mitigation & Protection		
Letter of Map Revisions CLOMR/LOMR	$400,000	Removes significant properties from floodplain based on recent flood modeling.
Subtotal	***$400,000***	
Total (All Systems)	**$19,327,839**	

TEDD Financial Capacity

Market potential from the *2016 Comprehensive Development Plan* for the Lockwood TEDD utilized County wide projections to the year 2035 to develop estimates of future demand for industrial development within the Lockwood TEDD. Calculations included a close evaluation of recent and historic trends at six existing industrial areas in the Billings/Yellowstone County region. Overall projections assumed Lockwood would capture 25 percent of future growth.

Revenue from the TEDD tax increment is projected to be just shy of $12 million over the full 15-year build out period. Whereas $19.3 million is needed for infrastructure development. As development occurs, increased tax increment accrues which can be used to fund infrastructure development.

However, in order to obtain the projected revenue targets, infrastructure development must occur, which creates a funding timing gap.

Since the tax increment accruals will not hit a level high enough to bond for the funding level needed until year 10, and the year 10 estimates cannot be reached without necessary infrastructure, two options might be considered to fill this funding/timing gap.

1. Form a **developer partnership** where the developer finances the infrastructure costs upfront, and is reimbursed by the TEDD tax increment accruals over time.
2. A **municipal bond** backed by *projected* revenues and development rates. This has not been done in Montana for a TEDD before, however is a common practice to assist in jump starting infrastructure needed to attract new development.

Local & State Resources

As with any substantial infrastructure planning or construction, costs can be high. We are aware that the Yellowstone County Commissioners and BSEDA have, in the past, successfully utilized several traditional federal, state, and local resources to assist the community in addressing infrastructure needs. Such programs as MDT's Transportation Alternatives Program (TAP), Community Development Block Grant (CDBG), Treasure State Endowment Program (TSEP), US Department of Agriculture (USDA), Economic Development Administration (EDA), and Big Sky Trust Fund (BSTF) planning and construction grants and loans are all feasible financial resources in addressing infrastructure development needs. In addition to those common granting and loan resources already outlined, the County has at its disposal traditional local resources including, but not limited to, private and developer investments, bonding, and TEDD revenues.

Federal Resources

As previously indicated, there are many traditional resources, including federal resources, that would be appropriate for use in addressing independent infrastructure needs in the TEDD. Although these resources should absolutely be considered, particularly for smaller specific projects, for a project of this magnitude, with the potential for both regional and national economic significance, transformative federal resources, such as Transportation Investment Generating Economic Recovery (TIGER) and Infrastructure for Rebuilding America (INFRA) should be more thoroughly discussed and considered.

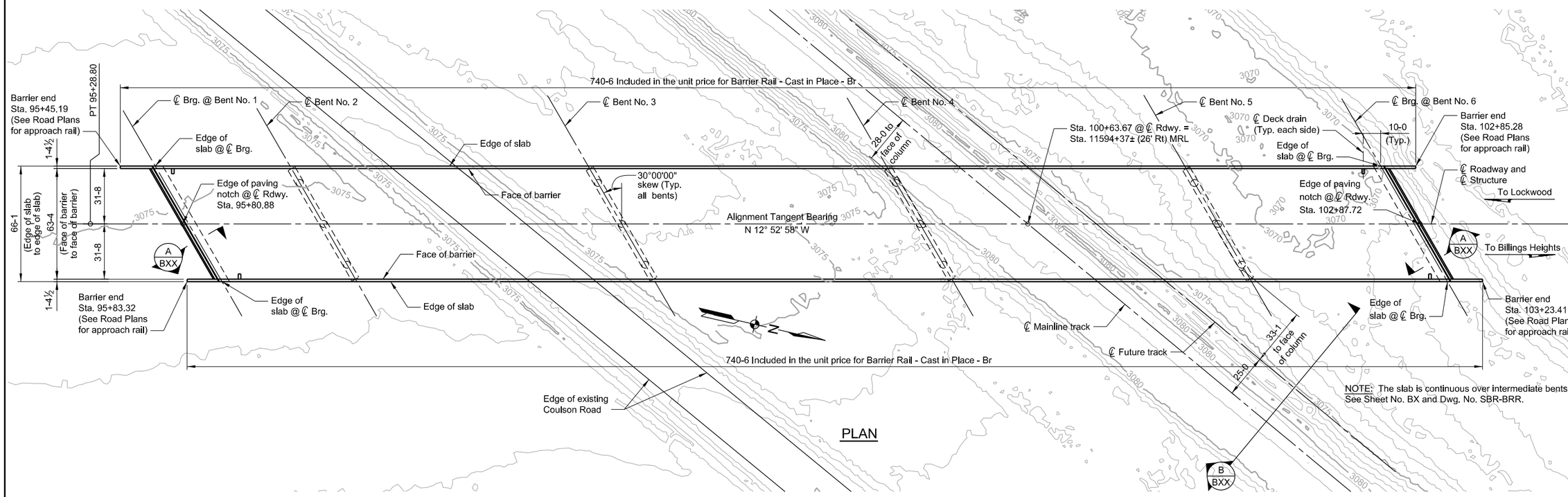
<u>TIGER grants</u> offer the opportunity to access between $5 and $25 million dollars in federal assistance for multi-modal, multi-jurisdictional transportation infrastructure projects that improve the safety, state of good repair, economic competitiveness, environmental sustainability, and quality of life in communities, states, regions and on a national level. TIGER grants are extremely competitive (less than 4 percent of applications submitted are awarded). To be competitive, applicants must have projects that are shovel-ready (able to be constructed within 12 months of TIGER award). Additionally, TIGER expects significant matching resources to be brought to the table. Although the minimum grant criteria indicate local/private match of 20 percent, in truth, a match of 40 to 60 percent is generally expected for an applicant to be considered competitive. TIGER grants are also directed to those projects that show regional and national significance. For this reason, development that promotes businesses that conduct trade and movement of freight or goods outside the Billings/Yellowstone County area to other states and countries, is most favorable to garnering federal TIGER assistance.

