Draft Report

Pavement Utility Cut Impact Fee Study

City of Riverside, CA

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Riverside Public Works Department
3900 Main St #4
Riverside, CA 92522

February 2025

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NCE Project No. 879.02.30

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Prepared for:

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Executive Summary

Public agencies and utility providers have been investigating the effects of utility cuts on pavement performance for over 30 years in order to quantify their impact on streets and estimate the corresponding financial impacts. However, to fully understand the impact of utility cuts on pavement performance for a particular agency, site-specific studies and analyses must be performed.

To fully understand the impact of utility cuts on pavements in the City of Riverside (City), develop an appropriate fee schedule to recover costs associated with such damage, and compare that fee schedule with typical fees charged by similar California agencies, NCE reviewed relevant studies and investigated the structural and functional deterioration of pavements due to utility cuts.

NCE used field evaluations to examine pavement deterioration, which included analysis of functional and structural damage at 30 different sites within the City. The selected field sites had varying functional classes and conditions (Pavement Condition Index [PCI]). NCE used a falling weight deflectometer to assess loss of structural capacity due to cuts at the sites, and surveyed pavement conditions to assess functional damage.

The findings from this study include:

- Ninety-seven percent of the test sites were either structurally or functionally damaged by utility cuts. Seventy-three percent of the test sites had both structural and functional damage.
- Utility cuts cause structural damage to pavements. An average overlay thickness of 4 inches is needed to compensate for the loss in structural capacity.
- Overall, pavements with cuts deteriorate more rapidly than pavements without cuts. An average condition reduction of 18 PCI points was observed when utility cuts were present.
- Thirty percent of the test sites displayed damage beyond the edge of the cut, known as the "Zone of Influence (2 ft outside the edge of the cut/T-arm).

These findings were used to develop the following fee schedule for the City:

Functional Class	PCI Group	Fees ($/SF*)
Arterials/Collectors	PCI ≥ 60	$ 5.00
	25 ≤ PCI < 60	$ 3.50
	PCI < 25	$ 0.00
Residentials	PCI ≥ 70	$ 4.50
	25 ≤ PCI < 70	$ 3.50
	PCI < 25	$ 0.00

* The total square footage includes the zone of influence (2 ft outside the edge of the cut/T-arm).

The information required to implement this fee schedule includes the functional class of the pavement section, the PCI of the section at the time of cut, and the trench dimensions. Because the City seeks to implement fair and appropriate fee programs, streets with a functional classification of Very Poor will not incur a fee. Furthermore, NCE recommends that the fee schedule be indexed to inflation and annually adjusted to reflect increases in repair costs.

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1 Introduction

Utility providers often need to cut existing pavements to access and service their underground facilities. Over the last 30 years, local agencies have sought answers to the following questions:

- How do utility cuts affect pavement performance?
- If pavement performance is affected, what is the corresponding financial impact?

To answer these questions, public agencies and utility providers have sponsored engineering studies (Todres and Baker 1996). Studies of utility cut impacts often use deflection testing, condition surveys, and statistical analysis to quantify the impacts of performance. The performance impacts are typically expressed as a loss in structural capacity and/or a decrease in pavement condition, and to manage them, many studies have recommended restoring areas surrounding the cut, increasing overlay thickness, or imposing a restoration fee on utility providers.

These studies and recommendations have led to an increase in the number of public policies that 1) compensate local agencies for the loss of pavement life through utility cut fees, and 2) establish rigorous utility cut restoration standards and moratoria, or “no-cut” periods to achieve more acceptable performance of repair work following underground utility access and maintenance.

The impact of utility cuts varies with:

- Existing pavement condition, structure, and age.
- Location, orientation, and extent of the utility cut.
- Environmental factors.
- Traffic loads.
- Restoration practices and standards.
- Local maintenance treatments and their costs.

Utility cut impacts can vary significantly among sites and agencies, and existing studies are often performed in-house or by consulting companies and are therefore unpublished or difficult to access. Because of this, site-specific studies and analyses are necessary to understand the impact of utility cuts on pavement performance for a particular agency.

The purpose of this study was to compare the performance of pavement sections with and without utility cuts in the City of Riverside (City), quantify the damage, if any, caused by the cuts, and develop a fee schedule for the City to recover any costs associated with such damage.

