City of Bend: Murphy Road – Segment 1 Preliminary Design Memorandum

PREPARED FOR: City of Bend

PREPARED BY: CH2M HILL

DATE: October 7, 2009

Introduction

This design memorandum documents the preliminary design work performed for Segment 1 of the Murphy Road Corridor. It provides the background information on roadway and drainage design, along with utility information. Cost estimates based on quantities generated from the concept level design are also included. Technical drawings showing the scope and limits of the project are attached to the report.

Due to significant reductions in transportation capital improvement project (CIP) revenues and the need to re-prioritize CIP expenditures, plans to advance some elements of the Murphy Road corridor to construction have been deferred for several years.

For ease of discussion and to define work efforts, we have divided the Murphy Road project corridor into three segments. CH2M HILL completed the *Murphy Corridor Refinement Plan* in 2008, which included developing alternatives for improvements to Murphy Road from Parrell Road to 15th Street. These limits constitute Segments 2 and 3 of the corridor. Separate design memorandums have been prepared for these segments.

Project Description

Segment 1 includes a new roadway alignment for Murphy Road from Brookswood Boulevard to Parrell Road and is commonly referred to as the Murphy Crossing segment of the project. The horizontal alignment of Murphy Road between Brookswood Boulevard and the Bend Parkway was conceptually defined in the Murphy Crossing Refinement Plan, which was adopted as a special zoning and design overlay by the City in 2006. Topographic mapping and boundary resolution suitable for preliminary and final design efforts was collected by CH2M HILL for this segment. Design refinements for Murphy Road from a point west of the Bend Parkway to Parrell Road (including the bridge over the Bend Parkway) are not addressed in this memorandum.

This segment is within the ODOT lead Interchange Area Management Plan (IAMP) study limits and discussions are underway between the City and ODOT on a work scope to advance and complete the IAMP, which will include refining the design of Murphy Road over the Bend Parkway and east to include the Parrell Road intersection.

Existing Conditions

The land use is residential and undeveloped commercial between Brookswood Boulevard and the Bend Parkway. The proposed alignment for Segment 1, beginning at Brookswood Boulevard, generally follows an existing dirt road along a 60' wide public right-of-way approximately 900 feet southeast before turning east and extending approximately 700 feet though a residential development. At a point 1600 feet from Brookswood Boulevard, the road alignment enters the undeveloped commercial land and the concept alignment limits of study in this memorandum terminate at 2000 feet from Brookswood Boulevard. This termination point coincides with the approximate location of a future intersection with an unnamed north-south City street that will be located and designed in conjunction with future development.

The roadway design standards for Segment 1 are defined in Table 1.

TABLE 1
Design Standards

Design Feature	Design Criteria	Source
Classification	Major Collector	City of Bend
Design Vehicle	WB-50 Accommodate WB-67 (tractor-trailer unit with 53 ft. length)	AASHTO, Chapter 2
Design Speed	30 mph	AASHTO, Chapter 6, p.430
Stopping Sight Distance	200' (grade dependent)	AASHTO, Chapter 3, p.110
Minimum KSAG	37	AASHTO, Chapter 3, p.175
Minimum KCREST	19	AASHTO, Chapter 3, p.271
Minimum L	125' (grade difference <1%, grade breaks are allowed)	City of Bend, Design Stds, Section IIA6, p.9
Maximum K	100' (where drainage is a factor)	City of Bend, Design Stds, Section IIA6, p.9
Minimum Horizontal Curvature	R = 299 ft. (normal crown, low speed urban) or 230 ft. @ 4% Max. Superelevation R = 180 ft. min. @ roundabout approach (normal crown 25 mph)	City of Bend, Design Stds, Section IIA7, p.10
Maximum Grade	8% (10% for hillsides exceeding 15% slope).	City of Bend, Design Stds, Section IIA1, p.2 and 3
Minimum Grade	0.5%	City of Bend, Design Stds, Section IIA2, p.6
Minimum Cross Slope	2.0%	City of Bend, Design Stds, Section IIA3 and 10, p.6 and 11

TABLE 1
Design Standards

Design Feature	Design Criteria	Source
Maximum Superelevation	6% (4.0% preferred)	City of Bend, Design Stds, Section IIA3, p.6
Lane Widths Travel Lanes Center Turn Lane Bike Lanes (2) Landscape Planter (2) Sidewalk (2)	 11’ N/A 6’ 8’ 5’	City of Bend, Design Stds, Section IIA1, p.2 thru 5
Right-of-way Width	60’ Minimum. May increase at intersections as stipulated by City Engineer	Project Specific, City of Bend, Design Stds, Section IIA1, p.2
Bike Lanes	Required on all major collectors	City of Bend, Design Stds, Section IIA1, p.2 thru 4
Side slopes	1:1.5 Max (Rock Cut – site specific) 1:2Max	City of Bend, Std Dwg 2-1, Typical Cross Section
Curbs	12-inch standard curb with 6” exposure	City of Bend, Std Dwg 2-3, Sidewalk and Conc. Curbs
Clear Zone	Varies	AASHTO Roadside Design Guide, Chapter 3
Access Management	Driveway Spacing: 22’ (Minimum, bottom of curb drop to bottom of curb drop)	City of Bend, Design Stds, Section IIA11, p.11

Note: All references to American Association of State Highway and Transportation Officials (AASHTO) are for *A Policy on Geometric Design of Highways and Streets, 2004,* unless otherwise noted.

The roundabout design standards for Segment 1 are defined in Table 2.

TABLE 2
Roundabout Design Standards

Design Feature	Design Criteria	Source
Classification	Single Lane Urban	FHWA, Exhibit 1-7
Design Year/Traffic	20 year	City of Bend, Design Stds, Section IIA18, p.21
Design Vehicle	WB-50, Emergency Vehicles shall not be required to use truck apron.	City of Bend, Design Stds, Section IIA18, p.21
Circulating Design Speed	20 mph	FHWA, Exhibit 6-4

TABLE 2
Roundabout Design Standards

Design Feature	Design Criteria	Source
Inscribed Circle Diameter	120' minimum	City of Bend, Design Stds, Section IIA18, p.22
Entry/Exit Width - Striped	15'/18' (Curb to Curb - 20'/20')	City of Bend, Design Stds, Section IIA18, p.22
Circulating Roadway Width	20'-22'	City of Bend, Design Stds, Section IIA18, p.22
Crosswalks	25' minimum from circulating roadway yield line	City of Bend, Design Stds, Section IIA18, p.22
Splitter Island	25' minimum beyond crosswalk	City of Bend, Design Stds, Section IIA18, p.22
Maximum Approach Grade	4.0%	City of Bend, Design Stds, Section IIA18, p.21
Cross Slope	2.0%	FHWA, Section 6.3.11.2, Exhibit 6-37, p.166
Bike Accomodations:		City of Bend, Design Stds, Section IIA18, p.22 and 23
Bike Lane Taper	15:1	
Bike Exit Ramp	100' upstream of circulating roadway yield line	
Multi-use Path	10'	
Illumination	Shall meet minimum AASHTO's Table 3 in "An Informational Guide for Roadway Lighting" requirements	City of Bend, Design Stds, Section IIA18, p.23
Signing	Shall conform to MUTCD and City of Bend Street Signing Specifications	City of Bend, Std Dwg 2-28, Roundabout Signing

Notes:

All references to FWHA are for *ROUNDABOUTS, AN INFORMATIONAL GUIDE,* 2000, unless otherwise noted.

Roadway Typical Sections

The preliminary plans are attached in Appendix A. The typical roadway width for Segment 1 is 34 feet to provide two 11 foot lanes with 6 foot bike lanes on each side. The roadway section is defined by a Murphy Crossing Refinement Plan overlay that was adopted in 2006.

Intersection Design

A roundabout has been selected as the intersection form for the Murphy Road/Brookswood Boulevard intersection, designed in accordance with the criteria provided in Table 2. There are four approach roads to this roundabout; two for Brookswood Boulevard, one for Murphy Road and one for Larkwood Drive.

The ideal design for a roundabout strives to maximize the distance between the legs or approaches to the roundabout, such that for a four leg roundabout, the adjacent legs would be located at 90 degrees to one another. Balancing the design goals with the need to minimize private property impacts, two options were developed during the conceptual design phase. Both options used the same center point and inscribed circle diameter for the roundabout. The center point established for this roundabout is near the existing centerline intersection of Larkwood Dr. and Brookswood Blvd. This location was selected because it was found that shifting the center in any one direction did not provide a significant advantage to reduce property impacts. The two concepts varied in the Murphy Road approach design. Option #1 utilized an approach that more closely fit within the existing right-of-way. Option #2, which shifts the Murphy Road approach east, was selected and is shown in the preliminary plans. Option #2 optimized the geometry by separating the legs to be as close as possible to 90 degrees while providing for the appropriate approaching and departing geometry for each leg. Sketches of Option #1 and #2 are included in Appendix A.

When the design for this intersection is re-started in the future, additional small refinements should be explored, including shifting the proposed center of the roundabout to the southwest approximately 10-20 feet along the centerline of Brookswood. This may allow the Larkswood Drive and Murphy Road approaches to shift to better fit within existing right-of-way. Improvements to pedestrian connectivity along Brookswood should also be explored. There is an existing sidewalk on the west side of Brookswood that terminates at Larkwood, with no sidewalks on either side of the street for approximately 700 feet. Sidewalks exist on both sides of the street beyond this gap. If possible, new sidewalks to close this gap should be included with the intersection improvements. Pedestrian connectivity (sidewalk gaps, pedestrian crossing locations) along Larkswood Drive and on Brookswood between the roundabout and PineBrook Boulevard should also be reviewed and improvements evaluated.

Traffic Analysis

Traffic analysis for the Murphy Road/Brookswood Boulevard intersection was performed and summarized in an August 6, 2006 memorandum prepared by DKS Associates entitled *Murphy Crossing Refinement Plan Supplement Transportation Operations Analysis*. This intersection was analyzed as a single lane roundabout and was reported to perform at Level of Service A using 2030 traffic projections.

Horizontal Alignment

The horizontal alignment for Murphy Road is based on the design adopted in the Murphy Crossing Refinement Plan overlay, with some exceptions. In order to achieve greater separation between the intersecting roadways at the roundabout and provide the geometry needed for speed reduction at the Murphy Road approach to the roundabout, some deviation from the refinement plan overlay is proposed. In the first 500 feet of the Murphy

Road approach to Brookswood Boulevard, a shift to the east of the Murphy Road alignment of up to approximately 90 feet from the alignment contained in the refinement plan overlay is proposed. The adopted code text for this overlay plan allows that the roadway alignment may be shifted up to 30 feet in one direction without need to amend the plan, but this shift would clearly require an amendment.

Speed consistency along Segment 1 has been a topic of discussion while reviewing the alignment that was adopted by the City from the Murphy Crossing Refinement Plan. A proposed curve located approximately 800 feet southeast of Brookswood was defined in the refinement plan with a design speed of 25 mph. This is the sharpest curve in Segment 1 and is sharper than desirable for a street with the function anticipated for Murphy Road. To achieve greater speed consistency, while minimizing impacts to the residential neighborhood, the radius was increased for this curve to comply with a 30 mph design speed. The change in alignment at this location would not require an amendment to the refinement plan overlay.

Designing the roadway to encourage safe and appropriate travel speeds has also been raised as a topic for further review. In particular, eastbound drivers leaving the intersection with the future roadway to the south will encounter a relatively straight alignment for approximately 1000 feet before entering the sharp curve discussed in the previous paragraph. A review of possible changes to the cross section should be considered, including a raised median and bike lane treatments to delineate the travel lane and encourage drivers to stay in their lane through the curve. The design standards currently limit this roadway right-of-way width to 60 feet, which would likely need to be modified, if a raised center median were introduced. City standards require that a 20 foot wide curb-to-curb clear path be maintained.