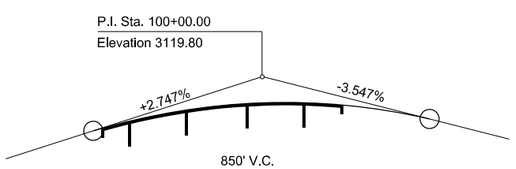
INFRA (Previously FASTLANE) grants are similar to TIGER in that they offer the same level of potential grant award and address safety, state of good repair, economic competitiveness, environmental sustainability, and quality of life. INFRA is also similar in the expectation of a project to be shovel-ready and that there is a significant private/local financial contribution (again, although the minimum requirements indicate 20 percent, a much higher match is expected to be competitive). Where INFRA diverts is that this funding source has an added emphasis on the movement of freight and people on a regional or national level. Merit criteria utilized to determine grant awards for INFRA include support for regional and national economic vitality, the ability to leverage federal funding with private investment, and the potential of a project for innovation in environmental review and permitting, experimental project delivery and safety and technology.

It is our recommendation that should the BOCC or BSED be interested in pursuing TIGER or INFRA resources, a consultant with expertise in preparing communities to be competitive in this process be engaged at least 1 year in advance of considering application.

Appendix A

Morrison Maierle





PROFILE GRADE

No Scale

NOTES

FINISHED GRADE: Finished grade of bridge at centerline roadway is the same as the Profile Grade shown on Road Plans.

LIVE LOAD: Standard HL-93 loading.

SPECIFICATIONS: Montana Department of Transportation and the Montana Transportation Commission Standard Specifications for Road and Bridge Construction, 2014 edition, and any amendments thereto, and the Special Provisions govern unless otherwise noted. The design was prepared in accordance with AASHTO LRFD Bridge Design Specifications, Seventh Edition - 2014 with XXXX Interim revisions.

REINFORCING STEEL: Use new deformed type reinforcing steel meeting the requirements of AASHTO M 31 Grade 60. Include all costs associated with furnishing and placing new reinforcing steel in the unit price bid for either Reinforcing Steel or Reinforcing Steel - Epoxy Coated.

CAST IN PLACE CONCRETE: Unless otherwise approved or specified, use Concrete Class Structure for all substructure concrete and Concrete Class Deck for all superstructure and barrier concrete.

CONCRETE STRENGTH: Except as noted on Sheet No. BXX, Use f'c = 4000 p.s.i. for Concrete Class Structure. Use f'c = 4000 p.s.i. for Concrete Class Deck.

STRUCTURE EXCAVATION: Include structure excavation in the unit price bid for Concrete Class Structure at end bents. Structure excavation at bents will be calculated from natural ground lines as they exist prior to construction.

TRAFFIC CONTROL PLAN AND SEQUENCE OF OPERATIONS: See Special Provisions.

UTILITIES: Call 1-800-424-5555 for utility locates at least two working days prior to starting any construction activity that could disturb the utility.

STATE PLANE COORDINATES: Stations shown on the bridge plans are state plane grid stations based on (NAD83-1999). Dimensions shown on the bridge plans are horizontal ground distances and not state plane grid distances. The combination scale factor (CSF) at this locations is 0.99945297.
Horizontal ground distance x CSF = Grid Distance
Grid Distance/CSF = Distance to stake.

STRUCTURAL STEEL: All structural steel will be measured and paid for on the lump sum basis as set forth in the Standard Specifications. Use structural steel meeting the requirements of AASHTO M 270 Grade 50W: Estimated weight = XXX XXX lbs.

SHEET NO. B2

GENERAL LAYOUT

SCALE: 1" = 30'-0" except as noted

BRIDGE OVER MRL RAILROAD AT STA. 99+34.30

REFERENCE POINT XXX + X.XXX

ROUTE XXXXXXX

PRELIMINARY

FEDERAL AID PROJECT NO. NCPD-MT 56(55)

YELLOWSTONE COUNTY

MDT MONTANA DEPARTMENT OF TRANSPORTATION

BRIDGE BUREAU

REVISED	
REVISED	
REVISED	
REVISED	
CHECKED	XX-XX-XX X.X.X.
DRAWN	03-09-17 D.A.D.
DESIGNED	03-09-17 J.G.S.
3/28/2017	8:57:45 AM ...\4199001\br\4199001BRGENZ01.DGN

