Final Drainage Report
US-12, 18th St to Clearwater River Bridge
Project No. A012(009), Key No. 12009

Prepared for

Idaho Transportation Department - District 2
2600 Frontage Rd.
Lewiston, Idaho 83501

City of Lewiston
1134 F Street
Lewiston, ID 83501

Prepared by

Parametrix
7761 W Riverside Drive, Suite 201
Boise, ID 83714-5044
T. 208.898.0012 F. 1.855.542.6353
www.parametrix.com

January 2018 | 314-4006-046

CITATION

Parametrix. 2018. Final Drainage Report
US-12, 18th St to Clearwater River Bridge
Project No. A012(009), Key No. 12009
Prepared by Parametrix, Boise, ID
January 2018

TABLE OF CONTENTS

APPENDICES

ACRONYMS

BMP	Best Management Practices
cfs	cubic feet per second
FIRM	Flood Insurance Rate Map
IDF	Intensity-Duration-Frequency
ITD	Idaho Transportation Department
NPDES	National Pollutant Discharge Elimination System
MS4	municipal separate storm sewer systems
USACE	United States Army Corps of Engineers

1. INTRODUCTION

The Idaho Transportation Department (ITD) and the City of Lewiston are partnering to construct improvements to modify the existing US-12/21st Street intersection in Lewiston, ID as shown on the Vicinity Map in Appendix A. The purpose of the intersection modification is to improve capacity and safety by converting the existing multi-leg intersection into a more traditional four-leg signalized intersection. General project limits extend from the Main Street/19th Street intersection to the Main Street/22nd Street intersection and from the south side of the US-12 Bridge over the Clearwater River to the 21st Street/7th Avenue intersection. G Street will be turned into a dead end cul-de-sac.

This report addresses the existing drainage conditions, drainage design, analysis, and proposed drainage improvements. The City of Lewiston recently adopted a stormwater master plan that recommended a large trunk line be installed down 21st Street. The City will install the trunk line as part of this project.

2. EXISTING CONDITIONS

2.1 DRAINAGE PATTERNS

The existing drainage system was delineated through a combination of surveying, GIS, and collection of other pertinent data. The existing off-site drainage patterns will be perpetuated across the proposed corridor to the extent possible. The modifications proposed to the US-12/21st Street intersection will not necessitate changes to the existing storm drainage facilities outside of the project area.

There are six existing drainage basins that collect runoff from the project area. These basins are delineated on the exhibit in Appendix C. A comparison of the existing and proposed drainage areas is provided in Table 1 for each basin. The proposed drainage areas for four of the basins will not increase with the project. It was assumed that the existing downstream systems are sufficient, and therefore no further analysis will be performed for the downstream systems on these basins.

The first drainage Basin 'A' collects runoff from the section of US-12 (Main Street) located between 19th Street and 21st Street. A piped system collects the storm water and conveys it off-site through a piped system to the northwest to an unknown location. The Basin 'A' collects storm water from approximately 1.82 acres (1.58 acres of impervious and 0.24 acres of pervious) ground within the project area.

Basin 'B' collects drainage from the majority of the project footprint. This area includes a large portion of US-12, a significant portion of the east leg of Main Street, all of 21st Street within the project limits, and a portion of 7th Avenue. Basin 'B' encompasses about 3.32 acres (2.65 impervious acres, 0.67 pervious acres) and has a piped conveyance that directs the stormwater northerly through Locomotive Park to an unknown location.

Basin 'C' serves approximately 400-feet of US-12 from the end of the Memorial Bridge continuing south. It encompasses approximately 0.72 acres of impervious surfaces. The flow from this basin is collected and piped easterly to the existing ditch located between US-12 and 22nd Street. This ditch flows northward to an US Army Corps of Engineers (USACE) flow control structure before discharging to the Clearwater River.

Basins 'D' and 'E' were not used for the existing conditions analysis. Basin 'F' consists of a short section of Main St from its intersection with 22nd Street to the island separator for the Main Street Bypass. The runoff from Basin 'F' for approximately 0.56 acres of impervious surfaces is collected and is piped to the same ditch that Basin 'C' discharges into. The outfall for Basin 'F' is located approximately 150-ft upstream of the Basin 'C' outfall.

Basin 'G' is located on Idaho Street and serves a small portion of Idaho Street and 21st Street. The existing inlet is connected to a piped system that flows westerly down Idaho Street to an unknown location.

Basin 'H' collects runoff from G Street for approximately 0.44 acres of impervious surfaces. There are two existing inlets on either side of the street. The inlets connect to a piped conveyance that caries the stormwater westerly down G Street to an unknown location.

2.2 Off-Site Flows

It is not anticipated that the project area will see significant runoff generated from adjacent off-site parcels.

However, more regionally the City currently has a storm drain system that collects and conveys runoff from a large part of the City across 21st Street (near the southern limits of the project). The system flows through the Red Lion parking lot and ultimately discharges into the ditch located along the eastern limits of the project.

Relatively recently, the flows in this storm drain system exceeded capacity causing flooding to parts of downtown Lewiston. To help correct this issue, the City of Lewiston will be installing a large diameter trunk line down 21st Street to better collect and convey these large off-site flows.

2.3 Existing Storm Drain System Condition

The existing storm water drainage system currently in place will be replaced within the project limits; therefore an assessment of the existing system is unnecessary. It is recommended that the City of Lewiston inventory the condition of the conveyances downstream of the project to ensure there are no additional unidentified deficiencies.

3. PROPOSED CONDITIONS

3.1 General Improvements

The proposed improvements associated with this project have been designed to prevent additional runoff burden to existing facilities. It was assumed that the downstream conveyances are adequate for existing flows to Basins 'A', 'B', 'G', and 'H'. Since no additional flow will be directed to any of these basins, no additional downstream analysis was performed. An exhibit showing the proposed drainage area is located in Appendix C.

The proposed Basin 'A' will see a slight increase in the impervious footprint, but this increase will be offset by a reduction in total drainage area. Weighted for runoff coefficients, the change in area will

have negligible effects for peak flow rates when using the Rational Method. See the table below for impervious drainage areas for Basin 'A'.

The majority of runoff from existing Basin 'B' will now be conveyed and combined with Basin 'C'. The remaining area that will continue to flow to Basin 'B' is primarily the intersection footprint. As a result, the total drainage area for Basin 'B' was reduced significantly to include about 0.76 acres.

The majority of the project runoff will be collected within Basins 'C', 'D', and 'F', and will discharge to the ditch located between US-12 and 22nd Street. The City of Lewiston will be installing a large diameter trunk line that will convey stormwater through the project site and discharge into the channel. The channel flows northerly, flows through a USACE structure, and then enters the Clearwater River. Currently these three existing basins serve approximately 1.28 acres, while the proposed conditions will increase this to 4.56 acres. The increase of drainage area is not a concern at this location, as the existing channel is intended to serve as a primary flood route for the City of Lewiston.

The drainage area and boundaries for Basin 'G' will change very little in the proposed condition. The proposed modifications to Idaho Street are minimal, and there will be no impacts or improvements to the storm drain system.

The proposed condition for Basin 'H' has been reduced by 0.14 acres. G Street will be converted into a cul-de-sac as part of the project improvements. A significant portion of the impervious surfaces in the existing drainage basin will become landscaping. There will be no impacts or improvements to the storm drain system.

The table below summarizes the changes to impervious areas proposed for the project.

Table 1 – Existing and Proposed Impervious Drainage Area

Facility	Existing Drainage Area (acres)	Proposed Drainage Area (acres)
Basin 'A'	1.58	1.61
Basin 'B'	2.65	0.76
Basin 'C'	0.72	2.70
Basin 'D'	N/A*	1.13
Basin 'E'	N/A	N/A
Basin 'F'	0.56	0.32
Basin 'G'	0.11	0.11
Basin 'H'	0.44	0.30

*Area for proposed Basin 'D' is included in existing Basin 'B'

3.2 PROPOSED TRUNK LINE

The City of Lewiston has recently adopted a stormwater master plan that conveys water along 21st Street, north to the existing channel. The hydraulic model used in the basis of the master plan estimated the 25-year peak flow at approximately 300-cfs. It is assumed that the City will provide water quality treatment at an upstream location for this line prior to entering the project area.

4. HYDROLOGY/HYDRAULICS

4.1 DESIGN STANDARDS

This project will be designed in accordance with Section 600 and Appendix B of the Idaho Transportation Department (ITD) Roadway Design Manual (August 2013) and Section 2.3 of the City of Lewiston Public Works Department Stormwater Policy Design Manual (2010). The City's stormwater design manual recommends using the Rational Method to calculate peak flows used in stormwater design. Parametrix utilized this methodology to calculate the peak flow rates for the majority of the proposed improvements. The City of Lewiston provided the peak design flows for the proposed trunk line, which was determined from their adopted Stormwater Master Plan. The table below summarizes the design criteria for the project.

Table 2 – Design Criteria Summary

Feature	Design Requirements
Primary Conveyance (Storm Sewers)	25-year Storm Event
Minimum Pipe Size	18" for Storm Sewer Pipes (if there are no design constraints, otherwise 12")
Gutter Spread	25-year storm, no curb overtopping, the flow spread must not encroach upon more than one half of the adjacent travel lane.

The existing drainage systems were not evaluated for compliance to current design standards.

4.2 SOIL SURVEY AND INFILTRATION RATES

Based on the Phase II Soils Report completed by STRATA (April 2017), native soils within the project boundaries include Silt with Sand (ML), Poorly Graded Gravel with Cobbles (GP) alluvium, Poorly Graded Sand (SP), and Silty Sand (SM). No testing was conducted for infiltration rates as no infiltration facilities are being proposed with this project.

4.3 HYDROLOGY METHOD

4.3.1 RATIONAL METHOD

The Rational Method is an effective and simple method for calculating stormwater peak flow rates for smaller drainage basins. The City of Lewiston has adopted the Rational Method as their preferred methodology in calculating stormwater peak flows for basins smaller than 100 acres.

The peak stormwater runoff rate is estimated from the following equation:

Flow Rate

$$Q_d = C \times I_d \times A$$

where:

Q_d = design peak flow rate (cfs) at a certain storm duration
C = Runoff coefficient (0.95 for pavement and 0.20 for the pervious area)
I_d = Rainfall Intensity at a certain storm duration (Based on City of Lewiston Design Manual, Appendix C, Figure 1)
A = Area (acre)

For simplicity of calculations, a C value of 0.95 was used on all impervious areas and 0.20 was used for all the pervious areas within the drainage basins. The rainfall intensity is taken from the City of Lewiston, Idaho Stormwater Master Plan and is based on an Intensity Duration Frequency (IDF) graph or table, which is unique to the region. The Rational Method assumes an increasing rainfall intensity starting at zero and peaking at a duration equal to the time of concentration. The rainfall intensity is higher for shorter durations than for longer durations. City of Lewiston rainfall intensities for this project are located in Appendix D.

4.3.2 Design Storm

The 25-year storm is a typical engineering design storm for primary conveyance systems, and was used to analyze the conveyance systems within the project area as identified in the Design Criteria.

Based on the City of Lewiston Public Works Stormwater Policy and Design Manual (2010) the following 1-hour rainfall totals were used for this analysis. For the Rational Method, peak rainfall intensities were pulled off of the City of Lewiston Figure 1 for shorter rainfall durations (see Appendix D for Supporting Data).

Table 3 – Design Storm Rainfall Totals

Duration (min)	Intensity (inches per hour)			
	2 Yr	10 Yr	25 Yr	100 Yr
10	1.00	1.80	2.30	3.10
15	0.85	1.55	1.85	2.55
30	0.60	1.05	1.30	1.70
60	0.40	0.66	0.80	1.10

4.3.3 Time of Concentration

The time of concentration represents the amount of time it takes rainfall in a given area to collect and concentrate to a single point or area of interest. The lower the time of concentrations are, the higher the peak stormwater runoff rates are. This situation is typical of urban development where rainfall lands on impervious surfaces and quickly collects in a curb, ditch, or some other drainage facility. Conversely, the longer the time of concentration is, the lower the peak stormwater runoff rates. This situation is typical of larger rural drainage basins. Although the time of concentration significantly

impacts the peak flow rate, it has minimal effect on the total stormwater volume that a given storm produces.

For this analysis, a typical minimum urban time of concentration of 10-minutes was used as a beginning point for the calculations within the project area.

4.3.4 SNOWFALL

No special accommodations or considerations were taken into account that occur during spring snowmelt. Lewiston receives approximately 11" of snowfall annually, with 2-3" per month during winter. The average high temperature for Lewiston in January is 42° F, which is the lowest average high temperature during the winter months. Consequential snowmelt events are very unlikely to occur due to the above freezing temperatures throughout the winter months.

4.4 PIPE SIZING/HYDRAULIC GRADE

Based on ITD's design criteria, the new storm sewer pipes were designed to convey flows for a 25 year storm event. Pipe flows and hydraulic calculations are shown in Appendix F.

For the 25-year event, all the proposed pipes have sufficient capacity to convey the design flows assuming a free outlet condition. Several of the proposed pipes flow under a pressure condition due to the peak flow going through the proposed trunk line. The hydraulic grade line calculations assume a worst-case scenario where peak flows from the site and trunk line occur simultaneously, when most likely the peak flow from the trunk line probably would have a significant lag to it.

The calculated HGL's on each pipe show that a couple manholes or inlets may flood at the top of the structure. Again, it is anticipated that this is primarily due to the simultaneous peaks assumed for the worst case. The HGL for the peak flow in the trunk line is not anticipated to exceed manhole rims for the 25-year storm event (although the HGL does come within 1 foot of the rim elevation at two locations). Pipe sizing and HGL calculations are located in Appendix F.

Parametrix took the existing hydraulic model used for the masterplan modeling and updated the model to account for the proposed trunkline to be built with this project. The model predicts approximately 300-cfs will flow through the line during the 25-year event. Output data from the model can be seen in Appendix E.

4.5 SPREAD CALCULATIONS FOR INLET SPACING

The existing inlets are all spaced within the criteria of the City of Lewiston's Policy Manual, which requires a maximum spacing of 750' for inlets. Both of the City of Lewiston standard inlet types (the Type 1 inlets and the Curb Drop Inlets) will be used in the project to match other inlets throughout the City. The Curb Drop inlets have a curb opening, and therefore have a higher capture rate. These inlets are placed in areas where spread was more of a concern, such as at low points and along the steeper road grades (like 21st Street).

The existing inlet spacing was maintained to the extent practical. Additional inlets were proposed, as needed, to capture water at low points and where the roadway super elevation required it. Inlets were designed to allow no more encroachment than 1/2 lane adjacent to the inlet per ITD Design Manual

Standards. Inlet capture efficiency calculations were performed using Bentley's FlowMaster V8i software. The calculations are included in Appendix F.

4.6 OUTFALL PROTECTION

Two methods were used to determine rock sizing and bed dimensions for the outfall of the main 72" trunk line into the unnamed rock lined channel on the east side of the project. One method was taken from the National Engineering Handbook Part 654, Technical Supplement 14C, the other was developed based on the US Army Corps of Engineers' (USACE) Engineer Manual 1110-2-1601. Table 4 summarizes the dimensions recommended for the riprap outfall. Sizing calculations are located in Appendix F.

Table 4 –Outfall Sizing Summary

	USACE EM 1110-2-1601	
Design Parameter	**Initial Apron**	**Subsequent Apron**
Layer Thickness (ft)	4.0	2.25
D_{50} minimum (in)	28.0	16.0

5. WATER QUALITY REQUIREMENTS

The Clearwater River flows east to west near the project's northern extent. This stretch of the Clearwater is classified as Category 2 under the Idaho Department of Environmental Quality's 2012 Integrated Report. The Clearwater joins the Snake River approximately 1.5 miles west of the project. The section of the Snake River is listed as Category 5 in IDEQ's 2012 integrated report for water temperature concerns. Temperature is the only pollutant of concern identified for the Snake River downstream from the Hells Canyon Dam to the project site.

The City of Lewiston will qualify as a small MS4 (municipal separate storm sewer system) community under the Stormwater Phase II program under the Clean Water Act. The State of Idaho submitted a "Preliminary Draft" General Permit to EPA Region X in spring of 2016 for all regulated MS4 communities in the state. Thus far, a Final General National Pollutant Discharge Elimination System (NPDES) Permit has not been issued.

The proposed Preliminary Draft General Permit contains requirements to manage stormwater during construction, treatment of the 24-hour 95th percentile storm event for new or redeveloped sites, management of illicit discharges, and public education and outreach.

During the Final Design stage of this project, oil/sediment traps were included as a structural BMP (best management practice). It appears that the City does not currently have any oil/sediment traps on storm sewer systems within the City. Since there are no current permit standards in effect, and after some deliberation, the City requested the proposed sediment and oil traps be removed from the project due to maintenance concerns.

The water quality treatment design included at final design treated the first 0.4 inches of any rainfall event (the amount from a 2-year, 1-hour design storm) before leaving the project site. Storm water

runoff produced by the addition of impermeable surfaces was going to be treated using sediment and oil traps prior to entering existing storm sewer systems and leaving the project area. These structural BMPs were going to be 1,000 gallon vaults with baffles spaced a minimum of 16" apart. Two sediment and grease traps were required for the outlet of storm drainage Line C. Calculations for the sediment and grease traps are located in Appendix F from Final Design.