Vertical Alignment

The vertical alignment for Segment 1 slopes down from Brookswood Boulevard to the south and east towards the Bend Parkway at a gentle grade between approximately 0.5 % and 1.5%. For the roadway profile, see Appendix A.

Right-of-Way

There is a 60 foot wide public right-of-way extending from Brookswood Boulevard southeasterly and this proposed alignment would utilize a portion of this right-of-way. Existing right-of-way is shown on the preliminary plans. New right-of-way will be needed for the revised alignment approach to Brookswood and for approximately 700 – 800 feet of new alignment between Station 18+00 and 26+00, an east-west oriented segment that traverses along the north side of a manufactured home park and the south side of a single family home development. Based on a visual inspection of the mapping, up to five manufactured homes would need to be relocated. The single family homes located to the north appear to be set back from the proposed alignment and will not require relocation. With the exception of the manufactured homes, the majority of the proposed alignment traverses open space and rear or side yards with limited improvements and large setbacks to the homes. An assessment of impacts should be conducted on the site by a right-of-way appraiser to verify these assumptions. New or proposed right-of-way and easements are

not shown on the preliminary plans and will need to be established once the design is refined and the roadway footprint finalized.

Drainage

The roadway profiles slopes down hill away from Brookswood Boulevard. The proposed drainage design would convey the roadway drainage to a sag location at Station 38+00, which is east of the future intersection and outside the preliminary plan limits. The exact location for this water quality facility will be determined as the design moves forward, but placement north of the roadway is one possible location. The Segment 1 water quality facility is preliminarily sized to treat and dispose of runoff from 2.3-acres of roadway from the project. The system utilizes aninfiltration swale and discharges flows above the water quality flow into drywells for disposal. This type of water quality facility allows for a reduction of the required volume to be disposed of through the use of drywells. The drywell disposal calculation assuming a 20-foot depth identifies the requirement of 5 new drywells for disposal of all flows above the water quality flow. More details on the storm drainage design are contained in Appendix B.

Utilities

Table 3 shows the utilities, contacts and action needed for future phases of design development for Segment 1:

TABLE 3
Murphy Road Utilities

Utility	Owner	Contact	Action Needed
Water	Roats Water	Casey Roats 61147 Hamilton Lane Bend, OR 97702 541-382-3029	Facilities along Brookswood Boulevard. Coordinate facility needs along the new alignment of Murphy and conflict resolution with Brookswood intersection design.
Electric	Pacific Power	Mike Bower 328 NE Webster Ave Bend, OR 97701 541-388-7167	Define and coordinate facility relocations along Brookswood and undeveloped Murphy right-of-way.
Natural Gas	Cascade Natural Gas	Donna Dunlap 3334 NE Hawthorne Ave. Bend, OR 97701 541-382-6465	Facilities along Brookswood Boulevard. Define and coordinate conflict resolution.
Communications	Qwest	Bob Kitchen 100 NW Kearney St. Bend, OR 97701 541-385-0224	Qwest has underground facilities in Segment 1, but has not provided information. Obtain facility locations, define and resolve conflicts.
Communications	Bend Broadband	Jeff James 63090 Sherman Road Bend, OR 97701 541-388-5820-3-1 jkjames@bendbroadband.net	Majority of facilities on Pacific Power poles, with some underground. Define and resolve conflicts.

TABLE 3
Murphy Road Utilities

Utility	Owner	Contact	Action Needed
Irrigation	Arnold Irrigation	Shawn Gerdes 19604 Buck Canyon Rd. Bend, OR 97702 541-382-7664 sgerdes@bendcable.com	Irrigation canal that parallels Bend Parkway and is outside of current design efforts, but within new alignment of Murphy Road.

Cost

A preliminary cost estimate was developed for Segment 1, including construction, engineering, administrative and right-of-way costs. A construction contingency of 30 percent is included and the costs are based on 2009 unit cost empirical data with no escalation. Actual project cost will vary depending on year of construction, actual labor and material costs, competitive market conditions, final project scope, and other variable factors.

The estimated construction costs are summarized in the Table below. A detail cost breakdown is included in Appendix C.

TABLE 4

Estimated Construction Costs – Segment 1

Task	Cost
Construction (with contingency)	$2,503,000
Engineering, Administration, Other	$501,000
Right of Way	$1,280,000
Total	**$4,284,000**

APPENDIX A

Preliminary Drawings

MURPHY ROAD - SEGMENT 1

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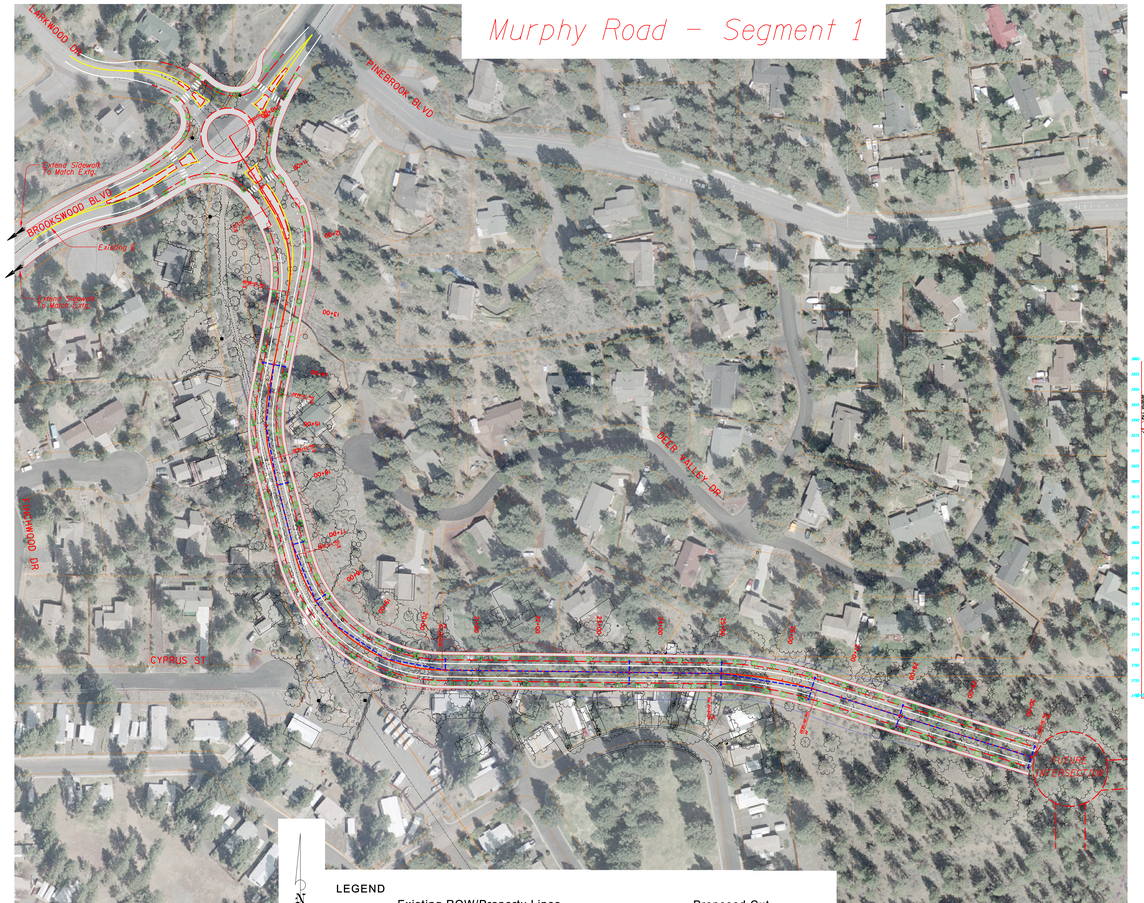
Murphy Road – Segment 1



LEGEND

- Existing ROW/Property Lines
- Existing Centerline
- Proposed Curb
- Proposed Manhole
- Proposed Inlet
- Proposed Cut
- Proposed Fill
- Proposed Sewer Pipe

PROJECT
MURPHY ROAD
SEGMENT 1 - PLAN

SCALE: 1" = 50' H, 1" = 10' V
DATE: 8/8/2009 10:54:25 AM
NOM: 348153 - Murphy_Seg. 1A Rail Plot.dv

0 50 100 150
Horizontal Scale In Feet
0 10 20 30
Vertical Scale In Feet

Segment 1 Vertical Alignment

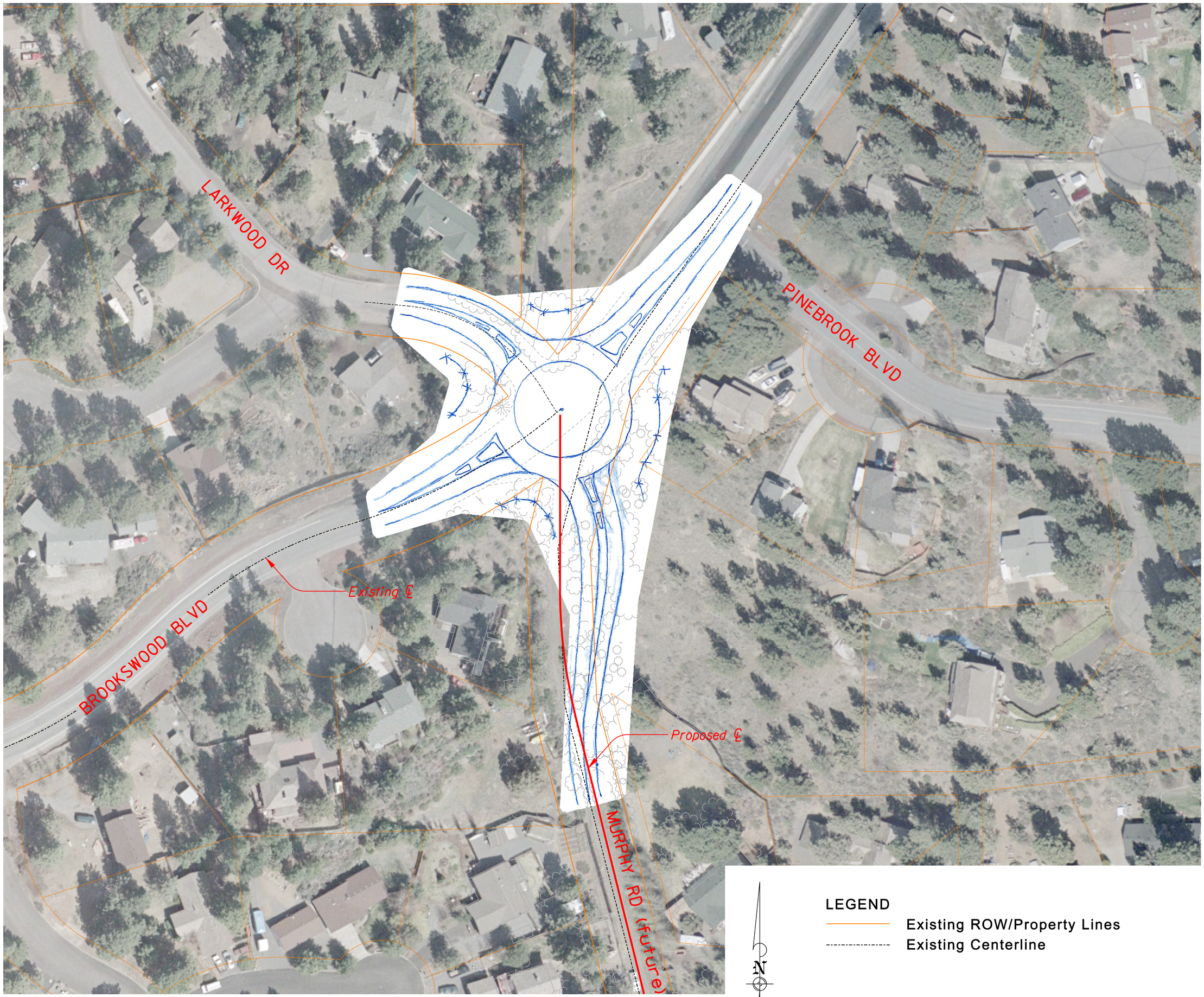
0 50 100 150
Horizontal Scale In Feet
0 5 10
Vertical Scale In Feet