1.1 Damage Mechanisms

Underground utility work can damage pavements in 3 general ways (Figure 1).

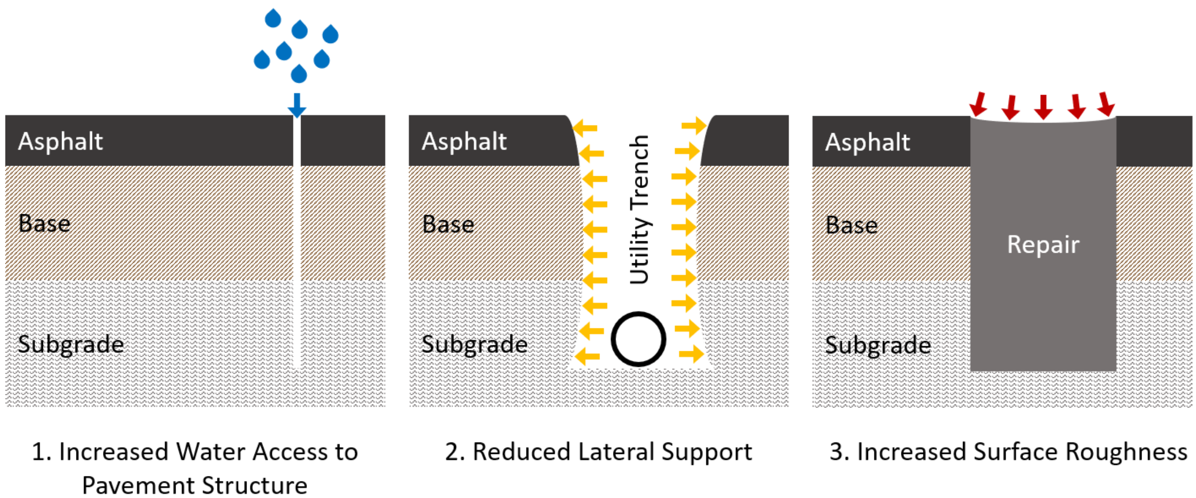

Figure 1. Utility Cut Damage Mechanisms

First, cutting a pavement structure creates an entry point for water, which can damage the underlying pavement layers. Second, removing pavement layers creates a plane of weakness where the pavement structure may not be adequately supported laterally, particularly during underground utility maintenance, but also after restoration. Third, repairing the pavement can introduce roughness if the patch/restored cut does not closely match the adjacent pavement structure. Rough pavements can cause vehicles to bounce, which increases loads on the pavement and leads to more rapid deterioration (Tarakji 1995, Wilde et al. 2002). These mechanisms can reduce the condition and structural capacity of pavement within and adjacent to the utility cut, which reduces its service life (Stevens et al. 2010).

Having multiple pavement utility cuts on the same street can magnify their negative impact (San Francisco Department of Public Works 1998, Tarakji 1995). Pavement networks are typically divided into management sections, each of which represents a portion of a street that has the same construction history, traffic, and structure along its length. The PCI calculation methodology in ASTM D 6433, indicates that individual or collective medium severity cuts constituting 10 percent of a management section's area will cause the PCI for the entire management section to drop, even if no other distresses are present, from excellent condition (PCI of 100) into fair condition (PCI of 69). Based on typical local agency decision trees, this PCI reduction triggers the need for mill and overlay or other rehabilitation treatment. Although only the cut area and adjacent zone of influence is directly damaged, the damaged area affects the condition and management of the entire management section, and any rehabilitation treatment would typically be done on the entire management section.

1.2 Literature Review

Researchers have used falling weight deflectometer (FWD) testing, condition surveys, and statistical analyses to quantify the impact of utility cuts on pavement performance (Chow and Troyan 1999, Jensen et al. 2005). These tests have shown that utility cuts can reduce pavement life by 15 to 55 percent, resulting in millions of dollars in costs to local agencies for premature street repairs and remediation (Dunn et al. 2024, Ghosh et al. 2024). In addition, underground utility work often affects not only the excavated area, but the adjacent pavement (Chow and Troyan 1999, Jensen et al. 2005). Typically, pavement 4 – 5 feet from the edges of the trench is affected, though this varies among agencies and locations (Jensen et al. 2005).

