FCS GROUP
Solutions-Oriented Consulting | Technical Memorandum

Date: February 26, 2018

To: Martin Montalvo, Operations Manager, City of Oregon City

Bob George, Chief Engineer, Clackamas River Water (CRW)

From: Gordon Wilson, Senior Program Manager Gordon Wilson

Copy: Brian Ginter, Murraysmith

Subject: Remuneration Methodology for Service Area Transfers from CRW to Oregon City

The following technical memo documents the recommended methodology for determining fair remuneration when service area is transferred from Clackamas River Water (CRW) to Oregon City. The first part of the memo discusses why Original Cost Less Depreciation is the valuation approach we recommend in this case, and the second part gives step-by-step instructions for using the valuation model that accompanies this memo. Our work is part of a larger study of boundary issues that has been conducted by Murraysmith.

SECTION 1: VALUATION APPROACH

PURPOSE

The purpose of this memo is to develop a standard methodology for determining remuneration from Oregon City to CRW when water service area and assets are transferred from CRW to the City. The timing of the transfers is uncertain, and available data may vary. The methodology must be robust and straightforward enough to be implemented by staff, with ready agreement between the two parties, without help from consultants.

WHY A REMUNERATION METHODOLOGY IS NEEDED

The City is growing, gradually annexing area within the Urban Growth Boundary (UGB). CRW, an ORS 264 water district, is the existing provider of water service to developed areas surrounding the City on three sides. CRW has invested and continues to invest in the network of pipes and related assets that distribute water to its service area.

The majority of the Murraysmith study has been to examine several specific conflict areas between the two jurisdictions and determine which provider makes the most sense for each, both now and ultimately. For the most part, there is clarity about who the service provider should be within city limits (the City) or outside the Urban Growth Boundary (CRW). Most of the conflict areas addressed by Murraysmith have to do with areas that are now outside the City but inside the UGB.

State law in general favors cities in the provision of services within their boundaries, and after annexation, the City has the right to withdraw service area from CRW. Barring reasons to the contrary, there is a presumption that eventually the entire UGB area will be annexed into the City and become part of the City water system.

However, even for areas expected eventually to be inside the City, there are reasons it might make sense for CRW to retain ownership of certain assets. For example, some segments of pipe passing through the City might be necessary to provide connectivity for CRW service areas outside the UGB.

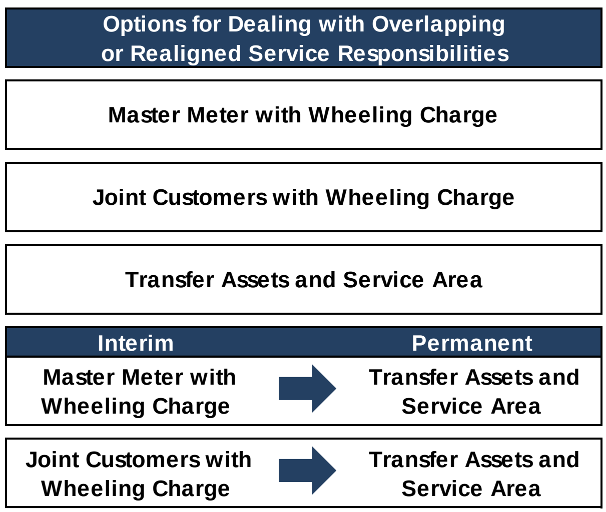
Firm Headquarters
Redmond Town Center
7525 166th Ave NE, Ste D-215
Redmond, Washington 98052

Locations
Washington | 425.867.1802
Oregon | 503.841.6543

In addition, there is uncertainty about the timing of annexations and development, so the short-term disposition of a given set of pipes and other assets might be different from the ultimate disposition.

As depicted in **Exhibit 1**, there are several mechanisms for dealing with overlapping or realigned responsibilities. In general, whenever the customer revenue is received by one agency but those customers are served through pipes that are owned by another agency, then a “wheeling charge” can compensate the agency that owns the pipes. If there is a master meter, the wheeling charge can be calculated based on the amount of water passing through the meter. Where there is a “ragged boundary” or the areas are so small that it would not be cost-effective to install a master meter, customers can be designated as “joint customers,” and the agency who owns the pipes can be compensated based on the metered water consumption of those particular customers.

Exhibit 1: Options for Dealing with Overlapping or Realigned Service Responsibilities



However, sometimes when there are overlapping or realigned service responsibilities, the most straightforward resolution is simply to transfer the service area from CRW to the City, either now or after some triggering event in the future. This raises the question of remuneration. The two parties agree that when service area and assets are transferred from CRW to the City, there should be some kind of compensation from the City to CRW. So the question we deal with in this memo is: how much? And how should that amount be determined when the time comes?

This memo focuses only on the capital value of the transferred assets and service area. We assume that if a transfer area is large enough to affect the number of CRW employees, the two agencies will separately negotiate an employee transfer agreement complying with ORS 236.605-236.640.

DECISION: FOCUS ON CUSTOMERS OR ON PIPES?

Cost, Market, and Income

In business valuation—including for utilities—there are three general methods traditionally used to develop a fair value estimate: Cost, Market, and Income. The Cost method looks at what the owners invested to build or acquire the assets; the Market method looks at comparable sales; and the Income method looks at the future income potential of the business. Each method has several sub-methods.

For utilities, the Market method (based on comparable sales) is noticeably weaker than the other two, simply because water systems are not sold very often. However, the Cost and Income method are quite useful and potentially relevant to Oregon City and CRW. This leads to a judgment call in constructing a standard methodology for the two agencies: should we focus on customers or pipes?

Customers vs. Assets

Utilities are both a set of *customers* and a set of *assets*. Customers generate revenue. If they are existing customers, they generate monthly rate revenue, so transferring customers reduces revenue to one party and increases it to another party. If the service area being transferred is undeveloped land, then the development process can generate revenue from Systems Development Charges (SDCs).

Assets generate costs. Water system assets can include treatment facilities, water rights, pumps, buildings, vehicles and equipment, pipes, hydrants, meters, and services. These assets must be maintained and receive periodic capital investment. If the area transferred includes undeveloped land, the transfer includes the responsibility for planning and investing in future capital improvements.

The conflict areas described in this study are all relatively small parts of a water system rather than an entire system. No pumps, treatment facilities, or water rights are being considered for transfer. If the two parties choose to focus on the cost of the assets being transferred, those assets can be understood to consist of pipes and the things associated with a length of pipe—hydrants, valves, services, and meters along with the mains.

Both the Cost method and the Income method of valuation can yield useful insights into the value of a water system or subsystem. When FCS Group performs a full appraisal of a utility, we look at both methods closely before choosing the method that best fits a given set of facts. In this case, any methodology we recommend needs to be one that can be unambiguously applied by both agencies at some indeterminate time in the future. Simplicity and reliability are at a premium.

SUGGESTED FOCUS – COST OF ASSETS

Our recommendation in this case is that the standard methodology focus on the *cost* of the transferred pipe and other assets, not on the potential income from the transfer of customers and undeveloped land. Following are the reasons for this recommendation.

- The Cost method would be easier to replicate in the future without the help of a consultant.
- The Cost method relies on data from the past rather than projections about the future. While historical data is rarely as complete as we might wish, at least the basic facts are relatively unambiguous, so both parties could readily reach agreement on the remuneration value.
- With the Income method, more subjective judgment is needed, particularly with respect to:
    - What discount rate to use in the discounted cash flow forecast;
    - What growth rate to assume for undeveloped land; and
    - How to deal with stranded overhead and fixed plant capacity costs.

  The discount rate in particular can make a big difference to the outcome, and it is inherently a subjective judgment.

- With the Cost method, the data is not always clean, but there are ways to deal with incomplete data that can be agreed to in advance.
- Finally, the pipes and other assets are what the City and CRW managers themselves focus on most when they discuss this subject.

We recognize that there is a revenue impact to a service area transfer. However, a methodology based on asset costs will best fit the two agencies' mutual goals.

MEASURING THE COST OF ASSETS

Even after deciding to focus on the cost of assets, we still need to decide how to measure that cost in particular instances. There is more than one way to measure an agency's prior investment in a group of assets, so we will next consider which method best applies in this case.

Criteria

In choosing a way to measure CRW's investment, we use two main criteria. These criteria should ensure that each agency has the right incentives during the interim period before asset transfer.

(1) CRW should be made whole for its prior investment in system assets.

Given the uncertain pace of development and annexation, as long as part of its service area is within the UGB, CRW should have the incentive to make needed investments without having to worry about those investments being stranded by a City takeover of assets without adequate compensation. Facing a choice about whether to invest in assets, CRW should be indifferent to the possibility of future City withdrawal of those assets. This is Criterion #1.

There can be a consultation requirement for new water line extensions within the UGB, to allow the City to raise objections before CRW makes a particular investment. It is also reasonable for the pipe design and construction standards to match the City's requirements, given that the City will eventually be maintaining the pipe. That is analogous to developers having to meet the utility's standards when installing infrastructure that is to be accepted by either CRW or the City.

For developer-built infrastructure, the asset value should be zero, since there is no CRW ratepayer investment in those lines. However, if a water line originally built by a developer is later replaced by CRW, then the replacement cost should be included in the remuneration value.

(2) The remuneration method should take into account the age of the assets, as a surrogate measure for their physical condition.

The City should not have to worry about paying "like-new" prices for a set of pipes and then having to replace those pipes in just a few years because they are so deteriorated.

Sometimes pipes must be replaced prematurely because of growth—they may be too small for the demand generated by the next subdivision down the line. That is different from replacement due purely to age and condition. In designing a remuneration methodology, Criterion #2 is to make sure that the risk of having to reinvest for age-related reasons is taken into account in the price.

Potential Measures of the Cost of Assets to be Transferred

Original Cost Less Depreciation (OCLD)

This is the "net book value" of an asset after subtracting developer-funded infrastructure. It is also known as the value of the "remaining useful life" of the asset. It is simply whatever CRW originally spent on an asset minus accumulated depreciation since the year of construction.

This measure requires a way to allocate the cost from the original construction area to the area being transferred. It also requires some reasonable assumptions—which can be agreed upon in advance—about the estimated useful life of the assets.

This measure works best when historical cost records are available, but it can still be used (with agreed-upon assumptions) without original historical cost records.

This measure directly addresses Criterion #1, by ensuring that CRW receives what it put into the assets, adjusted only for the degree to which the asset is "used up" over time.

Reproduction Cost Less Depreciation (RCLD)

This method consists of the estimated reproduction cost in today's dollars, then subtracting developer-funded infrastructure and accumulated depreciation.

This method is sometimes used by state public utilities commissions to determine how much "rate base" to allow a private water company after the acquisition of another system. However, in this case, the two parties do not include a regulated private water company whose rate-setting is limited by its calculated rate base. Both parties are municipal utilities with authority to set rates as needed to meet current and future costs.

Like OCLD, this measure also requires a way to allocate the cost from the original investment area to the area being transferred. It also requires some reasonable assumptions—which can be agreed upon in advance—about the estimated useful life of the assets.

This measure can be used regardless of the availability of historical cost data. However, it would require updated estimates of reproduction unit costs each time a transfer took place.

This measure will yield a higher cost than the OCLD. By starting with reproduction cost, it is more detached from what CRW actually paid for an asset.

Percentage of Debt Service

There is another method that is unambiguous in its administration even though it is really based on revenue rather than asset cost. That is to have the City pay for a percentage of the District's debt service equal to the percentage of total rate revenue that comes from the transferred service area. In other words, if a transferred area generates 1.5% of the total CRW rate revenue at the time of the transfer, the City would pay 1.5% of the debt service each year on the debt that is outstanding at the time of the transfer, until that debt is retired. If that debt is refunded and replaced for more favorable financing terms, the City's payment would be reduced in proportion with the reduction in CRW's debt service.

This method focuses on making CRW whole not for its capital investment—in fact, it is not even related to the amount of capital investment in a particular set of assets. Instead, it focuses on making

CRW whole by ensuring receipt of the amount of revenue that would have been generated by customers in the transferred area for their proportionate share of debt service. In other words, at the time of a transfer, it allows CRW to ensure that it can still pay its already-committed debt service without raising rates on everyone else.

This method is used in some agreements between districts and cities in Washington. (Like Oregon statutes, Washington statutes give cities the right to withdraw territory from a district after annexation.) One agreement between a city and district in Washington uses a hybrid approach—if the assets are less than ten years old, the district receives the Original Cost Net Less Depreciation, and if the assets are ten or more years old, the "percentage of debt service" method is used.

The assurance of receiving the same share of debt service has some appeal for districts in cases where the amount of service area taken by the city might be a significant share of the district's territory. It guarantees that a district will not have stranded debt, no matter how much territory is withdrawn at one time.

This method can also be readily calculated by staff without ambiguity and without help from consultants. This is the simplest of the three alternatives to administer.

However, the "percentage of debt service" approach has some notable drawbacks.

- First, it ignores equity-funded capital investments—those paid for with reserves or current rates. Instead, it only takes into account debt-funded capital investment. If a district's capital program were 100% funded by debt, then this method would compensate for a proportionate share of all asset costs, but that is rarely the case. In this case, CRW capital is mostly funded by current rates, so this method would result in lower compensation than the actual cost of the assets.
- Secondly, it does not at all meet Criterion #1, which is for CRW to have an incentive to invest in the system. Because this method is disconnected from the cost of a particular set of assets, and because there may be little relationship between the geographic distribution of rate revenue and the location of capital projects, CRW would have a disincentive to extend a water line into a previously unserved area, particularly if that area is ready for development but with few customers at present.

Recommended Approach

We recommend Original Cost Less Depreciation (OCLD).

It directly addresses the two criteria, giving both parties the incentive to make logical capital investment decisions during the interim period before service area withdrawal.

Conceptually, it is the most straightforward of the three methods discussed here. It can be calculated by the staff without ambiguity. Although it is dependent on historical data that might be incomplete, there can be agreed-upon ways of addressing situations where data on historical costs is limited.