CH2MHILL

CH2MHILL

MURPHY ROAD - BROOKSWOOD BLVD & MURPHY RD

DATE: 11/26/2008 10:54:19 AM SCALE: 1" = 50' H



LEGEND

Existing ROW/Property Lines

Existing Centerline

N

0 50 100 150

Horizontal Scale In Feet

Notes -
Option: #1
Size: 130' ICD
Location: Centered In Intersection

PROJECT

MURPHY ROAD -
BROOKSWOOD BLVD & MURPHY RD INTERSECTION

SCALE: 1" = 50' H
DATE: 11/26/2008 10:54:19 AM
NDM: 348153 : Murphy_Brookswood_RB1.dlv
$$$$username$$$$

CH2MHILL

MURPHY ROAD -

BROOKSWOOD BLVD & MURPHY RD

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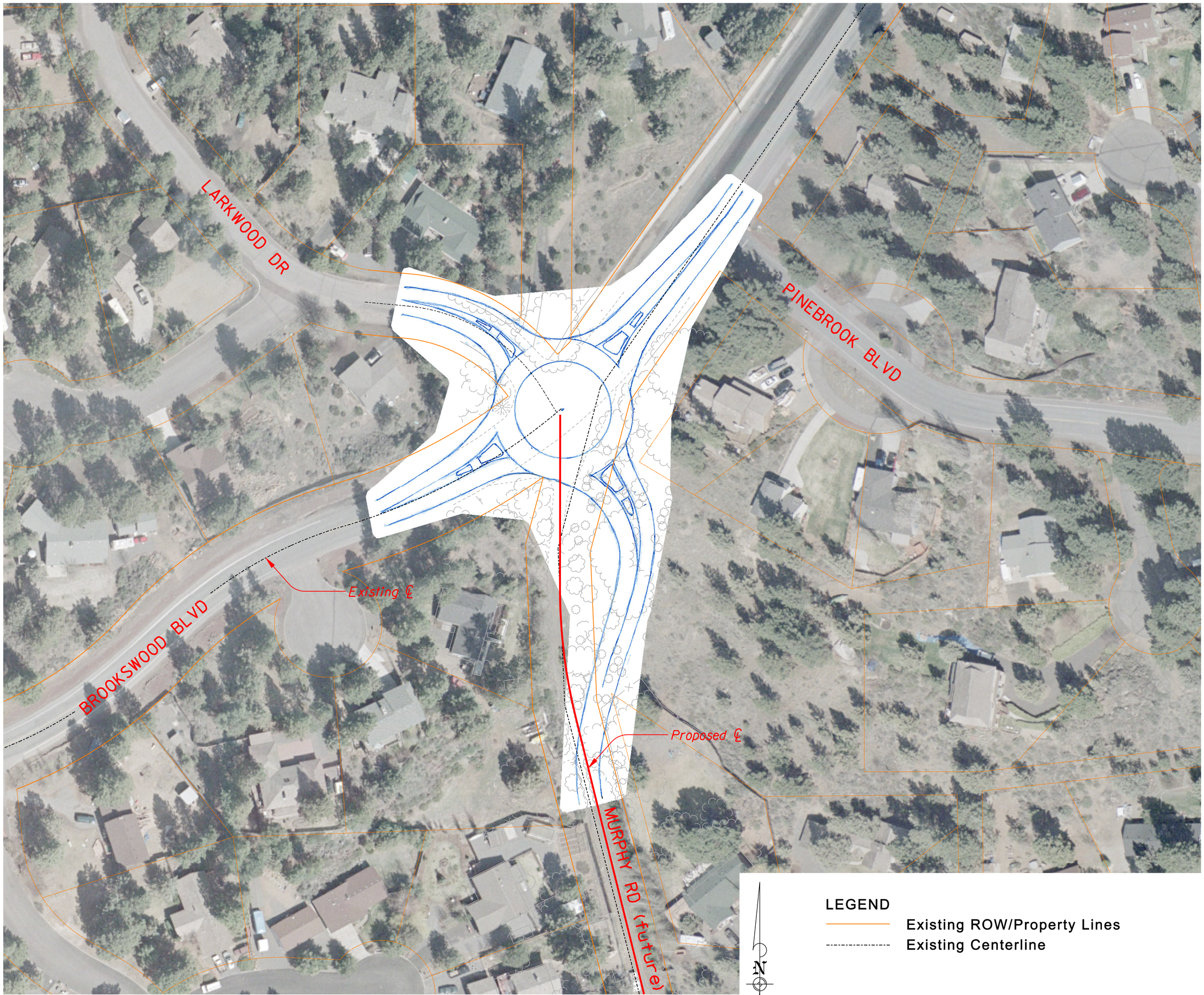

LEGEND

Existing ROW/Property Lines

Existing Centerline

Notes -
Option: #2
Size: 130' ICD
Location: Centered In Intersection

PROJECT

MURPHY ROAD -
BROOKSWOOD BLVD & MURPHY RD INTERSECTION

SCALE: 1" = 50' H
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APPENDIX B

Drainage Technical Memorandum

Murphy Road Preliminary Drainage Design Memorandum

PREPARED FOR: City of Bend

PREPARED BY: Jeff Stallard,
Rick Attanasio, P.E.

DATE: April 28, 2009

PROJECT NUMBER: 348153.A2.07

Introduction

Upon completion of the Murphy Road Refinement Plan, the City of Bend (COB) requested CH2M HILL to advance with the preliminary design of Murphy Road from Brookswood Boulevard to 15th Street. The preliminary design for the stormwater system was to evaluate water quality and water quantity control options, and develop conceptual level plans based on these results. This memorandum summarizes the analysis performed.

To simplify discussion, the Murphy Road corridor was broken into three separate segments:

- Segment 1: Includes Murphy Road from Brookswood Boulevard to Parrell Road.
- Segment 2: Includes Murphy Road from Parrell Road to Brosterhous Road
- Segment 3: Includes Murphy Road from Brosterhous Road to 15th Street

Design Criteria

To establish the design criteria, the City of Bend Design Standards, the Central Oregon Stormwater manual and the Oregon Department of Transportation Hydraulic Manual were referenced. See Table 1 for a summary of the design standards utilized.

TABLE 1
Design Standards

Design Feature	Design Criteria	Reference
Road Classification	Major Collector	City of Bend
Spread Design	ODOT Standards per City Requirement 8' max (2' into traveled way) with 6' Target. This 6' target was based upon a 6' bike lane and the desire to keep the spread out of the traveled way.	ODOT Hydraulics Manual Appendix D
Drainage Inlets	25-yr design storm and 50-yr for design storm sag inlets	COSM Chapter 8
Storm Pipe Type	Concrete pipe 2' minimum cover from top of pipe to bottom of pavement. Bottom of pavement refers to the asphalt or concrete	COSM Chapter 8

	above the base.	
Conveyance	25 year flow	COSM Chapter 8
Culvert	50-yr design storm HW/D = 2 max	COSM Chapter 8
Water Quality	6-month 24-hr Type I storm which is calculated as 67% of the 2-yr 24-hr Type I Storm.	COSM Chapter 6
Water Quantity	$Q25_{pre} = Q25_{post}$ peak analysis	COSM Chapter 7
Inlet Type	Type CG-3 Inlet	ODOT
Drywells	Design Capacity (CF)= Vb+9.5*Vr+Vs=k*0.1A Vb= Barrell Volume, Vr=Rock Volume, k=1 A= Impervious Area 0.1' is rainfall depth required for sizing drywells	City of Bend Design Standard 2.A.13.B

Water Quality and Drywell Disposal Evaluation

The water quality evaluation approach was based on an October 9, 2008 meeting with City staff; Hardy Hanson, Ollie Fick and David Buchanan. The City expressed a strong preference for vegetative treatment as opposed to mechanical treatment (i.e. Storm Filters). Each segment was first evaluated for treatment options based on the available space within the City right-of-way to incorporate natural treatment. If natural treatment wouldn't fit within the proposed right-of-way, a mechanical form of treatment was sized. Water quality flows were generated utilizing the Santa Barbra Urban Hydrograph (SBUH) methodology with a 6-month 24-hr storm event. Drywell disposal capacity calculations follow the methodology in the COB Design Standard. See Appendix A for the water quality and drywell disposal calculations.

Segment 1

Station 38+00 Natural Water Quality Facility

The road profile for Segment 1 identified an approximate sag location at Station 38+00. The exact location for this water quality facility will be determined as the

Segment 1 design moves forward. The Segment 1 water quality facility is preliminarily sized to treat and dispose of runoff from 2.3-acres of roadway from the project. The system utilizes an infiltration swale and discharges flows above the water quality flow into drywells for disposal. The total water quality volume, based on SBUH methodology is 6,207 CF with a peak runoff of 0.39 CFS. This type of water quality facility allows for a reduction of the required volume to be disposed of through the use of drywells. The drywell disposal calculation were completed assuming a 20-foot drywell depth and identifies the requirement of 6 new drywells for disposal of all flows above the water quality flow.

Segment 2

Station 317+10 Mechanical Water Quality Facility at Mel Ct

The facility being proposed at Mel Ct. uses mechanical treatment (Storm Filters) to provide water quality treatment. A Storm Filter vault with multiple filter cartridges will discharge into new drywells. The mechanical facility is proposed at this location because there is no readily available land for construction of a vegetative natural treatment facility. This facility is preliminarily sized to treat and dispose of runoff from 1.4-acres of the roadway project, which generates a peak water quality flow of 0.24 CFS and a total water quality volume of 3,778 CF. This system is comprised of a 6-foot x 12-foot concrete vault housing 9 filter cartridges for treatment. Since space for open detention is not available at this location, the entire water quality volume is proposed to be disposed of utilizing 15 new drywells.

Station 340+62 Vegetative Water Quality Facility with Drywells

The location for the vegetative water quality facility (WQF) is the south side of Murphy Road at station 340+62. This is across from the Jewel School property. This facility is preliminarily sized to treat and dispose of runoff from 4-ac of roadway from the project. The system is comprised of an infiltration swale that discharges flows exceeding the water quality flow. The total water quality flow based on SBUH methodology is 10,794 Cubic Feet (CF) with a peak runoff of 0.75 Cubic Feet per Second (CFS). The vegetative WQF allows for a reduction of the required volume to be disposed of through the use of drywells. The drywell disposal calculation were completed assuming a 20-foot drywell depth and identifies the requirement of 4 new drywells for disposal of all flows above the water quality flow. The discharge depth of the storm system in relation to the adjacent land will result in a deep facility that will require extensive excavation for construction.