Drainage areas and resulting discharges to existing facilities will be reduced with the proposed improvements, therefore existing facilities outside the project area will not be altered with this project. It is assumed that the existing facilities met the water quality requirements for the time they were constructed. Parametrix did not investigate the existing facilities and assumed them to be functioning within City of Lewiston standards.

Stormwater treatment was not considered for the proposed trunk line near the outfall. The City of Lewiston anticipates providing water quality treatment and stormwater management on flows through the trunk line further upstream as part of future City led projects.

6. FLOODPLAIN

The Nez Perce County Flood Insurance Rate Maps (FIRM – Map Number 1601040001B dated January 1982) identifies that the entire project area is within the Unshaded Zone C as shown in Appendix G. Consequently, this project will have no adverse impact to the delineated floodplain.

7. CONCLUSION

The changes to the existing drainage system associated with the US-12, 18th St to Clearwater River Bridge project have been minimized to the extent practical. The majority of the existing storm drain system within the project area will be replaced and additional inlets will be installed where necessary to accommodate intersection and roadway improvements.

The contributing drainage areas within the project vicinity that flow to existing facilities will be reduced with the exception of the discharge to the unnamed channel on the east side of the project between US-12 and 22nd Street. This channel will receive a negligible increase in flow as a direct result of the project improvements. However, the City of Lewiston will also be constructing a large diameter trunkline that discharges to this channel to help alleviate existing capacity deficiencies upstream of the project as part of their adopted Stormwater Master Plan. This channel flows northerly, and discharges into the Clearwater River a few hundred feet north of the proposed discharge points.

The proposed project improvements are in conformance with the design standards identified for this project.

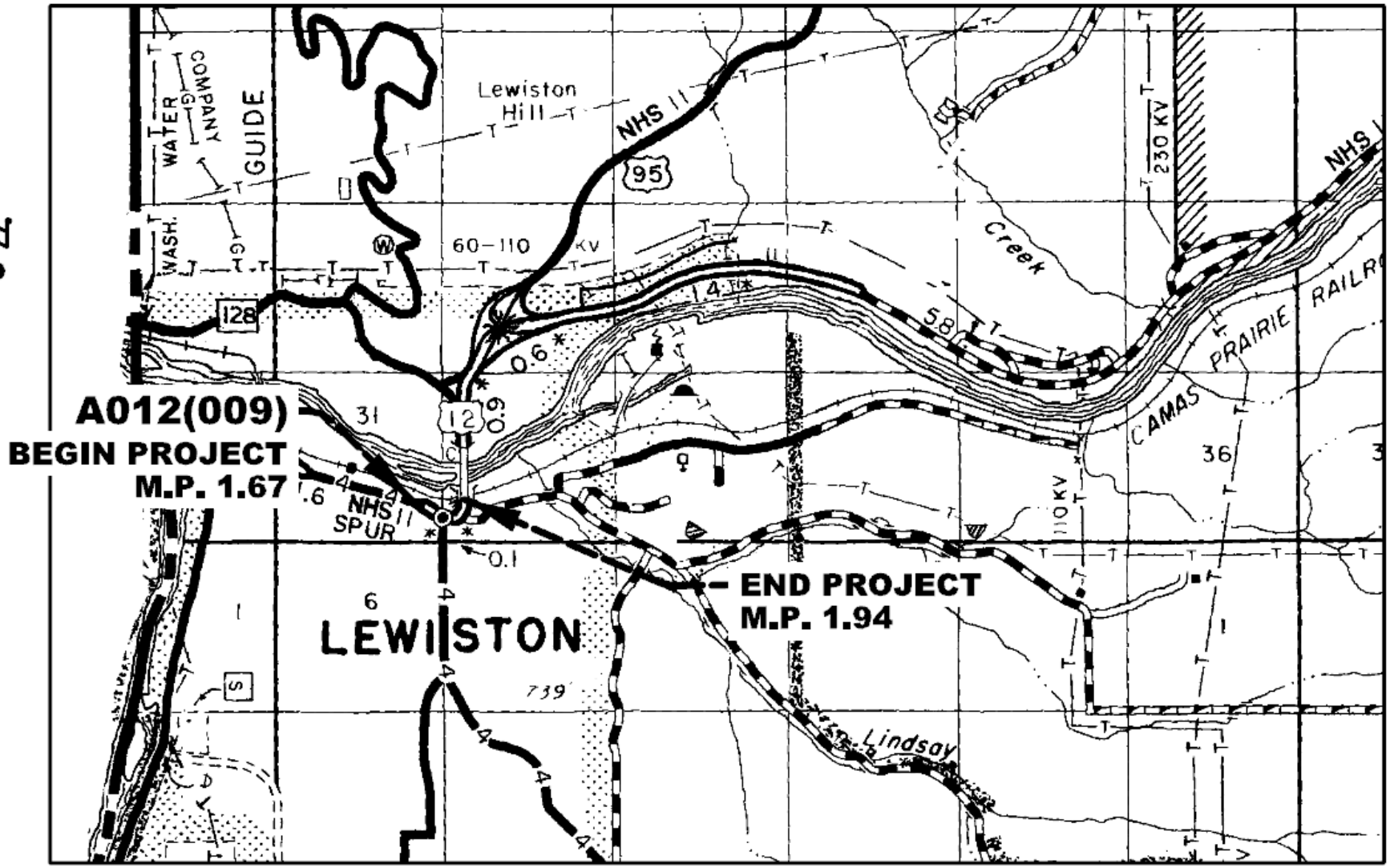
APPENDIX A

VICINITY MAP

Vicinity Map

US-12, 18th St to Clearwater River Bridge, Lewiston, ID

Project No. A012(009)



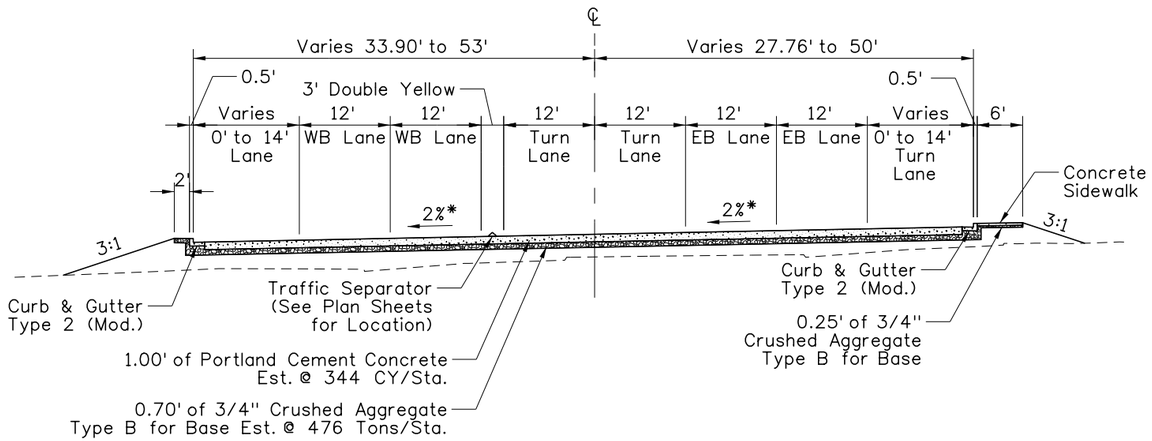
APPENDIX B

TYPICAL SECTIONS

US-12
TYPICAL SECTION
Scale:1"=20'

*See Superelevation Diagram

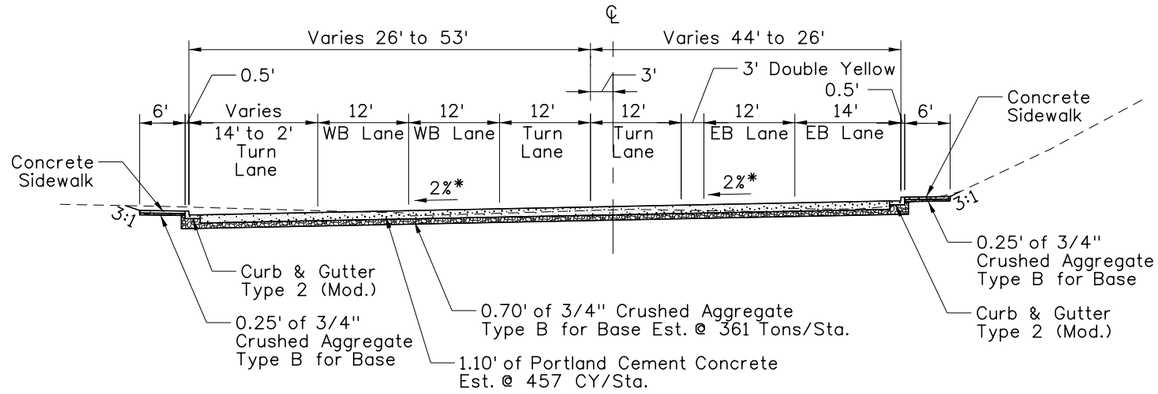
Sta. 278+99.03 to Sta. 284+00.00



E. MAIN STREET
TYPICAL SECTION
Scale:1"=20'

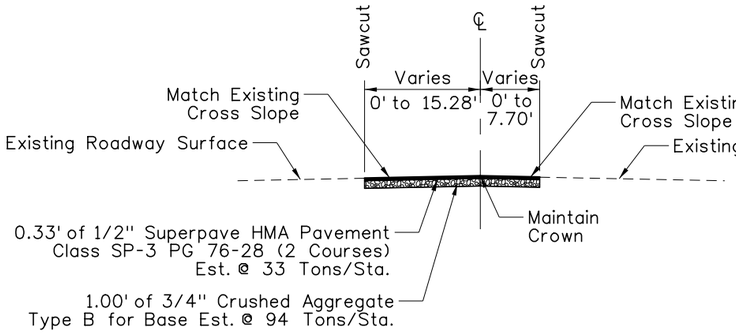
*See Superelevation Diagram

Sta. 284+00.00 to Sta. 290+00.00



US-12
TYPICAL SECTION
Scale:1"=20'

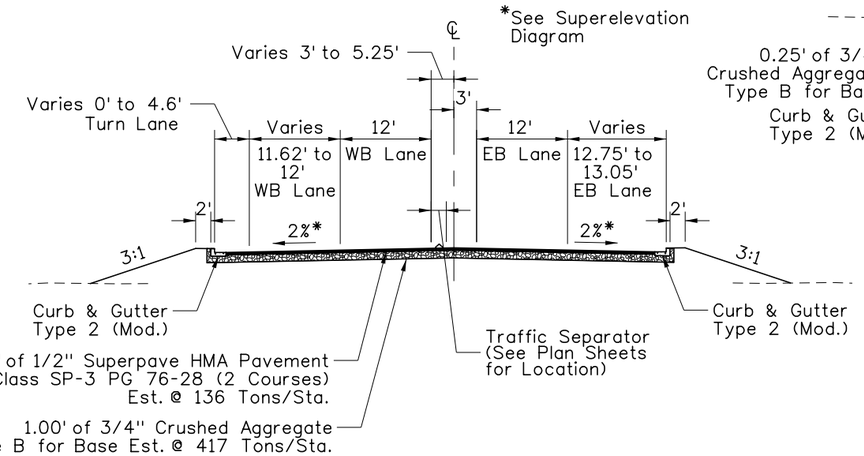
Sta. 275+53.12 to Sta. 278+30.00



US-12
TYPICAL SECTION
Scale:1"=20'

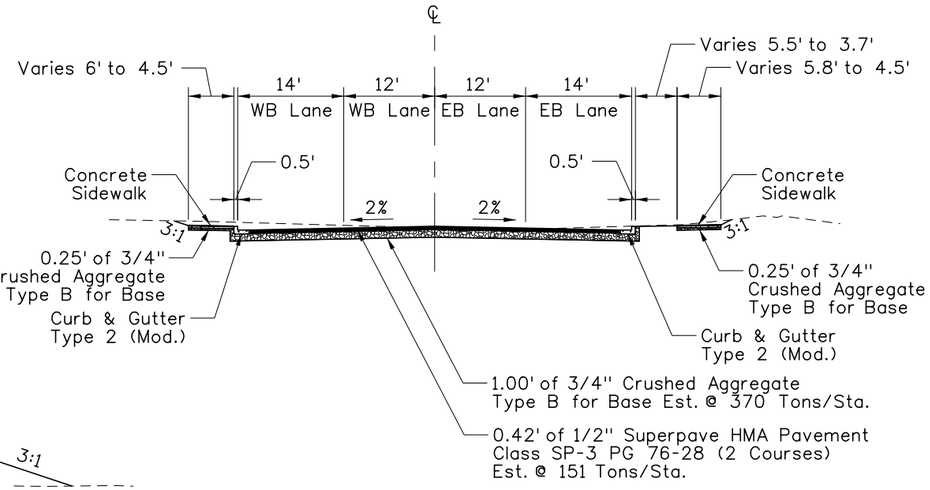
Sta. 278+30.00 to Sta. 278+99.03

*See Superelevation Diagram



E. MAIN STREET
TYPICAL SECTION
Scale:1"=20'

Sta. 290+00.00 to Sta. 290+30.00



REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED	JLJ
DESIGN CHECKED	DJC
DETAILED	KMR
DRAWING CHECKED	BTC

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

CADD FILE NAME 12009_typ_001.sht

DRAWING DATE: September, 2017

IDAHO TRANSPORTATION DEPARTMENT

Parametrix

PROJECT NO.

A012(009)

TYPICAL SECTIONS

US-12, 18TH ST TO CLEARWATER RV BR, LEWISTON

English

COUNTY Nez Perce

KEY NUMBER 12009

SHEET 4 OF 131

NOT APPROVED FINAL DESIGN FOR CONSTRUCTION

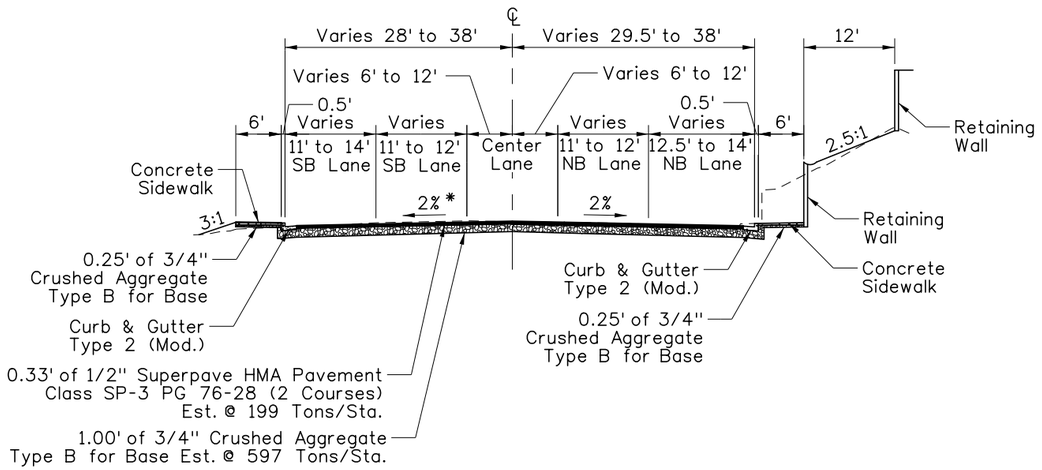
9/20/2017 3:48:12 PM

u:\bois\projects\clients\4006-ltd\3l4-4006-046 us-12,18th clearwater\99svcs\cadd\dgn\Sheets\12009_typ_001.sht

21ST STREET
TYPICAL SECTION
Scale:1"=20'

*See Superelevation Diagram

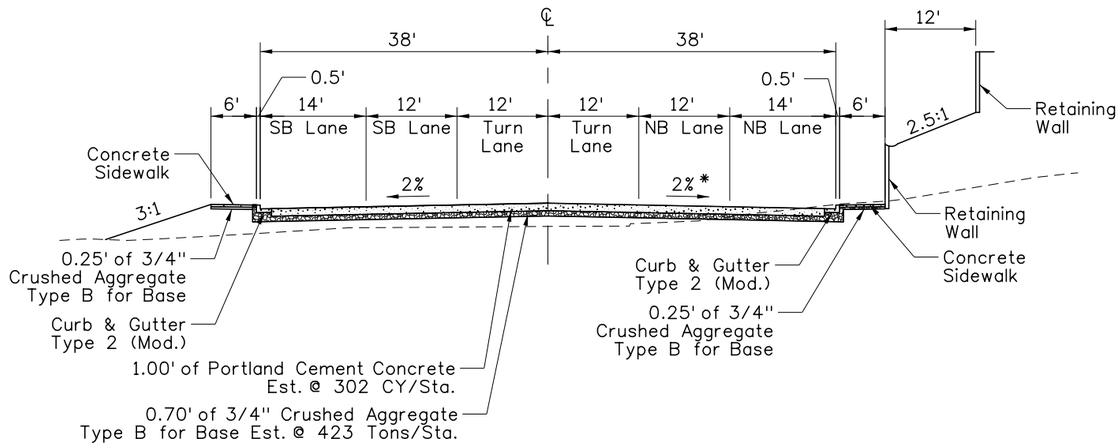
Sta. 107+98.00 to Sta. 109+31.30



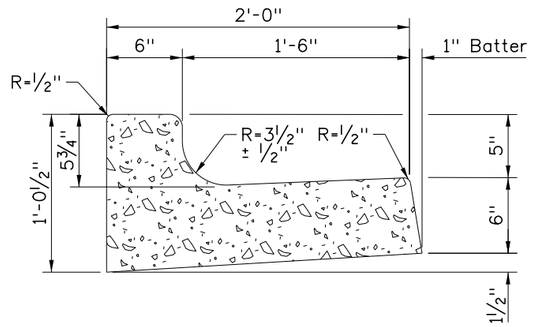
21ST STREET
TYPICAL SECTION
Scale:1"=20'

*See Superelevation Diagram

Sta. 109+31.30 to Sta. 111+50

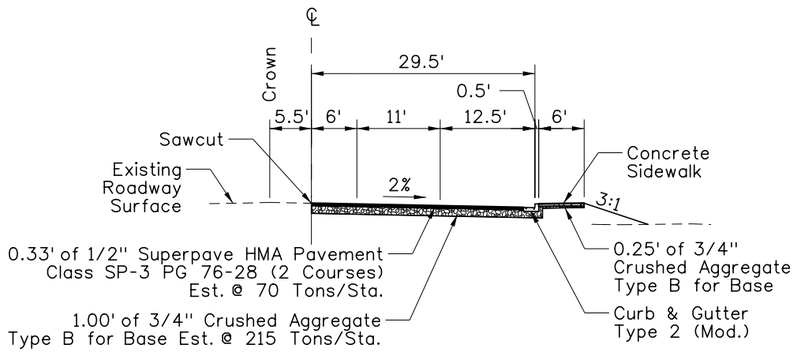


CURB & GUTTER TYPE 2 (MOD)
Item 615-492A
Scale: 1"=1'



21ST STREET
TYPICAL SECTION
Scale:1"=20'

Sta. 106+07.44 to Sta. 107+98.00



REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED	JLJ
DESIGN CHECKED	DJC
DETAILED	KMR
DRAWING CHECKED	BTC

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

CADD FILE NAME 12009_typ_002.sht

DRAWING DATE: September, 2017

IDAHO TRANSPORTATION DEPARTMENT

Parametrix

PROJECT NO.