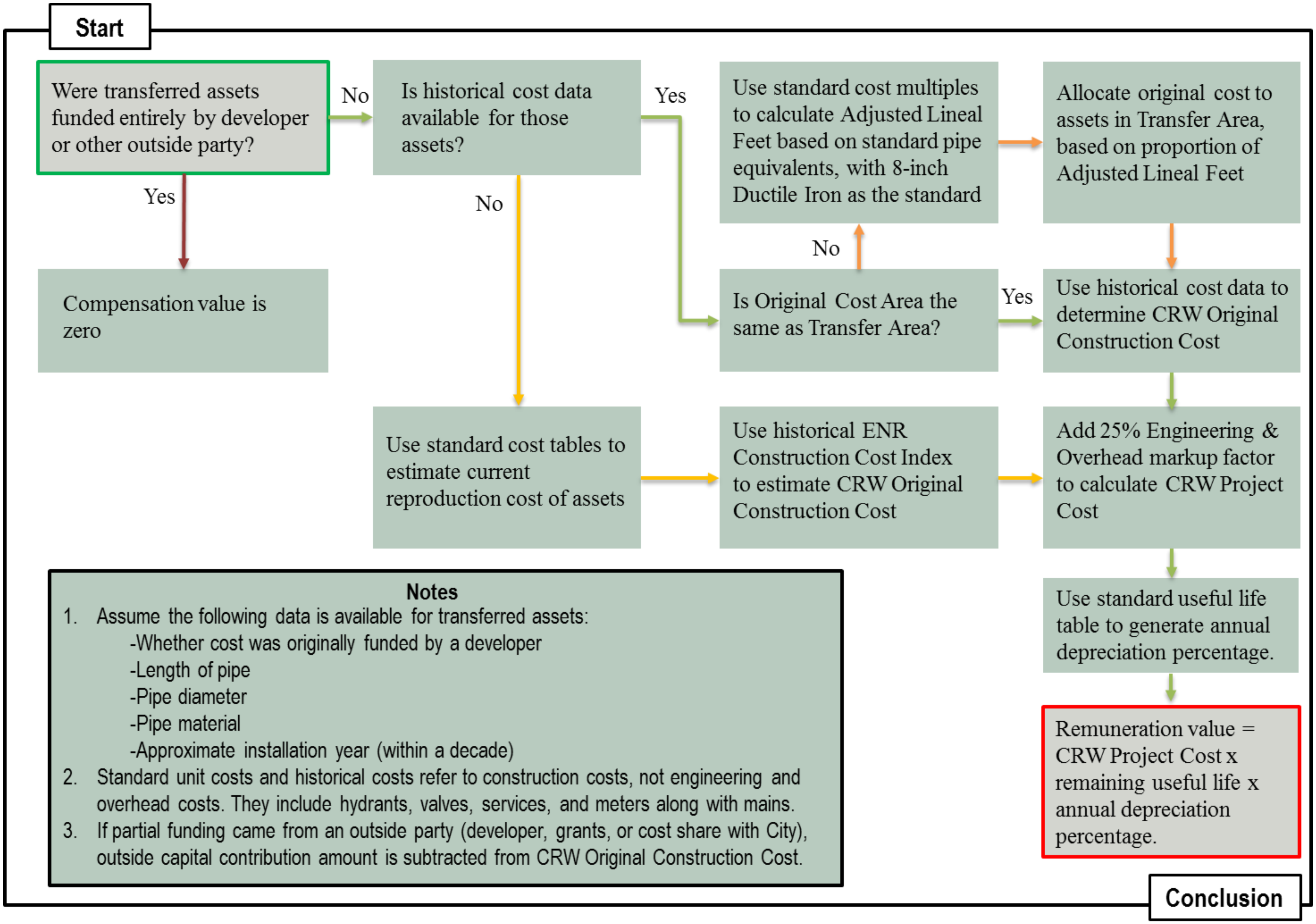
The conflict areas in this study are small, so for CRW, the potential for stranded debt is not a major risk and the "Percentage of Debt Service" method would have no appeal.

SECTION 2: HOW TO CALCULATE ORIGINAL COST LESS DEPRECIATION

OVERVIEW OF METHODOLOGY

Exhibit 2 on the following page gives an overview of the step-by-step approach to determining the Original Cost Less Depreciation. The required steps depend on what data is available and how the assets were originally funded. These steps are described more fully in the subsequent narrative.

Exhibit 2: Calculation Methodology – Remuneration Value of Water System Assets Transferred from CRW to Oregon City



INFRASTRUCTURE FUNDED BY OUTSIDE PARTIES

The first step is to ask whether any portion of the transferred assets were paid for by a developer or other outside party.

Any part of the transfer area that consists *entirely* of developer-built infrastructure would carry a remuneration value of zero, because CRW ratepayers did not invest in the infrastructure.

If *part* of the cost of an asset was funded by an outside party, then the amount of the outside capital contribution should be excluded from the calculation of the remuneration value, so that CRW is just being compensated for its own ratepayer investment.

- *Ratepayer investment* includes not only cash funding of capital projects but also proceeds of debt that is repaid by rate revenue—either past debt service already paid or future debt service yet to be paid. Either way it counts as ratepayer investment.

In addition to developer-built infrastructure, funding from outside parties could mean a State or federal grant, or it could mean cost-sharing from other agencies--including the City's contribution to the cost of the pipe in South End Road.

Even if a pipe was initially installed by a developer, if CRW made subsequent capital renovations of the pipe, that pipe does have a value based on its cost of renovation.

The general principle is that CRW should be compensated for the cost of that portion of its assets for which its ratepayers were the ultimate source of capital funding.

What if the records are unclear about whether a particular segment of pipe was developer-built or not?

- In that case, a reasonable guess will need to be made by CRW and discussed with the City, based on similar developments of the same approximate age and CRW development policies at the time. If there is no knowledge of standard development policies at the time that a particular set of pipe was constructed, a reasonable default assumption would be that any pipe serving a residential street was built by developers and that the larger pipe connecting neighborhoods was built by CRW.

AVAILABLE DATA

The next step is to consider what historical cost data is available.

This standard methodology assumes that CRW will have good information about its current asset inventory but not necessarily information about when those assets were built or how much they cost. The following data or some reasonable assumptions are needed for the model:

Length of Pipe – CRW should have this data in its inventory.

Pipe Diameter – CRW should have this data in its inventory.

Pipe Material – If this data is not in the CRW inventory, discussion with the City might be needed to arrive at an agreed-upon assumption. It can usually be inferred by the approximate year of installation, along with the type of pipe used in other areas of the same vintage.

Year of Installation – This data may or may not be available in CRW's records. If it is not, a reasonable assumption might need to be made by CRW staff and discussed with the City. Based on a combination of file research and the memory of long-time employees (of either CRW or County development staff), the staff should estimate the approximate decade in which a particular development was built, then assume the midpoint in that decade. In this estimate, our goal is not perfection but the best available.

Original Cost – There might or might not be historical cost data available for a given set of pipes proposed for transfer to the City. The following sections of this memo address both possibilities.

WHEN HISTORICAL COST DATA IS AVAILABLE

Original Cost Area and Transfer Area

Even when historical cost data is available, it is possible that the area to which the original construction data applies is not the same as the area proposed to be transferred to the City. For the sake of explanation, we will refer to two types of boundaries: *Original Cost Area* and *Transfer Area*. These two geographic areas might contain a different set of pipes.

Original Cost Area is defined by the geographic scope of the original construction project when the pipe was first built. Historical cost data applies to the Original Cost Area.

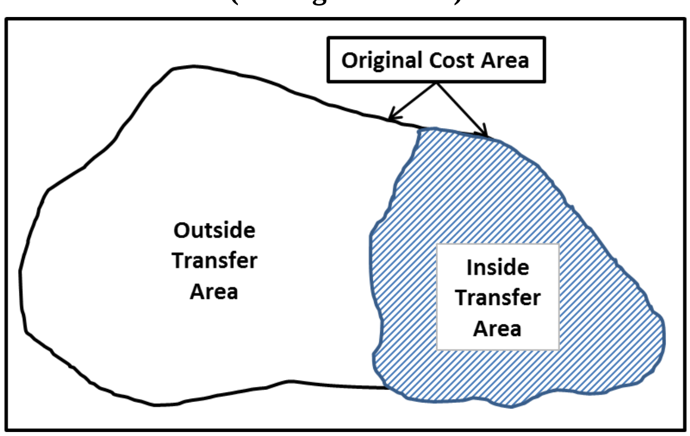
Transfer Area is the area containing the assets that are being transferred to the City.

Potential Types of Correspondence

There are three possible types of correspondence between Original Cost Area and Transfer Area. In this explanation, we will call them Configuration A, B, and C.

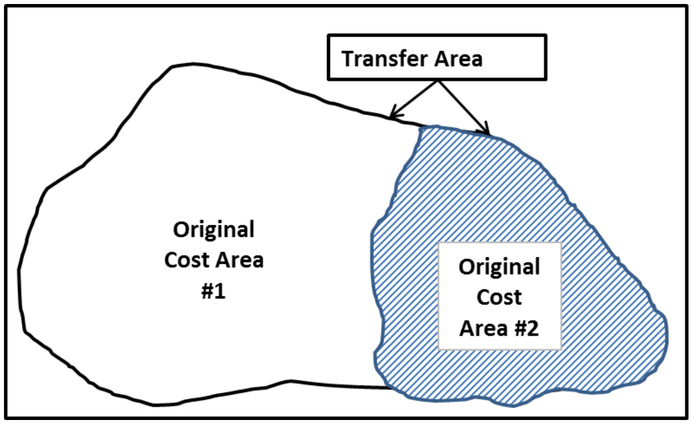
When an area is proposed for transfer from CRW to the City, the staff might find that the original cost data applies to an area that is larger than the Transfer Area, and that the Original Cost Area includes all of the Transfer Area. This is Configuration A, depicted in **Exhibit 3**. We will describe later how this allocation is to be done. In this case, the original costs will have to be allocated between Inside Transfer Area and Outside Transfer Area.

Exhibit 3: Allocate Original Cost Area Between Inside and Outside Transfer Area (Configuration A)



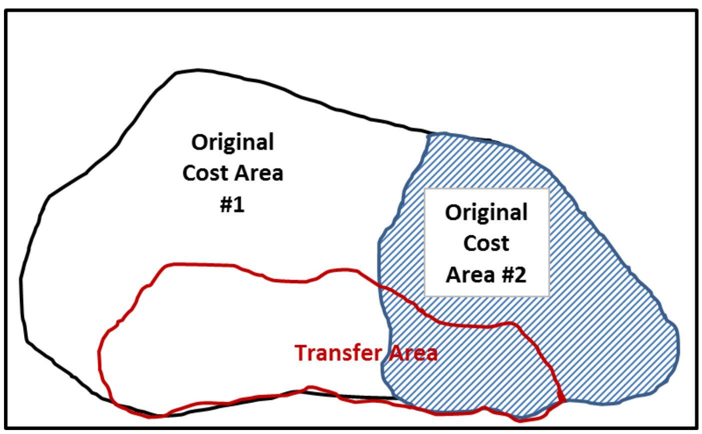
Another possibility is that the Transfer Area is a combination of more than one Original Cost Area. This is Configuration B, depicted in **Exhibit 4**. In this case, all that is needed is to simply add together the OCLD of each Original Cost area.

Exhibit 4: Sum Together Two or More Original Cost Areas (Configuration B)



Finally, the Transfer Area might be a subset of more than one Original Cost Area. This would be Configuration C, illustrated in **Exhibit 5**.

Exhibit 5: Allocate Multiple Original Cost Areas, then Sum Inside Transfer Areas (Configuration C)



In this case, more than one Original Cost Area should be allocated between Inside Transfer Area and Outside Transfer Area. After that calculation, all the Inside Transfer Areas would be summed together to arrive at the remuneration value for the combined Transfer Area. **Exhibit 6** illustrates an allocation with Configuration C, where neither Original Cost Area nor Transfer Area fit inside the other. The data is based on an actual utility valuation. It looks complicated, but it works reliably.

Exhibit 6: Example Valuation When Transfer Area Differs from Original Cost Area

Geographic Areas>>>			Area to be Transferred to City				
	Original Cost Area						
			Costa Estates				
Valuation Components	Total Original Cost Area	Sheldon Acres	Forest Village	Peak View	Total Costa Estates	Green Mountain	Total Transfer Area
District Investment							
Original Construction Cost	$ 2,837,518	$ 953,817	$ 30,077	$1,781,181	$1,883,701	$ -	$1,883,701
Subsequent Capital Improvements	4,401,786	1,612,503	553,692	2,079,315	2,761,354	25,000	2,846,354
Total District Investment	$ 7,239,303	$ 2,566,320	$ 583,769	$3,860,496	$4,645,055	$ 25,000	$4,730,055

Partial Knowledge

Looking at Configuration C raises the question: what if we know the historical costs for one area and do not know the historical costs for another area? That answer is that allocating historical costs between Inside and Outside Transfer Area only is needed when there are historical costs to allocate. If there are no historical costs, a different method is used—one that does not require allocating between different areas. That other method is the standard unit cost table, which is discussed below.

So in the situation depicted above in **Exhibit 5**, imagine that we have records of the original construction costs for Original Cost Area #1, but for Original Cost Area #2, we do not. In that case, the person generating the remuneration value would:

- Allocate the actual historical costs for Original Cost Area #1 between Inside Transfer Area and Outside Transfer Area; then,
- Use the standard unit cost method to estimate the OCLD of just the Inside Transfer Area part of Original Cost Area #2; and then,
- Sum the OCLD of the two Inside Transfer Areas.

Whenever any actual historical costs are available, they are preferable to using the standard unit cost method, even though the actual historical costs might have to be allocated across different areas.

Allocating an Original Cost Area Between Inside and Outside Transfer Area

For this section, we'll assume that historical cost data is available but needs to be allocated between Inside and Outside the Transfer Area. How should that be done?

The simplest approach would be to calculate the average cost per foot (total construction cost divided by total lineal feet) and multiply that unit cost by the number of lineal feet inside the Transfer Area. However, simple lineal feet might not yield an accurate result, so an adjustment is needed to control for the size and type of pipe.

For example, it is possible that an original area included a construction project with a 12" main along a major road along with some smaller 6" mains along side streets, and that the transfer area consists of just the 6" mains. (That seems like a realistic scenario, because the 12" main along the major road might need to remain with CRW for the sake of connectivity.) In that situation, if we simply allocate the construction cost by the number of lineal feet of mains, we will be over-valuing the transfer area.

Standard Pipe Equivalents

We suggest creating a new metric to create equivalence. For this discussion, we call it a "standard pipe equivalent," where the standard pipe is assumed to be an 8" ductile iron pipe. Each type of pipe material can be assigned a standard percentage equivalency in relation to the cost of ductile iron. Similarly, each size of pipe can be assigned a standard multiple in relation to the cost of 8" pipe. The goal of the equivalence factors would be to create a unit cost that can be compared with some other type and size of pipe.

In developing relative cost factors, local is better than national estimates, and recent is better than older estimates. The two parties should agree in advance about which factors should be used in defining the equivalent unit.

Our suggested equivalence factors are shown in **Tables 1 and 2**.