UPN NUMBER 4199001

MDT STRUCTURE XXXXX

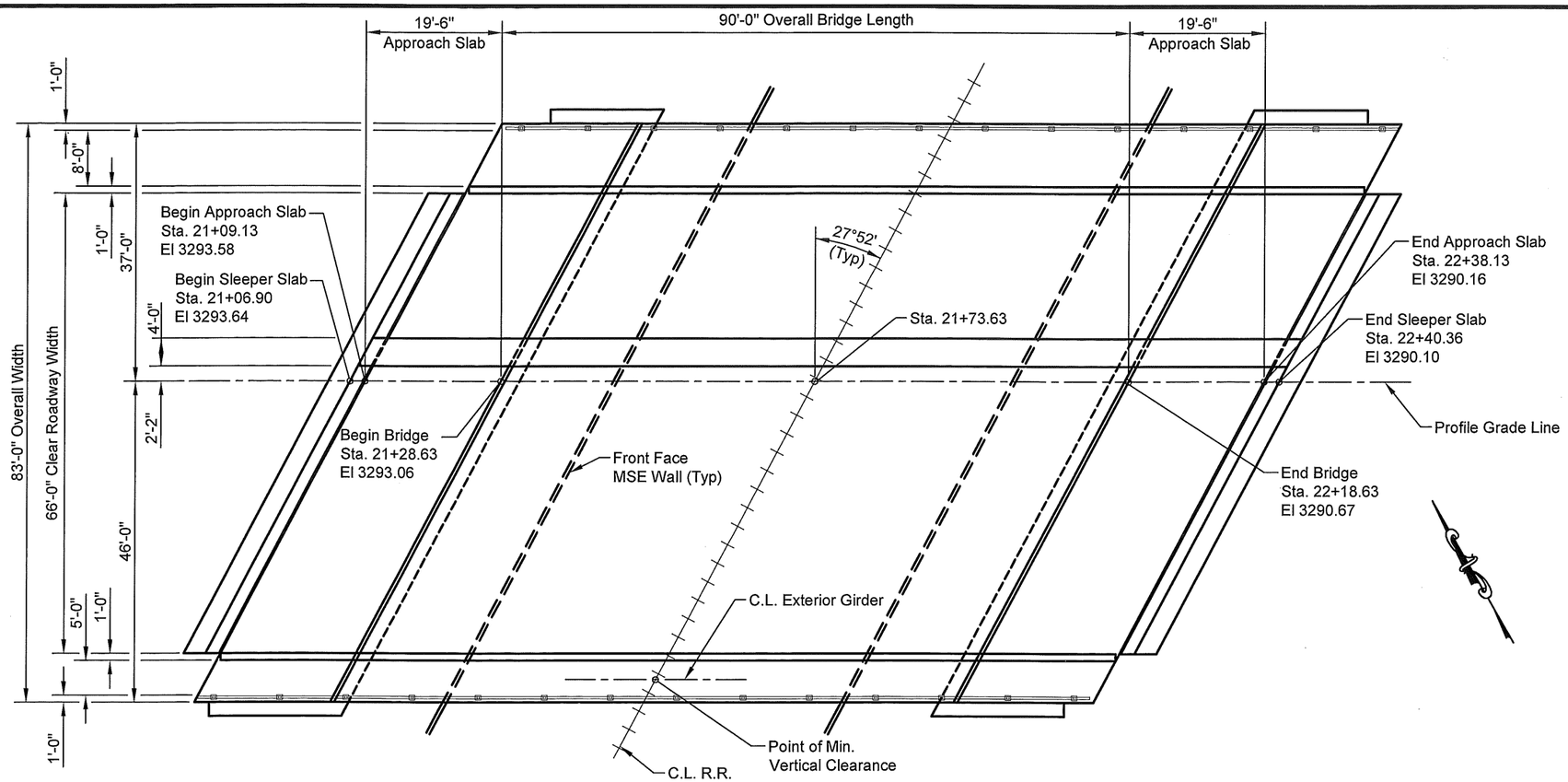
DRAWING NO. XXXXX

Appendix B

STATE OF SOUTH DAKOTA	Project No.	SHEET	TOTAL SHEETS
	P 1648(2)/EM 1648(1)	E2	E37

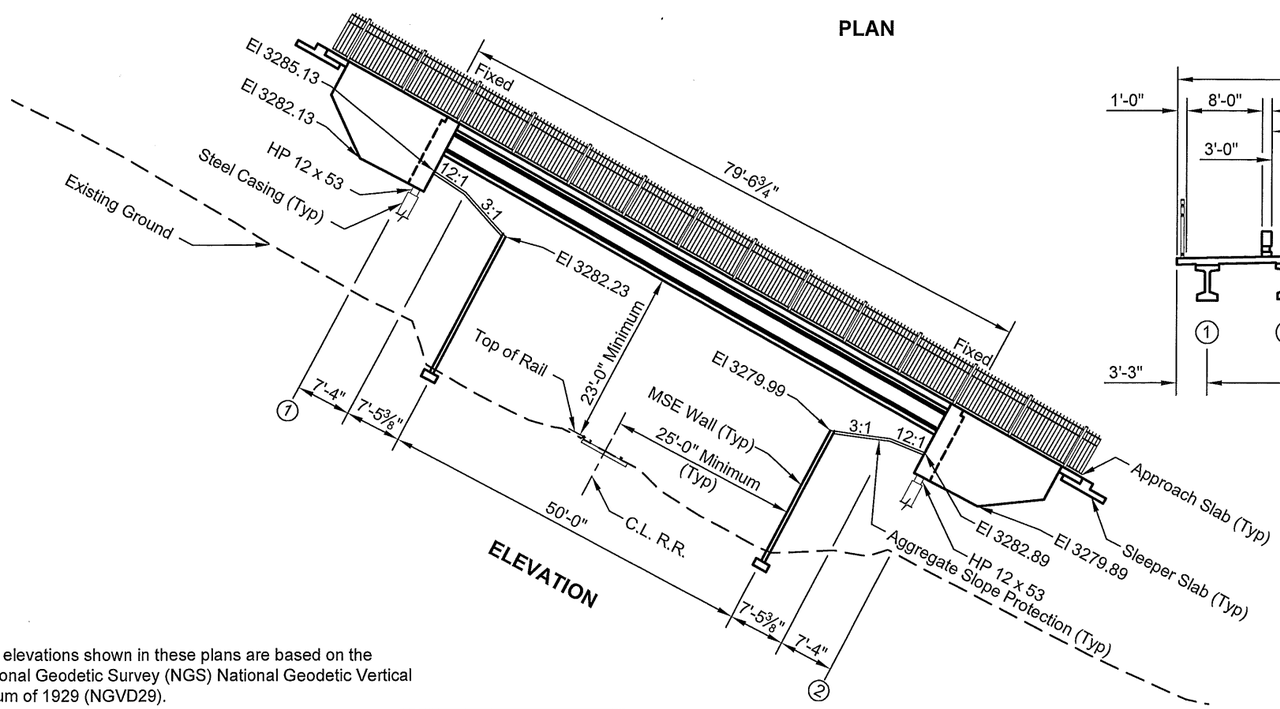
BRIDGE LAYOUT

REVISED 2/8/2011

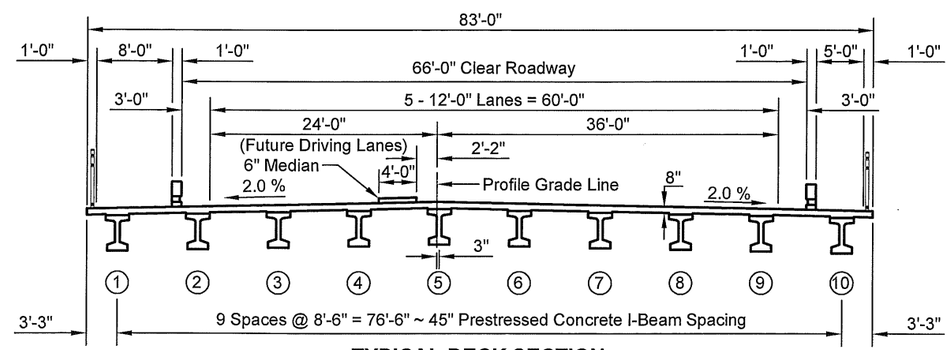


PLAN

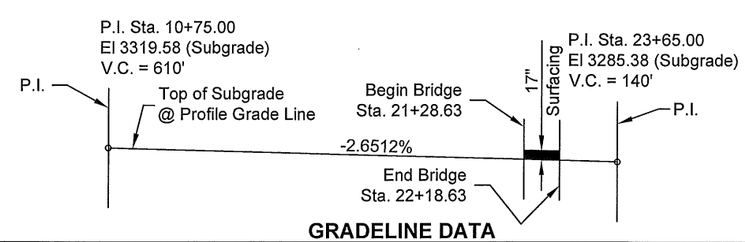
INDEX OF BRIDGE SHEETS



ELEVATION



TYPICAL DECK SECTION



GRADELINE DATA

Str. No. 52-429-291

Registered Professional Engineer
REG. No. 9175
WADE D. FRANK
SOUTH DAKOTA
2-10-11

The elevations shown in these plans are based on the National Geodetic Survey (NGS) National Geodetic Vertical Datum of 1929 (NGVD29).