Other studies have assessed the damage caused by utility cuts using functional evaluation of pavement conditions. Larger utility cuts have a greater impact on the street than smaller cuts, as treatments cover whole management sections (Dunn et al. 2024, Ghosh et al. 2024). Furthermore, a threshold of 10% of the management section areas was found for the large and small cut (Dunn et al. 2024, Ghosh et al. 2024).

To help restore structural capacity and performance loss due to utility cuts, many agencies have set restoration standards. For example, restoration standards in California typically include a T-cut (saw-cut) along with a restoration treatment that may be as extensive as replacing the full lane for the entire affected block. To recover costs associated with this restoration, many agencies impose utility cut fees. In California, these fees are typically based on functional classification, pavement age, Pavement Condition Index (PCI), and/or utility cut depth and orientation (longitudinal or transverse).

Appendix A summarizes the literature that details the impact of utility cuts on pavement performance among California agencies, the importance of adequate utility cut restoration, and the policies established to address pavement degradation caused by utility cuts.

2 Technical Approach

Utility cuts can negatively impact pavement structure (strength) and function (service life). For this study, City streets with and without utility cuts were evaluated for structural and functional deterioration, and fees were developed to compensate for both types of damages.

Structural deterioration is evaluated by measuring the overlay thickness needed to reach an acceptable structural capacity under a specified traffic load, usually expressed through the Traffic Index (TI). If a utility cut weakens the pavement structure, then sections with cuts will require a thicker overlay than sections with no cuts. Overlay thickness is calculated from deflection data obtained through FWD testing using the method in the California Department of Transportation's (Caltrans) Highway Design Manual (Caltrans 2020). Higher deflections represent lower structural capacity and vice versa. Pavements with utility cuts typically have higher deflections than pavements without utility cuts (Dunn et al. 2024). This loss of structural capacity necessitates thicker overlays and increases the cost of rehabilitation for pavement sections with utility cuts.

Functional deterioration is evaluated in terms of PCI, which ranges from 0 to 100 (Table 1). A pavement in excellent condition has a PCI ≥ 85, while a very poor (Failed) pavement has a PCI < 25. The PCI is calculated from pavement distress data collected through visual inspection. Pavement distresses are usually categorized as structural or environmental, and their degree is affected by their severity and quantity. Note that a loss in structural capacity via structural distresses like fatigue cracking or rutting can lead to functional deterioration, which adversely impacts PCI.

Table 1. Pavement Condition Categories

Condition Category*	PCI Range
Excellent	85 – 100
Very Good	70 – 84
Good	60 – 69
Fair	50 – 59
Marginal	40 – 49
Poor	25 – 39
Very Poor	0 – 24

*Based on the City's 2023 pavement management program (PMP) report

Pavement function can be evaluated through current field inspections and/or using the inspection history recorded within a pavement management program (PMP) database.

Figure 2 shows the methods used in this study. Both functional and structural deterioration were evaluated *in situ*.