Table 1: Assumed Equivalence for Pipe Material (Table 1 from Model)

Assumed % of Ductile Iron Cost for a Given Size Pipe	
Asbestos Cement	84%
Cast Iron	80%
Ductile Iron	100%
HDPE	70%
PVC	80%
Steel	123%

Table 2: Assumed Equivalence for Pipe Size (Table 2 from Model)

Assumed Multiple of 8" Cost for a Given Pipe Material	
1"	0.43
1.5"	0.49
2"	0.54
2.5"	0.69
3"	0.70
4"	0.78
6"	0.91
8"	1.00
10"	1.11
12"	1.19
14"	1.49
16"	1.51
20"	1.73
24"	1.95
36"	2.16

Sources

Where did these cost relationships come from? It is difficult to assemble enough data from actual bid tabulations from any one utility for the various potential pipe sizes and materials. Some of our past clients have taken the time to compare the cost of various sizes of pipe, but not many do a cost comparison for both size and material of the pipe. However, we performed an appraisal for the City of Vallejo, California in 2012, which had unit costs provided by the engineering firm CH2M for a wide range of pipe sizes and also pipe materials. We had also accumulated from various clients over time a set of cost relationships that dealt with pipe size only, but which included some sizes not found in Vallejo's pipe inventory. So we used that secondary source to fill in gaps in the Vallejo data. That combined set of unit costs became the starting point for the assumed cost relationships between different pipe sizes and materials, shown in Tables 1 and 2.

Terminology: "*Tables*" are part of the model; they are used in the actual calculation of the remuneration value. "*Exhibits*" are only part of the memo; they are used only for explanation or illustration. **Appendix A** shows all of the tables in order.

There are obvious limits with these sources. The CH2M unit costs were developed for a particular situation in northern California in 2012, not intended for use in Oregon in 2017. Those unit costs provided the differentiation we need between pipe sizes and materials, but as we noted earlier about cost estimates, local is better than national, and recent is better than older. So we asked the staff from the Portland office of Murraysmith to review the unit costs in light of their recent experience with construction projects in the Portland area. The Murraysmith staff made some adjustments and brought the whole table up to 2017 price levels. The result was a table of standard unit costs (Table 3 in the model, shown later in this memo). The source data is shown in **Appendix B**.

We have gone into detail in describing the source of the standard estimates in order to convey their limitations as well as their advantages. We do not want to oversell these tables, but even while being clear about their limitations, we believe that they provide a reasonable basis for differentiating between the cost of 8" ductile iron pipe and the cost of alternate materials and sizes. This makes them useful for helping Oregon City and CRW arrive at agreed-upon cost estimates at some future date. Based on discussions with staff from both the City and CRW, our understanding is that these standard cost assumptions are acceptable to both parties.

Example – How to Use Standard Pipe Equivalents

For an example, we will assume an original area that contained 600 lineal feet of 12" ductile iron main plus 1,800 lineal feet of 8" cast iron main. Of that total original area, only the 8" cast iron is proposed to be transferred, while the 12" ductile iron is proposed to be retained by CRW.

Exhibit 7 shows the allocation of a $360,000 construction cost between the two groups of pipe, both with and without an adjustment for standard pipe equivalents.

Exhibit 7: Example Allocation With and Without Adjustment for Standard Pipe Equivalents

Illustration of Use of Standard Pipe Equivalents	Total	12" Ductile Iron Pipe	8" Cast Iron Pipe
		Outside Transfer Area	Inside Transfer Area
Actual Construction Cost	$ 360,000		
Lineal Feet - Original Cost Area	2,400	600	1,800
Cost per Lineal Foot (Unadjusted)	$ 150.00		
Allocation without Adjustment	$ 360,000	$ 90,000	$ 270,000
Adjustment to Standard Pipe Equivalents:			
Adjustment Factor - Pipe Size		1.19	1.00
Adjustment Factor - Pipe Material		100%	80%
Adjusted Lineal Feet	2,154	714	1,440
Cost per Adjusted Lineal Foot	$ 167.13		
Allocation with Adjustment	$ 360,000	$ 119,331	**$ 240,669**
Impact of Adjustment	$ -	$ 29,331	$ (29,331)

If we simply allocate the total cost according to total lineal feet, we end up with an allocated construction cost of $270,000 for the transfer area. That is because each lineal foot in this example cost an average of $150.00 to construct, and there are 1,800 lineal feet inside the transfer area. (This is before adding an overhead factor, discussed later in this memo.)

However, if we adjust for the relative cost of various pipe sizes and materials, the picture changes. Following Tables 1 and 2, a 12" main carries a standard multiple of 1.19 times the unit cost of an 8" main, and a cast iron main is assumed to be on average 80% of the cost of a ductile iron main. So the

"Inside Transfer Area" segment would be 1,800 x 1.00 x 80% = 1,440 adjusted lineal feet, and the "Outside Transfer Area" segment would be 600 x 1.19 x 100% = 714 adjusted lineal feet. The total length of standard pipe equivalents is now 2,154 adjusted lineal feet, and the construction cost averages $167.13 per adjusted lineal foot. Because CRW in this example would be retaining the larger pipe with a higher-quality material, the construction cost allocated to the transfer area would only be $240,669 instead of $270,000—a difference of $29,331.

WHEN HISTORICAL COST DATA IS MISSING

What if there is no historical cost data? In that case there is no need to reconcile the Original Cost Area with the Transfer Area, since there is no Original Cost Area. There is only a Transfer Area, with a known set of pipes of a certain length, material and approximate vintage.

Where there is no historical cost data, developing an Original Cost is a two-step process. First, we use a standard unit cost table to estimate current reproduction cost—what the pipe would cost if built today. Then we use the Engineering News-Record Construction Cost Index (ENR-CCI) to project backwards in time, generating an estimate of what the pipe would have cost when it was installed.

Standard Unit Cost Table for Current Reproduction Costs

We described earlier our process of developing the standard unit costs. Those standard unit costs are shown in **Table 3**. This is our primary tool for dealing with areas where there is missing historical cost data.

Table 3: Standard Unit Costs as of 2017 (Table 3 from Model)

Benchmark Year for Cost Estimates	**2017**	8" Ductile Iron Unit Cost in Benchmark Year	**$159/LF**
Assumed Reference Year	**2017**	8" Ductile Iron Unit Cost in Reference Year	$159/LF

Assumed Reproduction Unit Costs of Water Pipe by Material and Size in Transfer Year 2017						
Size	**Asbestos Cement**	**Cast Iron**	**Ductile Iron**	**HDPE**	**PVC**	**Steel**
1"	57	55	68	48	55	84
1.5"	65	62	78	55	62	96
2"	72	69	86	60	69	106
2.5"	92	88	110	77	88	135
3"	93	89	111	78	89	137
4"	104	99	124	87	99	153
6"	122	116	145	101	116	178
8"	134	127	159	111	127	196
10"	148	141	176	124	141	217
12"	159	151	189	132	151	233
14"	199	190	237	166	190	291
16"	202	192	240	168	192	295
20"	231	220	275	193	220	338
24"	260	248	310	217	248	381
36"	288	275	343	240	275	422

Note: the unit costs shown above represent construction cost only; a 25% markup for engineering and overhead is added later in the calculation. These unit costs are intended to include not just the actual pipe but also the appurtenances (hydrants, valves, services, meters, etc.) customarily installed along with a water line extension.

In the earlier example (where the transfer area consisted of 1,800 lineal feet of 8-inch cast iron pipe), if historical costs are unavailable, then a current reproduction cost can be estimated by multiplying 1,800 lineal feet by the standard unit cost ($127/LF in 2017). This is illustrated in **Exhibit 8**.

Exhibit 8: Example Using Standard Unit Costs When Historical Cost Data is Missing

Illustration of Use of Standard Cost Table	8" Cast Iron Pipe
	Inside Transfer Area
Construction Cost	
Lineal Feet - Transfer Area	1,800
Cost per Lineal Foot (Table 3)	$ 127.00
Estimated Construction Cost	$ 228,600

Keeping the Standard Unit Costs Up-to-Date

Table 3 has unit costs for 2017. How can we update those costs in future years when an asset transfer might take place? We suggest one of two approaches. Either the unit costs can be benchmarked again using bid data, or—more simply—the table can be adjusted for ENR-CCI inflation.

Terminology: Benchmark Year and Reference Year

In this discussion we will use two terms: "benchmark year" and "reference year." The *benchmark year* is the year for which the most recent unit cost estimates were generated. In this case that is 2017, based on the date of the cost review by Murraysmith. The benchmark year will probably not change often, even when the reference year is changed.

The *reference year* is the most recent year for which a full year of ENR-CCI data is available, at the time a service area transfer is being planned. For example, for a transfer that is scheduled to take place on July 1, 2019, the most up-to-date estimate of the remuneration value could be generated in January of 2019, after the ENR index have been published for all twelve months of 2018. In this example, the *reference year* would be 2018, the year before the planned transfer date. The unit cost tables are set to automatically adjust with the ENR-CCI, but only if the "reference year" cell has been set to the most recent year of ENR index data and that data has been entered into the model. There is now ENR data for all of 2017, so in the model delivered with this memo, the reference year is 2017.

Updating the Benchmark Data

If the two agencies want to update the benchmark costs, one way to do it is to get a recent bid for the construction of 8" ductile iron pipe and divide by the number of lineal feet, leaving the relationship with other pipe sizes and materials as they are in Tables 1 and 2. If that approach is used to update the cost table, then the top row in Table 3—the benchmark year and the benchmark cost per foot of 8" ductile iron pipe—should have new values entered. In the model, the other values in this table will automatically change with the "8-inch Ductile Iron Unit Cost in Benchmark Year" cell.

Adjusting Unit Costs Using the ENR Construction Cost Index

Updating the benchmark data would be a research project that might take a lot of staff time. A simpler alternative is to use the ENR-CCI to escalate the unit costs. Furthermore, even if new benchmark data is generated, there still might be a need to make an inflation adjustment, just because the only available bid tabs for an updated benchmark might have been from a project 3 or 4 years earlier. How should unit costs be updated using the ENR Construction Cost Index?

In the model, updating the unit cost table with the ENR-CCI has two steps. First, enter the most recent ENR-CCI data; second, update the "reference year" in Table 3.

Entering ENR-CCI Data

Exhibit 9 shows recent monthly values for the 20-City Average ENR-CCI. The values through December 2017 are real. The values for January through December 2018 (highlighted in yellow) are hypothetical—they simply assume 4% inflation during the twelve months.

Exhibit 9: Monthly Values of 20-City ENR-CCI (Excerpt from Table 4 in the Model, with Hypothetical Data for January-December 2018)

YEAR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL AVERAGE
2015	9,971.96	9,961.75	9,972.38	9,992.34	9,975.48	10,036.38	10,037.40	10,038.79	10,065.09	10,128.32	10,092.38	10,135.00	**10,034**
2016	10,132.55	10,181.92	10,242.09	10,279.94	10,315.44	10,337.05	10,379.26	10,385.65	10,403.43	10,434.56	10,442.61	10,530.94	**10,339**
2017	10,542.01	10,558.63	10,667.39	10,678.15	10,692.17	10,702.81	10,789.41	10,826.31	10,822.92	10,817.11	10,870.06	10,873.46	**10,737**
2018	10,963.69	10,980.98	11,094.09	11,105.28	11,119.86	11,130.92	11,220.99	11,259.36	11,255.84	11,249.79	11,304.86	11,308.40	**11,166**
2019													**#N/A**
2020													**#N/A**
2021													**#N/A**

Hypothetical values for Jan-Dec 2018.

Not Valid Until Entire Year Filled

The rightmost column is the average of the values for each month of the year. After a year is completed and the monthly values are entered, the yearly average value can be used to update the unit costs to account for inflation between the benchmark year and the reference year.

A more complete version of this table is shown as Table 4 in Appendix A. When the time comes to generate a new remuneration value estimate, this data will need to be updated. You can either look it up on the ENR web site or you can call FCS GROUP for historical ENR-CCI data.

Updating the Reference Year

After entering the most recent ENR-CCI data, a new reference year will need to be entered at the top of Table 3. The entire table is then updated automatically. **Exhibit 10** shows what this would look like, assuming a transfer date in 2019 and the same inflation we saw in Exhibit 9 for 2018.

Exhibit 10: Unit Cost Table Incorporating Hypothetical Inflation through December 2018

Benchmark Year for Cost Estimates	**2017**	8" Ductile Iron Unit Cost in Benchmark Year	**$159/LF**
Assumed Reference Year	**2018**	8" Ductile Iron Unit Cost in Reference Year	$165/LF

Assumed Reproduction Unit Costs of Water Pipe by Material and Size in Transfer Year 2018

Size	Asbestos Cement	Cast Iron	Ductile Iron	HDPE	PVC	Steel
1"	60	57	71	50	57	87
1.5"	68	65	81	57	65	100
2"	75	71	89	63	71	110
2.5"	96	91	114	80	91	140
3"	97	93	116	81	93	142
4"	108	103	129	90	103	159
6"	126	120	150	105	120	185
8"	139	132	165	116	132	203
10"	154	147	184	128	147	226
12"	165	157	197	138	157	242
14"	207	197	246	172	197	303
16"	210	200	250	175	200	307
20"	240	229	286	200	229	352
24"	271	258	322	226	258	397
36"	300	286	357	250	286	439

Hypothetical with 2018 inflation data

In this example, our benchmark costs still came from 2017—that hasn't changed. However, the reference year for these cost estimates is a year later—2018 instead of 2017. As a result, the cost of 8" ductile iron pipe is no longer $159 per lineal foot; it is now assumed to be $165 per lineal foot because of the extra year of inflation. The other costs in the table are updated proportionately.

Caution – Enter Inflation Data *Before* Changing the Reference Year

Just as a cautionary note, **Exhibit 11** shows the unit cost table if we specify 2019 as the reference year but no ENR data has been entered for 2019. It doesn't work. The model cannot adjust unit costs to a year for which inflation data has not been entered.

Exhibit 11: Unit Cost Table Where ENR-CCI Data Has Not Been Entered for Reference Year

Benchmark Year for Cost Estimates	2017	8" Ductile Iron Unit Cost in Benchmark Year	$159/LF
Assumed Reference Year	2019	8" Ductile Iron Unit Cost in Reference Year	#N/A

Assumed Reproduction Unit Costs of Water Pipe by Material and Size in Transfer Year 2019						
Size	**Asbestos Cement**	**Cast Iron**	**Ductile Iron**	**HDPE**	**PVC**	**Steel**
1"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.5"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.5"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
4"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
6"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
8"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
12"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
14"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
16"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
24"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
36"	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Hypothetical where 2019 is the reference year but no ENR inflation data has been entiered for 2019

Projecting Backwards to Develop Estimated Original Costs

We mentioned earlier (way back, on page 15) that when historical cost data is missing, a two-step process is required. The first step was to use the standard unit cost table, after making sure that the unit costs are up-to-date.

The second step is to project current replacement costs backwards in time to the estimated date when the assets were built, using the historical ENR-CCI.

The unit cost table is useful for estimating *current* reproduction costs (including what might be "current" at some point in the future). However, our methodology for determining the remuneration value depends on the *original* cost of the transferred assets, not the current reproduction costs. The transferred assets might have been built in 2010 or 1980 or 1950. Because of inflation over time, there can be a big difference between the original cost and today's reproduction cost.

In the model accompanying this memo, Table 5 contains the annual average ENR-CCI (averaged over a sample of 20 cities across the country) for each year extending back to 1908. That table is shown in its entirety in Appendix A. A subset of those data points, showing the index every five years, is shown below in **Exhibit 12**.