Feb 10, 2011 - 9:05am - J:\municipal\Rapid City\10404106\Cadd\Bridge\E2_Bridge_Layout.dwg

Appendix C

Morrison Maierle	PROJECT:	LOCKWOOD TEDD INFRASTRUCTURE MASTER PLAN				
	BY:	JAC	DATE:	10/5/17	PROJECT NO.	5927.001
	CHK:	CMH	DATE:	10/5/17	PAGE:	1 OF 1

User	Address	Estimated % water returned to sewer	Annual water use, gal	2013-14 Winter* Monthly avg use, gal	2014-15 Winter* Monthly avg use, gal	2015-16 Winter* Monthly avg use, gal/mo	Avg of all 3 years, gal/mo	Approx Area (Ac)	Water Use, Avg Gal/(day * ac)	Avg daily WW flow, gal/day	Avg water use, gal/day/ac
Aspen Air	1524 Lockwood Rd	95%	11,053,600	1,021,171	941,414	1,055,457	1,006,014	5.78	5439	5167	5,239.42
Loveland Products	1525 Lockwood Rd	95%	3,352,800	266,700	240,871	286,071	264,548	26.15	316	8267	351.27
Billings Livestock	2443 N. Frontage Rd	50%	965,200	148,586	203,371	129,386	160,448	23.1	114	2639	114.48
Fly-In Lube and Wash	715 Johnson Ln	75%	2,949,200	243,571	237,871	232,557	238,000	4.69	1252	5872	1,722.81
MAC LLT Mfg.	1430 Hwy 87	95%	259,300	5,971	8,557	19,886	11,471	7.63	47	358	93.11
Polar Service Centers	1635 N. Frontage Rd	95%	644,500	10,200	12,157	30,443	17,600	5.47	101	550	322.81
Titan Machinery	1728 Old Hardin Rd.	95%	373,800	7,743	7,457	10,600	8,600	7.7	35	269	133.00
Crown Parts	1733 Hwy 87	95%	521,600	28,571	26,643	20,771	25,329	9.06	87	792	157.73

Assumptions: Exclude Aspen Air and Fly In Lube as unusually high users, of which kind are not anticipated in the TEDD

Total average winter monthly water use from industrial users, gal/ac	487,995	Excluding Aspen Air and Fly In Lube
Approx winter water use gal/day/acre	205.6	
Approx wastewater flow gal/day/ac, assuming 95% return rate	195.3	
Average year round use gal/day/acre	211.8	
Average year round water demand, including 5% for leakage	222.4	

Peaking factor, from 2016 LWSD Water Master Plan (average day to max day) =	2.2
Peaking factor for peak hour in 2016 LWSD Water Master Plan	3.5
Wastewater peaking factor, assumed	3

Lockwood Study Area - Phasing Area	Alternate Name	Acres	Developable With Flood Protection (acres)	Acreage assuming 30% to road, rail, public	Estimated avg wastewater flow, gal/day	Avg wastewater flow, gpm	Peak ww flow, gpm	Estimated avg water use, gal/day	Peak day water use, gal/day	Peak day water demand, gpm	Peak hour water demand, gpm	% of total
TEDD	TEDD	536.5	533.1	373.2	72,900	51	152	83,016	182,634	127	202	38%
Group A	Group A	256.6	256.6	179.6	35,089	24	73	39,958	87,908	61	97	18%
Group B	Group B	213.8	213.8	149.7	29,241	20	61	33,298	73,256	51	81	15%
Group C	Group C	386.8	386.8	270.7	52,887	37	110	60,226	132,497	92	146	28%
Infiltration					13,500	9	9					
Total		**1,393.7**	**1,390.4**	**973.3**	**203,617.86**	**141.40**	**405.45**	**216,498.11**	**476,295.84**	**330.76**	**526.21**	

Estimated needs in 20 years

Lockwood Study Area - Phasing Area	Alternate Name	Acres	Developable With Flood Protection and assuming 30% reduction for road, rail, public(acres)	% Y20	Estimated avg wastewater flow, gal/day	Avg ww flow, gpm	Peak ww flow, gpm	Estimated avg water use, gal/day	Peak day water use, gal/day	Peak day water demand, gpm	Peak hour water demand, gpm	% of total
TEDD	TEDD	536.5	373.2	68%	49,572	34	103	56,451	124,191	86	137	57%
Group A	Group A	256.6	179.6	45%	15,790	11	33	17,981	39,559	27	44	18%
Group B	Group B	213.8	149.7	0%	-	-	-	-	-	-	-	0%
Group C	Group C	386.8	270.7	41%	21,684	15	45	24,693	54,324	38	60	25%
Total TEDD Study Area		**1,393.7**	**973.3**	**46%**	**93,664**	**65**	**187**	**99,589**	**219,096**	**152**	**242**	

Appendix D

FIRTH LIFT STATION

EXXON FLOWS
2 MGD

LWSD SEWER LIFT STATION

FORCE MAIN TO
CITY OF BILLINGS

A
B
C
D
E
F
G
H
R

30" - 0.10%
27" - 0.12%
24" - 1.56%
24" - 0.07%
24" - 0.07%
24" - 0.14%
18" - 0.12%
15" - 0.20%

LEGEND

- LWSD BOUNDARY
- 2" PIPE
- 3" PIPE
- 6" PIPE
- 8" PIPE
- 10" PIPE
- 12" PIPE
- 15" PIPE
- 18" PIPE
- 24" PIPE
- 27" PIPE
- 30" PIPE
- FORCE MAIN

N

1000 500 0 1000 2000
SCALE IN FEET

Based on information provided by LWSD, May 2015. Best information available.