A012(009)

TYPICAL SECTIONS

US-12, 18TH ST TO CLEARWATER
RV BR, LEWISTON

English

COUNTY Nez Perce

KEY NUMBER 12009

SHEET 5 OF 131

NOT APPROVED FINAL DESIGN FOR CONSTRUCTION

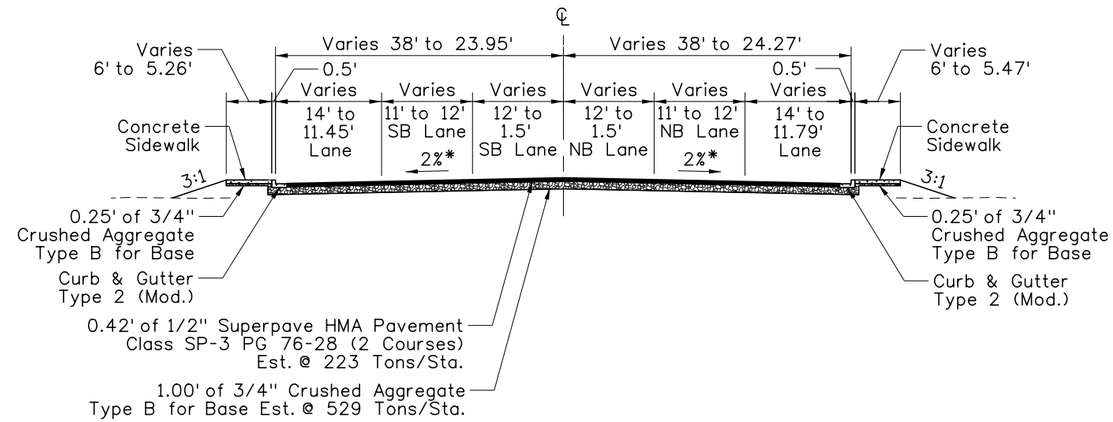
9/20/2017 3:48:15 PM

u:\bols\projects\clients\4006-ITD\314-4006-046 us-12,18th clearwater\99svcs\cadd\dgn\Sheets\12009_typ_002.sht

US-12
TYPICAL SECTION
Scale:1"=20'

*See Superelevation Diagram

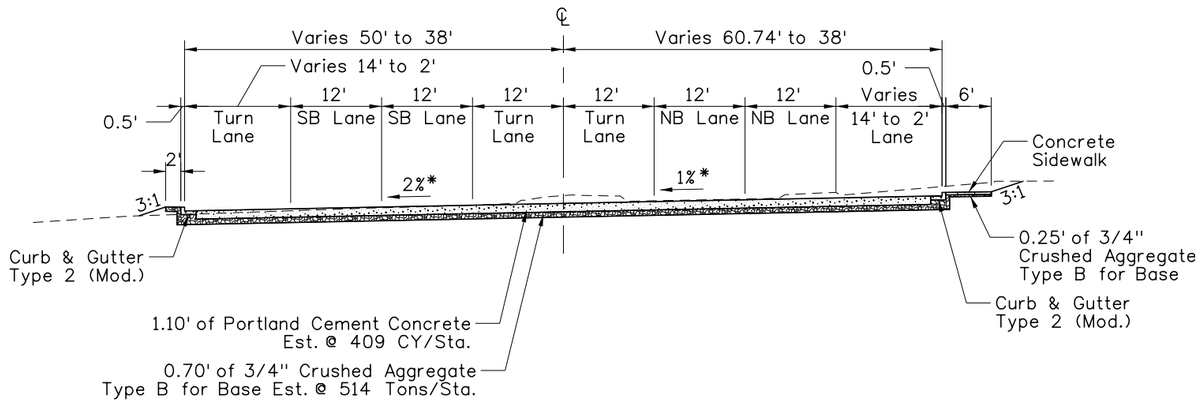
Sta. 118+25.17 to Sta. 119+79.00



US-12
TYPICAL SECTION
Scale:1"=20'

*See Superelevation Diagram

Sta. 112+94.69 to Sta. 118+25.17



REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED	JLJ
DESIGN CHECKED	DJC
DETAILED	KMR
DRAWING CHECKED	BTC

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

CADD FILE NAME 12009_typ_003.sht

DRAWING DATE: September, 2017

IDAHO TRANSPORTATION DEPARTMENT

Parametrix

PROJECT NO.

A012(009)

TYPICAL SECTIONS

US-12, 18TH ST TO CLEARWATER RV BR, LEWISTON

English

COUNTY Nez Perce

KEY NUMBER 12009

SHEET 6 OF 131

NOT APPROVED FINAL DESIGN FOR CONSTRUCTION

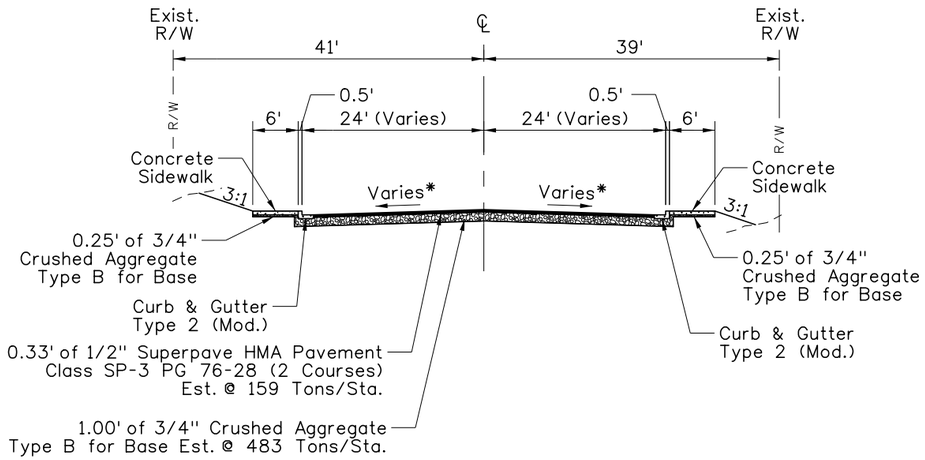
9/20/2017 3:48:16 PM

u:\bols\projects\clients\4006-itd\314-4006-046 us-12,18th clearwater \99svcs\cadd\dgn\Sheets\12009_typ_003.sht

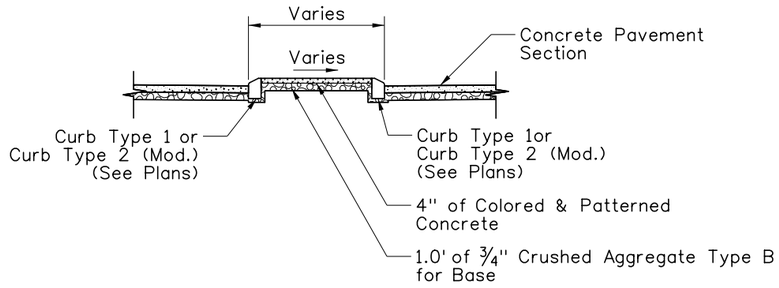
G STREET
TYPICAL SECTION
Scale:1"=20'

*See G St. Detail

Sta. 63+25 to Sta. 64+14.02



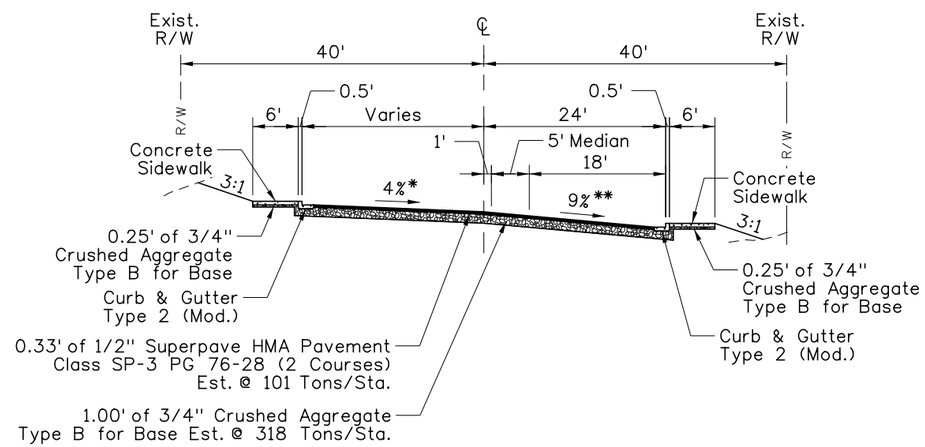
INTERSECTION ISLAND
TYPICAL SECTION
Scale:1"=20'



IDAHO STREET
TYPICAL SECTION
Scale:1"=20'

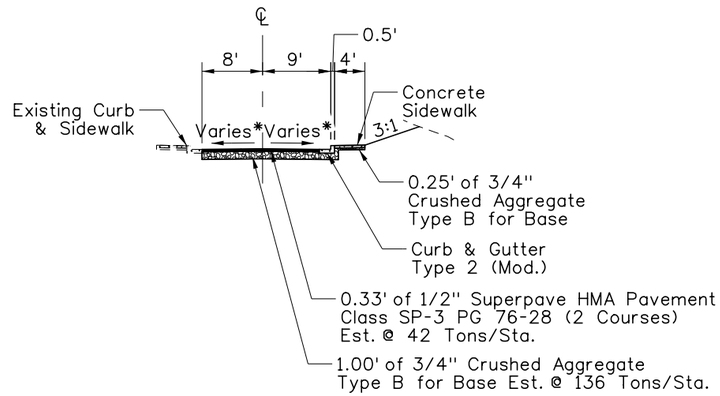
*Varies
**Varies (Match Existing at Sta. 51+00 Rt.)

Sta. 50+58.89 to Sta. 51+45.00



7TH AVENUE
TYPICAL SECTION
Scale:1"=20'

*See 7th Ave. Detail



REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED	JLJ
DESIGN CHECKED	DJC
DETAILED	KMR
DRAWING CHECKED	BTC

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

CADD FILE NAME 12009_typ_004.sht

DRAWING DATE: September, 2017

IDAHO TRANSPORTATION DEPARTMENT

Parametrix

PROJECT NO.

A012(009)

TYPICAL SECTIONS

US-12, 18TH ST TO CLEARWATER RV BR, LEWISTON

English

COUNTY Nez Perce

KEY NUMBER 12009

SHEET 7 OF 131

NOT APPROVED FINAL DESIGN FOR CONSTRUCTION

9/20/2017 3:48:18 PM

U:\Bols\Projects\Clients\4006-ITD\314-4006-046 US-12,18th Clearwater\99Svcs\CADD\DGN\Sheets\12009_typ_004.sht

APPENDIX C

DRAINAGE PATTERNS

Existing Drainage Basin Map

Proposed Drainage Basin Map

Existing Drainage Basin Map

Parametrix September 2017

US-12, 18th St to
Clearwater Bridge, Lewiston, ID

Legend:

- Existing Drainage Basin
- SS — Storm Drain
- Flow Arrow

Scale (Feet)
75 0 75 150

Existing Drainage Basin A
(1.58 AC Impervious
0.24 AC Pervious)

Existing Drainage Basin C
(0.72 AC Impervious)

Existing Drainage Basin H
(0.44 AC Impervious)

Existing Drainage Basin G
(0.11 AC Impervious)

Existing Drainage Basin B
(2.65 AC Impervious
0.67 AC Pervious)

Existing Drainage Basin F
(0.56 AC Impervious)

Proposed Drainage Basin Map

Parametrix September 2017

US-12, 18th St to
Clearwater Bridge, Lewiston, ID

Legend:

- Proposed Drainage Basin
- SS — Proposed Storm Drain
- Flow Arrow

N

Scale (Feet)

75 0 75 150

Proposed Drainage Basin A
(1.61 AC Impervious
0.09 AC Pervious)

Proposed Drainage Basin B
(0.76 AC Impervious)

Proposed Drainage Basin H
(0.30 AC Impervious)

Proposed Drainage Basin G
(0.11 AC Impervious)

Proposed Drainage Basins C & D
(3.83 AC Impervious)

Proposed Drainage Basin F
(0.32 AC Impervious)

APPENDIX D

SUPPORTING INFORMATION

Typical Runoff Coefficients

Design Storm Data

Table 3-1. Runoff Coefficients for Rational Formula.[14]	
Type of Drainage Area	Runoff Coefficient, C*
Business:	
Downtown areas	0.70 - 0.95
Neighborhood areas	0.50 - 0.70
Residential:	
Single-family areas	0.30 - 0.50
Multi-units, detached	0.40 - 0.60
Multi-units, attached	0.60 - 0.75
Suburban	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
Industrial:	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, cemeteries	0.10 - 0.25
Playgrounds	0.20 - 0.40
Railroad yard areas	0.20 - 0.40
Unimproved areas	0.10 - 0.30 0.20
Lawns:	
Sandy soil, flat, 2%	0.05 - 0.10
Sandy soil, average, 2 - 7%	0.10 - 0.15
Sandy soil, steep, 7%	0.15 - 0.20
Heavy soil, flat, 2%	0.13 - 0.17
Heavy soil, average, 2 - 7%	0.18 - 0.22
Heavy soil, steep, 7%	0.25 - 0.35
Streets:	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Drives and walks	0.75 - 0.85
Roofs	0.75 - 0.95
*Higher values are usually appropriate for steeply sloped areas and longer return periods because infiltration and other losses have a proportionally smaller effect on runoff in these cases.	

2.3.2 Design Storm

There are two storm types of interest for stormwater analyses in the Lewiston area. Short-duration thunderstorms can occur in late spring through early fall and are characterized by high intensity rainfall for short periods of time over localized areas. These types of storms can produce high rates of runoff and flash-flooding and are important where flooding, water quality, peak discharge and erosion are design considerations.

Long-duration general storms can occur at anytime of the year but are more common during the cool seasons. These storms are characterized by sequences of storm activity with intervening periods of little or no rainfall occurring over several days. Rainfall intensity is low to moderate with occasions of high intensity. Under naturally vegetated soil conditions in the City, almost all rainfall from these events is infiltrated; however, these types of events can create large volumes of runoff from impervious surfaces.

To facilitate designing facilities to manage runoff from these storms, Design Storms have been developed. Design Storms are developed with two components: a precipitation magnitude for a specified duration and a dimensionless storm pattern. The precipitation magnitude for the specified duration is determined based on a recurrence interval or frequency, in years, with published data typically available for 2, 5, 10, 25, 50, and 100 year returns. The selected precipitation magnitudes are used to scale the dimensionless storm pattern models producing model storm hydrographs. Generally, the model is used to predict the maximum intensity (in/hr) or the total rainfall (inches over some time period, usually inches/24 hr, that might be expected over a specified return period. The storm pattern models in most common use are those developed by the SCS (now NRCS), and are the ones used in this Stormwater Manual and presented in Appendix C.