Exhibit 12: Historical Data from ENR-CCI (Selected Data Points from Table 5)

Engineering News-Record (ENR) 20 City Average Construction Cost Index (CCI)
Assumed Reference Year: 2017

Year	ENR CCI (Yearly Avg)	Yearly Increase	2017 Cost as Multiple of Original Cost	Original Cost as % of 2017 Cost
1908	97	N/A	110.69	0.9%
1910	96	5.5%	111.84	0.9%
1915	93	4.5%	115.45	0.9%
1920	251	26.8%	42.78	2.3%
1925	207	-3.7%	51.87	1.9%
1930	203	-1.9%	52.89	1.9%
1935	196	-1.0%	54.78	1.8%
1940	242	2.5%	44.37	2.3%
1945	308	3.0%	34.86	2.9%
1950	510	6.9%	21.05	4.8%
1955	660	5.1%	16.27	6.1%
1960	824	3.4%	13.03	7.7%
1965	971	3.7%	11.06	9.0%
1970	1,381	8.8%	7.77	12.9%
1975	2,212	9.5%	4.85	20.6%
1980	3,237	7.8%	3.32	30.1%
1985	4,182	0.8%	2.57	39.0%
1990	4,732	2.5%	2.27	44.1%
1995	5,471	1.2%	1.96	51.0%
2000	6,221	2.7%	1.73	57.9%
2005	7,446	4.7%	1.44	69.4%
2010	8,802	2.7%	1.22	82.0%
2015	10,034	2.3%	1.07	93.5%
2016	10,339	3.0%	1.04	96.3%
2017	10,737	3.8%	1.00	100.0%

The reference year shown here is 2017. So in this table, the fourth column shows costs in 2017 as a multiple of costs in a given historical year. The fifth column shows costs in a given historical year as a percentage of costs in 2017. In order to project backwards in time, the model automatically refers to Table 5, finds the year of construction for the assets, then multiplies the current reproduction cost of the assets by the percentage in the fifth column. For example, consider an asset with an estimated 2017 reproduction cost of $500,000 for which the estimated construction year was 1985. The estimated original cost of this asset in 1985 dollars would be 39.0% x $500,000, or $195,000. This approach obviously depends on a lot of averages and theoretical adjustments, but lacking real historical costs, this is a reasonable way to do it.

FINAL STEPS

So far we have developed an estimate of the CRW Original Construction Cost of the assets being transferred, using either actual historical data (with any needed adjustments to match the Original Cost Area with the Transfer Area) or using estimates from a standard unit cost table, which are then projected backward to the year of construction. We have made sure that the City is only compensating CRW for investments that CRW ratepayers have made in the assets, not for pipes paid for by developers, grants, or cost-sharing partnerships.

There are two more steps. One is to add an engineering and overhead markup factor. The other is to factor in depreciation.

Engineering and Overhead Markup Factor

The most readily measurable cost component in any construction project is the direct construction cost—what the contractor charges the owner for building a water line and its appurtenances. However, the full project cost also includes costs that are just as necessary, though less measurable. These "soft costs" include the engineering to design the capital project, project administration, construction inspection, and indirect support (payroll, accounts payable, etc.) for the people who directly perform the project administration, design, or construction.

The most common approach to these costs in intergovernmental contracts is for the parties to agree on a markup percentage that can be applied to the direct construction costs. Based on our experience with other agencies, we suggest a 1.25 markup factor, which implies that engineering and other soft costs average about 25% of direct construction costs. For example, if the Original Construction Cost of a set of pipes is $200,000, the Original Project Cost would be 1.25 x $200,000, or $250,000.

The managers from both the City and CRW indicated support for that factor, so that is built into the procedure we are documenting in this memo. In our terminology, "Original *Construction* Cost" is without the markup factor, while "Original *Project* Cost" includes the markup factor.

Depreciation

Depreciation is a theoretical construct that allows for the value of an asset to diminish over time as the asset becomes more physically or functionally obsolete. In our methodology we assume straight-line depreciation. Under straight-line depreciation, the annual charge simply consists of original asset cost divided by expected useful life. The *annual depreciation percentage* is the percentage of original cost subtracted from the asset value each year. This is calculated as 1 divided by the expected useful life. For example, if a water line is expected to last for 50 years, then the depreciation percentage is 2%, because 1 divided by 50 equals 2%.

With depreciation, the key variable is the expected useful life chosen for a particular type of asset—the longer the expected useful life, the more the remuneration value will be at a given asset age. **Table 6** shows the expected useful life assumptions that were discussed with and agreed upon by managers from both the City and CRW.

Terminology: *Remaining useful life* is the expected useful life minus the age of the asset, but not less than zero. "Net book value" refers to the original cost minus accumulated depreciation over the life of the asset. "Net book value" is also described as the *value of the remaining useful life*. For our purposes, the terms "net book value," "value of remaining useful life," original cost less depreciation" (OCLD), and "remuneration value" all mean the same thing.

Table 6: Assumed Useful Life of Various Types of Pipe

Assumed Asset Useful Lives, By Pipe Material		
	Useful Life	Deprec. %
Asbestos Cement	50 Years	2.00%
Cast Iron	75 Years	1.33%
Ductile Iron	100 Years	1.00%
HDPE	50 Years	2.00%
PVC	50 Years	2.00%
Steel	50 Years	2.00%

Calculating the OCLD

The simplest way to calculate the OCLD is to multiply three quantities: the CRW Original Project Cost, the annual depreciation percentage, and the remaining useful life (which is the expected useful life minus the age of the asset, but not less than zero).

For example, imagine steel water lines with an Original Project Cost of $100,000, to be transferred when 40 years old. In Table 6, steel pipes have a 50-year useful life, implying a 2% annual depreciation percentage. At the transfer date, there are 10 years of remaining useful life. Multiplying the 2% annual depreciation percentage by 10 years means 20% of the value remains. When applied to the $100,000 Original Project Cost, that means $20,000 of value is being transferred.

METHODOLOGY – SUMMARY OF STEPS

1. Examine what data is available about the assets in the transfer area.
2. If infrastructure is entirely developer-funded, then there are no further steps—the remuneration is zero. If there was outside funding that partially contributed to the cost of the assets, make sure that the cost figures only include CRW ratepayer investment.
3. If CRW invested in a group of assets, then research pipe length, diameter, material, installation year, and any relevant original cost figures for the initial construction and any subsequent renovations.
4. If there is data on original costs, compare the Original Cost Area with the Transfer Area. If needed, allocate the cost of pipes in one or more Original Cost Areas between Inside Transfer Area and Outside Transfer Area, and sum the allocated costs for all the Inside Transfer Areas. The allocation should be based on the number of adjusted lineal feet in standard pipe equivalents, where an 8" ductile iron pipe is the standard. Tables 1 and 2 are used for this adjustment. The result of matching up these areas should be a CRW Original Construction Cost for the assets in the Transfer Area.
5. If there is no data on original cost, use the standard cost table (Table 3) to generate a current reproduction cost. (If necessary, update the standard cost table for subsequent inflation by entering the most recent ENR data in Table 4 and then adjusting the reference year in Table 3.) From that point, project backwards in time using the ENR Construction Cost Index history (Table 5) to estimate the CRW Original Construction Cost for the assets in the Transfer Area at the time the pipe was installed. If there is no exact data on the installation year, estimate the decade and assume the midpoint in the decade.
6. After arriving at the CRW Original Construction Cost, add a 25% engineering and overhead markup factor to calculate the CRW Original Project Cost.
7. Based on the type of pipe and the standard useful life in Table 6, identify the depreciation percentage. The remaining useful life consists of the expected total useful life minus the age of this particular asset, but not less than zero.
8. The remuneration value consists of the value of the remaining useful life (also referred to as the "net book value" or the "Original Cost Less Depreciation" or "OCLD"). This is calculated by multiplying the CRW Original Project Cost, the depreciation percentage, and the remaining useful life.

CALCULATIONS FOR ACTUAL CONFLICT AREAS

Appendix A shows calculations for the actual conflict areas discussed in the Murraysmith study. For these estimates, CRW staff provided the pipe lengths, diameter, materials, approximate installation year, and (where available) historical cost information. Tables 1-6 contain the standard cost tables and ENR inflation tables. Tables 7-9 show how the remuneration value can be calculated. For the sake of illustration, the remuneration values in Table 9 assume a transfer year of 2020 for each of the conflict areas. In reality, this parameter would need to be specified whenever a particular area is being considered for transfer from CRW to the City, because the transfer year affects the remaining useful life, which in turn affects the remuneration value.

For the 2001 South End Road water line, the cost detail is shown in **Appendix C**. The Murraysmith analysis divided that project into five pipe segments. The first segment (between the old master meter near John McLaughlin Elementary School and the relocated master meter) was subject to a 50% cost-sharing agreement with the City. The remaining four segments were entirely paid for by CRW.

Because the cost detail for South End Road lumped together the CRW share of the cost, that cost needed to be allocated across the five segments. We did that with a two-step process. First we dealt with the first segment—the 12" ductile iron line between the old and new master meter, for which there was a 50% cost-sharing agreement. We assumed that the CRW share of the first segment matched the City's cost share for each regular line item in the cost breakdown. (The three change orders for that segment were special requests by one party or the other, not subject to the 50% cost sharing, so the total cost of that segment ended up with 50.9% of the cost borne by the City rather than 50%.)

After subtracting the CRW share of the first segment from the total CRW cost, the remainder represented the combined cost for the four segments that were entirely funded by CRW. That cost was allocated to the individual segments based on adjusted lineal feet, using 8" ductile iron as the standard pipe equivalent—the same method that would be used if some segments were inside and other segments were outside the transfer area.

TIPS FOR USING THE MODEL

If no updates are made to the benchmark costs and no further changes are made to the pipe inventory and cost data, then in the future, the tables shown in Appendix A can almost be used as they are. However, three steps will always be required:

1. Update Table 4 (the monthly ENR table) with the most recent data available. FCS GROUP maintains ENR-CCI data in the format used for Table 4. If the parties don't maintain the data themselves, they can always call us, and we can send you our latest ENR index file.
2. Go to Table 3 and enter the most recent full year of ENR data as the "Reference Year." This will automatically update the standard unit costs.
3. Go to Table 9 and specify the planned transfer year for a particular group of pipes.

After those three steps, the rightmost column of Table 9 will show the remuneration value for a given pipe or group of pipes.

Over time, changes will likely be made to the pipe inventory data as a result of new CIP projects or developer-installed infrastructure. If this happens to the segments in the conflict areas identified by Murraysmith, or if a proposed transfer area does not quite fit the Murraysmith pipe segments, then additional rows may need to be added to either Table 7 or 8 (depending on whether there is historical cost data) and also to Table 9. Then the relevant data on pipe material, diameter, length, and date of installation will need to be entered.

In the model, only the cells with blue font are direct-entry cells. The cells with black font are formulas that should not be changed. If new rows need to be added, the formula cells can be copied from existing rows to the new rows. In all cases, of course, the results should be reviewed to ensure that they make sense and any errors are corrected.

This page is intentionally blank.

APPENDIX A

Standard Tables in Remuneration Model

Table 1: Assumed % of Ductile Iron Cost for a Given Size Pipe

Table 2: Assumed Multiple of 8” Cost for a Given Pipe Material

Table 3: Standard Unit Costs as of 2017

Table 4: Monthly ENR Construction Cost Index Data (20-City Average), to be Updated in Future Years

Table 5: Annual Average ENR Construction Cost Index, with Factors to Convert Between a Historical Year and a Reference Year

Table 6: Assumed Asset Useful Lives by Pipe Material

Table 7: Original Cost of Transfer Area When Original Cost Data is Available

Table 8: Original Cost of Transfer Area When Original Cost Data is Not Available

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation)

Table 1: Assumed Equivalents for Pipe Material

Assumed % of Ductile Iron Cost for a Given Size Pipe	
Asbestos Cement	84%
Cast Iron	80%
Ductile Iron	100%
HDPE	70%
PVC	80%
Steel	123%

Table 2: Assumed Equivalents for Pipe Size

Assumed Multiple of 8" Cost for a Given Pipe Material	
1"	0.43
1.5"	0.49
2"	0.54
2.5"	0.69
3"	0.70
4"	0.78
6"	0.91
8"	1.00
10"	1.11
12"	1.19
14"	1.49
16"	1.51
20"	1.73
24"	1.95
36"	2.16

Table 3: Standard Unit Costs as of 2017

Benchmark Year for Cost Estimates	**2017**	8" Ductile Iron Unit Cost in Benchmark Year	**$159/LF**
Assumed Reference Year	**2017**	8" Ductile Iron Unit Cost in Reference Year	$159/LF

Assumed Reproduction Unit Costs of Water Pipe by Material and Size in Transfer Year 2017						
Size	**Asbestos Cement**	**Cast Iron**	**Ductile Iron**	**HDPE**	**PVC**	**Steel**
1"	57	55	68	48	55	84
1.5"	65	62	78	55	62	96
2"	72	69	86	60	69	106
2.5"	92	88	110	77	88	135
3"	93	89	111	78	89	137
4"	104	99	124	87	99	153
6"	122	116	145	101	116	178
8"	134	127	159	111	127	196
10"	148	141	176	124	141	217
12"	159	151	189	132	151	233
14"	199	190	237	166	190	291
16"	202	192	240	168	192	295
20"	231	220	275	193	220	338
24"	260	248	310	217	248	381
36"	288	275	343	240	275	422

Note: the unit costs shown above represent construction cost only; a 25% markup for engineering and overhead is added later in the calculation. These unit costs are intended to include not just the actual pipe but also the appurtenances (hydrants, valves, services, meters, etc.) customarily installed along with a water line extension.