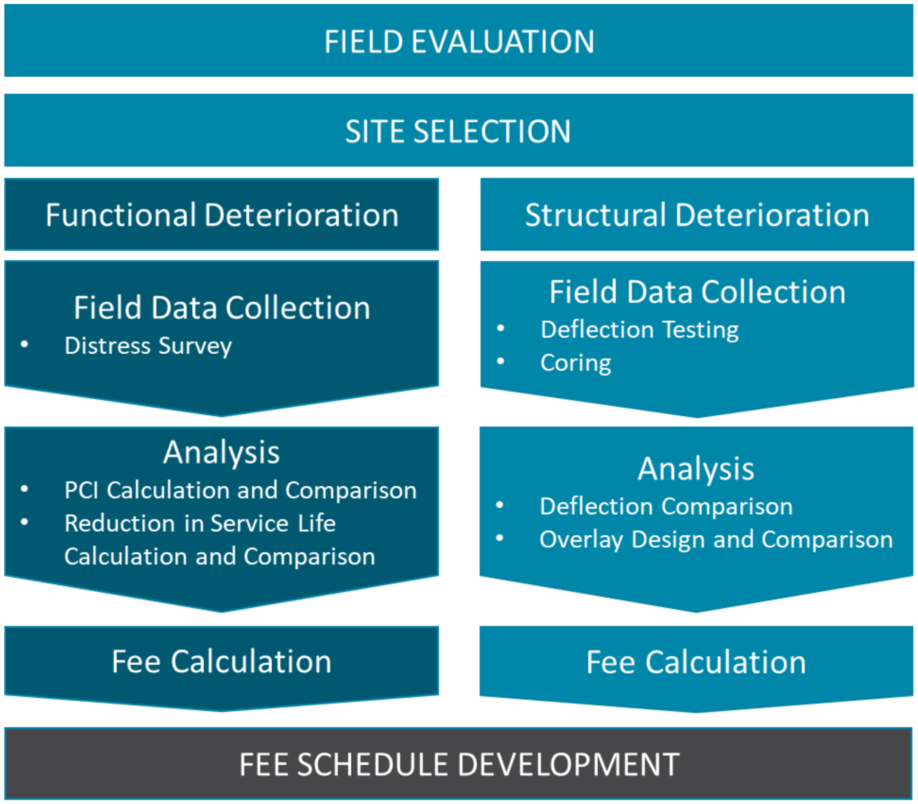

Figure 2. Study Methodology

3 Field Evaluation

Functional and structural field data were collected at 30 test sites throughout the City. Test sites were selected based on current PCI and functional classification (arterials/collectors and residentials). Each test site included a section with a utility cut (Cut Section) and an adjacent section without a utility cut (No-Cut Section; Figure 3). Both Cut Sections and No-Cut Sections were typically 100 feet long and at least 1 lane wide and were adjacent to each other to ensure that they had the same pavement structure and experienced the same traffic loads and environmental conditions.

- To evaluate functional deterioration (more details provided in Section 3.1), NCE:
    - Surveyed pavement distresses for the Cut and No-Cut Sections per ASTM D6433 standards.
    - Compared the PCIs of the Cut and No-Cut Sections by functional class.
    - Calculated the percent reduction in pavement service life associated with utility cuts and compared the impacts across functional classes and PCI groups from the pavement deterioration curves.
- To evaluate structural deterioration (more details provided in Section 3.2), NCE:
    - Tested deflection at each site per California Test Method (356).
    - Extracted cores from each of the No-Cut Sections to measure pavement thickness.
    - Calculated average pavement deflections and required overlay thicknesses on the cut, the T-arm of the cut, 2 feet away from the cut, and in the No-Cut Section.

Figure 3. Example Test Site

3.1 Functional Deterioration

The following subsections detail the process and findings related to functional deterioration in this study. This includes gathering distress data, calculating and comparing the PCI values for sections with and without utility cuts, and assessing the resulting reductions in service life from pavement deterioration curve. These data were then used to calculate the corresponding cost of functional damage to pavements caused by utility cuts.

3.1.1 Field Data Collection

NCE surveyed distresses for the Cut and No-Cut Sections at each site. Distress surveys were performed in accordance with ASTM D6433 (ASTM 2020) and included identification of each distress type, its severity, and its extent. The PCIs for all sections were then calculated per ASTM D6433.

3.1.2 PCI Results

Table 2 lists the PCIs for all sections at all test sites. At 93.3% of the test sites, the PCI of the Cut Section was lower than the PCI of the No-Cut Section, suggesting functional deterioration due to utility cuts. This trend is illustrated in Figure 4, with a diagonal line illustrating a 1-to-1 relationship. Data points that fall below the line (red dots) represent sections with functional damage. At 2 sites, the PCI of the Cut Section was equal to or greater than the PCI of the No-Cut Section (blue dots). The Cut Sections at these 2 sites are performing better than the No-Cut Sections because the cut repairs removed some distresses, and existing restorations are performing well.

On average, the PCI of No-Cut Sections was 59, and 41 for Cut Sections, indicating a drop in condition category from Fair to Marginal (Table 1). This average decrease of 18 PCI points is primarily due to the cut itself, but additional longitudinal/transverse/fatigue cracking near cuts also impacts PCI. Figure 5 shows propagating longitudinal/transverse/fatigue cracking near a patch on Indiana Avenue.