Total rainfall over a given surface area and a given time period gives the total volume of rainfall. The maximum runoff volume then is developed from rainfall data for the predicted maximum storms (design storm) for a given return period. Table 1 shows the one- and 24-hour rainfall at Lewiston for various recurrence intervals. The 24-hour rainfall is to be used for total stormwater volume calculations for all sites.

Table 1. One-Hour and 24-Hour Precipitation for Various Recurrence Intervals at Lewiston, Idaho

Recurrence Interval (years)	24-hour rainfall (inches)	1-hour rainfall (inches)
2	1.2	0.4
5	1.6	0.55
10	2.0	0.66
25	2.2	0.8
50	2.6	0.9
100	2.8	1.1

Appendix C

Reference Graphs and Tables

Figure 1. Rainfall Intensity, Duration, and Frequency Relationship

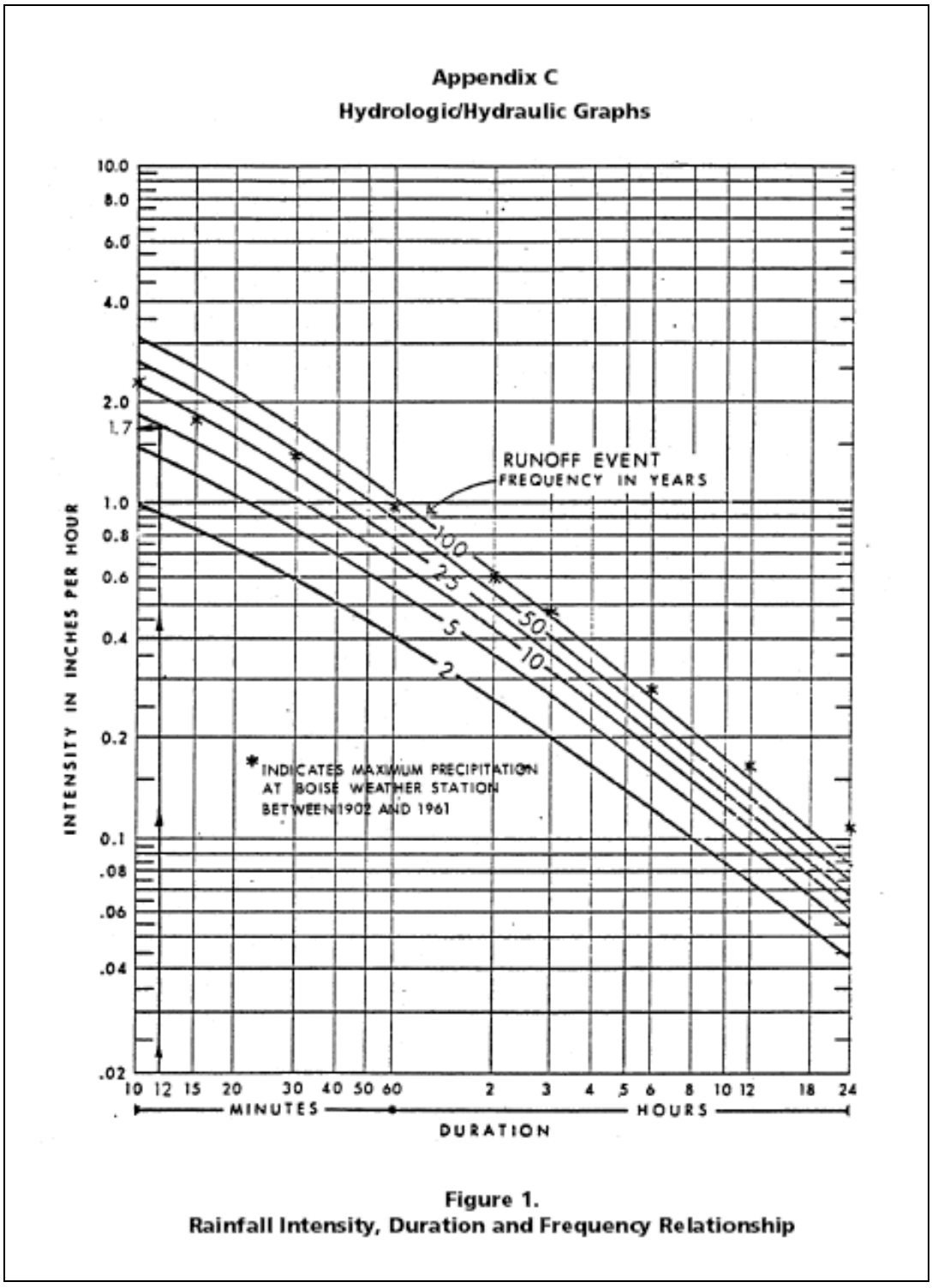


Figure 1.
Rainfall Intensity, Duration and Frequency Relationship

APPENDIX E

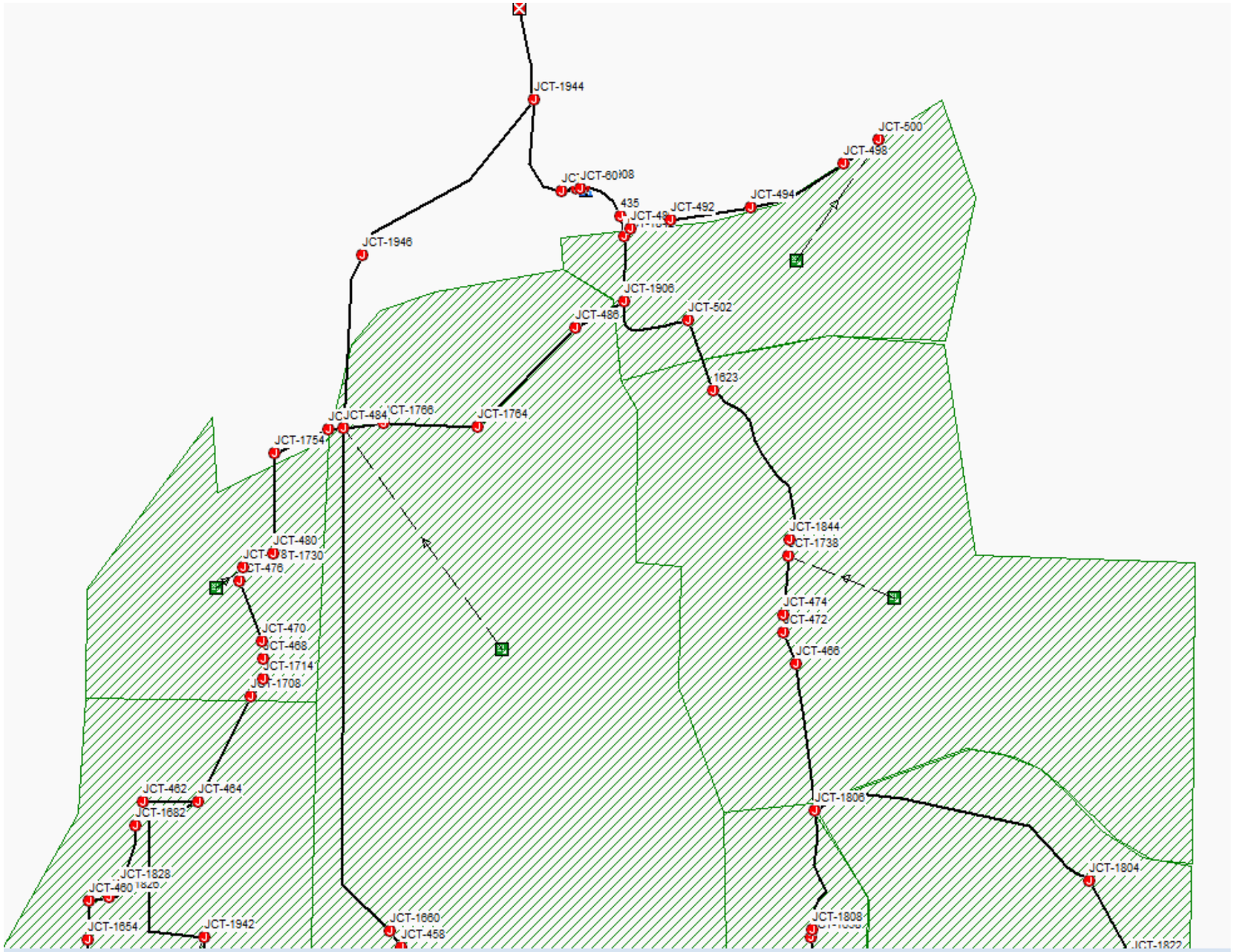
CITY TRUNKLINE MASTERPLAN MODEL

Unmodified Model Plan and Profile of Rock Lined Channel

Modified Model Plan and Profile of Trunkline

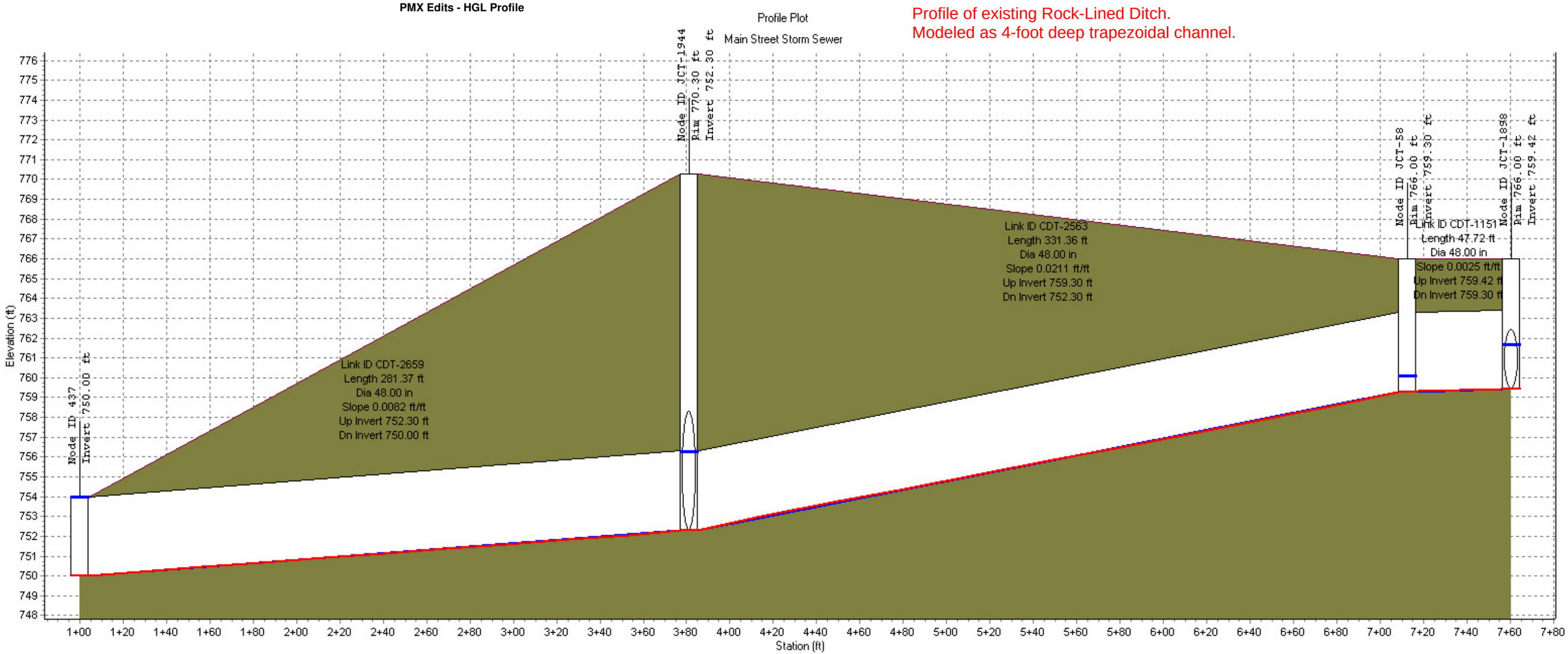
Lewiston's Masterplan Model

Basin 7_Scenario 3 - Unmodified Model



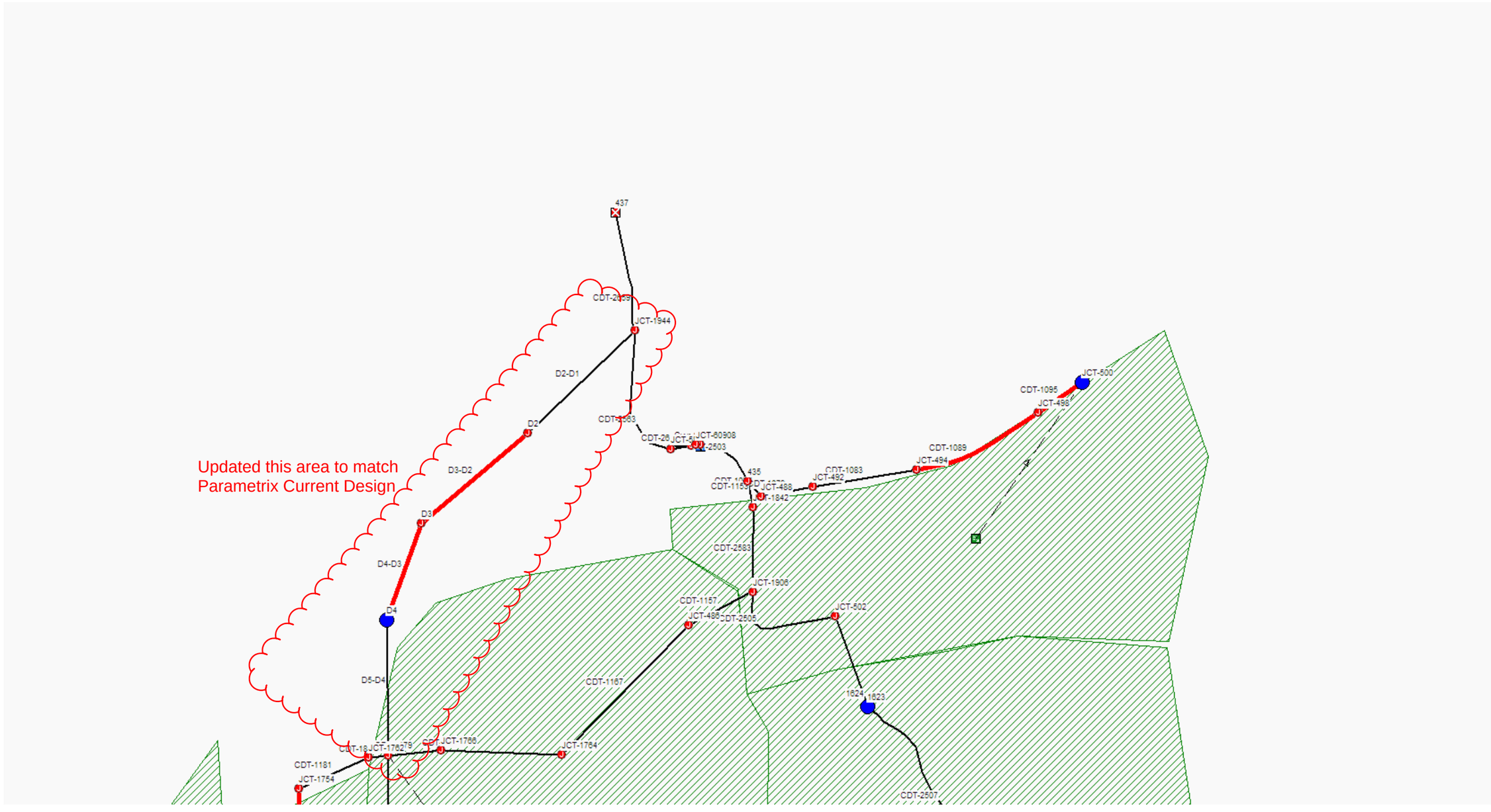
PMX Edits - HGL Profile

Profile of existing Rock-Lined Ditch.
Modeled as 4-foot deep trapezoidal channel.