Table 4: Monthly ENR Construction Cost Index Data (20-City Average)

FCS Group Interest Rate Database
ENR-CCI (20-City Average)

ENR Construction Cost Index - 20 City Average: 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of Portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

Source: http://enr.construction.com/magazine/archives.asp http://www.enr.com/topics/604-construction-economics
View entire issue > Construction Economics

Enter ENR CCI Index

YEAR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL AVERAGE
1990	4,680.00	4,685.00	4,691.00	4,693.00	4,707.00	4,732.00	4,734.00	4,752.00	4,774.00	4,771.00	4,787.00	4,777.00	**4,732**
1991	4,777.00	4,773.00	4,772.00	4,766.00	4,801.00	4,818.00	4,854.00	4,892.00	4,891.00	4,892.00	4,896.00	4,889.00	**4,835**
1992	4,888.00	4,884.00	4,927.00	4,946.00	4,965.00	4,973.00	4,992.00	5,032.00	5,042.00	5,052.00	5,058.00	5,059.00	**4,985**
1993	5,071.00	5,070.00	5,106.00	5,167.00	5,262.00	5,260.00	5,252.00	5,230.00	5,255.00	5,264.00	5,278.00	5,310.00	**5,210**
1994	5,336.00	5,371.00	5,381.00	5,405.00	5,405.00	5,408.00	5,409.00	5,424.00	5,437.00	5,437.00	5,439.00	5,439.00	**5,408**
1995	5,443.00	5,444.00	5,435.00	5,432.00	5,433.00	5,432.00	5,484.00	5,506.00	5,491.00	5,511.00	5,519.00	5,524.00	**5,471**
1996	5,523.00	5,532.00	5,537.00	5,550.00	5,572.00	5,597.00	5,617.00	5,652.00	5,683.00	5,719.00	5,740.00	5,744.00	**5,622**
1997	5,765.00	5,769.00	5,759.00	5,799.00	5,837.00	5,860.00	5,863.00	5,854.00	5,851.00	5,848.00	5,838.00	5,858.00	**5,825**
1998	5,852.00	5,874.00	5,875.00	5,883.00	5,881.00	5,895.00	5,921.00	5,929.00	5,963.00	5,986.00	5,995.00	5,991.00	**5,920**
1999	6,000.00	5,992.00	5,986.00	6,008.00	6,006.00	6,039.00	6,076.00	6,091.00	6,128.00	6,134.00	6,127.00	6,127.00	**6,060**
2000	6,130.00	6,160.00	6,202.00	6,201.00	6,233.00	6,238.00	6,225.00	6,233.00	6,224.00	6,259.00	6,266.00	6,283.00	**6,221**
2001	6,281.00	6,272.00	6,279.00	6,286.00	6,288.00	6,318.00	6,404.00	6,389.00	6,391.00	6,397.00	6,410.00	6,390.00	**6,342**
2002	6,462.00	6,462.00	6,502.00	6,480.00	6,512.00	6,532.00	6,605.00	6,592.00	6,589.00	6,579.00	6,578.00	6,563.00	**6,538**
2003	6,581.00	6,640.00	6,627.00	6,635.00	6,642.00	6,694.00	6,696.00	6,733.00	6,741.00	6,771.00	6,794.00	6,782.00	**6,695**
2004	6,825.00	6,861.00	6,957.00	7,017.00	7,064.00	7,109.00	7,126.00	7,188.00	7,298.00	7,314.00	7,312.00	7,308.00	**7,115**
2005	7,297.00	7,298.00	7,309.00	7,355.00	7,398.00	7,415.00	7,422.00	7,479.00	7,540.00	7,563.00	7,630.00	7,647.00	**7,446**
2006	7,660.00	7,689.00	7,692.00	7,695.00	7,691.00	7,700.00	7,721.00	7,723.00	7,763.00	7,883.00	7,911.00	7,888.00	**7,751**
2007	7,879.58	7,879.54	7,856.27	7,864.70	7,942.00	7,938.58	7,959.17	8,007.48	8,049.65	8,045.14	8,091.81	8,089.45	**7,967**
2008	8,090.06	8,094.28	8,109.00	8,112.00	8,141.00	8,185.00	8,293.00	8,362.00	8,557.00	8,623.00	8,602.45	8,551.32	**8,310**
2009	8,549.06	8,532.73	8,534.00	8,528.39	8,573.87	8,578.28	8,566.14	8,563.80	8,585.71	8,596.31	8,591.79	8,641.45	**8,570**
2010	8,660.08	8,672.00	8,671.07	8,676.68	8,761.00	8,804.79	8,864.72	8,858.00	8,836.00	8,920.54	8,950.64	8,952.40	**8,802**
2011	8,938.30	8,998.02	9,010.80	9,027.23	9,034.67	9,052.64	9,080.15	9,088.24	9,115.95	9,146.95	9,173.21	9,171.73	**9,070**
2012	9,175.94	9,198.29	9,267.57	9,272.95	9,289.65	9,291.40	9,323.58	9,350.99	9,341.03	9,375.52	9,398.41	9,412.25	**9,308**
2013	9,437.27	9,453.02	9,455.98	9,483.70	9,515.86	9,542.33	9,551.78	9,545.33	9,551.58	9,688.86	9,666.46	9,667.77	**9,547**
2014	9,664.00	9,681.11	9,702.00	9,749.51	9,795.92	9,800.38	9,834.63	9,846.00	9,870.12	9,886.06	9,912.01	9,936.44	**9,807**
2015	9,971.96	9,961.75	9,972.38	9,992.34	9,975.48	10,036.38	10,037.40	10,038.79	10,065.09	10,128.32	10,092.38	10,135.00	**10,034**
2016	10,132.55	10,181.92	10,242.09	10,279.94	10,315.44	10,337.05	10,379.26	10,385.65	10,403.43	10,434.56	10,442.61	10,530.94	**10,339**
2017	10,542.01	10,558.63	10,667.39	10,678.15	10,692.17	10,702.81	10,789.41	10,826.31	10,822.92	10,817.11	10,870.06	10,873.46	**10,737**

Not Valid Until Entire Year Filled

Rolling Annual CCI Increases

YEAR	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Annual Increase
1991	2.07%	1.88%	1.73%	1.56%	2.00%	1.82%	2.53%	2.95%	2.45%	2.54%	2.28%	2.34%	**2.18%**
1992	2.32%	2.33%	3.25%	3.78%	3.42%	3.22%	2.84%	2.86%	3.09%	3.27%	3.31%	3.48%	**3.10%**
1993	3.74%	3.81%	3.63%	4.47%	5.98%	5.77%	5.21%	3.93%	4.22%	4.20%	4.35%	4.96%	**4.53%**
1994	5.23%	5.94%	5.39%	4.61%	2.72%	2.81%	2.99%	3.71%	3.46%	3.29%	3.05%	2.43%	**3.78%**
1995	2.01%	1.36%	1.00%	0.50%	0.52%	0.44%	1.39%	1.51%	0.99%	1.36%	1.47%	1.56%	**1.18%**
1996	1.47%	1.62%	1.88%	2.17%	2.56%	3.04%	2.43%	2.65%	3.50%	3.77%	4.00%	3.98%	**2.76%**
1997	4.38%	4.28%	4.01%	4.49%	4.76%	4.70%	4.38%	3.57%	2.96%	2.26%	1.71%	1.98%	**3.61%**
1998	1.51%	1.82%	2.01%	1.45%	0.75%	0.60%	0.99%	1.28%	1.91%	2.36%	2.69%	2.27%	**1.64%**
1999	2.53%	2.01%	1.89%	2.12%	2.13%	2.44%	2.62%	2.73%	2.77%	2.47%	2.20%	2.27%	**2.35%**
2000	2.17%	2.80%	3.61%	3.21%	3.78%	3.30%	2.45%	2.33%	1.57%	2.04%	2.27%	2.55%	**2.67%**
2001	2.46%	1.82%	1.24%	1.37%	0.88%	1.28%	2.88%	2.50%	2.68%	2.20%	2.30%	1.70%	**1.94%**
2002	2.88%	3.03%	3.55%	3.09%	3.56%	3.39%	3.14%	3.18%	3.10%	2.85%	2.62%	2.71%	**3.09%**
2003	1.84%	2.75%	1.92%	2.39%	2.00%	2.48%	1.38%	2.14%	2.31%	2.92%	3.28%	3.34%	**2.40%**
2004	3.71%	3.33%	4.98%	5.76%	6.35%	6.20%	6.42%	6.76%	8.26%	8.02%	7.62%	7.76%	**6.28%**
2005	6.92%	6.37%	5.06%	4.82%	4.73%	4.30%	4.15%	4.05%	3.32%	3.40%	4.35%	4.64%	**4.65%**
2006	4.97%	5.36%	5.24%	4.62%	3.96%	3.84%	4.03%	3.26%	2.96%	4.23%	3.68%	3.15%	**4.10%**
2007	2.87%	2.48%	2.14%	2.21%	3.26%	3.10%	3.08%	3.68%	3.69%	2.06%	2.29%	2.55%	**2.78%**
2008	2.67%	2.73%	3.22%	3.14%	2.51%	3.10%	4.19%	4.43%	6.30%	7.18%	6.31%	5.71%	**4.31%**
2009	5.67%	5.42%	5.24%	5.13%	5.32%	4.80%	3.29%	2.41%	0.34%	-0.31%	-0.12%	1.05%	**3.13%**
2010	1.30%	1.63%	1.61%	1.74%	2.18%	2.64%	3.49%	3.44%	2.92%	3.77%	4.18%	3.60%	**2.71%**
2011	3.21%	3.76%	3.92%	4.04%	3.12%	2.81%	2.43%	2.60%	3.17%	2.54%	2.49%	2.45%	**3.04%**
2012	2.66%	2.23%	2.85%	2.72%	2.82%	2.64%	2.68%	2.89%	2.47%	2.50%	2.45%	2.62%	**2.63%**
2013	2.85%	2.77%	2.03%	2.27%	2.44%	2.70%	2.45%	2.08%	2.25%	3.34%	2.85%	2.71%	**2.56%**
2014	2.40%	2.41%	2.60%	2.80%	2.94%	2.70%	2.96%	3.15%	3.33%	2.04%	2.54%	2.78%	**2.72%**
2015	3.19%	2.90%	2.79%	2.49%	1.83%	2.41%	2.06%	1.96%	1.98%	2.45%	1.82%	2.00%	**2.32%**
2016	1.61%	2.21%	2.70%	2.88%	3.41%	3.00%	3.41%	3.46%	3.36%	3.02%	3.47%	3.91%	**3.04%**
2017	4.04%	3.70%	4.15%	3.87%	3.65%	3.54%	3.95%	4.24%	4.03%	3.67%	4.09%	3.25%	**3.85%**

Not Valid Until Entire Year Filled

Table 5: Historical ENR Construction Cost Index – Annual Average

Engineering News-Record (ENR) 20 City Average Construction Cost Index (CCI)

Assumed Reference Year: 2017

Year	ENR CCI (Yearly Avg)	Yearly Increase	2017 Cost as Multiple of Original Cost	Original Cost as % of 2017 Cost
1908	97	N/A	110.69	0.9%
1909	91	-6.2%	117.99	0.8%
1910	96	5.5%	111.84	0.9%
1911	93	-3.1%	115.45	0.9%
1912	91	-2.2%	117.99	0.8%
1913	100	9.9%	107.37	0.9%
1914	89	-11.0%	120.64	0.8%
1915	93	4.5%	115.45	0.9%
1916	130	39.8%	82.59	1.2%
1917	181	39.2%	59.32	1.7%
1918	189	4.4%	56.81	1.8%
1919	198	4.8%	54.23	1.8%
1920	251	26.8%	42.78	2.3%
1921	202	-19.5%	53.15	1.9%
1922	174	-13.9%	61.71	1.6%
1923	214	23.0%	50.17	2.0%
1924	215	0.5%	49.94	2.0%
1925	207	-3.7%	51.87	1.9%
1926	208	0.5%	51.62	1.9%
1927	206	-1.0%	52.12	1.9%
1928	207	0.5%	51.87	1.9%
1929	207	0.0%	51.87	1.9%
1930	203	-1.9%	52.89	1.9%
1931	181	-10.8%	59.32	1.7%
1932	157	-13.3%	68.39	1.5%
1933	170	8.3%	63.16	1.6%
1934	198	16.5%	54.23	1.8%
1935	196	-1.0%	54.78	1.8%
1936	206	5.1%	52.12	1.9%
1937	235	14.1%	45.69	2.2%
1938	236	0.4%	45.49	2.2%
1939	236	0.0%	45.49	2.2%
1940	242	2.5%	44.37	2.3%
1941	258	6.6%	41.62	2.4%
1942	276	7.0%	38.90	2.6%
1943	290	5.1%	37.02	2.7%
1944	299	3.1%	35.91	2.8%
1945	308	3.0%	34.86	2.9%
1946	346	12.3%	31.03	3.2%
1947	413	19.4%	26.00	3.8%
1948	461	11.6%	23.29	4.3%
1949	477	3.5%	22.51	4.4%
1950	510	6.9%	21.05	4.8%
1951	543	6.5%	19.77	5.1%
1952	569	4.8%	18.87	5.3%
1953	628	10.4%	17.10	5.8%
1954	628	0.0%	17.10	5.8%
1955	660	5.1%	16.27	6.1%
1956	692	4.8%	15.52	6.4%
1957	724	4.6%	14.83	6.7%
1958	759	4.8%	14.15	7.1%
1959	797	5.0%	13.47	7.4%
1960	824	3.4%	13.03	7.7%
1961	847	2.8%	12.68	7.9%
1962	872	3.0%	12.31	8.1%
1963	901	3.3%	11.92	8.4%
1964	936	3.9%	11.47	8.7%
1965	971	3.7%	11.06	9.0%
1966	1,019	4.9%	10.54	9.5%
1967	1,074	5.4%	10.00	10.0%
1968	1,155	7.5%	9.30	10.8%
1969	1,269	9.9%	8.46	11.8%
1970	1,381	8.8%	7.77	12.9%
1971	1,581	14.5%	6.79	14.7%
1972	1,753	10.9%	6.12	16.3%
1973	1,895	8.1%	5.67	17.6%
1974	2,020	6.6%	5.32	18.8%
1975	2,212	9.5%	4.85	20.6%
1976	2,401	8.5%	4.47	22.4%
1977	2,576	7.3%	4.17	24.0%
1978	2,776	7.8%	3.87	25.9%
1979	3,003	8.2%	3.58	28.0%
1980	3,237	7.8%	3.32	30.1%
1981	3,535	9.2%	3.04	32.9%
1982	3,825	8.2%	2.81	35.6%
1983	4,066	6.3%	2.64	37.9%
1984	4,148	2.0%	2.59	38.6%
1985	4,182	0.8%	2.57	39.0%
1986	4,295	2.7%	2.50	40.0%
1987	4,406	2.6%	2.44	41.0%
1988	4,519	2.6%	2.38	42.1%
1989	4,615	2.1%	2.33	43.0%
1990	4,732	2.5%	2.27	44.1%
1991	4,835	2.2%	2.22	45.0%
1992	4,985	3.1%	2.15	46.4%
1993	5,210	4.5%	2.06	48.5%
1994	5,408	3.8%	1.99	50.4%
1995	5,471	1.2%	1.96	51.0%
1996	5,622	2.8%	1.91	52.4%
1997	5,825	3.6%	1.84	54.3%
1998	5,920	1.6%	1.81	55.1%
1999	6,060	2.3%	1.77	56.4%
2000	6,221	2.7%	1.73	57.9%
2001	6,342	1.9%	1.69	59.1%
2002	6,538	3.1%	1.64	60.9%
2003	6,695	2.4%	1.60	62.4%
2004	7,115	6.3%	1.51	66.3%
2005	7,446	4.7%	1.44	69.4%
2006	7,751	4.1%	1.39	72.2%
2007	7,967	2.8%	1.35	74.2%
2008	8,310	4.3%	1.29	77.4%
2009	8,570	3.1%	1.25	79.8%
2010	8,802	2.7%	1.22	82.0%
2011	9,070	3.0%	1.18	84.5%
2012	9,308	2.6%	1.15	86.7%
2013	9,547	2.6%	1.12	88.9%
2014	9,807	2.7%	1.09	91.3%
2015	10,034	2.3%	1.07	93.5%
2016	10,339	3.0%	1.04	96.3%
2017	10,737	3.8%	1.00	100.0%