Segment 3

Station 376+99 Vegetative Water Quality Facility

The road profile for Segment 3 identifies one sag location at Station 376+99. The water quality facility location has been proposed for the north side of Murphy Road at this location. The Segment 3 water quality facility is preliminarily sized to treat and dispose of runoff from 1.4-acres of roadway from the project. The system utilizes an infiltration swale and then discharges flows exceeding the water quality flow into drywells for disposal. The total water quality volume, based on SBUH methodology, is 3,778 CF with a peak runoff of 0.26 CFS. The vegetative WQF allows for a reduction of the required volume to be disposed of through the use of drywells. The drywell disposal calculation was completed assuming a 20-foot dry well depth and identifies the requirement of 3 new drywells for disposal of all flows above the water quality flow.

Conveyance and Inlet Locations

The inlet spacing has been calculated, for an allowable spread of 6-feet, utilizing the 25-yr return event for all at grade inlets, and the 50-yr return event for all sag inlets. The allowable spread for safety considerations was limited to the 6-foot bike lane. This will allow the spread to remain within the proposed bike lane and out of any vehicular travel lanes. The conveyance system was design utilizing the Rational method, maintaining the hydraulic grade line within the pipe for a 25-yr return event. See Appendix B for all inlet spacing calculations completed, and Appendix C for all conveyance calculations.

Special design considerations

The bridge over the railroad in Segment 3 is superelevated with 2% shed section to the north. The road then transitions to a 2% superelevation to the south. Due to this transition from north to south an increased number of inlets were required to minimize the runoff crossing over Murphy Road from north to south. The amount of water transitioning across Murphy Road needs to be minimized as it would have the potential to create a safety hazard due to icing in the winter months.

Future Work Items

As this design effort described above preliminary, below are work items identified for the future design efforts on the Murphy Road Corridor.

1. The four corridor roundabouts located at Country Club Drive, Brookswood Boulevard, Brosterhous Road, and 15th Street at this time have not been graded in detail. Therefore, drainage design was not completed. For the cost estimate, it was assumed that each roundabout would require 12 inlets, 4 Manholes, and 200 lineal feet of 12-inch storm pipe.

2. The bridge over Bend Parkway was not completed as part of this study. Due to the winter weather conditions in Bend, the bridge drainage features should be analyzed closely to minimize the potential icy conditions typically associated with bridges.

APPENDIX A

Water Quality and Drywell Disposal Calculations

CH2MHILL

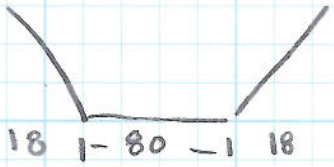
SUBJECT Murphy Road Seg 1 WQF @ STA 38+00 Drywell Disposal

BY JSS

SHEET NO. 1 of 4 DATE 4-27-09

PROJECT NO. 348153

Foot Print of WQF



Size = 80' wide x 100' Long

So 9" WQ Storage ≈ 8000 CF

Drywell Calculation

2.3 Acres Runoff Area = A = 100,188 ft²

20' Deep Drywells so h = 18

From Manual

$$\#wells\left[V_b + 9.5V_R + V_S\right] = 0.1A - WQ\ Storage$$

$V_b = \pi r^2 h = 3.14(2)^2(18) = 226$ CF

$V_R = 20$ CY From Manual type B standard

$V_S = 0$

This Gives us

$$\#\ wells\left[226 + 9.5(20) + (0)\right] = 0.1(100188) - 8000$$

$$\#wells = \frac{2018}{416} = 4.85 \rightarrow 5\ \text{Drywells For Disposal}$$

WQF will Be A 6' x 12' Storm Filter VAULT with 9 Filter CARTRIDGES So WQ STORAGE = 0

So Dry well Disposal

1.4 Acres of Runoff AREA = A = 60,984 ft^2

20' Deep wells So h = 18

From Bend MANUAL

$$\#\text{ wells}\left[V_b + 9.5\,V_R + V_S\right] = 0.1\,A - \text{WQ STORAGE}$$

$V_b = \pi R^2 h = 3.14(2)^2(18) = 226$ CF

V_R = 20 Cy From MANUAL type B STANDARD

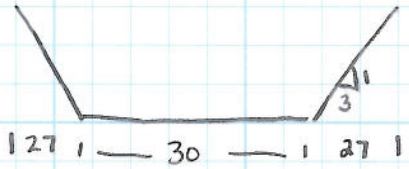
$V_S = 0$

This Gives us

$$\#\text{ wells}\left[226 + 9.5(20) + 0\right] = 0.1(60,984) - 0$$

#wells = 14.65 → 15 Dry wells For Disposal

Foot Print of WQF



Size 30' wide x 500' Long

So 9" WQ Depth Volume $\approx$ 15,000 ft^3 = WQ Storage

Drywell Calculation

4 Acres of Run off AREA = A = 174,240 ft^2

20' Deep wells, so h = 18

From Bend Manual

$$\#_{wells}\left[Vb + 9.5\,VR + Vs\right] = 0.1\,A - WQ\ Storage$$

$Vb = \pi r^2 h \rightarrow 3.14(2)^2(18) = 226$ CF

Vr = 20 CY From Manual Type B (Standard)

Vs = 0

This Gives us

$$\#_{wells}\left[226 + (9.5)(20) + 0\right] = 0.1\,(174{,}240) - 15{,}000$$

$$\#_{wells} = \frac{2424}{416} = 5.8 \rightarrow 6 \text{ Dry wells for Disposal}$$

Foot Print of WQF

Size = 70' wide x 75' Long

So 9" WQ Storage ≈ 5100 CF

Dry well Calculation

1.4 Acres Runoff Area = A = 60,984 ft²

20' Deep wells, so h = 18

From Bend Manual

$$\#\text{wells}\left[V_b + 9.5\,V_R + V_S\right] = 0.1\,A - \text{WQ Storage}$$

$V_b = \pi r^2 h = 3.14\,(2)^2(18) = 226$ CF

$V_r = 20$ CY From Manual type B standard

$V_S = 0$

This gives us

$$\#\text{wells}\left[226 + 9.5(20) + 0\right] = 0.1(60{,}984) - 5100$$

$$\#\text{wells} = \frac{998}{416} = 2.4 \rightarrow$$ 3 Dry wells for Disposal

SBUH DESIGN WORKSHEET

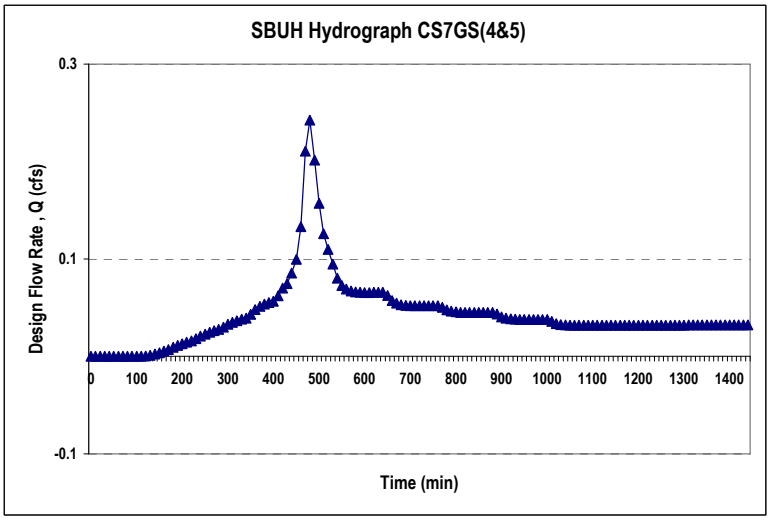
PROJECT:	Murphy Road	
BASIN	Bend, OR	
OUTFALL:		
LOCATION:	Sta 317+10	
TREATMENT FACILITY:	Mechanical	
FACILITY NAME:		
TOTAL IMPERVIOUS AREA	60,984	sq ft
	1.40	acre

Parameters		**Units**			**Comments**			
Total length of Flow	1740	ft						
Sheet Flow Segment								
Length	30	ft						
Slope of hydraulic Grid Line - S_o	0.02	ft/ft						
n_s - Sheet flow Manning' Effective roughness coeff.	0.25				*[City of Portland Stormwater Management Manual 2004 page 2-74]*			
Travel time (sheet Flow Segment) $T_1 = 0.42\ (n_sL)^{0.8}/((1.58*(S_o)^{0.4})$	6.4	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Shallow Concentrated Flow Segment								
Length	0	ft						
S_o	0.005	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Velocity V = 20.3282(S_o)^0.5	1.44	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
T_2 = L/(60*V)	0.0	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Pipe Flow Segment								
Length	1710	ft			Assume sheet flows empty into inlets connected to pipes.			
T_3 = L/(60*V)	9.5	min			Assume pipe flow velocity of 3fps			
Given Area	1.4	acres						
P_t Depth of Rainfall	0.94	in			67% of 2 year at 1.4			
d_t	10	min						
T_c	15.9	min			From Conveyance Spreadsheet			
Routing Constant w= $d_t/(2T_c+d_t)$	0.240							
Pervious Area (acres)	0.0		CN	85	S = (1000/CN)-10	1.7647059	0.2*S	0.352941
Impervious Area (acres)	1.4		CN	98	S = (1000/CN)-10	0.2040816	0.2*S	0.040816
Inputs								

Summary Results

Santa Barbara Urban Hydrograph (SBUH) Method Using SCS Type 1A Storm Distribution

Peak Design Flow Rate	0.24	cfs
Total Runoff	0.74	in
Total Runoff Volume	3,778	cf



SBUH DESIGN WORKSHEET

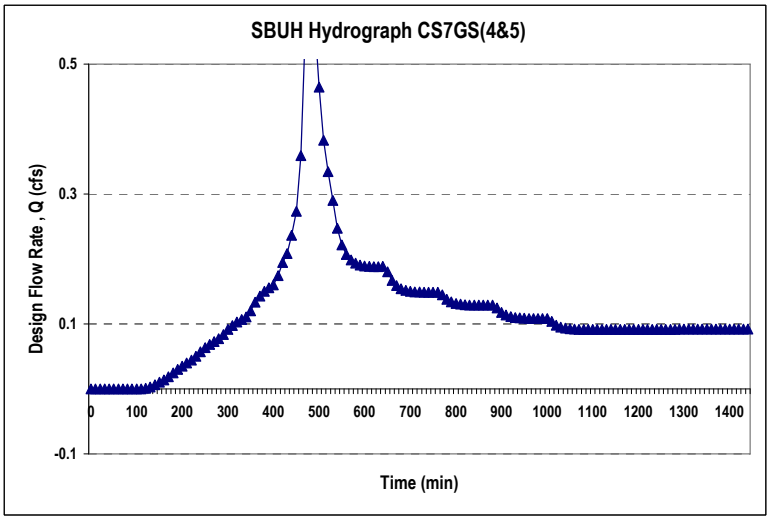
PROJECT:	Murphy Road	
BASIN	Bend, OR	
OUTFALL:		
LOCATION:	Sta 340+62	
TREATMENT FACILITY:	Grassy Swale	
FACILITY NAME:		
TOTAL IMPERVIOUS AREA	174,240	sq ft
	4.00	acre