Morrison Maierle
engineers • surveyors • planners • scientists

315 N. 25th Street
Suite 102
Billings MT 59101

Phone: (406) 656-6000
Fax: (406) 237-1201

DRAWN BY: RLL
CHK'D. BY: SAS
APPR. BY: SAS
DATE: 09/2017

LOCKWOOD WATER AND SEWER DISTRICT

LOCKWOOD MONTANA

EXISTING TRUNK MAIN SEWER SYSTEM

PROJECT NO.
5927.001

FIGURE NUMBER
FIG. 1

V:\5927\ACAD\Exhibits\LWSD SewerSize2.dwg Plotted by randy larance on Oct/4/2017

Appendix E

Morrison Maierle engineers • surveyors • planners • scientists	PROJECT: LOCKWOOD TEDD		
	BY: SAS	DATE: 10/5/17	PROJECT NO. 5927.001
	CHK: JAC	DATE: 10/5/17	PAGE: 1 OF 1

LIFT STATION #2 - FIRTH STREET - FLOW ESTIMATES

FLOW ESTIMATES FOR SERVICE AREA (ORIGINAL):

AVERAGE DAILY FLOW RATE	=	66,500	gpd
	=	50	gpm
PEAKING FACTOR	=	4.10	assumed
PEAK HOUR	=	272,650	gpd
	=	190	gpm

FLOW ESTIMATES FOR SERVICE AREA (REVISED BASED ON 2017 LWSD WASTEWATER FLOW PROJECTION STUDY):

AVERAGE DAILY FLOW RATE	=	38,000	gpd
	=	26	gpm
PEAKING FACTOR	=	4.10	assumed
PEAK HOUR	=	155,800	gpd
	=	108	gpm

FLOW ESTIMATES FOR TEDD AND GROUPS A, B, AND C (FROM KLJ):

AVERAGE DAILY FLOW RATE	=	190,118	gpd
INFILTRATION	=	13,500	gpd
	=	141	gpm
PEAKING FACTOR	=	3	
PEAK HOUR	=	583,854	gpd
	=	405	gpm

COMBINED FLOW ESTIMATES FOR SERVICE AREA, TEDD, AND GROUPS A, B, AND C (USING KLJ PEAKING FACTOR):

AVERAGE DAILY FLOW RATE	=	228,118	gpd
INFILTRATION	=	13,500	gpd
	=	168	gpm
PEAKING FACTOR	=	3	
PEAK HOUR	=	739,654	gpd
	=	514	gpm

CONCLUSION: ROUTING TEDD AND GROUPS A, B, AND C WASTEWATER FLOWS TO THE FIRTH LIFT STATION WILL EXCEED ITS CAPACITY. THE LIFT STATION COULD HANDLE THE COMBINED AVERAGE DAILY FLOW RATE BUT THE PEAK HOUR FLOW RATE WILL EXCEED THE LIFT STATION'S CAPACITY.

Appendix F

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers • surveyors • planners • scientists	BY: SAS	DATE: 10/5/17	PROJECT NO.	5927.001		
	CHK: JAC	DATE: 10/5/17	PAGE: 1	OF	2	

LIFT STATION #2, FIRTH STREET - WET WELL SIZING

DESIGN AVERAGE DAILY FLOW	168	gpm		
DESIGN PEAK FLOW	514	gpm		
PUMP 1 FLOW RATE	250	gpm		
PUMP 2 FLOW RATE	250	gpm		
MINIMUM PUMP RUN TIME	2	minutes		
WET WELL VOLUME BASED ON MINIMUM PUMP RUN TIME - (storage volume between lead pump on and lead pump off)	500	gallons		
MINIMUM CYCLE TIME - (length of time between pump starts) 5 minutes for 6 starts/hour/pump for a total of 12 starts/hour with duplex pumps.	5	minutes		
WET WELL VOLUME BASED ON CYCLE TIME - (storage volume between lead pump on and lead pump off) V = (t * q)/4	313	gallons		
CONTROLLING VOLUME	500	gallons		
WET WELL CONFIGURATION	6	ft diameter		
WET WELL AREA	28.274	sf =	211.49	gal/ft
REQUIRED USEABLE DEPTH	2.4	ft =	507.58	gals

PUMP CYCLE TIME CHECK

	AVE FLOW	PEAK HR FLOW	WORST CASE	
FILL RATE AT DESIGNATED FLOW	168.00	514.00	125.00	gpm
TIME TO PUMP 1 ON	3.02	0.99	4.06	minutes
PUMPING W/ 1 PUMP	250.00	250.00	250.00	gpm
EFFECTIVE PUMP DOWN RATE	82.00	-264.00	125.00	ft/min
EFFECTIVE TIME TO PUMP SHUTOFF	6.19	-1.92	4.06	minutes
PUMPING W/ 2 PUMPS	500.00	500.00	500.00	gpm
EFFECTIVE PUMP DOWN RATE	332.00	-14.00	375.00	ft/min
EFFECTIVE TIME TO PUMP SHUTOFF	1.53	-36.26	1.35	minutes
TOTAL CYCLE TIME - (avg flow cycle time = 30 minutes max per DEQ 2)	9.21	-35.27	8.12	minutes
STARTS PER HOUR PER PUMP	3.26	-1.70	3.69	

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers · surveyors · planners · scientists	BY: DNM	DATE: 10/5/17	PROJECT NO. 5927.001			
	CHK:	DATE:	PAGE: 2	OF	2	

LIFT STATION #2, FIRTH STREET - WET WELL SIZING

	ELEVATION	DIFFERENCE (ft)	
FINISHED GRADE	3106.5		
INFLUENT LINE	3089.5		
		0	
HIGH-HIGH WATER ALARM	3089.5		
		0.5	
HIGH WATER ALARM	3089.0		
		0.5	
LAG PUMP ON	3088.5		
		0.5	
LEAD PUMP ON	3088.0		
		2.4	
PUMPS OFF	3085.6		
		0.4	
LOW WATER ALARM	3085.2		
		0.3	
LOW-LOW WATER SHUTOFF	3084.9		(Set at mid-point of motor casing)
		2.2	(Required pump submergence)
BOTTOM OF WET WELL	3082.7		
TOTAL WET WELL DEPTH	23.8		

SEWER TRUNK MAINS AT ULTIMATE CAPACITY
LOCKWOOD WATER AND SEWER DISTRICT
INCLUDES TEDD AND GROUPS A, B, AND C AREAS
October 5, 2017