Table 6: Assumed Useful Life of Different Classes of Pipe

Assumed Asset Useful Lives, By Pipe Material		
	Useful Life	**Deprec. %**
Asbestos Cement	50 Years	2.00%
Cast Iron	75 Years	1.33%
Ductile Iron	100 Years	1.00%
HDPE	50 Years	2.00%
PVC	50 Years	2.00%
Steel	50 Years	2.00%

Table 7: Original Cost of Transfer Area When Historical Cost Data is Available

Conflict Area	Remun-eration ID #	Transfer Area	Asset ID #	Original Cost Area	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
Note: If transfer area is comprised of more than one original area, determine Inside Transfer Area cost for each original area, then sum them together.								
Park Place	8	Hilltop Road segment	899.1		Ductile Iron	8"	No	2004
Park Place	8	Donovan Road segment	899		Ductile Iron	12"	No	2004
		Total Area		Donovan Rd-Middle School				
Thayer	20	Thayer from Development to UGB	3532	Thayer from Development to UGB	Ductile Iron	12"	No	2003
South End Road	22	J McL ES to New Master Meter	0001	South End Rd - Cost Share Part	Ductile Iron	12"	No	2001
South End Road	23	New Master Meter to Sta 44+85	0002		Ductile Iron	12"	No	2001
South End Road	23	Sta 44+85 to Sta 56+15	0003		Ductile Iron	12"	No	2001
South End Road	23	Sta 56+15 to Sta 59+80	0004		Ductile Iron	12"	No	2001
South End Road	23	Sta 59+8015 to Sta 104+40	0005		Ductile Iron	8"	No	2001
		Total Area		South End Rd - 100% CRW Part				

Transfer Area	Asset ID #	Pipe Length (LF) Total Original Area	Pipe Length (LF) Inside Transfer Area	Pipe Length (LF) Outside Transfer Area	Adjusted Pipe Length (LF, 8" DI-equivalent) Inside Transfer Area	Adjusted Pipe Length (LF, 8" DI-equivalent) Outside Transfer Area	Adjusted Pipe Length (LF, 8" DI-equivalent) Total Original Area	Construction Cost in Original Area
Hilltop Road segment	899.1	2,211 LF	0 LF	2,211 LF	0 LF	2,211 LF	2,211 LF	
Donovan Road segment	899	1,637 LF	1,637 LF	0 LF	1,948 LF	0 LF	1,948 LF	
Total Area		3,848 LF	1,637 LF	2,211 LF	1,948 LF	2,211 LF	4,159 LF	$ 274,938
Thayer from Development to UGB	3532	9,245 LF	9,245 LF	0 LF	11,002 LF	0 LF	11,002 LF	$ 822,725
J McL ES to New Master Meter	0001	4,111 LF	4,111 LF	0 LF	4,892 LF	0 LF	4,892 LF	$ 408,198
New Master Meter to Sta 44+85	0002		445 LF		530 LF	0 LF		
Sta 44+85 to Sta 56+15	0003		1,130 LF		1,345 LF	0 LF		
Sta 56+15 to Sta 59+80	0004		365 LF		434 LF	0 LF		
Sta 59+8015 to Sta 104+40	0005		4,460 LF		4,460 LF	0 LF		
Total Area		6,400 LF	6,400 LF	0 LF	6,769 LF	0 LF	6,769 LF	$ 177,484

Transfer Area	Asset ID #	Construction Cost in Original Area	Partial Outside Funding	CRW Constr. Cost in Original Area	CRW Cost per Adjusted Lineal Foot	Allocated Cost Inside Transfer Area	CRW Orig Constr Cost in Transfer Area
Hilltop Road segment	899.1					$ -	$ -
Donovan Road segment	899					128,777	128,777
Total Area		$ 274,938	$ -	$ 274,938	$ 66.11	$ 128,777	$ 128,777
Thayer from Development to UGB	3532	$ 822,725	$ -	$ 822,725	$ 74.78	$ 822,725	$ 822,725
J McL ES to New Master Meter	0001	$ 408,198	$ 207,669	$ 200,528	$ 40.99	$ 200,528	$ 200,528
New Master Meter to Sta 44+85	0002					$ 13,886	$ 13,886
Sta 44+85 to Sta 56+15	0003					35,260	35,260
Sta 56+15 to Sta 59+80	0004					11,389	11,389
Sta 59+8015 to Sta 104+40	0005					116,949	116,949
Total Area		$ 177,484	$ -	$ 177,484	$ 26.22	$ 177,484	$ 177,484

Table 8: Original Cost of Transfer Area When Historical Cost Data is Not Available

Conflict Area	Remun-eration ID #	Transfer Area	Asset ID #	Additional Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
Leland McCord	4	Leland McCord	709		Steel	8"	No	1960
Leland McCord	4	Leland McCord	1524		Steel	6"	No	1960
Leland McCord	4	Leland McCord	1525		Steel	8"	No	1960
Leland McCord	4	Leland McCord	1937		Steel	8"	No	1960
Leland McCord	4	Leland McCord	2262		Steel	8"	No	1960
		Total Area						
Park Place	1	Holly Lane South to UGB	280		Steel	12"	No	1960
Park Place	1	Holly Lane South to UGB	3533		Steel	12"	No	1960
		Total Area						
Loder	2	Loder from Beavercreek to UGB	303		Ductile Iron	8"	No	1988
Canyon Ridge	6	Canyon Ridge	711		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	712		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3226		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3227		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3228		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3229		Ductile Iron	6"	Yes	1980
		Total Area						

Transfer Area	Asset ID #	Pipe Length (LF)	Reproduction Cost as of: 2017	ENR Adjustment to Install Year	Est Original Construction Cost	Partial Outside Funding ($)	CRW Original Construction Cost
Leland McCord	709	2,277 LF	$ 446,292	7.7%	$ 34,251	$ -	$ 34,251
Leland McCord	1524	1,658 LF	295,124	7.7%	22,650	-	22,650
Leland McCord	1525	333 LF	$ 65,268	7.7%	$ 5,009	$ -	$ 5,009
Leland McCord	1937	752 LF	147,392	7.7%	11,312	-	11,312
Leland McCord	2262	285 LF	55,860	7.7%	4,287	-	4,287
Total Area		5,305 LF	$ 1,009,936		$ 77,509	$ -	$ 77,509
Holly Lane South to UGB	280	1,292 LF	$ 301,036	7.7%	$ 23,103	$ -	$ 23,103
Holly Lane South to UGB	3533	1,307 LF	304,531	7.7%	23,372	-	23,372
Total Area		2,599 LF	$ 605,567		$ 46,475	$ -	$ 46,475
Loder from Beavercreek to UGB	303	3,686 LF	$ 586,074	42.1%	$ 246,674	$ -	$ 246,674
Canyon Ridge	711	2,016 LF	$ 292,320	30.1%	$ 88,131	$ -	$ -
Canyon Ridge	712	127 LF	18,415	30.1%	5,552	-	-
Canyon Ridge	3226	22 LF	3,190	30.1%	962	-	-
Canyon Ridge	3227	26 LF	3,770	30.1%	1,137	-	-
Canyon Ridge	3228	21 LF	3,045	30.1%	918	-	-
Canyon Ridge	3229	10 LF	1,450	30.1%	437	-	-
Total Area		2,222 LF	$ 322,190		$ 97,137	$ -	$ -

Table 8: Original Cost of Transfer Area When Historical Cost Data is Not Available, continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Additional Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	17	Parkland	2269	Street crossing	Ductile Iron	8"	No	2000
South End	17	Parkland	2385	Original development	Cast Iron	4"	Yes	1970
South End	17	Parkland	3430	Tie-in/hydrant branch-S End Rd CIP	Ductile Iron	6"	No	2000
South End	17	Parkland	3436	Fire hydrant branch	Ductile Iron	6"	No	2000
		Total Area						
Leland McCord	3	Kalal	708		Cast Iron	6"	Yes	1970
Leland McCord	5	Jessie Court	710		Cast Iron	4"	Yes	1970
Leland McCord	10	Jessie Avenue	1030		Cast Iron	6"	Yes	1970
Leland McCord	10	Jessie Avenue	2380		Cast Iron	6"	Yes	1970
Leland McCord	10	Jessie Avenue	3231		Cast Iron	6"	Yes	1970
		Total Area						
South End	12	Salmonberry	1102		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1516		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1519		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1521		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
		Total Area						

Transfer Area	Asset ID #	Pipe Length (LF)	Reproduction Cost as of: 2017	ENR Adjustment to Install Year	Est Original Construction Cost	Partial Outside Funding ($)	CRW Original Construction Cost
Parkland	2269	57 LF	$ 9,063	57.9%	$ 5,251	$ -	$ 5,251
Parkland	2385	611 LF	60,489	12.9%	7,780	-	-
Parkland	3430	13 LF	1,885	57.9%	1,092	-	1,092
Parkland	3436	15 LF	2,175	57.9%	1,260	-	1,260
Total Area		696 LF	$ 73,612		$ 15,384	$ -	$ 7,604
Kalal	708	965 LF	$ 111,940	12.9%	$ 14,398	$ -	$ -
Jessie Court	710	242 LF	$ 23,958	12.9%	$ 3,082	$ -	$ -
Jessie Avenue	1030	144 LF	$ 16,704	12.9%	$ 2,149	$ -	$ -
Jessie Avenue	2380	339 LF	39,324	12.9%	5,058	-	-
Jessie Avenue	3231	14 LF	1,624	12.9%	209	-	-
Total Area		497 LF	$ 57,652		$ 7,415	$ -	$ -
Salmonberry	1102	14 LF	$ 2,030	30.1%	$ 612	$ -	$ -
Salmonberry	1516	139 LF	20,155	30.1%	6,077	-	-
Salmonberry	1519	1,162 LF	168,490	30.1%	50,798	-	-
Salmonberry	1521	196 LF	28,420	30.1%	8,568	-	-
Salmonberry	N/A	20 LF	3,180	57.9%	1,843	-	1,843
Total Area		1,531 LF	$ 222,275		$ 67,897	$ -	$ 1,843

Table 8: Original Cost of Transfer Area When Historical Cost Data is Not Available, continued

Conflict Area	Remun-eration ID #	Transfer Area	Asset ID #	Additional Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	9	South End Court	1028		Steel	4"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	1100	Unsure of location--assume dev built	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	1101	Unsure of location--assume dev built	Cast Iron	6"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	1515	Sunnyridge Court	Cast Iron	6"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	1520	Maywood Street	Ductile Iron	6"	Yes	1979
South End	11	Forest Ridge/Maywood Loop	2375	Elizabeth to Sunnyridge	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2376	S. End Road to Elizabeth	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2378	Sunnyridge to Maywood Street	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2386	Elizbeth Court	Cast Iron	4"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	2387	Sunnyridge Court	Cast Iron	4"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
South End	11	Forest Ridge/Maywood Loop	N/A	Tie-in - South End Road CIP	Ductile Iron	6"	No	2000
		Total Area						
South End	19	Finnegan/Shamrock	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
South End	19	Finnegan/Shamrock	2382		Cast Iron	6"	Yes	1970
South End	19	Finnegan/Shamrock	2383		Cast Iron	6"	Yes	1975
South End	19	Finnegan/Shamrock	2384	Shamrock Lane	Cast Iron	6"	Yes	1975
		Total Area						

Transfer Area	Asset ID #	Pipe Length (LF)	Reproduction Cost as of: 2017	ENR Adjustment to Install Year	Est Original Construction Cost	Partial Outside Funding ($)	CRW Original Construction Cost
South End Court	1028	670 LF	$ 102,510	7.7%	$ 7,867	$ -	$ -
Forest Ridge/Maywood Loop	1100	15 LF	$ 1,830	7.7%	$ 140	$ -	$ -
Forest Ridge/Maywood Loop	1101	18 LF	2,088	12.9%	269	-	-
Forest Ridge/Maywood Loop	1515	338 LF	39,208	12.9%	5,043	-	-
Forest Ridge/Maywood Loop	1520	656 LF	95,120	28.0%	26,605	-	-
Forest Ridge/Maywood Loop	2375	336 LF	40,992	7.7%	3,146	-	-
Forest Ridge/Maywood Loop	2376	446 LF	54,412	7.7%	4,176	-	-
Forest Ridge/Maywood Loop	2378	403 LF	49,166	7.7%	3,773	-	-
Forest Ridge/Maywood Loop	2386	267 LF	26,433	12.9%	3,400	-	-
Forest Ridge/Maywood Loop	2387	200 LF	19,800	12.9%	2,547	-	-
Forest Ridge/Maywood Loop	N/A	63 LF	10,017	57.9%	5,804	-	5,804
Forest Ridge/Maywood Loop	N/A	10 LF	1,450	57.9%	840	-	840
Total Area		2,752 LF	$ 340,516		$ 55,743	$ -	$ 6,644
Finnegan/Shamrock	N/A	18 LF	$ 2,862	57.9%	$ 1,658	$ -	$ 1,658
Finnegan/Shamrock	2382	1,911 LF	221,676	12.9%	28,513	-	-
Finnegan/Shamrock	2383	241 LF	27,956	20.6%	5,760	-	-
Finnegan/Shamrock	2384	398 LF	46,168	20.6%	9,512	-	-
Total Area		2,568 LF	$ 298,662		$ 45,442	$ -	$ 1,658

Table 8: Original Cost of Transfer Area When Historical Cost Data is Not Available, continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Additional Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	18	Impala	2377	Impala	Ductile Iron	8"	No	2000
South End	7	Rose/Deer	713	Deer Lane	Asbestos Cement	4"	No	1960
South End	7	Rose/Deer	714	Rose	Steel	4"	No	1960
South End	7	Rose/Deer	3091	This line is owned by City				N/A
		Total Area						
South End	16	Forest Ridge/Allen	1980	Allen Court	Steel	4"	Yes	1960
South End	16	Forest Ridge/Allen	2374	Maywood to Allen	Asbestos Cement	6"	Yes	1960
South End	16	Forest Ridge/Allen	2379	Allen west to cul de sac	Asbestos Cement	6"	Yes	1960
		Total Area						
South End	15	Buetel	1979		Steel	6"	No	1960
South End	15	Buetel	2263		Steel	4"	No	1960
		Total Area						