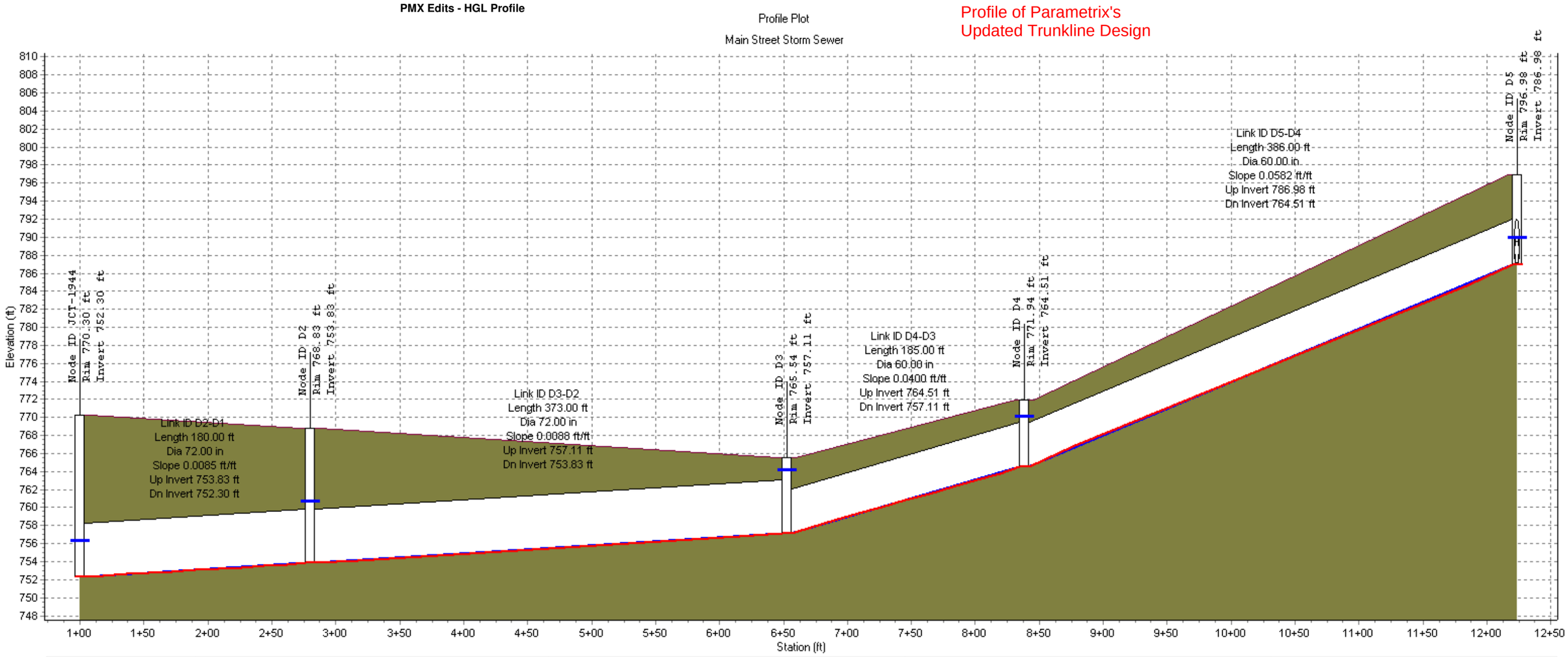
Node ID:	437	JCT-1944		JCT-58	JCT-1898
Rim (ft):		770.30		766.00	766.00
Invert (ft):	750.00	752.30		759.30	759.42
Min Pipe Cover (ft):		12.00		0.00	0.00
Max HGL (ft):	753.92	756.22		760.05	761.63

Link ID:	CDT-2659	CDT-2563	CDT-1151
Length (ft):	281.37	331.36	47.72
Dia (in):	48.00	48.00	48.00
Slope (ft/ft):	0.0082	0.0211	0.0025
Up Invert (ft):	752.30	759.30	759.42
Dn Invert (ft):	750.00	752.30	759.30
Max Q (cfs):	326.37	30.08	30.08
Max Vel (ft/s):	6.98	1.36	7.11
Max Depth (ft):	3.92	2.33	1.48


437
CDT-2499
JCT-1944
D2-D1
D2
CDT-2583
CDT-26
JCT-60908
-2503
D3-D2
Updated this area to match
Parametrix Current Design
D3
D4-D3
D4
D5-D4
CDT-18
JCT-1762
79
CDT
JCT-1766
JCT-1764
CDT-1181
JCT-1754
435
CDT-1159
JCT-488
-1842
CDT-1083
JCT-492
CDT-1089
JCT-494
JCT-500
CDT-1095
JCT-498
CDT-2583
JCT-1906
CDT-1157
JCT-498
CDT-2505
JCT-502
CDT-1167
1624
1623
CDT-2507

PMX Edits - HGL Profile

Profile of Parametrix's
Updated Trunkline Design



Node ID:	JCT-1944	D2	D3	D4	D5
Rim (ft):	770.30	768.83	765.54	771.94	796.98
Invert (ft):	752.30	753.83	757.11	764.51	786.98
Min Pipe Cover (ft):	12.00	9.00	2.43	2.43	4.97
Max HGL (ft):	756.22	761.16	765.04	771.66	789.91

Link ID:	D2-D1	D3-D2	D4-D3	D5-D4
Length (ft):	180.00	373.00	185.00	386.00
Dia (in):	72.00	72.00	60.00	60.00
Slope (ft/ft):	0.0085	0.0088	0.0400	0.0582
Up Invert (ft):	753.83	757.11	764.51	786.98
Dn Invert (ft):	752.30	753.83	757.11	764.51
Max Q (cfs):	298.32	297.77	297.30	329.67
Max Vel (ft/s):	11.96	10.53	18.02	25.77
Max Depth (ft):	4.96	6.00	5.00	3.71

APPENDIX F

DESIGN CALCULATIONS

HGL & Pipe Capacity

Inlet Spread

Storm Trunkline Outfall Protection Calculations

US-12, 18th St. to Clearwater Bridge, Lewiston
Parametrix
September 2017

HGL CALCULATIONS
Storm Sewer Main

Assumptions
1) Sub critical Flow
2) Pressure Flow Throughout (pipes full)

Based on Chapter 7 of the HEC-22 Publication

Equations

n = Manning's (0.024)
* = Sub critical Flow = $2 g n^2 / 2.21$
Hv = Velocity Head (ft) = $v^2 / 2 g$
R = Hydraulic Radius (ft) = A / Pw
Pw = Wetted Perimeter (ft) = 2 Pi r
Sf = Friction Slope (ft/ft) = (* Hv) / $R^{1.33}$
C = Runoff Coefficient

* Sub critical Flow
= $2 g n^2 / 2.21$
= $2 (32.2) (0.024)^2 / 2.21$
= 0.01678 (CMP)

* Sub critical Flow
= $2 g n^2 / 2.21$
= $2 (32.2) (0.013)^2 / 2.21$
= 0.004925 (PVC or Concrete)

Storm Line D - Trunk Line -> n=0.013

CONDUIT DATA													DESIGN FLOW	FLOW DATA								ENERGY LOSS							ENERGY AND HYDRAULIC DATA				COMMENTS				
Station		Size / Type	Size (ft)	Inverts		Length	Slope	Pipe					Q	A	R	*	Q	V	H_v	S_f	AVE S_f	Pipe	Junctions			Inlet Loss		Total Loss (ft)	Pipe		Transition		Press Flow (WS > 0.8D)	Q_{100} Normal Depth (ft)	Normal DS EGL	Controlling EGL	Other
From	To			DS IE	US IE			Smooth Type	Manning #	Capacity (cfs)	Full Vel (fps)	% Full	(cfs)	(ft^2)	(ft)		(cfs)	(fps)	(ft)	(ft/ft)	(ft/ft)	H_f (ft)	H_f (ft)	H_j (ft)	K_m	H_L (ft)	K_i		US EGL	US HGL	US EGL	US HGL					
					52.30														1.748													60.05	58.30		6.00	60.05	DS	Free Outlet
10+00	11+76	72"	6.00	52.30	53.57	176	0.7%	Yes	0.013	359.94	12.73	83%	300.00	28.27	1.50	0.00492	300.00	10.61	1.748	0.0050	0.0050	0.88							60.93	59.18		57.57	Yes				
11+76	11+85	MH D2	6.00	53.57	53.67	9	1.1%						300.00	28.27	1.50	0.00492	300.00	10.61	1.748	0.0050	0.0050		0.05	1.75	1.00	0.00		1.79			62.72	60.98	Yes	4.00	59.32	DS	
11+85	15+49	72"	6.00	53.67	56.29	364	0.7%	Yes	0.013	359.07	12.70	84%		28.27	1.50	0.00492	300.00	10.61	1.748	0.0050	0.0050	1.83							64.55	62.81		59.29	Yes				
15+49	15+58	MH D3	6.00	56.29	56.39	9	1.1%						300.00	28.27	1.50	0.00492	300.00	10.61	1.748	0.0050	0.0050		0.05	1.75	1.00	0.00		1.79			66.35	64.60	Yes	3.00	61.04	DS	
15+58	17+34	60"	5.00	56.39	63.46	176	4.0%	Yes	0.013	521.66	26.57	58%		19.63	1.25	0.00492	300.00	15.28	3.625	0.0133	0.0091	1.61							67.96	64.33		65.96	No				
17+34	17+43	MH D4	5.00	63.46	63.56	9	1.1%						300.00	19.63	1.25	0.00492	300.00	15.28	3.625	0.0133	0.0133		0.12	1.63	0.45	0.00		1.75			71.34	67.71	Yes	2.50	69.58	Normal	
17+43	21+21	60"	5.00	63.56	88.68	377	6.7%	Yes	0.013	671.98	34.22	45%		19.63	1.25	0.00492	300.00	15.28	3.625	0.0133	0.0133	5.01							76.34	72.72		91.18	No				
21+21	21+30	MH D5	5.00	88.68	88.78	9	1.1%						300.00	19.63	1.25	0.00492	300.00	15.28	3.625	0.0133	0.0133		0.12	4.78	1.32	0.00		4.90			99.71	96.08	Yes	2.50	94.80	Normal	

US-12, 18th St. to Clearwater Bridge, Lewiston
Parametrix
September 2017

HGL CALCULATIONS
Storm Sewer Main

Assumptions
1) Sub critical Flow
2) Pressure Flow Throughout (pipes full)

Based on Chapter 7 of the HEC-22 Publication

Equations

n = Manning's (0.024)
* = Sub critical Flow = $2 g n^2 / 2.21$
Hv = Velocity Head (ft) = $v^2 / 2 g$
R = Hydraulic Radius (ft) = A / Pw
Pw = Wetted Perimeter (ft) = 2 Pi r
Sf = Friction Slope (ft/ft) = (* Hv) / $R^{1.33}$
C = Runoff Coefficient

* Sub critical Flow
= $2 g n^2 / 2.21$
= $2 (32.2) (0.024)^2 / 2.21$
= 0.01678 (CMP)

* Sub critical Flow
= $2 g n^2 / 2.21$
= $2 (32.2) (0.013)^2 / 2.21$
= 0.004925 (PVC or Concrete)

Storm Line A - n=0.013

Size / Type	Size (ft)	Inverts		Length	Slope	Pipe					RATIONAL METHOD								DES FLOW	FLOW DATA								ENERGY LOSS					ENERGY AND HYDRAULIC DATA				COMMENTS				
		DS IE	US IE			Smooth Type	Mann #	Cap (cfs)	Full Vel (fps)	% Full	YR Storm Event	A New Imperv (ac)	A Total Area (ac)	C Weighted C	Tc (min)	Trav min	i (in/hr)	Q (cfs)	Q (cfs)	A (ft^2)	R (ft)	*	Q (cfs)	V (fps)	H_v (ft)	S_f (ft/ft)	AVE S_f (ft/ft)	Pipe H_f (ft)	Junctions H_f (ft)	Junctions H_j (ft)	Junctions K_m	Total Loss (ft)	Pipe US EGL	Pipe US HGL	Transition US EGL	Transition US HGL	Press Flow (WS > 0.8D)	Q_{100} Normal Depth (ft)	Normal DS EGL	Control EGL	Other
			38.22																					0.072								39.29								
MH A1	1.00	38.22	38.25	5	0.6%						25	0.000	0.821	0.95	11.47		2.17	1.69	1.69	0.79	0.25	0.004925	1.69	2.15	0.072	0.0022	0.0011		0.01	0.03	0.35	0.03			39.32	39.25	Yes	1.00	39.29	DS	Full Flow Condition
12"	1.00	38.25	40.40	165	1.3%	Yes	0.013	4.07	5.18	42%						0.53				0.79	0.25	0.004925	1.73	2.20	0.075	0.0023	0.0023	0.38					39.70	39.63		41.05	No				
SG A2	1.00	40.40	40.65	6	4.2%						25	0.000	0.821	0.95	10.94		2.22	1.73	1.73	0.79	0.25	0.004925	1.73	2.20	0.075	0.0023	0.0023		0.01	0.11	1.50	0.13			41.25	41.18	No	0.65	41.13	Normal	
12"	1.00	40.65	41.63	113	0.9%	Yes	0.013	3.32	4.22	53%						0.45				0.79	0.25	0.004925	1.76	2.24	0.078	0.0024	0.0024	0.27					41.52	41.44		42.13	No				
MH A3	1.00	41.63	41.73	4	2.5%						25	0.000	0.821	0.95	10.50		2.26	1.76	1.76	0.79	0.25	0.004925	1.76	2.24	0.078	0.0024	0.0024		0.01	0.08	1.00	0.09			42.30	42.22	No	0.50	42.21	Normal	
12"	1.00	41.73	42.59	51	1.7%	Yes	0.013	4.63	5.89	32%						0.14				0.79	0.25	0.004925	1.49	1.90	0.056	0.0017	0.0021	0.11					42.40	42.35		42.99	No				
CB A3.1	1.00	42.59	42.69	4	2.5%						25	0.147	0.693	0.95	10.35		2.27	1.49	1.49	0.79	0.25	0.004925	1.49	1.90	0.056	0.0017	0.0017		0.01	0.04	0.65	0.04			43.09	43.03	No	0.40	43.05	Normal	
12"	1.00	42.69	44.66	122	1.6%	Yes	0.013	4.53	5.76	26%						0.35				0.79	0.25	0.004925	1.19	1.52	0.036	0.0011	0.0014	0.17					43.26	43.23		45.06	No				
CB A3.3	1.00	44.66	44.70	4	1.0%						25	0.546	0.546	0.95	10.00		2.30	1.19	1.19	0.79	0.25	0.004925	1.19	1.52	0.036	0.0011	0.0011		0.00	0.05	1.50	0.06			45.15	45.12	No	0.40	45.10	Normal	
MH A3	1.00	41.63	41.73	4	2.5%															0.79	0.25	0.004925	0.00	0.00	0.000	0.0001	0.0000		0.00	0.00	1.00	0.00			42.30	42.22	No	0.30	41.93	Normal	Match A3
12"	1.00	41.73	42.00	28	1.0%	Yes	0.013	3.50	4.45	8%						0.10				0.79	0.25	0.004925	0.28	0.36	0.002	0.0001	0.0001	0.00					42.30	42.30		42.30	No				
CB A3.2	1.00	42.00	42.05	4	1.2%						25	0.128	0.128	0.95	10.00		2.30	0.28	0.28	0.79	0.25	0.004925	0.28	0.36	0.002	0.0001	0.0001		0.00	0.00	1.50	0.00			42.31	42.30	No	0.30	42.30	Normal	

Storm Line B - n=0.013

Size / Type	Size (ft)	Inverts		Length	Slope	Pipe					RATIONAL METHOD								DES FLOW	FLOW DATA								ENERGY LOSS					ENERGY AND HYDRAULIC DATA				COMMENTS				
		DS IE	US IE			Smooth Type	Mann #	Cap (cfs)	Full Vel (fps)	% Full	YR Storm Event	A New Imperv (ac)	A Total Area (ac)	C Weighted C	Tc (min)	Trav min	i (in/hr)	Q (cfs)	Q (cfs)	A (ft^2)	R (ft)	*	Q (cfs)	V (fps)	H_v (ft)	S_f (ft/ft)	AVE S_f (ft/ft)	Pipe H_f (ft)	Junctions H_f (ft)	Junctions H_j (ft)	Junctions K_m	Total Loss (ft)	Pipe US EGL	Pipe US HGL	Transition US EGL	Transition US HGL	Press Flow (WS > 0.8D)	Q_{100} Normal Depth (ft)	Normal DS EGL	Control EGL	Other
			51.29																					0.161								52.45								
SG B1	1.00	51.29	52.40	4	27.8%						25	0.000	1.196	0.95	10.81		2.23	2.53	2.53	0.79	0.25	0.004925	2.53	3.22	0.161	0.0050	0.0025		0.01	0.22	1.35	0.23			52.68	52.52	No	1.00	52.45	DS	Full Flow Condition
12"	1.00	52.40	52.60	49	0.4%	Yes	0.013	2.28	2.90	96%						0.28				0.79	0.25	0.004925	2.19	2.79	0.121	0.0038	0.0044	0.22					52.89	52.77		53.05	No				
CB B2	1.00	52.60	52.65	4	1.2%						25	0.728	1.025	0.95	10.53		2.25	2.19	2.19	0.79	0.25	0.004925	2.19	2.79	0.121	0.0038	0.0038		0.02	0.06	0.50	0.08			53.25	53.13	No	0.45	53.17	Normal	
12"	1.00	52.65	52.93	83	0.3%	Yes	0.013	2.07	2.63	31%						0.53				0.79	0.25	0.004925	0.65	0.83	0.011	0.0003	0.0021	0.17					53.42	53.41		53.38	No				
CB B3	1.00	52.93	52.98	4	1.2%						25	0.297	0.297	0.95	10.00		2.30	0.65	0.65	0.79	0.25	0.004925	0.65	0.83	0.011	0.0003	0.0003		0.00	0.02	1.50	0.02			53.43	53.42	No	0.45	53.39	DS	
SG B1	1.00	51.29	52.86	4	39.3%															0.79	0.25	0.004925	0.37	0.48	0.004	0.0001	0.0001		0.00	0.00	1.35	0.01			52.68	52.52	No	0.75	52.04	Normal	Match B1
12"	1.00	52.86	58.04	67	7.7%	Yes	0.013	9.91	12.61	4%						0.09			0.37	0.79	0.25	0.004925	0.37	0.48	0.004	0.0001	0.0001	0.01					52.69	52.68		58.34	No				
CB B1.1	1.00	58.04	58.09	4	1.3%						25	0.171	0.171	0.95	10.00		2.30	0.37	0.37	0.79	0.25	0.004925	0.37	0.48	0.004	0.0001	0.0001		0.00	0.01	1.50	0.01			58.35	58.35	No	0.30	58.34	Normal	