Trunk Main ID	Contributing Areas & Sewers	Contributing Area Cumulative Average Day Flow (gpd)	Contributing Area Infiltration (gpd)	Exxon Flows (gpd)	TEDD, Groups A, B, and C Average Day Flows (gpd)	TEDD, Groups A, B, and C Infiltration (gpd)	Peaking Factor*	Peak Hourly Flows (gpd)	Peak Hourly Flows (gpm)	Pipe Size (in)	Limiting Pipe Slope (%)	Max Design Depth**	Pipe Capacity at Design Depth and Limiting (gpm)	Accomodates Peak Hourly Flow?	Percent Full at Peak Hourly Flow
H-G	SE5, SE6, SE7, SE10, SE11, SE12	340,000			190,120	13,500	3	1,603,860	1,114	15	0.20%	1/2 Full	648	NO	70.9%
G-F	H-G, SE4	377,000					3	1,714,860	1,191	18	0.12%	3/4 Full	1,489	YES	
F-R	G-F, SE8, SE9, SE14, NE1, SE13, SE3,	768,000	10,000				3	2,897,860	2,012	24	0.07%	3/4 Full	2,450	YES	
R-E	F-R, SE1, SE2, SW2	959,000	10,000				3	3,480,860	2,417	24	0.07%	3/4 Full	2,450	YES	
E-D	R-E, SW1A, SW1C, SW1B, SW3, SW4, SW5, SW6	1,253,000	10,000				3	4,372,860	3,037	24	0.14%	3/4 Full	3,464	YES	
D-C	E-D, NW8	1,305,000					3	4,528,860	3,145	24	1.56%	3/4 Full	11,564	YES	
C-B	D-C, NW7A, NW7B	1,380,000	10,000	2,000,000			3	6,763,860	4,697	27	0.12%	3/4 Full	4,391	NO	79.3%
B-A	C-B, NW1, NW2, NW3, NW4, NW5, NW6	1,589,000	10,000				3	7,400,860	5,139	30	0.08%	3/4 Full	4,748	NO	80.2%

*Peaking factor is not applied to infiltration and Exxon flows.
**ASCE Manuals and Reports on Engineering Practice No. 60 and WEF MOP No. FD-5, *Gravity Sanitary Sewer Design and Construction*

Appendix G

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers • surveyors • planners • scientists	BY: SAS	DATE: 10/5/17	PROJECT NO.	5297.001		
	CHK: JAC	DATE: 10/5/17	PAGE: 1	OF	2	

LOCKWOOD MAIN LIFT STATION - WET WELL SIZING FOR ULTIMATE BUILD OUT FLOWS + EXXON FLOWS + TEDD FLOWS

				Build Out	Non-peak Flows
DESIGN AVERAGE DAILY FLOW	2668.5	gpm		1236	1433
LOW FLOW (IF NOT KNOWN, USE 1/8 DESIGN AVERAGE DAILY FLOW)	1587.4	gpm		154	1433
DESIGN PEAK FLOW	5139.5	gpm		3706.5	1433
PUMP 1, 2, AND 3 COMBINED FLOW RATE	5650	gpm	(2-1750 gpm & 1-2150 gpm)		
PUMP 4 FLOW RATE	1750	gpm			
MINIMUM PUMP RUN TIME	2	minutes			
WET WELL VOLUME BASED ON MINIMUM PUMP RUN TIME (STORAGE VOLUME BETWEEN LEAD PUMP ON AND LEAD PUMP OFF)	8125.2	gallons			
MINIMUM CYCLE TIME (LENGTH OF TIME BETWEEN PUMP STARTS) 10 MINUTES FOR 6 STARTS/HOUR/PUMP FOR A TOTAL OF 6 STARTS/HOUR WITH DUPLEX PUMPS	10	minutes			
WET WELL VOLUME BASED ON CYCLE TIME (STORAGE VOLUME BETWEEN LEAD PUMP ON AND LEAD PUMP OFF)	14125	gallons			
CONTROLLING VOLUME	14125	gallons			
WET WELL CONFIGURATION	18X18	ft x ft			
WET WELL AREA	324	sf =	2423.5 gal/ft		
REQUIRED USEABLE DEPTH	5.8	ft =	14056 gals		

*The discharge of 2 mgd from Exxon to the LWSD sewer system will be accomplished over a 24-hour period at a constant release rate.

	AVE FLOW	PEAK HR FLOW	LOW FLOW	
FILL RATE AT DESIGNATED FLOW	2668	5139	1587	gpm
TIME TO PUMP 1 ON	5.27	2.73	8.85	minutes
PUMP DOWN RATE	3500	5650	3500	gpm
COMBINED PUMP DOWN RATE	832	511	1913	gpm
COMBINED TIME TO PUMP DOWN	16.90	27.53	7.35	minutes
TOTAL CYCLE TIME (AVE FLOW CYCLE TIME = 30 MINUTES MAX PER DEQ-2, 42.62)	22.17	30.27	16.20	minutes
STARTS PER HOUR PER PUMP	2.71	1.98	3.70	
NUMBER OF PUMPS RUNNING PER CYCLE	2	3	2	

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers • surveyors • planners • scientists	BY:	SAS	DATE:	10/5/17	PROJECT NO.	5297.001
	CHK:	JAC	DATE:	10/5/17	PAGE: 2	OF 2

LOCKWOOD MAIN LIFT STATION - PUMP OPERATION SETTINGS FOR ULTIMATE BUILD OUT FLOWS + EXXON FLOWS + TEDD

	ELEVATION	DIFFERENCE (ft)	
FINISHED GRADE	3103.5		
INFLUENT LINE	3080.9		
		0	
HIGH-HIGH WATER ALARM	3080.9		
		0.5	
HIGH WATER ALARM	3080.4		
		0.5	
LAG PUMP ON	3079.9		
		0.5	
LEAD PUMP ON	3079.4		
		5.8	
PUMPS OFF	3073.6		
		0.5	
LOW WATER ALARM	3073.1		
		0.5	
LOW-LOW WATER ALARM	3072.6		(Generally set at mid-point of motor casing)
		1.8	(Required pump submergence)
BOTTOM OF WET WELL	3070.0		
TOTAL WET WELL DEPTH	33.5		

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers · surveyors · planners · scientists	BY: SAS	DATE: 10/5/17	PROJECT NO.	5297.001		
	CHK: JAC	DATE: 10/5/17	PAGE: 1	OF	3	