Transfer Area	Asset ID #	Pipe Length (LF)	Reproduction Cost as of: 2017	ENR Adjustment to Install Year	Est Original Construction Cost	Partial Outside Funding ($)	CRW Original Construction Cost
Impala	2377	403 LF	$ 64,077	57.9%	$ 37,128	$ -	$ 37,128
Rose/Deer	713	501 LF	$ 52,104	7.7%	$ 3,999	$ -	$ 3,999
Rose/Deer	714	212 LF	32,436	7.7%	2,489	-	2,489
Rose/Deer	3091	17 LF	-		-	-	-
Total Area		730 LF	$ 84,540		$ 6,488	$ -	$ 6,488
Forest Ridge/Allen	1980	501 LF	$ 76,653	7.7%	$ 5,883	$ -	$ -
Forest Ridge/Allen	2374	212 LF	25,864	7.7%	1,985	-	-
Forest Ridge/Allen	2379	17 LF	-		-	-	-
Total Area		730 LF	$ 102,517		$ 7,868	$ -	$ -
Buetel	1979	501 LF	$ 89,178	7.7%	$ 6,844	$ -	$ 6,844
Buetel	2263	212 LF	32,436	7.7%	2,489	-	2,489
Total Area		713 LF	$ 121,614		$ 9,333	$ -	$ 9,333

Table 8: Original Cost of Transfer Area When Historical Cost Data is Not Available, continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Additional Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	13	Navajo	1114	Cul de sac	Ductile Iron	6"	Yes	1979
South End	13	Navajo	1115	South End Rd/Navajo fire hydrant	Ductile Iron	6"	No	1979
South End	13	Navajo	1116	Navajo/S Turquoise Way (north)	Ductile Iron	6"	Yes	1979
South End	13	Navajo	1117	Navajo/S Turquoise Way (south)	Ductile Iron	6"	Yes	1979
South End	13	Navajo	1517	Navajo/S Turquoise to cul de sac	Ductile Iron	6"	Yes	1979
South End	13	Navajo	1518	Navajo/S End Rd to Turquoise Way	Ductile Iron	6"	Yes	1979
South End	13	Navajo	N/A	Tie in - South End Road CIP	Ductile Iron	8"	No	2000
		Total Area						
South End	21	Kelland Court	1209	Kelland Court	Ductile Iron	8"	Yes	1966
South End	21	Kelland Court	3437	Unsure of location--assume dev built	Ductile Iron	8"	Yes	1966
		Total Area						

Transfer Area	Asset ID #	Pipe Length (LF)	Reproduction Cost as of: 2017	ENR Adjustment to Install Year	Est Original Construction Cost	Partial Outside Funding ($)	CRW Original Construction Cost
Navajo	1114	76 LF	$ 11,020	28.0%	$ 3,082	$ -	$ -
Navajo	1115	12 LF	1,740	28.0%	487	-	487
Navajo	1116	140 LF	20,300	28.0%	5,678	-	-
Navajo	1117	229 LF	33,205	28.0%	9,287	-	-
Navajo	1517	801 LF	116,145	28.0%	32,485	-	-
Navajo	1518	626 LF	90,770	28.0%	25,388	-	-
Navajo	N/A	70 LF	11,130	57.9%	6,449	-	6,449
Total Area		1,954 LF	$ 284,310		$ 82,856	$ -	$ 6,936
Kelland Court	1209	1,005 LF	$ 159,795	9.5%	$ 15,166	$ -	$ -
Kelland Court	3437	14 LF	2,226	9.5%	211	-	-
Total Area		1,019 LF	$ 162,021		$ 15,377	$ -	$ -

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation)

Conflict Area	Remun-eration ID #	Transfer Area	Asset ID #	Original Cost Area/Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
Park Place	8	Hilltop Road segment	899.1	Donovan Rd-Middle School	Ductile Iron	8"	No	2004
Park Place	8	Donovan Road segment	899	Donovan Rd-Middle School	Ductile Iron	12"	No	2004
		Total Area						
Leland McCord	4	Leland McCord	709		Steel	8"	No	1960
Leland McCord	4	Leland McCord	1524		Steel	6"	No	1960
Leland McCord	4	Leland McCord	1525		Steel	8"	No	1960
Leland McCord	4	Leland McCord	1937		Steel	8"	No	1960
Leland McCord	4	Leland McCord	2262		Steel	8"	No	1960
		Total Area						
Thayer	20	Thayer from Development to UGB	3532	Thayer from Development to UGB	Ductile Iron	12"	No	2003
Park Place	1	Holly Lane South to UGB	280		Steel	12"	No	1960
Park Place	1	Holly Lane South to UGB	3533		Steel	12"	No	1960
		Total Area						
Loder	2	Loder from Beavercreek to UGB	303		Ductile Iron	8"	No	1988

If Yes, formulas refer to Table7
If No, formulas refer to Table 8

Transfer Area	Asset ID #	Historical Cost Data Available?	CRW Original Construction Cost	Eng/OH Markup 25%	CRW Original Project Cost	Projected Transfer Year	Assumed Useful Life	Annual Depreciation Percentage	Age at Transfer Year	Remaining Useful Life	Remuneration: Value of Remaining Useful Life
Hilltop Road segment	899.1	Yes	$ -	$ -	$ -	2020	100 Years	1.0%	16 Years	84 Years	$ -
Donovan Road segment	899	Yes	128,777	32,194	160,971	2020	100 Years	1.0%	16 Years	84 Years	135,216
Total Area			$ 128,777	$ 32,194	$ 160,971						$ 135,216
Leland McCord	709	No	$ 34,251	$ 8,563	$ 42,814	2020	50 Years	2.0%	60 Years	0 Years	$ -
Leland McCord	1524	No	22,650	5,662	28,312	2020	50 Years	2.0%	60 Years	0 Years	-
Leland McCord	1525	No	5,009	1,252	6,261	2020	50 Years	2.0%	60 Years	0 Years	-
Leland McCord	1937	No	11,312	2,828	14,140	2020	50 Years	2.0%	60 Years	0 Years	-
Leland McCord	2262	No	4,287	1,072	5,359	2020	50 Years	2.0%	60 Years	0 Years	-
Total Area			$ 77,509	$ 19,377	$ 96,886						$ -
Thayer from Development to UGB	3532	Yes	$ 822,725	$ 205,681	$ 1,028,406	2020	100 Years	1.0%	17 Years	83 Years	$ 853,577
Holly Lane South to UGB	280	No	$ 23,103	$ 5,776	$ 28,879	2020	50 Years	2.0%	60 Years	0 Years	$ -
Holly Lane South to UGB	3533	No	23,372	5,843	29,214	2020	50 Years	2.0%	60 Years	0 Years	-
Total Area			$ 46,475	$ 11,619	$ 58,094						$ -
Loder from Beavercreek to UGB	303	No	$ 246,674	$ 61,669	$ 308,343	2020	100 Years	1.0%	32 Years	68 Years	$ 209,673

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation), continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Original Cost Area/Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
Canyon Ridge	6	Canyon Ridge	711		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	712		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3226		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3227		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3228		Ductile Iron	6"	Yes	1980
Canyon Ridge	6	Canyon Ridge	3229		Ductile Iron	6"	Yes	1980
		Total Area						
South End	17	Parkland	2269	Street crossing	Ductile Iron	8"	No	2000
South End	17	Parkland	2385	Original development	Cast Iron	4"	Yes	1970
South End	17	Parkland	3430	Tie-in/hydrant branch-S End Rd CIP	Ductile Iron	6"	No	2000
South End	17	Parkland	3436	Fire hydrant branch	Ductile Iron	6"	No	2000
		Total Area						
Leland McCord	3	Kalal	708		Cast Iron	6"	Yes	1970
Leland McCord	5	Jessie Court	710		Cast Iron	4"	Yes	1970
Leland McCord	10	Jessie Avenue	1030		Cast Iron	6"	Yes	1970
Leland McCord	10	Jessie Avenue	2380		Cast Iron	6"	Yes	1970
Leland McCord	10	Jessie Avenue	3231		Cast Iron	6"	Yes	1970
		Total Area						

Transfer Area	Asset ID #	Historical Cost Data Available?	CRW Original Construction Cost	Eng/OH Markup 25%	CRW Original Project Cost	Projected Transfer Year	Assumed Useful Life	Annual Depreciation Percentage	Age at Transfer	Remaining Useful Life	Remuneration: Value of Remaining Useful Life
Canyon Ridge	711	No	$ -	$ -	$ -	2020	100 Years	1.0%	40 Years	60 Years	$ -
Canyon Ridge	712	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Canyon Ridge	3226	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Canyon Ridge	3227	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Canyon Ridge	3228	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Canyon Ridge	3229	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Total Area			$ -	$ -	$ -						$ -
Parkland	2269	No	$ 5,251	$ 1,313	$ 6,564	2020	100 Years	1.0%	20 Years	80 Years	$ 5,251
Parkland	2385	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Parkland	3430	No	1,092	273	1,365	2020	100 Years	1.0%	20 Years	80 Years	1,092
Parkland	3436	No	1,260	315	1,575	2020	100 Years	1.0%	20 Years	80 Years	1,260
Total Area			$ 7,604	$ 1,901	$ 9,505						$ 7,604
Kalal	708	No	$ -	$ -	$ -	2020	75 Years	1.3%	50 Years	25 Years	$ -
Jessie Court	710	No	$ -	$ -	$ -	2020	75 Years	1.3%	50 Years	25 Years	$ -
Jessie Avenue	1030	No	$ -	$ -	$ -	2020	75 Years	1.3%	50 Years	25 Years	$ -
Jessie Avenue	2380	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Jessie Avenue	3231	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Total Area			$ -	$ -	$ -						$ -

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation), continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Original Cost Area/Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	12	Salmonberry	1102		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1516		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1519		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	1521		Ductile Iron	6"	Yes	1980
South End	12	Salmonberry	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
		Total Area						
South End	9	South End Court	1028		Steel	4"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	1100	Unsure of location--assume dev built	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	1101	Unsure of location--assume dev built	Cast Iron	6"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	1515	Sunnyridge Court	Cast Iron	6"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	1520	Maywood Street	Ductile Iron	6"	Yes	1979
South End	11	Forest Ridge/Maywood Loop	2375	Elizabeth to Sunnyridge	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2376	S. End Road to Elizabeth	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2378	Sunnyridge to Maywood Street	Asbestos Cement	6"	Yes	1960
South End	11	Forest Ridge/Maywood Loop	2386	Elizbeth Court	Cast Iron	4"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	2387	Sunnyridge Court	Cast Iron	4"	Yes	1970
South End	11	Forest Ridge/Maywood Loop	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
South End	11	Forest Ridge/Maywood Loop	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
		Total Area						

Transfer Area	Asset ID #	Historical Cost Data Available?	CRW Original Construction Cost	Eng/OH Markup 25%	CRW Original Project Cost	Projected Transfer Year	Assumed Useful Life	Annual Depreciation Percentage	Age at Transfer Year	Remaining Useful Life	Remuneration: Value of Remaining Useful Life
Salmonberry	1102	No	$ -	$ -	$ -	2020	100 Years	1.0%	40 Years	60 Years	$ -
Salmonberry	1516	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Salmonberry	1519	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Salmonberry	1521	No	-	-	-	2020	100 Years	1.0%	40 Years	60 Years	-
Salmonberry	N/A	No	1,843	461	2,303	2020	100 Years	1.0%	20 Years	80 Years	1,843
Total Area			$ 1,843	$ 461	$ 2,303						$ 1,843
South End Court	1028	No	$ -	$ -	$ -	2020	50 Years	2.0%	60 Years	0 Years	$ -
Forest Ridge/Maywood Loop	1100	No	$ -	$ -	$ -	2020	50 Years	2.0%	60 Years	0 Years	$ -
Forest Ridge/Maywood Loop	1101	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Forest Ridge/Maywood Loop	1515	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Forest Ridge/Maywood Loop	1520	No	-	-	-	2020	100 Years	1.0%	41 Years	59 Years	-
Forest Ridge/Maywood Loop	2375	No	-	-	-	2020	50 Years	2.0%	60 Years	0 Years	-
Forest Ridge/Maywood Loop	2376	No	-	-	-	2020	50 Years	2.0%	60 Years	0 Years	-
Forest Ridge/Maywood Loop	2378	No	-	-	-	2020	50 Years	2.0%	60 Years	0 Years	-
Forest Ridge/Maywood Loop	2386	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Forest Ridge/Maywood Loop	2387	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Forest Ridge/Maywood Loop	N/A	No	1,843	461	2,303	2020	100 Years	1.0%	20 Years	80 Years	1,843
Forest Ridge/Maywood Loop	N/A	No	1,843	461	2,303	2020	100 Years	1.0%	20 Years	80 Years	1,843
Total Area			$ 3,685	$ 921	$ 4,606						$ 3,685

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation), continued

Conflict Area	Remun-eration ID #	Transfer Area	Asset ID #	Original Cost Area/Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year
South End	19	Finnegan/Shamrock	N/A	Tie-in - South End Road CIP	Ductile Iron	8"	No	2000
South End	19	Finnegan/Shamrock	2382		Cast Iron	6"	Yes	1970
South End	19	Finnegan/Shamrock	2383		Cast Iron	6"	Yes	1975
South End	19	Finnegan/Shamrock	2384	Shamrock Lane	Cast Iron	6"	Yes	1975
		Total Area						
South End	18	Impala	2377	Impala	Ductile Iron	8"	No	2000
South End	7	Rose/Deer	713	Deer Lane	Asbestos Cement	4"	No	1960
South End	7	Rose/Deer	714	Rose	Steel	4"	No	1960
South End	7	Rose/Deer	3091	This line is owned by City				N/A
		Total Area						
South End	16	Forest Ridge/Allen	1980	Allen Court	Steel	4"	Yes	1960
South End	16	Forest Ridge/Allen	2374	Maywood to Allen	Asbestos Cement	6"	Yes	1960
South End	16	Forest Ridge/Allen	2379	Allen west to cul de sac	Asbestos Cement	6"	Yes	1960
		Total Area						
South End	15	Buetel	1979		Steel	6"	No	1960
South End	15	Buetel	2263		Steel	4"	No	1960
		Total Area						