3.1.3 Reduction in Service Life

A reduction in PCI corresponds to a reduction in the remaining service life (RSL) of a pavement. A pavement's RSL is the number of years until it falls into failed condition, i.e., a pavement's RSL reaches 0 when the PCI drops below or equal to 25. Based on the inspection data that was provided by the City, deterioration cures were developed for the arterials/collectors and residentials as shown in Figure 6. Arterials/collectors have a total service life of approximately 29 years, while residentials have a total service life of approximately 36 years.

Table 2. Test Sites With and Without Cut Functional Damage

Functional Class	Site Name	PCI No-Cut Section	PCI Cut Section	Functional Damage
Arterials/Collectors	IN	77	44	Yes
	AC	75	60	Yes
	MS	74	61	Yes
	TS	67	52	Yes
	MB	61	46	Yes
	CA	59	58	Yes
	IA	58	60	No
	CS	57	54	Yes
	PA-1	54	32	Yes
	MA	52	29	Yes
	PA-2	42	32	Yes
	SA	41	27	Yes
	ML	36	16	Yes
	HA	32	29	Yes
	BS	32	33	No
Residentials	PL	85	65	Yes
	MI	84	36	Yes
	SD	75	24	Yes
	KD	74	44	Yes
	MO	71	43	Yes
	BA-1	69	54	Yes
	RS	67	45	Yes
	BA-3	62	46	Yes
	BU	62	46	Yes
	BA-2	61	35	Yes
	10S	58	51	Yes
	WS	54	47	Yes
	ED	52	8	Yes
	06S	50	31	Yes
	RA	39	30	Yes