LOCKWOOD MAIN LIFT STATION - PUMP & SYSTEM CURVES

PUMP CURVE DATA: FOUR PUMPS TOTAL, THREE FORCE MAINS

FLOW (GPM)	HEAD (FT)	EFFICIENCY (%)
0	112	0
500	103	35
1000	94	59
1500	82.5	71.5
2000	66	70.8
2500	44	57.5

PEAK HOUR FLOW = 5139 gpm

DEVELOP SYSTEM CURVE FOR ONLY ONE FORCE MAIN:

FORCE MAIN:

LENGTH	=	48	ft	
DIAMETER	=	12	in	
AREA	=	0.7854	ft^2	
DESIGN FLOW	=	2150	gpm	
C	=	120		(12" DI force main)

LENGTH	=	36	ft	
DIAMETER	=	16	in	
AREA	=	1.3963	ft^2	
DESIGN FLOW	=	2150	gpm	
C	=	120		(16" DI force main)

LENGTH	=	1,387	ft	
DIAMETER	=	16	in	
AREA	=	1.3963	ft^2	
DESIGN FLOW	=	2150	gpm	
C	=	120		(16" PVC force main)

STATIC HEAD CONDITIONS:

	ELEVATION	DIST (from static to discharge)
HIGH WATER LEVEL (HWL)	3079.4	44.1
LOW WATER LEVEL (LWL)	3073.3	50.2
DISCHARGE/HIGH POINT	3123.5	

LOCKWOOD MAIN LIFT STATION - PUMP & SYSTEM CURVES CONT'D

MINOR LOSSES SUMMARY:

		12" DI		16" DI				12" DI		16" DI	
Appurtenance	K	No.	Total	No.	Total	Appurtenance	K	No.	Total	No.	Total
Gate Valve						45° Wye					
3/4 Closed	24.0		0		0	Value	0.5		0		0
1/2 Closed	5.6		0		0	Sudden Contraction					
1/4 Closed	1.2		0		0	d/D = 1/4	0.4		0		0
Open	0.5		0		0	d/D = 1/2	0.3		0		0
Plug Valve						d/D = 3/4	0.2		0		0
Open	0.5	1	0.5	1	0.5	Sudden Enlargement					
Swing Ch Valve						d/D = 1/4	0.9		0		0
Value 1	0.6		0		0	d/D = 1/2	0.6		0		0
Value 2	2	1	2		0	d/D = 3/4	0.2	1	0.2		0
Elbows						d/D = 0.83	0.03	1	0.03		0
90° Standard	0.8	3	2.4	4	3.2	Entrance					
90° Long Rad	0.6		0		0	Pipe Projecting	0.8		0		0
45° Standard	0.2		0		0	Pipe Flush	0.5		0		0
22.5° Stand	0.15		0		0	Ball Check Valve	0.05	1	0.05		0
11.25° Stand	0.1		0		0	Exit					
Tee						All Conditions	1		0		0
Branch Flow	0.75		0		0	**TOTAL "K"**			**5.2**		**3.7**

		16" PVC						16" PVC		0	
Appurtenance	K	No.	Total	No.	Total	Appurtenance	K	No.	Total	No.	Total
Gate Valve						45° Wye					
3/4 Closed	24.0		0		0	Value	0.5		0		0
1/2 Closed	5.6		0		0	Sudden Contraction					
1/4 Closed	1.2		0		0	d/D = 1/4	0.4		0		0
Open	0.5		0		0	d/D = 1/2	0.3		0		0
Plug Valve						d/D = 3/4	0.2		0		0
Open	0.5		0		0	Sudden Enlargement					
Swing Ch Valve						d/D = 1/4	0.9		0		0
Value 1	0.6		0		0	d/D = 1/2	0.6		0		0
Value 2	2		0		0	d/D = 3/4	0.2		0		0
Elbows						d/D = 0.83	0.03		0		0
90° Standard	0.8	8	6.4		0	Entrance					
90° Long Rad	0.6		0		0	Pipe Projecting	0.8		0		0
45° Standard	0.2	4	0.8		0	Pipe Flush	0.5		0		0
22.5° Stand	0.15	4	0.6		0	Ball Check Valve	0.05		0		0
11.25° Stand	0.1	4	0.4		0	Exit					
Tee						All Conditions	1	1	0		0
Branch Flow	0.75		0		0	**TOTAL "K"**			**8.2**		**0.0**

Morrison Maierle	PROJECT:	LOCKWOOD TEDD				
engineers · surveyors · planners · scientists	BY: SAS	DATE: 10/5/17	PROJECT NO.	5297.001		
	CHK: JAC	DATE: 10/5/17	PAGE: 3	OF	3	

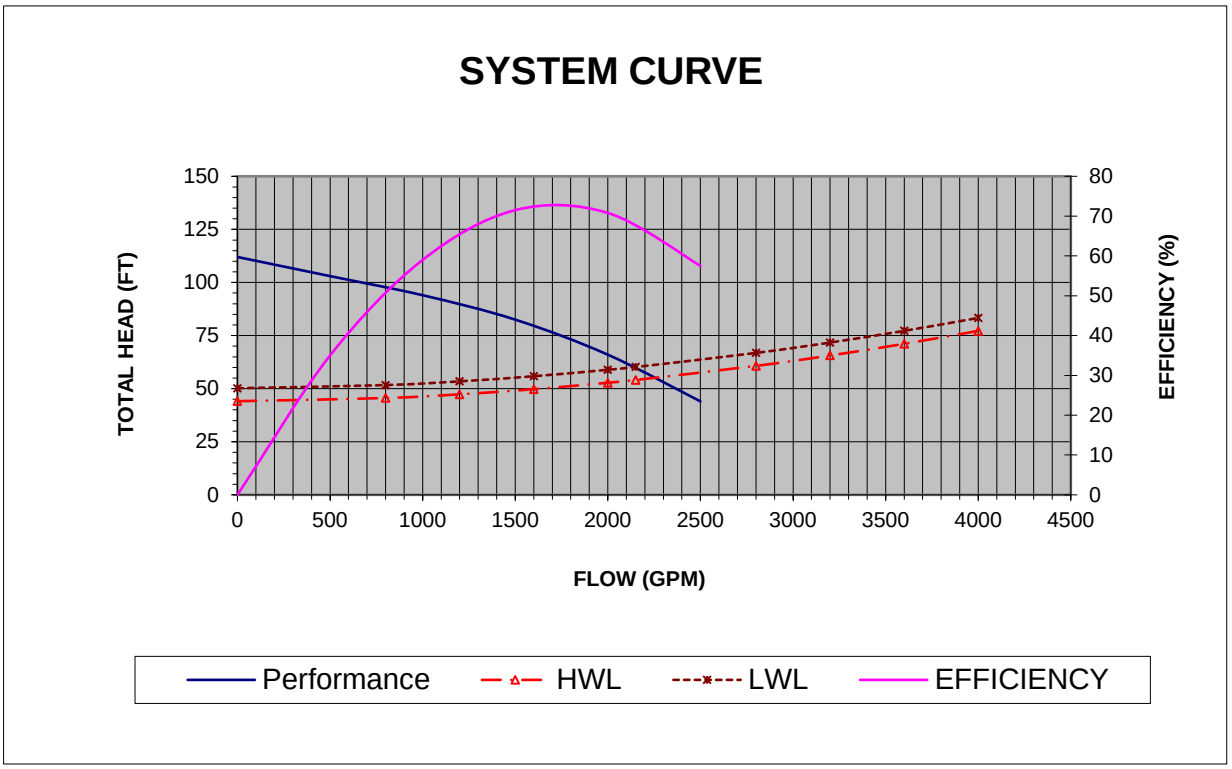
LOCKWOOD MAIN LIFT STATION - PUMP & SYSTEM CURVES CONT'D