Transfer Area	Asset ID #	Historical Cost Data Available?	CRW Original Construction Cost	Eng/OH Markup 25%	CRW Original Project Cost	Projected Transfer Year	Assumed Useful Life	Annual Depreciation Percentage	Age at Transfer Year	Remaining Useful Life	Remuneration: Value of Remaining Useful Life
Finnegan/Shamrock	N/A	No	$ 1,843	$ 461	$ 2,303	2020	100 Years	1.0%	20 Years	80 Years	$ 1,843
Finnegan/Shamrock	2382	No	-	-	-	2020	75 Years	1.3%	50 Years	25 Years	-
Finnegan/Shamrock	2383	No	-	-	-	2020	75 Years	1.3%	45 Years	30 Years	-
Finnegan/Shamrock	2384	No	-	-	-	2020	75 Years	1.3%	45 Years	30 Years	-
Total Area			$ 1,843	$ 461	$ 2,303						$ 1,843
Impala	2377	No	$ 37,128	$ 9,282	$ 46,410	2020	100 Years	1.0%	20 Years	80 Years	$ 37,128
Rose/Deer	713	No	$ 3,999	$ 1,000	$ 4,998	2020	50 Years	2.0%	60 Years	0 Years	$ -
Rose/Deer	714	No	2,489	622	3,112	2020	50 Years	2.0%	60 Years	0 Years	-
Rose/Deer	3091	No	-	-	-	2020	N/A	N/A	N/A	N/A	-
Total Area			$ 6,488	$ 1,622	$ 8,110						$ -
Forest Ridge/Allen	1980	No	$ -	$ -	$ -	2020	50 Years	2.0%	60 Years	0 Years	$ -
Forest Ridge/Allen	2374	No	-	-	-	2020	50 Years	2.0%	60 Years	0 Years	-
Forest Ridge/Allen	2379	No	-	-	-	2020	N/A	N/A	N/A	N/A	-
Total Area			$ -	$ -	$ -						$ -
Buetel	1979	No	$ 6,844	$ 1,711	$ 8,555	2020	50 Years	2.0%	60 Years	0 Years	$ -
Buetel	2263	No	2,489	622	3,112	2020	50 Years	2.0%	60 Years	0 Years	-
Total Area			$ 9,333	$ 2,333	$ 11,667						$ -

Table 9: Calculation of Remuneration Value (CRW Original Cost Less Depreciation), continued

Conflict Area	Remuneration ID #	Transfer Area	Asset ID #	Original Cost Area/Description	Pipe Material	Pipe Size (inches)	Developer Built?	Installation Year	Historical Cost Data Available?
South End	13	Navajo	1114	Cul de sac	Ductile Iron	6"	Yes	1979	No
South End	13	Navajo	1115	South End Rd/Navajo fire hydrant	Ductile Iron	6"	No	1979	No
South End	13	Navajo	1116	Navajo/S Turquoise Way (north)	Ductile Iron	6"	Yes	1979	No
South End	13	Navajo	1117	Navajo/S Turquoise Way (south)	Ductile Iron	6"	Yes	1979	No
South End	13	Navajo	1517	Navajo/S Turquoise to cul de sac	Ductile Iron	6"	Yes	1979	No
South End	13	Navajo	1518	Navajo/S End Rd to Turquoise Way	Ductile Iron	6"	Yes	1979	No
South End	13	Navajo	N/A	Tie in - South End Road CIP	Ductile Iron	8"	No	2000	No
		Total Area							
South End	21	Kelland Court	1209	Kelland Court	Ductile Iron	8"	Yes	1966	No
South End	21	Kelland Court	3437	Unsure of location--assume dev built	Ductile Iron	8"	Yes	1966	No
		Total Area							
South End Road	22	J McL ES to New Master Meter	0001	South End Rd - Cost Share Part	Ductile Iron	12"	No	2001	Yes
South End Road	23	New Master Meter to Sta 44+85	0002	South End Rd - 100% CRW Part	Ductile Iron	12"	No	2001	Yes
South End Road	23	Sta 44+85 to Sta 56+15	0003	South End Rd - 100% CRW Part	Ductile Iron	12"	No	2001	Yes
South End Road	23	Sta 56+15 to Sta 59+80	0004	South End Rd - 100% CRW Part	Ductile Iron	12"	No	2001	Yes
South End Road	23	Sta 59+8015 to Sta 104+40	0005	South End Rd - 100% CRW Part	Ductile Iron	8"	No	2001	Yes
		Total Area							

Transfer Area	Asset ID #	Historical Cost Data Available?	CRW Original Construction Cost	Eng/OH Markup 25%	CRW Original Project Cost	Projected Transfer Year	Assumed Useful Life	Annual Depreciation Percentage	Age at Transfer Year	Remaining Useful Life	Remuneration: Value of Remaining Useful Life
Navajo	1114	No	$ -	$ -	$ -	2020	100 Years	1.0%	41 Years	59 Years	$ -
Navajo	1115	No	487	122	608	2020	100 Years	1.0%	41 Years	59 Years	359
Navajo	1116	No	-	-	-	2020	100 Years	1.0%	41 Years	59 Years	-
Navajo	1117	No	-	-	-	2020	100 Years	1.0%	41 Years	59 Years	-
Navajo	1517	No	-	-	-	2020	100 Years	1.0%	41 Years	59 Years	-
Navajo	1518	No	-	-	-	2020	100 Years	1.0%	41 Years	59 Years	-
Navajo	N/A	No	1,843	461	2,303	2020	100 Years	1.0%	20 Years	80 Years	1,843
Total Area			$ 2,329	$ 582	$ 2,912						$ 2,202
Kelland Court	1209	No	$ -	$ -	$ -	2020	100 Years	1.0%	54 Years	46 Years	$ -
Kelland Court	3437	No	-	-	-	2020	100 Years	1.0%	54 Years	46 Years	-
Total Area			$ -	$ -	$ -						$ -
J McL ES to New Master Meter	0001	Yes	$ 200,528	$ 50,132	$ 250,660	2020	100 Years	1.0%	19 Years	81 Years	$ 203,035
New Master Meter to Sta 44+85	0002	Yes	$ 13,886	$ 3,471	$ 17,357	2020	100 Years	1.0%	19 Years	81 Years	$ 14,059
Sta 44+85 to Sta 56+15	0003	Yes	35,260	8,815	44,075	2020	100 Years	1.0%	19 Years	81 Years	35,701
Sta 56+15 to Sta 59+80	0004	Yes	11,389	2,847	14,237	2020	100 Years	1.0%	19 Years	81 Years	11,532
Sta 59+8015 to Sta 104+40	0005	Yes	116,949	29,237	146,186	2020	100 Years	1.0%	19 Years	81 Years	118,411
Total Area			$ 177,484	$ 44,371	$ 221,855						$ 179,703
Total Conflict Areas Identified by Murraysmith			$ 1,770,425	$ 442,606	$ 2,213,032						$ 1,635,508

APPENDIX B

Source Data for Standard Costs:

Exhibit B-1: Unit Cost Data from Vallejo, California 2012 Appraisal

Exhibit B-2: Supplemental Unit Cost Assumptions - Lakehaven Water & Sewer District Model

Exhibit B-3: August 3, 2017 Update by Brian Ginter of Murraysmith, Based on Local Data

Exhibit B-1: Data from Vallejo, California 2012 Appraisal

Unit costs originally provided by CH2M-Hill were specific to that time and location
They were used here as a starting point that differentiates different types of materials.

Pipe Size (inches)	Pipe Material	Unit Reproduction Cost	Unit Cost as Multiple of 8" for Given Material	Unit Price as % of DI for Given Size
2.5	CI	98	0.69	N/A
4	CI	112	0.78	N/A
4	PVC	112	0.80	N/A
4	AC	112	0.75	N/A
6	HDPE	110	0.87	71%
6	CI	126	0.88	81%
6	AC	130	0.87	84%
6	PVC	140	1.00	90%
6	DI	155	0.86	100%
6	Steel	199	1.00	129%
8	HDPE	126	1.00	70%
8	PVC	140	1.00	78%
8	CI	143	1.00	80%
8	AC	149	1.00	83%
8	DI	179	1.00	100%
8	Steel	200	1.00	112%
10	CI	155	1.08	N/A
12	HDPE	170	1.35	N/A
12	PVC	170	1.21	N/A
14	PVC	184	1.32	70%
14	DI	263	1.47	100%
14	Steel	337	1.69	128%
24	Steel	526	2.63	N/A
Average % of Ductile Iron (DI) for Applicable Sizes:				
	CI			80%
	AC			84%
	HDPE			70%
	PVC			80%
	DI			100%
	Steel			123%
Average Multiple of 8" for Applicable Materials:				
2.5			0.69	
4			0.78	
6			0.91	
8			1.00	
10			1.08	
12			1.28	
14			1.49	
24			2.63	

Exhibit B-2: Supplemental Assumptions from Lakehaven Water & Sewer District Model

Composite profile drawn from multiple clients over the years, used when reasonable assumptions are needed about cost relationships across wide range of pipe sizes. Used here to fill in gaps for pipe sizes not included in Vallejo data.

Size	Price per Lineal Foot	Unit Price as Multiple of 8"
1"	80	0.43
1.5"	90	0.49
2"	100	0.54
3"	115	0.62
4"	130	0.70
6"	160	0.86
8"	185	1.00
10"	215	1.16
12"	230	1.24
14"	250	1.35
16"	280	1.51
20"	320	1.73
24"	360	1.95
36"	400	2.16

Exhibit B-3: August 3, 2017 Update by Brian Ginter of Murraysmith, Based on Local Data

Benchmark Year: **2017**

Size	Material	Construction Cost ($/LF)	Implied Multiple of 8"
8"	Ductile Iron	159	1.00
10"	Ductile Iron	176	1.11
12"	Ductile Iron	189	1.19

APPENDIX C

Backup Data for South End Road 2001 Water Line Construction Project:

Exhibit C-1: Cost of South End Road 2001 Water Line Project – Allocation to Segments

Exhibit C-2: South End Road - Cost Sharing Detail between City and CRW

Exhibit C-1: Cost of South End Road 2001 Water Line Project

South End Road Project Costs		Length of Pipe			Cost ($)					
					Cost-Share Segment					
Segment #	***Assuming Data from Cost Detail***	Lineal Feet	Adjusted Lineal Feet	% of Adjusted Lineal Feet	City Share	CRW Share	Total	100% CRW Segment	Total CRW Cost	Total Project
	Cost-sharing Segment:				50.9%	49.1%	100.0%			
0001	12" DI - J McLoughlin ES to Sta 40+40	4,432 LF			$ 207,669	$ 200,528	$ 408,198	$ -	$ 200,528	$ 408,198
	100% CRW Segments:									
0002	12" DI - Sta 40+40 to Sta 44+85 (2001 UGB)	429 LF	510 LF	7%				13,199	13,199	13,199
0003	12" DI - Sta 44+85 to Sta 56+15 (2006 UGB)	1,089 LF	1,294 LF	19%				33,516	33,516	33,516
0004	12" DI - Sta 56+15 to Sta 59+80 (May Road)	352 LF	418 LF	6%				10,826	10,826	10,826
0005	8" DI Sta 59+8015 to Sta 104+40 (end of project)	4,631 LF	4,631 LF	68%				119,943	119,943	119,943
	Total	10,932 LF	6,853 LF	100%	$ 207,669	$ 200,528	$ 408,198	$ 177,484	$ 378,012	$ 585,682

Adjusted lineal feet is based on standard pipe cost equivalent of 8" Ductile Iron.

Exhibit C-2: Detailed Breakdown for Cost-Share Segment between City and CRW – South End Road

Data from Cost Detail		Lineal Feet			Cost ($)					
Source: Bob George, CRW		Cost-Share Segment	100% CRW Segment	Total Project	Cost-Share Segment: City Share	Cost-Share Segment: CRW Share	Cost-Share Segment: Total	100% CRW	Total CRW Cost	Total Project
Pipe										
12" Ductile Iron:										
Non-restrained	Class A	105 LF	855 LF	960 LF	$ 1,050	$ 1,050	$ 2,100	$ 17,100	$ 18,150	$ 19,200
	Class D	3,589 LF	748 LF	4,337 LF	$ 73,575	73,575	147,149	30,668	104,243	177,817
Restrained	Class D	417 LF	266 LF	683 LF	$ 12,302	12,302	24,603	15,694	27,996	40,297
Total 12" Ductile Iron		4,111 LF	1,869 LF	5,980 LF	$ 86,926	$ 86,926	$ 173,852	$ 63,462	$ 150,388	$ 237,314
8" Ductile Iron:										
Non-restrained	Class A	0 LF	4,211 LF	4,211 LF	$ -	$ -	$ -	$ 71,587	$ 71,587	$ 71,587
	Class D	0 LF	30 LF	30 LF	-	-	-	1,050	1,050	1,050
Restrained	Class A or D	0 LF	390 LF	390 LF	-	-	-	17,550	17,550	17,550
	Class F	240 LF	0 LF	240 LF	8,880	8,880	17,760	-	8,880	17,760
Total 8" Ductile Iron		240 LF	4,631 LF	4,871 LF	$ 8,880	$ 8,880	$ 17,760	$ 90,187	$ 99,067	$ 107,947
6" Ductile Iron:										
Restrained	Class D	67 LF	0 LF	67 LF	1,508	1,508	3,015	$ -	$ 1,508	$ 3,015
	Class F	14 LF	0 LF	14 LF	525	525	1,050	-	525	1,050
Total 6" Ductile Iron		81 LF	0 LF	81 LF	$ 2,033	$ 2,033	$ 4,065	$ -	$ 2,033	$ 4,065
Total Pipe		4,432 LF	6,500 LF	10,932 LF	$ 97,839	$ 97,839	$ 195,677	$ 153,649	$ 251,488	$ 349,326
Other Cost Elements										
Mobilization					$ 14,500	$ 14,500	$ 29,000	$ -	$ 14,500	$ 29,000
Gate valves and boxes					13,750	13,750	27,500	5,550	19,300	33,050
Reconnect hydrant					-	-	-	750	750	750
New hydrants					6,300	6,300	12,600	1,800	8,100	14,400
1" combination air relief valve					250	250	500	1,500	1,750	2,000
MJ adaptors					1,600	1,600	3,200	550	2,150	3,750
Elbows, crosses and tees					7,978	7,978	15,955	3,100	11,078	19,055
Miscellaneous fittings					993	993	1,985	185	1,178	2,170
Replace services					5,925	5,925	11,850	800	6,725	12,650
Transfer existing services					1,350	1,350	2,700	-	1,350	2,700
Hot tapping sleeve and valve					3,800	3,800	7,600	1,800	5,600	9,400
Master meter vault					11,500	11,500	23,000	-	11,500	23,000
Surface restoration					16,164	16,164	32,328	400	16,564	32,728
Tree and stump removal					1,750	1,750	3,500	-	1,750	3,500
General surface restoration					750	750	1,500	-	750	1,500
Water line abandonment					500	500	1,000	-	500	1,000
Connect to existing pipes					2,500	2,500	5,000	-	2,500	5,000
Roadside ditch restoration					-	-	-	7,400	7,400	7,400
Testing/flushing					500	500	1,000	-	500	1,000
Removal of pipes from existing vault					500	500	1,000	-	500	1,000
Sheeting, shoring & traffic control					1,000	1,000	2,000	-	1,000	2,000
Change order #1					8,727	772	9,498	-	772	9,498
Change order #2					7,959	9,959	17,918	-	9,959	17,918
Change order #3					1,536	350	1,886	-	350	1,886
Total Other Cost Elements					$ 109,831	$ 102,690	$ 212,521	$ 23,835	$ 126,525	$ 236,356
Total Project					$ 207,669	$ 200,528	$ 408,198	$ 177,484	$ 378,012	$ 585,682
					50.9%	**49.1%**	**100.0%**		64.5%	100.0%