Parameters		**Units**			**Comments**			
Total length of Flow	1658	ft						
Sheet Flow Segment								
Length	58	ft						
Slope of hydraulic Grid Line - S_o	0.02	ft/ft						
n_s - Sheet flow Manning' Effective roughness coeff.	0.25				*[City of Portland Stormwater Management Manual 2004 page 2-74]*			
Travel time (sheet Flow Segment) $T_1 = 0.42 (n_sL)^{0.8}/((1.58*(S_o)^{0.4})$	10.8	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Shallow Concentrated Flow Segment								
Length	0	ft						
S_o	0.005	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Velocity V = 20.3282(S_o)^0.5	1.44	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
T_2 = L/(60*V)	0.0	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Pipe Flow Segment								
Length	1600	ft			Assume sheet flows empty into inlets connected to pipes.			
T_3 = L/(60*V)	8.9	min			Assume pipe flow velocity of 3fps			
Given Area	4.0	acres						
P_t Depth of Rainfall	0.94	in			67% of 2 year which is 1.4			
d_t	10	min						
T_c	19.7	min			From Conveyance Spreadsheet			
Routing Constant w= $d_t/(2T_c+d_t)$	0.203							
Pervious Area (acres)	0.0		CN	85	S = (1000/CN)-10	1.7647059	0.2*S	0.352941
Impervious Area (acres)	4.0		CN	98	S = (1000/CN)-10	0.2040816	0.2*S	0.040816
Inputs								

Summary Results

Santa Barbara Urban Hydrograph (SBUH) Method Using SCS Type 1A Storm Distribution

Peak Design Flow Rate	0.65	cfs
Total Runoff	0.74	in
Total Runoff Volume	10,794	cf



SBUH DESIGN WORKSHEET

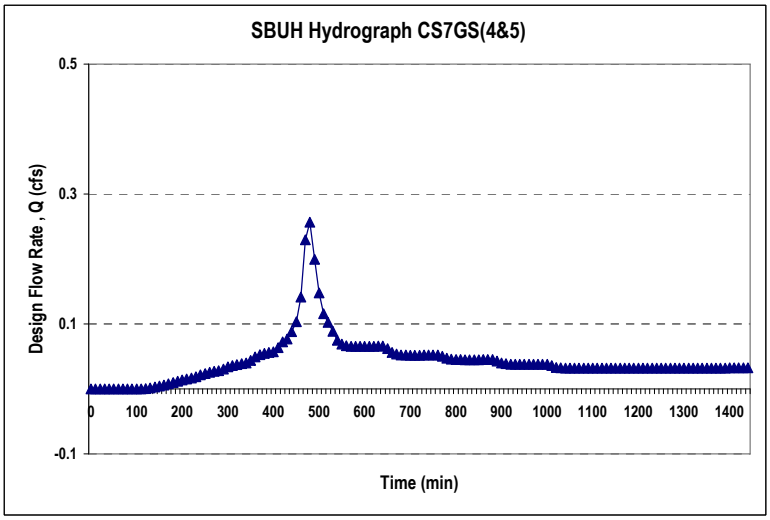
PROJECT:	Murphy Road	
BASIN	Bend, OR	
OUTFALL:		
LOCATION:	Sta 376+99	
TREATMENT FACILITY:	Grassy Swale	
FACILITY NAME:		
TOTAL IMPERVIOUS AREA	60,984	sq ft
	1.40	acre

Parameters		**Units**			**Comments**			
Total length of Flow	1130	ft						
Sheet Flow Segment								
Length	30	ft						
Slope of hydraulic Grid Line - S_o	0.02	ft/ft						
n_s - Sheet flow Manning' Effective roughness coeff.	0.25				*[City of Portland Stormwater Management Manual 2004 page 2-74]*			
Travel time (sheet Flow Segment) $T_1 = 0.42\ (n_sL)^{0.8}/((1.58*(S_o)^{0.4})$	6.4	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Shallow Concentrated Flow Segment								
Length	0	ft						
S_o	0.005	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Velocity V = 20.3282(S_o)^0.5	1.44	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
T_2 = L/(60*V)	0.0	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Pipe Flow Segment								
Length	1100	ft			Assume sheet flows empty into inlets connected to pipes.			
T_3 = L/(60*V)	6.1	min			Assume pipe flow velocity of 3fps			
Given Area	1.4	acres						
P_t Depth of Rainfall	0.94	in			67% of 2 year at 1.4			
d_t	10	min						
T_c	12.5	min			From Conveyance Spreadsheet			
Routing Constant w= $d_t/(2T_c+d_t)$	0.286							
Pervious Area (acres)	0.0		CN	85	S = (1000/CN)-10	1.7647059	0.2*S	0.352941
Impervious Area (acres)	1.4		CN	98	S = (1000/CN)-10	0.2040816	0.2*S	0.040816
Inputs								

Summary Results

Santa Barbara Urban Hydrograph (SBUH) Method Using SCS Type 1A Storm Distribution

Peak Design Flow Rate	0.26	cfs
Total Runoff	0.74	in
Total Runoff Volume	3,778	cf



SBUH DESIGN WORKSHEET

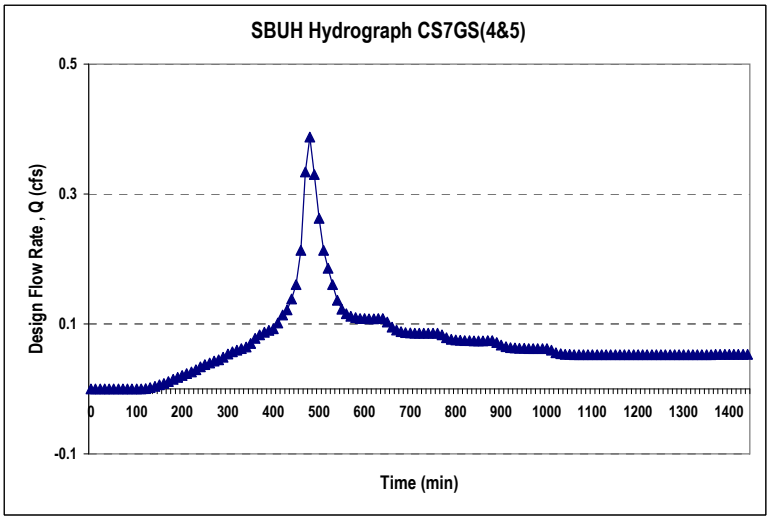
PROJECT:	Murphy Road	
BASIN	Bend, OR	
OUTFALL:		
LOCATION:	Sta 38+00	
TREATMENT FACILITY:	Grassy Swale	
FACILITY NAME:		
TOTAL IMPERVIOUS AREA	100,188	sq ft
	2.30	acre

Parameters		**Units**			**Comments**			
Total length of Flow	0	ft						
Sheet Flow Segment								
Length	30	ft						
Slope of hydraulic Grid Line - S_o	0.02	ft/ft						
n_s - Sheet flow Manning' Effective roughness coeff.	0.25				*[City of Portland Stormwater Management Manual 2004 page 2-74]*			
Travel time (sheet Flow Segment) $T_1 = 0.42\ (n_sL)^{0.8}/((1.58*(S_o)^{0.4})$	6.4	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Shallow Concentrated Flow Segment								
Length	0	ft						
S_o	0.005	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Velocity V = 20.3282(S_o)^0.5	1.44	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
T_2 = L/(60*V)	0.0	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*			
Pipe Flow Segment								
Length	2000	ft			Assume sheet flows empty into inlets connected to pipes.			
T_3 = L/(60*V)	11.1	min			Assume pipe flow velocity of 3fps			
Given Area	2.3	acres						
P_t Depth of Rainfall	0.94	in			67% of 2 year at 1.4			
d_t	10	min						
T_c	17.5	min			From Conveyance Spreadsheet			
Routing Constant w= $d_t/(2T_c+d_t)$	0.222							
Pervious Area (acres)	0.0		CN	85	S = (1000/CN)-10	1.7647059	0.2*S	0.352941
Impervious Area (acres)	2.3		CN	98	S = (1000/CN)-10	0.2040816	0.2*S	0.040816
Inputs								

Summary Results

Santa Barbara Urban Hydrograph (SBUH) Method Using SCS Type 1A Storm Distribution