COMPUTE FRICTION HEAD: $h_F = (L/D^{4.87})*((2.31*Q)/(C*448.8))^{1.852}$

12" DI:	$(L/D^{4.87})$ =	47.8	$2.31/(C*448.8))^{1.852}$ =	8E-09
16" DI:		8.8439		8E-09
16" PVC:		341.68		8E-09

COMPUTE MINOR LOSSES $h_M = K*V^2/2g$

		12" DI			16" DI			16" PVC							
Q (gpm)	$Q^{1.852}$	V (fps)	h_F (ft)	h_M (ft)	V (fps)	h_F (ft)	h_M (ft)	V (fps)	h_F (ft)	h_M (ft)	$\sum h_L$ (ft)	HWL (ft)	HWL (psi)	LWL (ft)	LWL (psi)
0	0	0	0	0	0	0	0	0	0	0	0.0	44.10	19.1	50.20	21.7
800	237970.2	2.2696	0.0927	0.4143	1.2766	0.0172	0.0936	1.2766	0.6627	0.2075	1.5	45.59	19.7	51.69	22.4
1200	504247.4	3.4044	0.1964	0.9322	1.915	0.0363	0.2107	1.915	1.4042	0.4669	3.2	47.35	20.5	53.45	23.1
1600	859073.3	4.5392	0.3347	1.6573	2.5533	0.0619	0.3746	2.5533	2.3923	0.8301	5.7	49.75	21.5	55.85	24.2
2000	1298696.1	5.674	0.5059	2.5895	3.1916	0.0936	0.5852	3.1916	3.6166	1.297	8.7	52.79	22.9	58.89	25.5
2150	1484827.6	6.0995	0.5785	2.9925	3.431	0.107	0.6763	3.431	4.1349	1.4989	10.0	54.09	23.4	60.19	26.1
2800	2421791.1	7.9436	0.9435	5.0754	4.4683	0.1746	1.1471	4.4683	6.7441	2.5422	16.6	60.73	26.3	66.83	28.9
3200	3101257.0	9.0784	1.2082	6.6292	5.1066	0.2235	1.4982	5.1066	8.6363	3.3204	21.5	65.62	28.4	71.72	31.0
3600	3857200.7	10.213	1.5027	8.39	5.7449	0.278	1.8962	5.7449	10.741	4.2024	27.0	71.11	30.8	77.21	33.4
4000	######	11.348	1.8264	10.358	6.3832	0.3379	2.341	6.3832	13.056	5.1881	33.1	77.21	33.4	83.31	36.1



LOCKWOOD LIFT STATION - FORCE MAIN

Q = VA

12" FM:	Velocity =	6.1	fps
16" FM:		3.4	fps

(per DEQ-2, para. 49.1, min. cleaning velocity = 2 fps with 3 fps desirable, max. velocity = 8 fps)

Appendix H

ENGINEER'S OPINION OF PROBABLE COST
Lockwood TEDD
Water & Sewer Main Cost
October 9, 2017

ITEM	ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
	Schedule 1 (Water & Sanitary Sewer)				
101	Mobilization/Demobilization	1	LS	$ 524,000.00	$524,000
102	Taxes, Bonds & Insurance	1	LS	$ 262,000.00	$262,000
103	Dewatering	1	LS	$ 1,500,000.00	$1,500,000
104	Storm Water Management & Erosion Control	1	LS	$ 133,000.00	$133,000
105	Traffic Control	1	LS	$ 15,000.00	$15,000
106	Type II Bedding	2,500	CY	$ 44.00	$110,000
107	Imported Backfill	11,345	CY	$ 40.00	$454,000
108	Flowable Fill	240	CY	$ 137.00	$33,000
109	Connect to Existing Sewer Main	1	EA	$ 1,500.00	$2,000
110	48" Sanitary Sewer Manhole	89	EA	$ 5,000.00	$445,000
111	6-inch Sanitary Sewer Pressure Main	14,230	LF	$ 110.00	$1,565,000
112	8-inch Sanitary Sewer Gravity Main	35,350	LF	$ 100.00	$3,535,000
113	Lift Station	1	EA	$ 153,000.00	$153,000
114	10" Connection to Existing Water Main	2	EA	$ 3,000.00	$6,000
115	12-inch Water Main	10,900	LF	$ 70.00	$763,000
116	10-inch Water Main	20,500	LF	$ 60.00	$1,230,000
117	12-inch Gate Valve	22	EA	$ 2,850.00	$63,000
118	12-inch Cross	2	EA	$ 1,700.00	$3,000
119	12x6-inch Tee	22	EA	$ 1,050.00	$23,000
120	12-inch Bends	10	EA	$ 1,000.00	$10,000
121	10-inch Bends	10	EA	$ 800.00	$8,000
122	10-inch Gate Valve	45	EA	$ 2,500.00	$113,000
123	10x6-inch Tees	41	EA	$ 900.00	$37,000
124	10x10-inch Tees	2	EA	$ 1,150.00	$2,000
125	12x10-inch Reducer	5	EA	$ 1,300.00	$7,000
126	Fire Hydrant Assembly	63	EA	$ 4,400.00	$277,000
				Subtotal	$8,731,000
				Contingency (30%)	$2,619,000
				Total	**$11,350,000**