US-12, 18th St. to Clearwater Bridge, Lewiston
Parametrix
September 2017

HGL CALCULATIONS
Storm Sewer Main

Storm Line C - n=0.013

Size / Type	Size (ft)	Inverts		Length	Slope	Pipe					RATIONAL METHOD								DES FLOW	FLOW DATA								ENERGY LOSS					ENERGY AND HYDRAULIC DATA				COMMENTS				
		DS IE	US IE			Smooth Type	Mann #	Cap (cfs)	Full Vel (fps)	% Full	YR	A	A	C	Tc	Trav	i	Q	Q	A	R	*	Q	V	H_v	S_f	AVE S_f	Pipe	Junctions			Total Loss (ft)	Pipe		Transition		Press Flow (WS > 0.8D)	Q_{100} Normal Depth (ft)	Normal DS EGL	Control EGL	Other
											Storm Event	New Imperv (ac)	Total Area (ac)	Weighted C	(min)	min	(in/hr)	(cfs)	(cfs)	(ft^2)	(ft)		(cfs)	(fps)	(ft)	(ft/ft)	(ft/ft)	H_f (ft)	H_f (ft)	H_j (ft)	K_m		US EGL	US HGL	US EGL	US HGL					
			57.91																					0.100								59.01								
MH D2	1.50	57.91	57.93	6	0.3%						25	0.000	2.256	0.95	12.27		2.10	4.49	4.49	1.77	0.38	0.004925	4.49	2.54	0.100	0.0018	0.0009		0.01	0.10	1.00	0.11			61.08	60.98	Yes	1.00	59.01	DS	Match D2
18"	1.50	57.93	57.99	13	0.5%	Yes	0.013	7.14	4.04	63%						0.05				1.77	0.38	0.004925	4.50	2.55	0.101	0.0018	0.0018	0.02					61.11	61.00		58.89	Yes				
SG C2	1.50	57.99	58.24	6	4.2%						25	0.000	2.256	0.95	12.21		2.10	4.50	4.50	1.77	0.38	0.004925	4.50	2.55	0.101	0.0018	0.0018		0.01	0.14	1.35	0.15			61.25	61.15	Yes	0.90	58.99	DS	
18"	1.50	58.24	58.85	145	0.4%	Yes	0.013	6.81	3.86	68%						0.63				1.77	0.38	0.004925	4.62	2.62	0.106	0.0019	0.0019	0.27					61.53	61.42		59.55	Yes				
CB C3	1.50	58.85	58.85	4	0.0%						25	0.738	2.256	0.95	11.59		2.16	4.62	4.62	1.77	0.38	0.004925	4.62	2.62	0.106	0.0019	0.0019		0.01	0.11	1.00	0.11			61.64	61.53	Yes	0.70	59.66	DS	
18"	1.50	58.85	59.17	81	0.4%	Yes	0.013	6.60	3.74	48%						0.36				1.77	0.38	0.004925	3.16	1.79	0.050	0.0009	0.0014	0.11					61.75	61.70		59.82	Yes				
MH C4	1.50	59.17	59.17	4	0.0%						25	0.000	1.518	0.95	11.23		2.19	3.16	3.16	1.77	0.38	0.004925	3.16	1.79	0.050	0.0009	0.0009		0.00	0.05	1.00	0.05			61.81	61.76	Yes	0.65	59.87	DS	
18"	1.50	59.17	59.54	94	0.4%	Yes	0.013	6.59	3.73	40%						0.42				1.77	0.38	0.004925	2.65	1.50	0.035	0.0006	0.0008	0.07					61.88	61.84		60.04	Yes				
CB C5	1.50	59.54	59.54	4	0.0%						25	0.374	1.254	0.95	10.81		2.23	2.65	2.65	1.77	0.38	0.004925	2.65	1.50	0.035	0.0006	0.0006		0.00	0.02	0.45	0.02			61.90	61.86	Yes	0.50	60.08	DS	
18"	1.50	59.54	59.86	80	0.4%	Yes	0.013	6.64	3.76	28%						0.35				1.77	0.38	0.004925	1.89	1.07	0.018	0.0003	0.0005	0.04					61.94	61.92		60.21	Yes				
CB C6	1.50	59.86	59.96	4	2.5%						25	0.254	0.880	0.95	10.45		2.26	1.89	1.89	1.77	0.38	0.004925	1.89	1.07	0.018	0.0003	0.0003		0.00	0.01	0.30	0.01			61.94	61.92	Yes	0.35	60.23	DS	
18"	1.50	59.96	61.19	100	1.2%	Yes	0.013	11.65	6.59	12%						0.25				1.77	0.38	0.004925	1.36	0.77	0.009	0.0002	0.0002	0.02					61.97	61.96		61.44	No				
CB C7	1.50	61.19	61.29	4	2.5%						25	0.262	0.626	0.95	10.20		2.28	1.36	1.36	1.77	0.38	0.004925	1.36	0.77	0.009	0.0002	0.0002		0.00	0.00	0.30	0.00			61.97	61.96	No	0.25	61.45	DS	
18"	1.50	61.29	64.93	122	3.0%	Yes	0.013	18.14	10.27	4%						0.20				1.77	0.38	0.004925	0.80	0.45	0.003	0.0001	0.0001	0.01					61.98	61.98		65.18	No				
CB C8	1.50	64.93	64.93	4	0.0%						25	0.364	0.364	0.95	10.00		2.30	0.80	0.80	1.77	0.38	0.004925	0.80	0.45	0.003	0.0001	0.0003		0.00	0.00	1.50	0.01			65.19	65.19	No	0.25	65.18	Normal	

MH C4	1.50	59.17	59.20	4	0.8%															1.77	0.38	0.004925	0.58	0.33	0.002	0.0000	0.0000		0.00	0.00	1.00	0.00			61.81	61.76	Yes	0.20	59.37	Normal	Match C4
18"	1.50	59.20	60.53	37	3.6%	Yes	0.013	19.91	11.27	3%						0.05				1.77	0.38	0.004925	0.58	0.33	0.002	0.0000	0.0000	0.00					61.81	61.81		60.73	Yes				
CB C4.1	1.50	60.53	60.53	4	0.0%						25	0.264	0.264	0.95	10.00		2.30	0.58	0.58	1.77	0.38	0.004925	0.58	0.33	0.002	0.0000	0.0000		0.00	0.00	1.50	0.00			61.81	61.81	Yes	0.20	60.73	DS	

Storm Line D3 - n=0.013

Size / Type	Size (ft)	Inverts		Length	Slope	Pipe					RATIONAL METHOD								DES FLOW	FLOW DATA								ENERGY LOSS					ENERGY AND HYDRAULIC DATA				COMMENTS				
		DS IE	US IE			Smooth Type	Mann #	Cap (cfs)	Full Vel (fps)	% Full	YR	A	A	C	Tc	Trav	i	Q	Q	A	R	*	Q	V	H_v	S_f	AVE S_f	Pipe	Junctions			Total Loss (ft)	Pipe		Transition		Press Flow (WS > 0.8D)	Q_{100} Normal Depth (ft)	Normal DS EGL	Control EGL	Other
											Storm Event	New Imperv (ac)	Total Area (ac)	Weighted C	(min)	min	(in/hr)	(cfs)	(cfs)	(ft^2)	(ft)		(cfs)	(fps)	(ft)	(ft/ft)	(ft/ft)	H_f (ft)	H_f (ft)	H_j (ft)	K_m		US EGL	US HGL	US EGL	US HGL					
			56.29																					0.030								57.32								
MH D3	1.50	56.29	60.14	4	96.3%						25	0.000	1.1690	0.95	10.91		2.22	2.46	2.46	1.77	0.38	0.004925	2.46	1.39	0.030	0.0005	0.0005		0.00	0.03	1.00	0.03			64.63	64.60	Yes	1.00	57.32	DS	Match D3
18"	1.50	60.14	60.41	68	0.4%	Yes	0.013	6.62	3.75	19%						0.30				1.77	0.38	0.004925	1.28	0.73	0.008	0.0001	0.0001	0.01					64.64	64.63		60.96	Yes				
SG D3.4	1.50	60.41	60.67	4	6.5%						25	0.000	0.602	0.95	10.61		2.25	1.28	1.28	1.77	0.38	0.004925	1.28	0.73	0.008	0.0001	0.0001		0.00	0.01	1.35	0.01			64.65	64.64	Yes	0.55	60.97	DS	Overflows Rim
18"	1.50	60.67	60.70	7	0.4%	Yes	0.013	6.88	3.89	19%						0.03				1.77	0.38	0.004925	1.29	0.73	0.008	0.0001	0.0001	0.00					64.65	64.65		61.05	Yes				
CB D3.5	1.50	60.70	60.79	4	2.2%						25	0.045	0.602	0.95	10.58		2.25	1.29	1.29	1.77	0.38	0.004925	1.29	0.73	0.008	0.0001	0.0001		0.00	0.01	1.00	0.01			64.66	64.65	Yes	0.35	61.06	DS	
18"	1.50	60.79	62.41	81	2.0%	Yes	0.013	14.85	8.41	8%						0.16				1.77	0.38	0.004925	1.20	0.68	0.007	0.0001	0.0001	0.01					64.67	64.67		62.71	Yes				
CB D3.6	1.50	62.41	62.64	4	5.8%						25	0.140	0.557	0.95	10.42		2.26	1.20	1.20	1.77	0.38	0.004925	1.20	0.68	0.007	0.0001	0.0001		0.00	0.01	1.00	0.01			64.68	64.67	Yes	0.30	62.72	DS	
18"	1.50	62.64	70.20	199	3.8%	Yes	0.013	20.47	11.59	4%						0.29				1.77	0.38	0.004925	0.91	0.51	0.004	0.0001	0.0001	0.02					64.70	64.70		70.45	No				
CB D3.7	1.50	70.20	70.44	4	6.0%						25	0.070	0.417	0.95	10.13		2.29	0.91	0.91	1.77	0.38	0.004925	0.91	0.51	0.004	0.0001	0.0001		0.00	0.00	0.45	0.00			70.46	70.45	No	0.25	70.45	Normal	
18"	1.50	70.44	73.17	42	6.5%	Yes	0.013	26.78	15.15	3%						0.05				1.77	0.38	0.004925	0.76	0.43	0.003	0.0001	0.0001	0.00					70.46	70.46		73.42	No				
CB D3.8	1.50	73.17	73.41	4	6.0%						25	0.138	0.347	0.95	10.09		2.29	0.76	0.76	1.77	0.38	0.004925	0.76	0.43	0.003	0.0001	0.0001		0.00	0.00	0.30	0.00			73.42	73.42	No	0.25	73.42	Normal	
18"	1.50	73.41	76.65	45	7.2%	Yes	0.013	28.18	15.95	2%						0.05				1.77	0.38	0.004925	0.46	0.26	0.001	0.0000	0.0000	0.00					73.43	73.42		76.90	No				
CB D3.9	1.50	76.65	76.88	4	5.7%						25	0.085	0.209	0.95	10.04		2.30	0.46	0.46	1.77	0.38	0.004925	0.46	0.26	0.001	0.0000	0.0000		0.00	0.00	0.30	0.00			76.90	76.90	No	0.25	76.90	Normal	
18"	1.50	76.88	77.76	26	3.4%	Yes	0.013	19.32	10.94	1%						0.04				1.77	0.38	0.004925	0.27	0.15	0.000	0.0000	0.0000	0.00					76.90	76.90		77.96	No				
CB D3.10	1.50	77.76	77.80	4	1.0%						25	0.124	0.124	0.95	10.00		2.30	0.27	0.27	1.77	0.38	0.004925	0.27	0.15	0.000	0.0000	0.0000		0.00	0.00	1.50	0.00			77.96	77.96	No	0.20	77.96	Normal	

US-12, 18th St. to Clearwater Bridge, Lewiston
Parametrix
September 2017

HGL CALCULATIONS

Storm Sewer Main

MH D3	1.00	60.14	61.31	4	29.3%															0.79	0.25	0.004925	0.69	0.88	0.012	0.0004	0.0004		0.00	0.01	1.00	0.01			64.61	64.60	Yes	1.00	61.15	Normal	Match D3
12"	1.00	61.31	61.39	20	0.4%	Yes	0.013	2.25	2.87	31%						0.12			0.69	0.79	0.25	0.004925	0.69	0.88	0.012	0.0004	0.0004	0.01					64.62	64.61		61.59	Yes				
CB D3.1	1.00	61.39	61.39	4	0.0%						25	0.041	0.317	0.95	10.14		2.29	0.69	0.69	0.79	0.25	0.004925	0.69	0.88	0.012	0.0004	0.0004		0.00	0.01	0.45	0.01			64.63	64.61	Yes	0.20	61.60	DS	
12"	1.00	61.39	61.49	24	0.4%	Yes	0.013	2.30	2.93	12%						0.14				0.79	0.25	0.004925	0.28	0.36	0.002	0.0001	0.0002	0.01					64.63	64.63		61.64	Yes				
TY 8 D3.2	1.00	61.49	61.55	4	1.5%						25	0.130	0.130	0.95	10.00		2.30	0.28	0.28	0.79	0.25	0.004925	0.28	0.36	0.002	0.0001	0.0001		0.00	0.00	1.50	0.00			64.64	64.63	Yes	0.15	61.64	DS	Overflows Rim
CB D3.1	1.00	61.39	61.42	4	0.8%															0.79	0.25	0.004925	0.32	0.41	0.003	0.0001	0.0001		0.00	0.00	1.00	0.00			64.63	64.61	Yes	0.20	61.59	Normal	Match D3.1
12"	1.00	61.42	62.55	25	4.5%	Yes	0.013	7.57	9.64	4%						0.04			0.32	0.79	0.25	0.004925	0.32	0.41	0.003	0.0001	0.0001	0.00					64.63	64.63		62.75	Yes				
CB D3.3	1.00	62.55	62.60	4	1.3%						25	0.146	0.146	0.95	10.00		2.30	0.32	0.32	0.79	0.25	0.004925	0.32	0.41	0.003	0.0001	0.0001		0.00	0.00	0.45	0.00			64.63	64.63	Yes	0.20	62.75	DS	
MH D4	1.00	64.51	67.85	4	83.5%															0.79	0.25	0.004925	0.55	0.70	0.008	0.0002	0.0001		0.00	0.01	1.35	0.01			67.72	67.71	No	1.00	65.52	Normal	Match D4
12"	1.00	67.85	67.98	26	0.5%	Yes	0.013	2.52	3.21	22%						0.14				0.79	0.25	0.004925	0.55	0.70	0.008	0.0002	0.0002	0.01					67.73	67.72		68.33	No				
CB D4.1	1.00	67.98	67.98	4	0.0%						25	0.250	0.250	0.95	10.00		2.30	0.55	0.55	0.79	0.25	0.004925	0.55	0.70	0.008	0.0002	0.0002		0.00	0.01	1.50	0.01			68.35	68.34	No	0.35	68.34	Normal	

Storm Line F - n=0.013

SG F2	1.00	63.75	65.91	4	54.0%						25	0.000	0.225	0.95	10.43		2.26	0.48		0.79	0.25	0.004925	0.48	0.62	0.001	0.0000	0.0000		0.00	0.00	1.35	0.00			64.75	64.75	No	1.00	64.75	DS	Full Flow Condition
12"	1.00	65.91	66.20	73	0.4%	Yes	0.013	2.25	2.86	8%						0.43			0.48	0.79	0.25	0.004925	0.18	0.23	0.001	0.0000	0.0000	0.00					64.75	64.75		66.40	No				
CB F3	1.00	66.20	66.25	4	1.2%						25	0.082	0.082	0.95	10.00		2.30	0.18	0.18	0.79	0.25	0.004925	0.18	0.23	0.001	0.0000	0.0000		0.00	0.00	1.50	0.00			66.40	66.40	No	0.20	66.40	Normal	
SG F2	1.00	63.75	64.09	4	8.5%															0.79	0.25	0.004925	0.31	0.40	0.002	0.0001	0.0001		0.00	0.00	1.35	0.00			64.75	64.75	No	0.30	64.05	Normal	
12"	1.00	64.09	64.91	55	1.5%	Yes	0.013	4.35	5.54	7%						0.17			0.31	0.79	0.25	0.004925	0.31	0.40	0.002	0.0001	0.0001	0.00					64.76	64.75		65.16	No				
CB F2.1	1.00	64.91	64.96	4	1.2%						25	0.143	0.143	0.95	10.00		2.30	0.31	0.31	0.79	0.25	0.004925	0.31	0.40	0.002	0.0001	0.0001		0.00	0.00	1.50	0.00			65.17	65.16	No	0.25	65.16	Normal	