Peak Design Flow Rate	0.39	cfs
Total Runoff	0.74	in
Total Runoff Volume	6,207	cf



APPENDIX B
Inlet Design Calculations

Inlet Placement
Project: Murphy Road
Job Number: 348153

Side	Inlet Sta	From Sta	To Sta	Section Width (ft)	Section Length (ft)	Area (ac)	C 0.90	Time T_c (min)	Intensity I (in/hr)	Flow Q (cfs)	Pavement Long. S_L (ft/ft)	Pavement Cross S_x (ft/ft)	Equiv Cross S_e (ft/ft)	Pavement Manning's n 0.012	Prev. Bypass Q_{bp} (cfs)	Total Gutter Q_{tot} (cfs)	Flow Depth D (ft)	Spread T (ft)	Grate Width W (ft)	Opening Length L (ft)	Opening Required Lt (ft)	Gutter Velocity V_g (ft/sec)	Efficiency E	Intercepted Flow Q_i (cfs)	Bypass Flow Q_{bp} (cfs)	
Super Left Sta 36+550 to 370+60																										
L	**367+00**	36550	36700	48	150	0.165	0.9	5.0	2.7	0.402	0.034	0.04	0.110	0.012	0	0.402	0.095	2.39	2	2.5	7.893	1.80	0.50	0.20	0.20	
L	**367+50**	36700	36750	48	50	0.055	0.9	5.0	2.7	0.134	0.045	0.04	0.119	0.012	0.20	0.336	0.084	2.11	2	2.5	7.628	1.93	0.51	0.17	0.16	
L	**368+00**	36750	36800	48	50	0.055	0.9	5.0	2.7	0.134	0.056	0.04	0.126	0.012	0.16	0.298	0.077	1.94	2	2.5	7.493	2.06	0.52	0.15	0.14	
L	**368+50**	36800	36850	48	50	0.055	0.9	5.0	2.7	0.134	0.067	0.04	0.131	0.012	0.14	0.278	0.073	1.82	2	2.5	7.484	2.19	0.52	0.14	0.13	
L	**369+00**	36850	36900	48	50	0.055	0.9	5.0	2.7	0.134	0.079	0.04	0.135	0.012	0.13	0.267	0.070	1.75	2	2.5	7.578	2.30	0.51	0.14	0.13	
L	**369+40**	36900	36940	48	40	0.044	0.9	5.0	2.7	0.107	0.075	0.04	0.139	0.012	0.13	0.237	0.067	1.68	2	2.5	7.001	2.38	0.55	0.13	0.11	
L	**369+80**	36940	36980	48	40	0.044	0.9	5.0	2.7	0.107	0.070	0.04	0.141	0.012	0.11	0.214	0.066	1.64	2	2.5	6.487	2.43	0.58	0.13	0.09	
L	**370+20**	36980	37020	48	40	0.044	0.9	5.0	2.7	0.107	0.096	0.04	0.151	0.012	0.09	0.196	0.060	1.50	2	2.5	6.617	2.84	0.57	0.11	0.08	
L	**370+40**	37020	37040	48	20	0.022	0.9	5.0	2.7	0.054	0.061	0.04	0.157	0.012	0.08	0.137	0.057	1.42	2	2.5	4.858	2.94	0.73	0.10	0.04	
L	**370+50**	37040	37050	48	10	0.011	0.9	5.0	2.7	0.027	0.060	0.04	0.195	0.012	0.04	0.064	0.043	1.08	2	2.5	3.079	10.07	0.95	0.06	0.00	
Super Right Sta 370+60 to 377+34																										
R	**373+00**	37050	37300	48	250	0.275	0.9	5.0	2.7	0.669	0.045	0.02	0.059	0.012	0.00	0.669	0.084	4.22	2	2.5	15.426	1.42	0.27	0.18	0.49	
R	**375+50**	37300	37550	48	250	0.275	0.9	5.0	2.7	0.669	0.022	0.02	0.055	0.012	0.49	0.669	0.096	4.81	2	2.5	13.180	1.38	0.32	0.21	0.46	
R	**376+50**	37550	37650	48	100	0.110	0.9	5.0	2.7	0.268	0.008	0.02	0.060	0.012	0.46	0.268	0.084	4.18	2	2.5	6.139	1.29	0.61	0.16	0.10	
Sag at Sta 376+99 Right Side																										
R	**376+99**	37650	37801	Varies	151	0.129	0.9	5.0	3	0.348	0.000	0.02			0.15	0.453	0.067	3.34								Spread From Flow Master
R	**377+09**																									
Crown Section at Sta 377+34 to 378+01																										
L	377+34	37801	37734	48	67	0.074	0.9	5.0	2.7	0.179	0.005	0.02	0.063	0.012	0.00	0.179	0.077	3.86	2	2.5	4.484	1.21	0.77	0.14	0.04	
Sag at Sta 349+01																										
L	**362+50**	36550	36250	24	300	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.29	2	2.5	8.999	1.35	0.44	0.18	0.22	
L	**359+50**	36250	35950	24	300	0.165	0.9	5.0	2.7	0.402	0.039	0.02	0.059	0.012	0.22	0.625	0.085	4.23	2	2.5	14.365	1.41	0.29	0.18	0.44	
L	**356+50**	35950	35650	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.046	0.012	0.22	0.845	0.129	6.44	2	2.5	11.628	1.37	0.35	0.30	0.55	
L	**353+50**	35650	35350	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.045	0.012	0.44	0.948	0.135	6.73	2	2.5	12.383	1.38	0.33	0.32	0.63	
L	**350+50**	35350	35050	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.044	0.012	0.55	1.033	0.139	6.95	2	2.5	12.977	1.39	0.32	0.33	0.70	
L	**349+61**	35050	34961	24	89	0.049	0.9	5.0	2.7	0.119	0.005	0.02	0.044	0.012	0.63	0.822	0.138	6.88	2	2.5	10.405	1.36	0.39	0.32	0.50	
L	**349+30**	35050	34930	24	120	0.066	0.9	5.0	2.7	0.161	0.003	0.02	0.042	0.012	0.70	0.864	0.153	7.67	2	2.5	9.528	1.37	0.42	0.36	0.50	
L	**349+01**	34930	34700	24	230	0.127	0.9	5.0	2.7	0.308		0.02			0.63	0.902	0.144	7.19								Spread From Flow Master
L	**348+91**																									
L	**346+75**	34505	34700	24	195	0.107	0.9	5.0	2.7	0.261	0.006	0.02	0.059	0.012	0.00	0.261	0.086	4.29	2	2.5	5.800	1.27	0.64	0.17	0.09	
L	**345+05**	34452	34505	24	53	0.029	0.9	5.0	2.77	0.073	0.002	0.02	0.072	0.012	0.00	0.073	0.064	3.21	2	2.5	2.223	0.82	1.00	0.07	0.00	
Sag at Sta 340+62																										
L	**340+62**	34452	34062	24	626	0.345	0.9	5.0	3	0.931		0.02			0.27	1.197	0.144	7.20								Spread From Flow Master
L	**340+52**																									
L	**332+26**	32926	33226	24	300	0.165	0.9	5.0	2.7	0.402	0.016	0.02	0.060	0.012	0.00	0.402	0.084	4.21	2	2.5	9.184	1.36	0.44	0.17	0.23	
L	**335+26**	33226	33526	24	300	0.165	0.9	5.0	2.7	0.402	0.007	0.02	0.049	0.012	0.23	0.628	0.116	5.78	2	2.5	9.850	1.35	0.41	0.26	0.37	
L	**337+43**	33743	33774																							
L	**337+75**	33526	33811	24	285	0.157	0.9	5.0	2.7	0.382	0.006	0.02	0.046	0.012	0.37	0.753	0.129	6.43	2	2.5	10.354	1.36	0.39	0.29	0.46	
L	**338+11**	33775	33811	24	36	0.020	0.9	5.0	2.7	0.048	0.006	0.02	0.050	0.012	0.46	0.506	0.111	5.54	2	2.5	8.318	1.32	0.47	0.24	0.27	
Sag at Sta 325+72																										
L	**Roundabout to be designed in the future**			24	0	0.000	0.9	5.0	3	0.000		0.02			0.00	0.000	0.078	3.89								Spread From Flow Master
L																										
Sag at Sta 317+07																										
L	**320+56**	32226	32056	24	170	0.094	0.9	5.0	2.7	0.228	0.025	0.02	0.073	0.012	0	0.228	0.063	3.14	2	2.5	7.284	1.41	0.53	0.12	0.11	
L	**320+10**	32056	32010	24	46	0.025	0.9	5.0	2.7	0.062	0.025	0.02	0.107	0.012	0.11	0.062	0.038	1.92	2	2.5	3.353	1.52	0.91	0.06	0.01	
L	**317+30**	32010	31730	24	280	0.154	0.9	5.0	2.7	0.375	0.025	0.02	0.064	0.012	0.01	0.375	0.076	3.79	2	2.5	9.724	1.39	0.41	0.16	0.22	
L	**317+07**	31730	31707	24	23	0.013	0.9	5.0	3	0.034		0.02			0.63	0.550	0.079	3.97								Spread From Flow Master
L	**316+97**																									
L	**311+57**	30857	31157	24	300	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.30	2	2.5	8.958	1.35	0.45	0.18	0.22	
L	**314+57**	31157	31457	24	300	0.165	0.9	5.0	2.7	0.402	0.024	0.02	0.056	0.012	0.00	0.625	0.093	4.64	2	2.5	12.826	1.39	0.32	0.20	0.42	
L	**316+57**	31457	31657	24	200	0.110	0.9	5.0	2.7	0.268	0.006	0.02	0.047	0.012	0.00	0.691	0.124	6.21	2	2.5	9.915	1.35	0.41	0.28	0.41	
Sag at Sta 305+54																										
L	**305+54**	30857	30554	24	303	0.167	0.9	5.0	3	0.451		0.02			0.00	0.451	0.066	3.28								Spread From Flow Master
L	**305+44**																									
TO BE COMPLETED WITH SEGMENT 1																										

Sag at Sta 349+01																									
R	**362+50**	36550	36250	24	300	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.29	2	2.5	8.999	1.35	0.44	0.18	0.22	
R	**359+50**	36250	35950	24	300	0.165	0.9	5.0	2.7	0.402	0.039	0.02	0.059	0.012	0.22	0.625	0.085	4.23	2	2.5	14.365	1.41	0.29	0.18	0.44	
R	**356+50**	35950	35650	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.046	0.012	0.22	0.845	0.129	6.44	2	2.5	11.628	1.37	0.35	0.30	0.55	
R	**353+50**	35650	35350	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.045	0.012	0.44	0.948	0.135	6.73	2	2.5	12.383	1.38	0.33	0.32	0.63	
R	**350+50**	35350	35050	24	300	0.165	0.9	5.0	2.7	0.402	0.008	0.02	0.044	0.012	0.55	1.033	0.139	6.95	2	2.5	12.977	1.39	0.32	0.33	0.70	
R	**349+30**	35050	34930	24	120	0.066	0.9	5.0	2.7	0.161	0.003	0.02	0.042	0.012	0.70	0.864	0.153	7.67	2	2.5	9.528	1.37	0.42	0.36	0.50	
R	**349+11**																									
R	**349+01**	34930	34700	24	230	0.127	0.9	5.0	2.7	0.308		0.02			0.63	0.928	0.144	7.19								Spread From Flow Master
R	**346+75**	34475	34700	24	225	0.124	0.9	5.0	2.7	0.301	0.006	0.02	0.057	0.012	0.00	0.301	0.090	4.52	2	2.5	6.291	1.28	0.60	0.18	0.12	
R	**345+06**	34452	34475	24	23	0.013	0.9	5.0	2.77	0.032	0.002	0.02	0.091	0.012	0.00	0.032	0.047	2.34	2	2.5	1.359	0.59	1.00	0.03	0.00	
Sag at Sta 340+62																										
R	**340+62**	34452	34062	24	626	0.345	0.9	5.0	3	0.931		0.02			0.26	1.187	0.144	7.20								Spread From Flow Master
R	**340+52**																									
R	**332+26**	32926	33226	24	300	0.165	0.9	5.0	2.7	0.402	0.016	0.02	0.060	0.012	0.00	0.402	0.084	4.21	2	2.5	9.184	1.36	0.44	0.17	0.23	
R	**335+26**	33226	33526	24	300	0.165	0.9	5.0	2.7	0.402	0.007	0.02	0.049	0.012	0.23	0.628	0.116	5.78	2	2.5	9.850	1.35	0.41	0.26	0.37	
R	**337+56**	33526	33756	24	230	0.127	0.9	5.0	2.7	0.308	0.006	0.02	0.047	0.012	0.37	0.679	0.124	6.19	2	2.5	9.785	1.35	0.41	0.28	0.40	
R	**338+26**	33756	33826	24	70	0.039	0.9	5.0	2.7	0.094	0.006	0.02	0.050	0.012	0.40	0.493	0.110	5.49	2	2.5	8.199	1.32	0.48	0.24	0.26	
Sag at Sta 325+72																										
R	**Roundabout to be designed in the future**			24	0	0.000	0.9	5.0	3	0.000		0.02			0.00	0.000	0.078	3.89								Spread From Flow Master
R																										
Sag at Sta 317+07																										
R	**320+25**	32226	32025	24	201	0.111	0.9	5.0	2.7	0.269	0.025	0.02	0.070	0.012	0	0.269	0.067	3.34	2	2.5	8.030	1.40	0.49	0.13	0.14	
R	**317+07**	32025	31657	24	368	0.203	0.9	5.0	3	0.547		0.02			0.41	1.094	0.079	3.97								Spread From Flow Master
R	**316+97**																									
R	**311+57**	30857	31157	24	300	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.30	2	2.5	8.958	1.35	0.45	0.18	0.22	
R	**314+57**	31157	31457	24	300	0.165	0.9	5.0	2.7	0.402	0.024	0.02	0.056	0.012	0.00	0.625	0.093	4.64	2	2.5	12.826	1.39	0.32	0.20	0.42	
R	**316+57**	31457	31657	24	200	0.110	0.9	5.0	2.7	0.268	0.006	0.02	0.047	0.012	0.00	0.691	0.124	6.21	2	2.5	9.915	1.35	0.41	0.28	0.41	
Sag at Sta 305+54																										
R	**305+54**	30857	30554	24	303	0.167	0.9	5.0	3	0.451		0.02			0.00	0.451	0.066	3.28								Spread From Flow Master
R	**305+44**																									
TO BE COMPLETED WITH SEGMENT 1																										
Segment 1 Sta 10+00 to Sta 30+28																										
L	**14+00**	1000	1400	18	400	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.29	2	2.5	8.999	1.35	0.44	0.18	0.22	
L	**16+00**	1400	1600	36	200	0.165	0.9	5.0	2.7	0.402	0.039	0.04	0.101	0.012	0.22	0.625	0.110	2.74	2	2.5	10.458	1.75	0.39	0.24	0.38	
L	**17+00**	1600	1700	36	100	0.083	0.9	5.0	2.7	0.201	0.008	0.04	0.086	0.012	0.22	0.583	0.145	3.63	2	2.5	6.831	1.55	0.56	0.33	0.26	
L	**18+00**	1700	1800	36	100	0.083	0.9	5.0	2.7	0.201	0.008	0.04	0.090	0.012	0.38	0.458	0.133	3.32	2	2.5	5.988	1.54	0.62	0.28	0.17	
L	**20+50**	1800	2050	36	250	0.207	0.9	5.0	2.7	0.502	0.008	0.04	0.083	0.012	0.26	0.675	0.153	3.84	2	2.5	7.391	1.56	0.52	0.35	0.32	
L	**23+50**	2050	2350	18	300	0.124	0.9	5.0	2.7	0.301	0.039	0.02	0.059	0.012	0.32	0.622	0.084	4.22	2	2.5	14.326	1.41	0.29	0.18	0.44	
L	**25+00**	2350	2500	18	150	0.062	0.9	5.0	2.7	0.151	0.008	0.02	0.050	0.012	0.32	0.591	0.113	5.64	2	2.5	9.553	1.34	0.42	0.25	0.34	
L	**26+50**	2500	2650	18	150	0.062	0.9	5.0	2.7	0.151	0.008	0.02	0.052	0.012	0.44	0.493	0.105	5.26	2	2.5	8.636	1.33	0.46	0.23	0.27	
L	**28+00**	2650	2800	18	150	0.062	0.9	5.0	2.7	0.151	0.039	0.02	0.066	0.012	0.27	0.417	0.073	3.63	2	2.5	11.392	1.42	0.36	0.15	0.27	
L	**30+28**	2800	3025	18	225	0.093	0.9	5.0	2.7	0.226	0.008	0.02	0.052	0.012	0.27	0.493	0.105	5.26	2	2.5	8.635	1.33	0.46	0.23	0.27	
Segment 1 Sta 10+00 to Sta 30+28																										
R	**14+00**	1000	1400	18	400	0.165	0.9	5.0	2.7	0.402	0.015	0.02	0.059	0.012	0.00	0.402	0.086	4.29	2	2.5	8.999	1.35	0.44	0.18	0.22	
R	**23+50**	2050	2350	18	300	0.124	0.9	5.0	2.7	0.301	0.039	0.02	0.064	0.012	0.00	0.475	0.076	3.82	2	2.5	12.280	1.42	0.34	0.16	0.32	
R	**25+00**	2350	2500	18	150	0.062	0.9	5.0	2.7	0.151	0.008	0.02	0.052	0.012	0.32	0.466	0.103	5.15	2	2.5	8.369	1.32	0.47	0.22	0.25	
R	**26+50**	2500	2650	18	150	0.062	0.9	5.0	2.7	0.151	0.008	0.02	0.054	0.012	0.25	0.397	0.097	4.85	2	2.5	7.646	1.31	0.51	0.20	0.19	
R	**28+00**	2650	2800	18	150	0.062	0.9	5.0	2.7	0.151	0.039	0.02	0.069	0.012	0.19	0.345	0.068	3.38	2	2.5	10.209	1.44	0.40	0.14	0.21	
R	**30+28**	2800	3025	18	225	0.093	0.9	5.0	2.7	0.226	0.008	0.02	0.053	0.012	0.21	0.434	0.100	5.02	2	2.5	8.042	1.32	0.49	0.21	0.22	

APPENDIX C
Conveyance Design Calculations

Conveyance Calculations
Project: **Murphy Rd.**
Job Number: **348153**

Location					Hydrology												Sewer Design						ewer Profi		
Description	Pipe From	Pipe To	Length (ft)	Width (ft)	Area (ft²)	Total Area (acres)	Cf = C	1.0 CfCA	Sum CA	Tc from STA (min)	Tc in Pipe (min)	Sum Tc (min)	Intensity I (in/hr)	Flow (cfs)	Offsite Flow (cfs)	Total Flow (cfs)	Diameter D (in)	Slope S (ft/ft)	Manning's n 0.013	Capacity Qf (cfs)	Velocity V (fps)	Q/Qf	Length L (ft)	Q/Qf Check	Slope Check
Murphy Road																									
Main line																									
SAG AT STA 376+99																									
From East	**378+01.00**	**377+34.00**	67.00	48.00	3216	0.07	0.90	0.07	0.07	**5.00**	0.37	**5.4**	2.70	0.18		**0.18**	**12**	0.45%	0.013	2.38	3.04	**0.08**	67.00	ok	ok
	377+34.00	**376+99.00**	35.00	48.00	1680	0.04	0.90	0.03	0.10	**5.37**	0.17	**5.5**	2.70	0.27		**0.27**	**12**	0.57%	0.013	2.69	3.43	**0.10**	35.00	ok	ok
From West	**365+50.00**	**367+00.00**	150.00	48.00	7200	0.17	0.90	0.15	0.15	**5.00**	0.50	**5.5**	2.70	0.40		**0.40**	**12**	1.23%	0.013	3.96	5.04	**0.10**	150.00	ok	ok
	367+00.00	**367+50.00**	50.00	48.00	2400	0.06	0.90	0.05	0.20	**5.50**	0.08	**5.6**	2.70	0.54		**0.54**	**12**	4.80%	0.013	7.80	9.94	**0.07**	50.00	ok	ok
	367+50.00	**368+00.00**	50.00	48.00	2400	0.06	0.90	0.05	0.25	**5.58**	0.13	**5.7**	2.70	0.67		**0.67**	**12**	2.00%	0.013	5.04	6.42	**0.13**	50.00	ok	ok
	368+00.00	**368+50.00**	50.00	48.00	2400	0.06	0.90	0.05	0.30	**5.71**	0.08	**5.8**	2.70	0.80		**0.80**	**12**	4.80%	0.013	7.80	9.94	**0.10**	50.00	ok	ok
	368+50.00	**369+00.00**	50.00	48.00	2400	0.06	0.90	0.05	0.35	**5.79**	0.08	**5.9**	2.70	0.94		**0.94**	**12**	4.84%	0.013	7.84	9.98	**0.12**	50.00	ok	ok
	369+00.00	**369+40.00**	40.00	48.00	1920	0.04	0.90	0.04	0.39	**5.88**	0.07	**5.9**	2.70	1.04		**1.04**	**12**	4.82%	0.013	7.82	9.97	**0.13**	40.00	ok	ok
	369+40.00	**369+80.00**	40.00	48.00	1920	0.04	0.90	0.04	0.29	**5.71**	0.04	**5.8**	2.70	0.78		**0.78**	**12**	11.38%	0.013	12.01	15.31	**0.06**	40.00	ok	ok
	369+80.00	**370+20.00**	40.00	48.00	1920	0.04	0.90	0.04	0.34	**5.79**	0.05	**5.8**	2.70	0.91		**0.91**	**12**	8.62%	0.013	10.46	13.33	**0.09**	40.00	ok	ok
	370+20.00	**370+40.00**	20.00	48.00	960	0.02	0.90	0.02	0.37	**5.88**	0.05	**5.9**	2.70	0.99		**0.99**	**12**	2.50%	0.013	5.63	7.18	**0.18**	20.00	ok	ok
	370+40.00	**370+50.00**	10.00	48.00	480	0.01	0.90	0.01	0.40	**5.94**	0.02	**6.0**	2.70	1.07		**1.07**	**12**	3.80%	0.013	6.94	8.85	**0.15**	10.00	ok	ok
	370+50.00	**373+00.00**	250.00	48.00	12000	0.28	0.90	0.25	0.54	**5.75**	0.43	**6.2**	2.70	1.45		**1.45**	**12**	4.59%	0.013	7.63	9.72	**0.19**	250.00	ok	ok
	373+00.00	**375+50.00**	250.00	48.00	12000	0.28	0.90	0.25	0.59	**5.84**	0.45	**6.3**	2.70	1.58		**1.58**	**12**	4.13%	0.013	7.24	9.23	**0.22**	250.00	ok	ok
	375+50.00	**376+50.00**	100.00	48.00	4800	0.11	0.90	0.10	0.47	**5.92**	0.34	**6.3**	2.70	1.26		**1.26**	**12**	1.17%	0.013	3.85	4.91	**0.33**	100.00	ok	ok
	376+50.00	**376+99.00**	49.00	48.00	2352	0.05	0.90	0.05	0.45	**5.96**	0.23	**6.2**	2.70	1.20		**1.20**	**12**	0.61%	0.013	2.79	3.55	**0.43**	49.00	ok	ok
SAG AT STA 340+62																									
From East																									
	362+50.00	**359+50.00**	300.00	48.00	14400	0.33	0.90	0.30	0.30	**5.00**	0.55	**5.5**	2.70	0.80		**0.80**	**12**	4.03%	0.013	7.15	9.11	**0.11**	300.00	ok	ok
	359+50.00	**356+50.00**	300.00	48.00	14400	0.33	0.90	0.30	0.60	**5.55**	0.80	**6.3**	2.70	1.61		**1.61**	**12**	1.90%	0.013	4.91	6.26	**0.33**	300.00	ok	ok
	356+50.00	**353+50.00**	300.00	48.00	14400	0.33	0.90	0.30	0.89	**6.35**	1.27	**7.6**	2.70	2.41		**2.41**	**12**	0.75%	0.013	3.08	3.93	**0.78**	300.00	ok	ok
	353+50.00	**350+50.00**	300.00	48.00	14400	0.33	0.90	0.30	1.19	**7.62**	1.19	**8.8**	2.70	3.21		**3.21**	**12**	0.85%	0.013	3.28	4.18	**0.98**	300.00	ok	ok
	350+50.00	**349+61.00**	89.00	48.00	4272	0.10	0.90	0.09	1.28	**8.81**	0.31	**9.1**	2.70	3.45		**3.45**	**12**	1.12%	0.013	3.78	4.81	**0.91**	89.00	ok	ok
	349+61.00	**349+30.00**	31.00	48.00	1488	0.03	0.90	0.03	1.31	**9.12**	0.11	**9.2**	2.70	3.53		**3.53**	**12**	1.13%	0.013	3.78	4.82	**0.93**	31.00	ok	ok
	349+30.00	**349+01.00**	29.00	48.00	1392	0.03	0.90	0.03	1.34	**9.23**	0.13	**9.4**	2.70	3.61		**3.61**	**15**	0.52%	0.013	4.64	3.79	**0.78**	29.00	ok	ok
	349+01.00	**348+91.00**	10.00	48.00	480	0.01	0.90	0.01	1.35	**9.36**	0.04	**9.4**	2.70	3.64		**3.64**	**15**	0.50%	0.013	4.57	3.72	**0.80**	10.00	ok	ok
	348+91.00	**347+00.00**	191.00	48.00	9168	0.21	1.90	0.40	1.75	**9.40**	0.80	**10.2**	2.70	4.72		**4.72**	**18**	0.45%	0.013	7.00	3.97	**0.67**	191.00	ok	ok
	347+00.00	**345+05.00**	195.00	48.00	9360	0.21	2.90	0.62	2.37	**10.21**	0.76	**11.0**	2.70	6.40		**6.40**	**18**	0.51%	0.013	7.52	4.26	**0.85**	195.00	ok	ok
	345+05.00	**344+52.00**	53.00	48.00	2544	0.06	3.90	0.23	2.60	**10.97**	0.20	**11.2**	2.70	7.02		**7.02**	**18**	0.57%	0.013	7.90	4.47	**0.89**	53.00	ok	ok
	344+52.00	**340+62.00**	390.00	48.00	18720	0.43	4.90	2.11	4.70	**11.17**	1.15	**12.3**	2.70	12.70		**12.70**	**24**	0.62%	0.013	17.74	5.65	**0.72**	390.00	ok	ok
From West																									
	325+72.00	**329+26.00**	354.00	48.00	16992	0.39	0.90	0.35	0.35	**5.00**	1.96	**7.0**	2.70	0.95		**0.95**	**12**	0.44%	0.013	2.36	3.01	**0.40**	354.00	ok	ok
	329+26.00	**332+26.00**	300.00	48.00	14400	0.33	0.90	0.30	0.65	**6.96**	1.59	**8.5**	2.70	1.75		**1.75**	**12**	0.48%	0.013	2.47	3.14	**0.71**	300.00	ok	ok
	332+26.00	**335+26.00**	300.00	48.00	14400	0.33	0.90	0.30	0.95	**8.55**	1.05	**9.6**	2.70	2.55		**2.55**	**12**	1.10%	0.013	3.73	4.75	**0.68**	300.00	ok	ok
	335+26.00	**337+43.00**	217.00	48.00	10416	0.24	0.90	0.22	1.16	**9.60**	0.79	**10.4**	2.70	3.14		**3.14**	**12**	1.01%	0.013	3.59	4.57	**0.87**	217.00	ok	ok
	337+43.00	**337+75.00**	32.00	48.00	1536	0.04	0.90	0.03	1.19	**10.39**	0.13	**10.5**	2.70	3.22		**3.22**	**15**	0.66%	0.013	5.23	4.27	**0.62**	32.00	ok	ok
	337+75.00	**338+11.00**	36.00	48.00	1728	0.04	0.90	0.04	1.23	**10.52**	0.12	**10.6**	2.70	3.32		**3.32**	**15**	0.83%	0.013	5.89	4.81	**0.56**	36.00	ok	ok
	338+11.00	**340+62.00**	251.00	48.00	12048	0.28	0.90	0.25	1.48	**10.64**	0.73	**11.4**	2.70	3.99		**3.99**	**15**	1.20%	0.013	7.06	5.76	**0.57**	251.00	ok	ok
SAG AT STA 317+07																									
From East																									
	320+56.00	**320+10.00**	46.00	48.00	2208	0.05	0.90	0.05	0.05	**5.00**	0.24	**5.2**	2.70	0.12		**0.12**	**12**	0.50%	0.013	2.52	3.21	**0.05**	46.00	ok	ok
	320+10.00	**317+30.00**	280.00	48.00	13440	0.31	0.90	0.28	0.32	**5.24**	0.79	**6.0**	2.70	0.87		**0.87**	**12**	1.71%	0.013	4.66	5.94	**0.19**	280.00	ok	ok
	317+30.00	**317+07.00**	23.00	48.00	1104	0.03	0.90	0.02	0.35	**6.02**	0.04	**6.1**	2.70	0.93		**0.93**	**12**	4.35%	0.013	7.43	9.46	**0.13**	23.00	ok	ok
From West	**308+57.00**	**311+57.00**	300.00	48.00	14400	0.33	0.90	0.30	0.30	**5.00**															
	311+57.00	**314+57.00**	300.00	48.00	14400	0.33	0.90	0.30	0.60	**5.00**	0.78	**5.8**	2.70	1.61		**1.61**	**12**	2.00%	0.013	5.04	6.42	**0.32**	300.00	ok	ok
	314+57.00	**316+57.00**	200.00	48.00	9600	0.22	0.90	0.20	0.79	**5.78**	0.60	**6.4**	2.70	2.14		**2.14**	**12**	1.50%	0.013	4.36	5.56	**0.49**	200.00	ok	ok
	316+57.00	**316+97.00**	40.00	48.00	1920	0.04	0.90	0.04	0.83	**6.38**	0.17	**6.6**	2.70	2.25		**2.25**	**12**	0.72%	0.013	3.03	3.86	**0.74**	40.00	ok	ok
	316+97.00	**317+07.00**	10.00	48.00	480	0.01	0.90	0.01	0.84	**6.55**	0.01	**6.6**	2.70	2.28		**2.28**	**12**	7.10%	0.013	9.49	12.09	**0.24**	10.00	ok	ok
SAG AT STA 38+00																									
From West																									
	14+00.00	**16+00.00**	200.00	36.00	7200	0.17	0.90	0.15	0.15	**5.00**	0.73	**5.7**	2.70	0.40		**0.40**	**12**	1.00%	0.013	3.56	4.54	**0.11**	200.00	ok	ok
	16+00.00	**17+00.00**	100.00	36.00	3600	0.08	0.90	0.07	0.22	**5.73**	0.52	**6.3**	2.70	0.60		**0.60**	**12**	0.50%	0.013	2.52	3.21	**0.24**	100.00	ok	ok
	17+00.00	**18+00.00**	100.00	36.00	3600	0.08	0.90	0.07	0.30	**6.25**	0.52	**6.8**	2.70	0.80		**0.80**	**12**	0.50%	0.013	2.52	3.21	**0.32**	100.00	ok	ok
	18+00.00	**20+50.00**	250.00	36.00	9000	0.21	0.90	0.19	0.48	**6.77**	1.30	**8.1**	2.70	1.31		**1.31**	**12**	0.50%	0.013	2.52	3.21	**0.52**	250.00	ok	ok
	20+50.00	**23+50.00**	300.00	36.00	10800	0.25	0.90	0.22	0.71	**8.07**	0.88	**8.9**	2.70	1.91		**1.91**	**12**	1.58%	0.013	4.48	5.71	**0.43**	300.00	ok	ok
	23+50.00	**25+00.00**	150.00	36.00	5400	0.12	0.90	0.11	0.82	**8.95**	0.45	**9.4**	2.70	2.21		**2.21**	**12**	1.50%	0.013	4.36	5.56	**0.51**	150.00	ok	ok
	25+00.00	**26+50.00**	150.00	36.00	5400	0.12	0.90	0.11	0.93	**9.40**	0.45	**9.8**	2.70	2.51		**2.51**	**12**	1.50%	0.013	4.36	5.56	**0.58**	150.00	ok	ok
	26+50.00	**28+00.00**	150.00	36.00	5400	0.12	0.90	0.11	1.04	**9.85**	0.63	**10.5**	2.70	2.81		**2.81**	**12**	0.77%	0.013	3.12	3.97	**0.90**	150.00	ok	ok
	28+00.00	**30+25.00**	225.00	36.00	8100	0.19	1.90	0.35	1.39	**10.48**	0.79	**11.3**	2.70	3.77		**3.77**	**15**	0.82%	0.013	5.86	4.78	**0.64**	225.00	ok	ok
	30+25.00	**33+25.00**	300.00	36.00	10800	0.25	2.90	0.72	2.11	**11.26**	1.19	**12.4**	2.70	5.71		**5.71**	**18**	0.50%	0.013	7.43	4.21	**0.77**	300.00	ok	ok
	33+25.00	**36+25.00**	300.00	36.00	10800	0.25	3.90	0.97	3.08	**12.45**	0.93	**13.4**	2.70	8.32		**8.32**	**21**	0.67%	0.013	12.93	5.38	**0.64**	300.00	ok	ok
	36+25.00	**38+00.00**	175.00	36.00	6300	0.14	3.90	0.56	3.64	**13.38**	0.59	**14.0**	2.70	9.84		**9.84**	**21**	0.57%	0.013	11.97	4.98	**0.82**	175.00	ok	ok