US-12, 18th St to Clearwater Bridge
Lewiston, ID
KN: 12009

Inlet	Gutter Discharge Design Frequency					Gutter Discharge Allowable Spread				Inlet Discharge							
No.	Drain. Area (ac)	Runoff C	Tc (min)	I 25yr (in/hr)	Q=CIA 25yr (ft^3/s)	Long Slope (ft/ft)	Cross Slope (ft/ft)	Prev. Bypass Flow (ft^3/s)	Total Gutter Flow (ft^3/s)	Inlet Type (City of Lewiston)	Grade or Sag	Spread (ft)	Depth (ft)	Intercept Flow (ft^3/s)	Bypass Flow (ft^3/s)	Bypass to Inlet No.	Remarks
D4.1	0.250	0.9	10	2.3	0.52	0.053	0.020	0.00	0.52	Curb Drop	GRADE	3.26	0.11	0.52	0.00	D3.3	
D3.10	0.124	0.9	10	2.3	0.26	0.700	0.020	0.30	0.56	Curb Drop	GRADE	1.33	0.07	0.55	0.01	D3.9	Assumed off-site flow
D3.9	0.085	0.9	10	2.3	0.18	0.074	0.020	0.01	0.18	Lewiston 1	SAG	2.58	0.1	0.18	0.00	n/a	
D3.8	0.138	0.9	10	2.3	0.29	0.068	0.020	0.00	0.29	Lewiston 1	GRADE	2.10	0.09	0.29	0.00	D3.7	
D3.7	0.070	0.9	10	2.3	0.14	0.058	0.020	0.00	0.14	Curb Drop	GRADE	2.39	0.09	0.14	0.00	G1	
D3.6	0.140	0.9	10	2.3	0.29	0.036	0.020	0.00	0.29	Curb Drop	GRADE	2.62	0.1	0.29	0.00	B3	
D3.5	0.045	0.9	10	2.3	0.09	0.035	0.020	0.00	0.09	Lewiston 1	GRADE	1.27	0.06	0.09	0.00	B2	
D3.3	0.146	0.9	10	2.3	0.30	0.017	0.010	0.00	0.30	Curb Drop	GRADE	4.81	0.11	0.30	0.00	D3.1	
D3.2	0.130	0.2	10	2.3	0.06	0.000	0.003	0.00	0.06	8	SAG	3.17	0.02	0.06	0.00	n/a	
D3.1	0.041	0.9	10	2.3	0.09	0.000	0.005	0.00	0.09	Lewiston 1	SAG	1.46	0.11	0.09	0.00	n/a	
F3	0.082	0.9	10	2.3	0.17	0.005	0.020	0.00	0.17	Lewiston 1	GRADE	2.31	0.09	0.16	0.01	C2	
F2.1	0.143	0.9	10	2.3	0.30	0.010	0.020	0.00	0.30	Lewiston 1	GRADE	3.83	0.13	0.27	0.03	C2	
C8	0.364	0.9	10	2.3	0.75	0.032	0.020	0.00	0.75	Lewiston 1	GRADE	4.50	0.14	0.55	0.20	C7	
C7	0.262	0.9	10	2.3	0.54	0.035	0.020	0.20	0.75	Lewiston 1	GRADE	4.42	0.13	0.56	0.19	C6	
C6	0.254	0.9	10	2.3	0.52	0.015	0.020	0.19	0.71	Curb Drop	GRADE	5.24	0.15	0.48	0.23	B2	
C5	0.374	0.9	10	2.3	0.77	0.000	0.018	0.00	0.77	Curb Drop	SAG	4.23	0.13	0.77	0.00	B4	
C4.1	0.264	0.9	10	2.3	0.55	0.003	0.016	0.00	0.55	Curb Drop	GRADE	7.33	0.17	0.55	0.00	C4.1	
C3	0.738	0.9	10	2.3	1.53	0.000	0.020	0.04	1.56	Curb Drop	SAG	7.47	0.19	1.56	0.00	n/a	
B1.1	0.171	0.9	10	2.3	0.35	0.018	0.020	0.00	0.35	Curb Drop	GRADE	3.56	0.12	0.35	0.00	B2	
B3	0.297	0.9	10	2.3	0.61	0.040	0.020	0.66	1.28	Lewiston 1	GRADE	5.48	0.15	0.88	0.40	A3.3	
B2	0.728	0.9	10	2.3	1.51	0.040	0.020	0.24	1.74	Lewiston 1	GRADE	6.26	0.17	1.08	0.66	B3	
A3.3	0.546	0.9	10	2.3	1.13	0.030	0.020	0.40	1.53	Lewiston 1	GRADE	6.30	0.17	0.97	0.56	A3.1	
A3.2	0.128	0.9	10	2.3	0.27	0.027	0.020	0.00	0.27	Lewiston 1	GRADE	2.74	0.1	0.26	0.01	Ex. A	
A3.1	0.147	0.9	10	2.3	0.30	0.018	0.020	0.56	0.86	Curb Drop	GRADE	5.48	0.15	0.75	0.11	Ex. A	
H1	0.540	0.9	10	2.3	1.12	0.044	0.020	0.00	1.12	Lewiston 1	GRADE	5.05	0.15	0.81	0.31	Ex. H	

Spread, Depth, and Intercept Flow Calculated with Bentley Flowmaster

12009_Combination Inlet In Sag Report

Label	Solve For	Discharge (ft^3/s)	Spread (ft)	Gutter Width (ft)	Gutter Cross Slope (ft/ft)
CDSAG-C3	Spread	1.56	7.48	1.50	0.05
CDSAG-C5	Spread	0.77	4.24	1.50	0.05
CDSAG-D3.1	Spread	0.09	1.45	1.50	0.05
SAG-D3.9	Spread	0.18	2.59	1.50	0.05
SAG-D2.1	Spread	0.14	2.12	1.50	0.05

Road Cross Slope (ft/ft)	Local Depression (in)	Local Depression Width (ft)	Grate Width (ft)	Grate Length (ft)	Grate Type	Clogging (%)
0.02	0.00	0.00	1.42	2.00	Curved Vaned	50.00
0.02	0.00	0.00	1.42	2.00	Curved Vaned	50.00
0.01	0.00	0.00	1.42	2.00	Curved Vaned	50.00
0.02	0.00	0.00	1.42	2.00	Curved Vaned	50.00
0.02	0.00	0.00	1.42	2.00	Curved Vaned	50.00

Curb Opening Length (ft)	Opening Height (ft)	Curb Throat Type	Throat Incline Angle (degrees)	Depth (ft)	Gutter Depression (ft)	Total Depression (ft)
5.00	0.27	Horizontal	90.00	0.19	0.05	0.05
5.00	0.27	Horizontal	90.00	0.13	0.05	0.05

12009_Combination Inlet In Sag Report

Curb Opening Length (ft)	Opening Height (ft)	Curb Throat Type	Throat Incline Angle (degrees)	Depth (ft)	Gutter Depression (ft)	Total Depression (ft)
2.00	0.27	Horizontal	90.00	0.07	0.06	0.06
2.00	0.27	Horizontal	90.00	0.10	0.05	0.05
2.00	0.27	Horizontal	90.00	0.09	0.05	0.05

Open Grate Area (ft^2)	Active Grate Weir Length (ft)	Calculation Option	Notes	Messages
0.50	3.42	Use Both		
0.50	3.42	Use Both		
0.50	3.42	Use Both		
0.50	3.42	Use Both		
0.50	3.42	Use Both		

12009_Combination Inlet On Grade Report

Label	Solve For	Discharge (ft^3/s)	Slope (ft/ft)	Grate Width (ft)	Gutter Cross Slope (ft/ft)
CD-D4.1	Efficiency	0.52	0.05300	1.42	0.05
D3.7	Efficiency	0.86	0.06800	1.42	0.05
CD-D3.1	Efficiency	0.32	0.05800	1.50	0.05
CD-D3.6	Efficiency	0.29	0.03600	1.42	0.05
CD-D3.5	Efficiency	0.09	0.03600	1.42	0.05
CD-F2.1	Efficiency	0.30	0.01000	1.42	0.05
CD-D3.3	Efficiency	0.30	0.01700	1.42	0.05
CD-C4.1	Efficiency	0.55	0.00300	1.42	0.05
B2	Efficiency	1.74	0.04000	1.42	0.05
B3	Efficiency	1.28	0.04000	1.42	0.05
A3.3	Efficiency	1.53	0.03000	1.42	0.05
CD-D3.8	Efficiency	0.29	0.06800	1.42	0.05
H1	Efficiency	1.12	0.04400	1.42	0.05
CD-B1.1	Efficiency	0.35	0.01800	1.42	0.05
A3.1	Efficiency	0.86	0.01800	1.42	0.05
A3.2	Efficiency	0.27	0.02700	1.42	0.05
CD-D3.10	Efficiency	0.56	0.07000	1.42	0.05
F3	Efficiency	0.17	0.01800	1.42	0.05
G1	Efficiency	0.75	0.03200	1.42	0.05

Parametrix

12009_Combination Inlet On Grade Report

Label	Solve For	Discharge (ft^3/s)	Slope (ft/ft)	Grate Width (ft)	Gutter Cross Slope (ft/ft)
C8	Efficiency	0.75	0.03200	1.42	0.05
C7	Efficiency	0.75	0.03500	1.42	0.05
C6	Efficiency	0.71	0.01500	1.42	0.05

Road Cross Slope (ft/ft)	Manning Coefficient	Local Depression (in)	Local Depression Width (ft)	Efficiency (%)	Gutter Width (ft)	Grate Length (ft)
0.02	0.015	0.00	0.00	99.59	1.50	2.00
0.02	0.015	0.00	0.00	79.65	1.50	2.00
0.02	0.015	0.00	0.00	100.00	1.50	2.00
0.02	0.015	0.00	0.00	100.00	1.50	2.00
0.02	0.015	0.00	0.00	100.00	1.50	2.00
0.02	0.015	0.00	0.00	89.65	1.50	2.00
0.01	0.015	0.00	0.00	99.86	1.50	2.00
0.02	0.015	0.00	0.00	100.00	1.50	2.00
0.02	0.015	0.00	0.00	62.11	1.50	2.00
0.02	0.015	0.00	0.00	68.64	1.50	2.00
0.02	0.015	0.00	0.00	62.56	1.50	2.00
0.02	0.015	0.00	0.00	100.00	1.50	2.00
0.02	0.015	0.00	0.00	72.36	1.50	2.00

12009_Combination Inlet On Grade Report

Road Cross Slope (ft/ft)	Manning Coefficient	Local Depression (in)	Local Depression Width (ft)	Efficiency (%)	Gutter Width (ft)	Grate Length (ft)
0.02	0.015	0.00	0.00	99.55	1.50	2.00
0.02	0.015	0.00	0.00	87.08	1.50	2.00
0.02	0.015	0.00	0.00	96.20	1.50	2.00
0.02	0.015	0.00	0.00	97.37	1.50	2.00
0.02	0.013	0.00	0.00	99.45	1.50	2.00
0.02	0.013	0.00	0.00	80.89	1.50	2.00
0.02	0.013	0.00	0.00	77.45	1.50	2.00
0.02	0.013	0.00	0.00	81.64	1.50	2.00
0.02	0.013	0.00	0.00	76.11	1.50	2.00

Grate Type	Clogging (%)	Curb Opening Length (ft)	Intercepted Flow (ft^3/s)	Bypass Flow (ft^3/s)	Spread (ft)	Depth (ft)
Curved Vaned	50.00	7.00	0.52	0.00	3.29	0.11
Curved Vaned	50.00	2.00	0.68	0.18	4.02	0.13
Curved Vaned	50.00	7.00	0.32	0.00	2.39	0.09
Curved Vaned	50.00	5.00	0.29	0.00	2.62	0.10
Curved Vaned	50.00	2.00	0.09	0.00	1.27	0.06
Curved Vaned	50.00	2.00	0.27	0.03	3.83	0.12
Curved Vaned	50.00	5.00	0.30	0.00	4.81	0.11

Parametrix

12009_Combination Inlet On Grade Report

Grate Type	Clogging (%)	Curb Opening Length (ft)	Intercepted Flow (ft^3/s)	Bypass Flow (ft^3/s)	Spread (ft)	Depth (ft)
Curved Vaned	50.00	7.00	0.55	0.00	7.33	0.17
P-50 mm (P-1-7/8")	50.00	2.00	1.08	0.66	6.26	0.17
Curved Vaned	50.00	2.00	0.88	0.40	5.48	0.15
Curved Vaned	50.00	2.00	0.96	0.57	6.30	0.17
Curved Vaned	50.00	5.00	0.29	0.00	2.10	0.09
Curved Vaned	50.00	2.00	0.81	0.31	5.05	0.15
Curved Vaned	50.00	5.00	0.35	0.00	3.56	0.12
Curved Vaned	50.00	5.00	0.75	0.11	5.48	0.15
Curved Vaned	50.00	2.00	0.26	0.01	2.74	0.10
Curved Vaned	50.00	5.00	0.55	0.01	3.18	0.11
Curved Vaned	50.00	2.00	0.17	0.00	2.08	0.09
Curved Vaned	50.00	2.00	0.61	0.14	4.21	0.13
P-50 mm (P-1-7/8")	0.00	2.00	0.58	0.17	4.21	0.13
Curved Vaned	50.00	2.00	0.61	0.14	4.12	0.13
Curved Vaned	50.00	2.00	0.54	0.17	4.91	0.14

Flow Area (ft^2)	Gutter Depression (ft)	Total Depression (ft)	Velocity (ft/s)	Splash Over Velocity (ft/s)	Frontal Flow Factor	Side Flow Factor
0.14	0.05	0.05	3.65	3.99	1.00	0.01

Parametrix

12009_Combination Inlet On Grade Report

Flow Area (ft^2)	Gutter Depression (ft)	Total Depression (ft)	Velocity (ft/s)	Splash Over Velocity (ft/s)	Frontal Flow Factor	Side Flow Factor
0.19	0.05	0.05	4.41	3.99	0.96	0.01
0.09	0.05	0.05	3.53	3.99	1.00	0.01
0.10	0.05	0.05	2.84	3.99	1.00	0.02
0.04	0.05	0.05	2.23	3.99	1.00	0.03
0.18	0.05	0.05	1.66	3.99	1.00	0.05
0.16	0.06	0.06	1.87	3.99	1.00	0.02
0.49	0.05	0.05	1.11	3.99	1.00	0.09
0.43	0.05	0.05	4.09	5.66	1.00	0.01
0.33	0.05	0.05	3.84	3.99	1.00	0.01
0.43	0.05	0.05	3.55	3.99	1.00	0.01
0.08	0.05	0.05	3.72	3.99	1.00	0.01
0.29	0.05	0.05	3.88	3.99	1.00	0.01
0.16	0.05	0.05	2.18	3.99	1.00	0.03
0.33	0.05	0.05	2.57	3.99	1.00	0.02
0.11	0.05	0.05	2.48	3.99	1.00	0.03
0.13	0.05	0.05	4.16	3.99	0.99	0.01
0.08	0.05	0.05	2.20	3.99	1.00	0.03
0.21	0.05	0.05	3.55	3.99	1.00	0.01
0.21	0.05	0.05	3.55	8.13	1.00	0.06
0.20	0.05	0.05	3.69	3.99	1.00	0.01

Parametrix

12009_Combination Inlet On Grade Report

Flow Area (ft^2)	Gutter Depression (ft)	Total Depression (ft)	Velocity (ft/s)	Splash Over Velocity (ft/s)	Frontal Flow Factor	Side Flow Factor
0.27	0.05	0.05	2.58	3.99	1.00	0.02

Grate Flow Ratio	Equivalent Cross Slope (ft/ft)	Active Grate Length (ft)	Length Factor	Total Interception Length (ft)	Grate Flow Option	Notes
0.86	0.04655	1.00	0.41	14.78	Exclude None	
0.78	0.04419	1.00	0.05	20.30	Exclude None	
0.97	0.04911	1.00	0.50	12.00	Exclude None	
0.93	0.04856	1.00	0.40	10.04	Exclude None	
1.00	0.05000	1.00	0.17	6.04	Exclude None	
0.80	0.04480	1.00	0.14	7.28	Exclude None	
0.80	0.04271	1.00	0.46	8.78	Exclude None	
0.52	0.03492	1.00	0.79	7.60	Exclude None	
0.57	0.03792	1.00	0.04	25.52	Exclude None	
0.64	0.03984	1.00	0.05	21.78	Exclude None	
0.57	0.03783	1.00	0.05	22.21	Exclude None	
0.97	0.04962	1.00	0.33	12.00	Exclude None	
0.68	0.04101	1.00	0.05	20.82	Exclude None	
0.83	0.04568	1.00	0.44	9.16	Exclude None	
0.64	0.03983	1.00	0.28	14.50	Exclude None	

Parametrix

12009_Combination Inlet On Grade Report

Grate Flow Ratio	Equivalent Cross Slope (ft/ft)	Active Grate Length (ft)	Length Factor	Total Interception Length (ft)	Grate Flow Option	Notes
0.92	0.04824	1.00	0.11	8.97	Exclude None	
0.87	0.04693	1.00	0.24	16.50	Exclude None	
0.97	0.04964	1.00	0.14	7.01	Exclude None	
0.76	0.04355	1.00	0.06	16.81	Exclude None	
0.76	0.04355	2.00	0.00	16.81	Exclude None	
0.77	0.04385	1.00	0.06	17.19	Exclude None	
0.69	0.04141	1.00	0.07	13.49	Exclude None	

Messages

12009_Combination Inlet On Grade Report

Messages

12009_Ditch Inlet In Sag Report

Label	Solve For	Discharge (ft^3/s)	Spread (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))
SAG-D3.2	Spread	0.06	3.17	5.00	5.00

Bottom Width (ft)	Grate Width (ft)	Grate Length (ft)	Local Depression (in)	Local Depression Width (ft)	Grate Type	Clogging (%)
3.00	3.00	3.00	0.00	0.00	Curved Vaned	50.00

Depth (ft)	Wetted Perimeter (ft)	Top Width (ft)	Open Grate Area (ft^2)	Active Grate Weir Length (ft)	Notes	Messages
0.02	3.17	3.17	1.58	9.00		

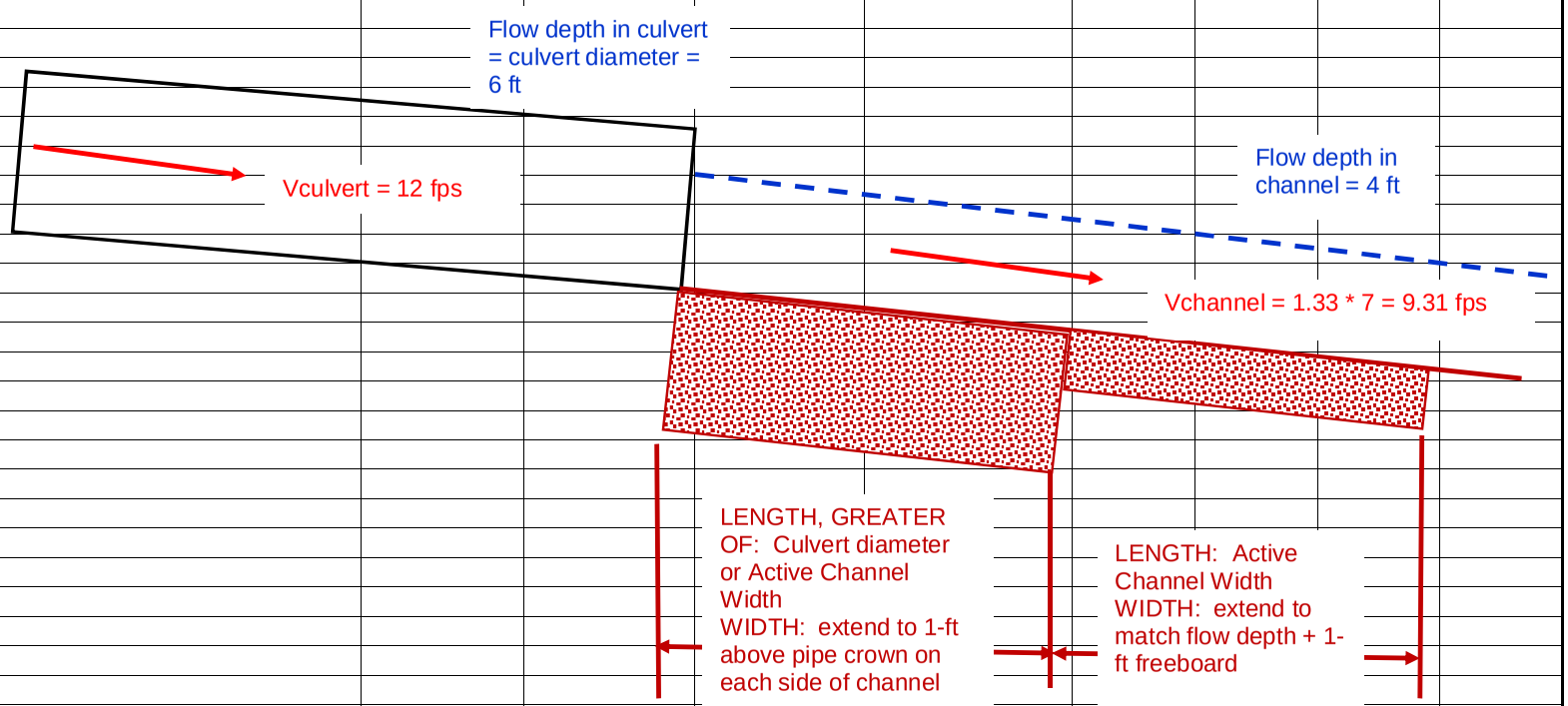
IDOT/CITY OF LEWISTON					
US 12, 18th St to Clearwater River Bridge					
Rock sizing calculation based on USACE EM1110-2-1601; see reference below.					
			Value		
Parameter		**Units**	**For discharge at culvert**	**For downstream of culvert**	**Equations**
Safety factor	Sf		1.1	1.1	
Stability coefficient for incipient failure	Cs		0.300	0.3	0.3 for angular rock, 0.375 for rounded rock, 1.7 <= D85/D15 <= 5.2
Coefficient for vertical velocity distribution	Cv		1.25	1.25	Can vary; see reference for variations. 1.25 used for highest value listed; for ends of dikes or downstream of concrete channels
D50		ft	0.500	0.5	Assumed
1.5*D50			0.750	0.750	
D100		ft	2.000	2.0	Assumed
1*D100		ft	2.000	2.000	
Coefficient for thickness	Ct		1.00	1.00	Greater of 1 (for 1D100) or 1.5D50. Assume the minimum required thickness will be installed with no reduction for a greater thickness.
Flow depth	d	ft	6.00	4.00	Assumed depth based on culvert diameter
A = Sf * Cs * Cv * Ct * d			**2.4750**	**1.6500**	Part of Eqn. 3-3.
Angle of repose for riprap	Phi	degress	40.00	40.0	
		radians	0.70	0.70	
Side slope	XH:1v		1.00	1.0	
K1			0.55	0.55	Selected from Plate B-39.
Unit weight of water	Gw	lb / cf	62.4	62.4	
Unit weight of stone	Gs	lb / cf	165	165.0	
Velocity	V	fps	12.00	9.31	Channel velocity includes 1.33 factor per ODOT Hydraulics Manual.
Gravitational constant	g	ft / sec^2	32.20	32.2	
B = [sqrt[Gw / (Gs - Gw)] * [V / sqrt(K*g*d)]] ^ 2.5			**0.7853**	**0.6912**	Part of Eqn. 3-3.
D30 = A * B		**ft**	**1.944**	**1.140**	
		in	**23.32**	**13.68**	
W100, max		lbs	5,529	984	
VOL100, max		cu ft	33.51	5.96	
D100, max		ft	4.00	2.25	
D100, max		in	48	27	
W100, min		lbs	2,212	394	
VOL100, min		cu ft	13.41	2.39	
D100, min		ft	2.95	1.66	
D100, min		in	35	20	
D90		ft	2.82	1.59	
D90		in	34	19	
W50, max		lbs	1,638	292	
VOL50, max		cu ft	9.93	1.77	
D50, max		ft	2.67	1.50	
D50, max		in	32	18	
W50, min		lbs	1,106	197	
VOL50, min		cu ft	6.70	1.19	
D50, min		ft	2.34	1.32	
D50, min		in	28	16	
W15, max		lbs	819	146	
VOL15, max		cu ft	4.96	0.88	
D15, max		ft	2.12	1.19	
D15, max		in	25	14	
W15, min		lbs	346	62	
VOL15, min		cu ft	2.10	0.38	
D15, min		ft	1.59	0.90	
D15, min		in	19	11	
For checking Cs:					
D90/D15max			1.33	1.33	
D90/D15min			1.78	1.78	
Layer thickness					
D100max		ft	4.00	2.25	
1.5*D50max		ft	4.00	2.25	
Reference:					
"Hydraulic Design of Flood Control Channels"					
USACE EM 1110-2-1601					
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1601.pdf					

IDOT/CITY OF LEWISTON					
US 12, 18th St to Clearwater River Bridge					
Rock sizing calculation based on ODOT Hydraulics Manual; see reference below.					
		Value			
Parameter	**Units**	**For discharge at culvert**	**For downstream of culvert**	**Equations**	
Velocity	fps	12.0	7.0		
Factor to account bends		1.0	1.3		
Total velocity	fps	12.0	9.3		
Side slope	XH:1v	1.00	1.0		
D50	ft	1.75	1.20	Figure 15-9	
Riprap class		2000	700		
D100	ft	2.85	2.01		
D100	in	34.20	24.12		
D50	ft	2.01	1.32		
D50	in	24.12	15.84		
Layer thickness	ft	4.0	3.0	Table 15-5	
Reference:					
ODOT Hydraulics Manual Chapter 15					
Bank Protection					
ftp://ftp.odot.state.or.us/techserv/Geo-Environmental/Hydraulics/Hydraulics%20Manual/Chapter_15/Chapter_15.pdf					

IDOT/CITY OF LEWISTON				
US 12, 18th St to Clearwater River Bridge				
Rock sizing calculation based on NEH 654 Technical Supplement 14C; see reference below.				
		Value		
Parameter	**Units**	**For discharge at culvert**	**For downstream of culvert**	**Equations**
Velocity	fps	12.0	7.0	
Factor to account bends		1.0	1.3	
Total velocity	fps	12.0	9.3	
Stone unit weight	lb/cu ft	165	165.0	
D50	in	21.00	12.50	Figure TS14C-5
D50	ft	1.75	1.04	
Volume	cf ft	2.81	0.59	
Weight	lbs	463.02	97.65	
Gradation based on USACE 1110-2-1601 Table 3-1 based on D50 calculated above:				
W100, max	lbs	1,797	463	
VOL100, max	cu ft	10.89	2.81	
D100, max	ft	2.75	1.75	
D100, max	in	33	21	
W100, min	lbs	719	185	
VOL100, min	cu ft	4.36	1.12	
D100, min	ft	2.03	1.29	
D100, min	in	24	15	
D90	ft	1.34	1.23	
D90	in	16	15	
W50, max	lbs	532	137	
VOL50, max	cu ft	3.22	0.83	
D50, max	ft	1.83	1.17	
D50, max	in	22	14	
W50, min	lbs	359	93	
VOL50, min	cu ft	2.18	0.56	
D50, min	ft	1.61	1.02	
D50, min	in	19	12	
W15, max	lbs	266	69	
VOL15, max	cu ft	1.61	0.42	
D15, max	ft	1.45	0.93	
D15, max	in	17	11	
W15, min	lbs	112	29	
VOL15, min	cu ft	0.68	0.18	
D15, min	ft	1.09	0.69	
D15, min	in	13	8	
Layer thickness				
D100max	ft	2.75	1.75	
1.5*D50max	ft	2.75	1.75	

IDOT/CITY OF LEWISTON
US 12, 18th St to Clearwater River Bridge

Summary of rock sizing and gradation calculations



ODOT									
Layer Thickness	ft		4		3				
D50	in		24		15.84				
D100	in		34		24.12				
NEH Part 654 Tech. Supp. 14C									
Layer Thickness	ft		2.75		1.75				
D15, minimum	in		13		8.34				
D50, minimum	in		19		12.30				
D100, minimum	in		24		15				
USACE EM 1110-2-1601									
Layer Thickness	ft		4.00		2.25				
D15, minimum	in		19		11				
D50, minimum	in		28		16				
D100, minimum	in		35		20				

Calculation Sheet for Sand/Grease Traps

A2

Steps for Sand/Grease Trap Velocity Calculation

1 **Project Name** **US-12, 18th St to Clearwater Bridge**

2 Enter number of Sand/Grease Traps (25 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	1.69	16	48	5.33	0.32	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

Calculation Sheet for Sand/Grease Traps

B1

Steps for Sand/Grease Trap Velocity Calculation

1 **Project Name** **US-12, 18th St to Clearwater Bridge**

2 Enter number of Sand/Grease Traps (25 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	2.53	16	48	5.33	0.47	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

Calculation Sheet for Sand/Grease Traps

C2

Steps for Sand/Grease Trap Velocity Calculation

1 **Project Name** **US-12, 18th St to Clearwater Bridge**

2 Enter number of Sand/Grease Traps (25 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	2	4.5	16	48	10.67	0.42	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

Calculation Sheet for Sand/Grease Traps

D3.4

Steps for Sand/Grease Trap Velocity Calculation

1 **Project Name** **US-12, 18th St to Clearwater Bridge**

2 Enter number of Sand/Grease Traps (25 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	1.28	16	48	5.33	0.24	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

Calculation Sheet for Sand/Grease Traps

F2

Steps for Sand/Grease Trap Velocity Calculation

1 **Project Name** **US-12, 18th St to Clearwater Bridge**

2 Enter number of Sand/Grease Traps (25 max) **1**

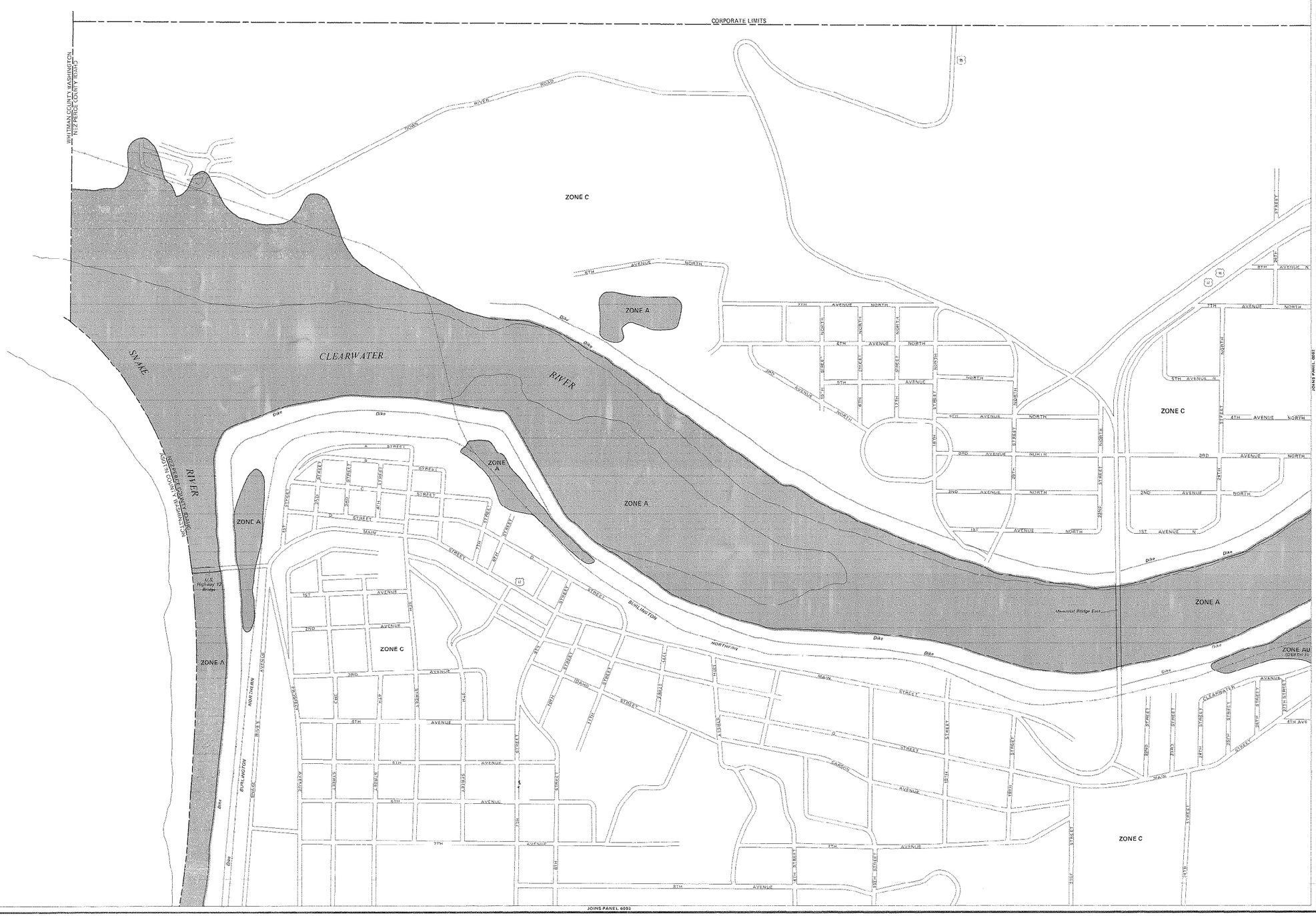
Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	0.48	16	48	5.33	0.09	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

APPENDIX G

FLOODPLAIN MAP



KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1 DATE
Zone Designations* With Date of Identification e.g., 12/2/74	ZONE A5 DATE
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation in Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7x
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
AUGUST 16, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:
MAY 28, 1976

FLOOD INSURANCE RATE MAP EFFECTIVE:
JANUARY 20, 1982

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
LEWISTON, IDAHO
NEZ PERCE COUNTY

PANEL 1 OF 7
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
160104 0001 B

EFFECTIVE DATE:
JANUARY 20, 1982

federal emergency management agency
federal insurance administration