APPENDIX C

Cost Estimates

CITY OF BEND

PROJECT NAME MURPHY ROAD PRELIMINARY DESIGN

COST ESTIMATE SEGMENT 1

MARK-UPS	Percent	
ELEC/I&C	NOTE 1	
MECHANICAL	NOTE 2	
ALLOWANCE	10%	
MOB/BOND/INS	8%	
CONTINGENCY	NOTE 3	
ENGINEERING	NOTE 4	
CAPITALIZED INTEREST (BOND)	NOTE 5	COB PROVIDED
COB INTERNAL CHARGES	13%	COB PROVIDED
OTHER COB COSTS	NOTE 5	COB PROVIDED
ADMIN/LEGAL	5%	COB PROVIDED

Prepared By: BILLY ADAMS
Proj. Manager: DAVE SIMMONS
Project No: 348153
Date: October 7, 2009

NO.	DESCRIPTION	QTY	UNIT	Material Unit $	Installation Unit $	TOTAL	RESOURCE
A	CONSTRUCTION COST ESTIMATE						
1	MOBILIZATION	ALL	LS		10%	$175,000	
2	TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	ALL	LS		1.5%	$25,600	
3	EROSION CONTROL	ALL	LS		1.0%	$17,100	
4	REMOVALOF STRUCTURES AND OBSTRUCTIONS	ALL	LS		$3,000	$3,000	
5	CLEARING AND GRUBBING	ALL	LS		$26,700	$26,700	
6	GENERAL EXCAVATION	14760	CY		$15	$221,400	
7	SUBGRADE GEOTEXTILE	8440	SY		$1.50	$12,700	
8	12 INCH STORM SEWER PIPE, 5 FT DEPTH	1750	LF		$60	$105,000	
9	15 INCH STORM SEWER PIPE, 10 FT DEPTH	225	LF		$100	$22,500	
10	18 INCH STORM SEWER PIPE, 10 FT DEPTH	300	LF		$100	$30,000	
11	21 INCH STORM SEWER PIPE, 10 FT DEPTH	475	LF		$100	$47,500	
12	CONCRETE STORM SEWER MANHOLES	10	EA		$3,000	$30,000	
13	CONCRETE INLETS, TYPE CG-3	16	EA		$1,700	$27,200	
14	WATER QUALITY FACILITY	ALL	LS		$160,000	$160,000	
15	DRYWELL DISPOSAL	ALL	LS		$45,000	$45,000	
16	COLD PLANE PAVEMENT REMOVAL, 0 - 2 INCHES DEEP	1480	SY		$5.00	$7,400	
17	AGGREGATE BASE (Note 6)	5890	TON		$22.00	$129,600	
18	CONCRETE CURBS, CURB AND GUTTER	4720	LF		$15.00	$70,800	
19	CONCRETE CURBS, MOUNTABLE CURB	290	LF		$20.00	$5,800	
20	CONCRETE ISLANDS	6106	SF		$10.00	$61,100	
21	CONCRETE WALKS (INCL DW APRONS)	28670	SF		$4.00	$114,700	
22	LEVEL 3, HMAC (Note 6)	ALL	LS		$243,880	$243,880	
23	SIGNING AND STRIPING	ALL	LS		$29,030	$29,030	
24	LANDSCAPING	ALL	LS		$228,190	$228,190	
25	ILLUMINATION, COMPLETE	ALL	LS		$85,000	$85,000	
B	SUBTOTAL					**$1,925,000**	
C	ELEC/I&C	(% of B)				$0	
D	MECHANICAL	(% of B)				$0	
E	SUBTOTAL					**$0**	
F	ALLOWANCE =	(% of G)				$0	
G	MOB/BOND/INS. =	(% of G)				$0	
H	CONTINGENCY =	30%				$578,000	
I	SUBTOTAL					**$2,503,000**	
J	ENGINEERING	20%				$500,600	
	CAPITALIZED INTEREST (BOND)	(% of I)				$0	
	COB INTERNAL CHARGES	(% of I)				$0	
	OTHER COB COSTS	(% of I)				$0	
K	ADMIN/LEGAL	(% of I)				$0	
L	PROPERTY COSTS (ROW/EASEMENTS) Assumed Cost	103,000	SF		$10.00	$1,030,000	
	RESIDENTAIL RELOCATIONS	5	EA		$50,000	$250,000	
M	UTILITIES COSTS					$0	
N	PERMIT FEES					$0	
	Total Estimated Project Cost					**$4,284,000**	

NOTES

1 Note: if this work is in the unit price bid schedule then use 0% and note this.
2 Note: if this work is in the unit price bid schedule then use 0% and note this.
3 Varies depending upon the 30%, 60% 95% design level.
4 Discuss with consultant and CIP mgr for percentage during planning.
5 This will vary by project in coordination with the funding mgr.
6 Pavement quantities are based on an assumed roadway section of 6" of HMAC and 12" of Aggregate Base.
7 Water quality facility unit cost includes seeding and limited plantings.