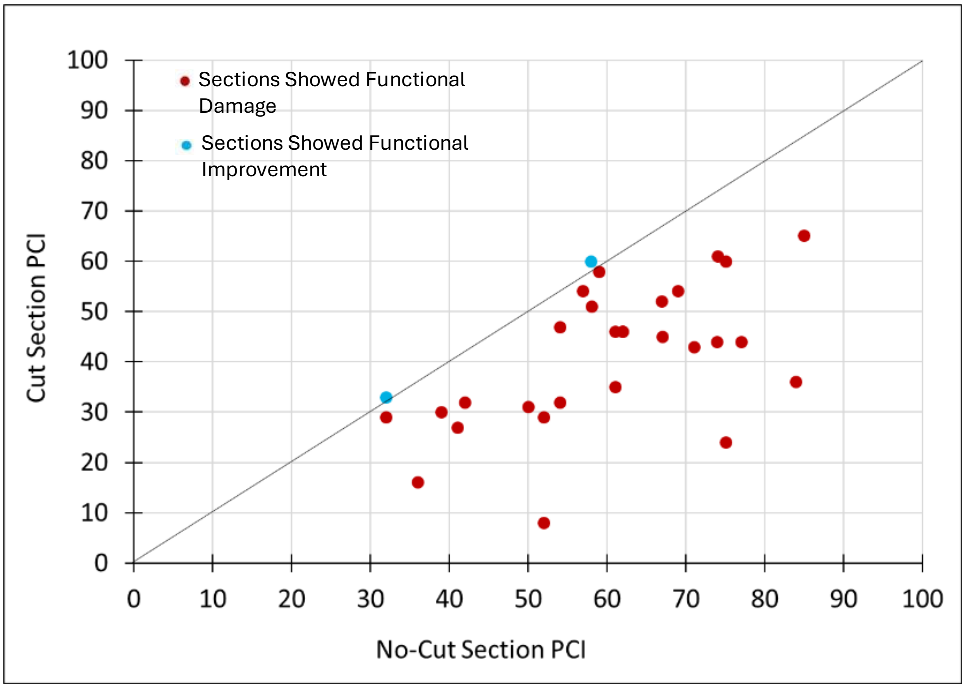

Figure 4. Comparison of PCIs of Pavement Sections With and Without Utility Cuts

Figure 5. Propagating Cracks (Highlighted) Near Patch on Indiana Avenue

For each test site, the percent reduction in service life due to utility cuts was estimated using the deterioration curves. For instance, the No-Cut Section of the residential Bushnell Avenue (site BA-1) test site had a PCI of 69, which corresponds to a pavement age of 19.4 years based on the family deterioration curve. In contrast, the Cut Section at that same test site had a PCI of 54, which corresponds to an equivalent pavement age of 28.5 years. This means that the service life of the pavement was reduced by approximately 9.1 years, or 23.0% of its total service life, because of utility cuts. This reduction in service life was calculated for all 30 test sites and plotted relative to the PCIs of the No-Cut Sections (Figure 7). The percent reduction in RSL ranged from 0.0% to 73.0% and was 24.1% on average. One test site showed a negative percent reduction in life, indicating that the Cut Sections are performing better than the No-Cut Sections, because the cut areas have repaired some existing distresses. At one test site there was no difference in condition between the Cut and No-Cut Sections, suggesting that some distresses were removed during the cut/restoration.

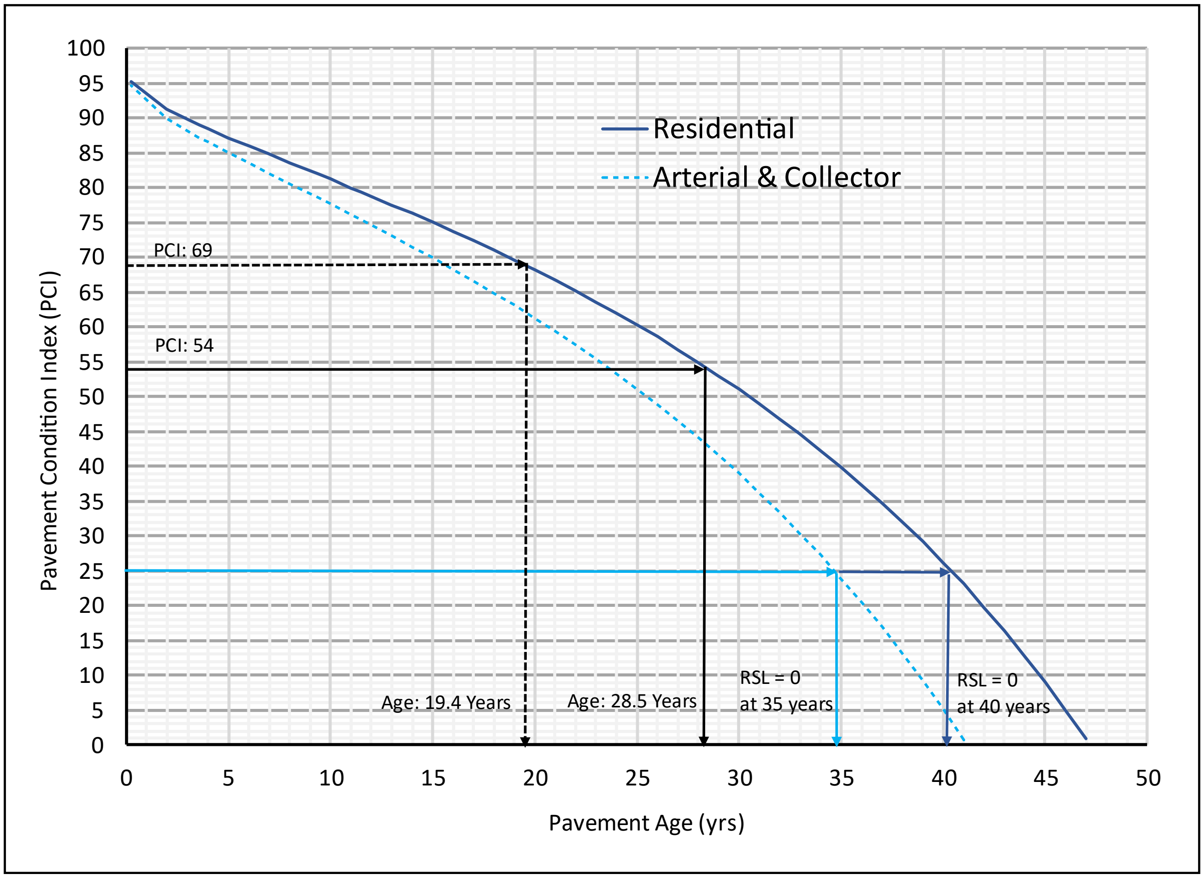

Figure 6. Pavement Deterioration Curves for City Streets

* RSL: Remaining service life in years.

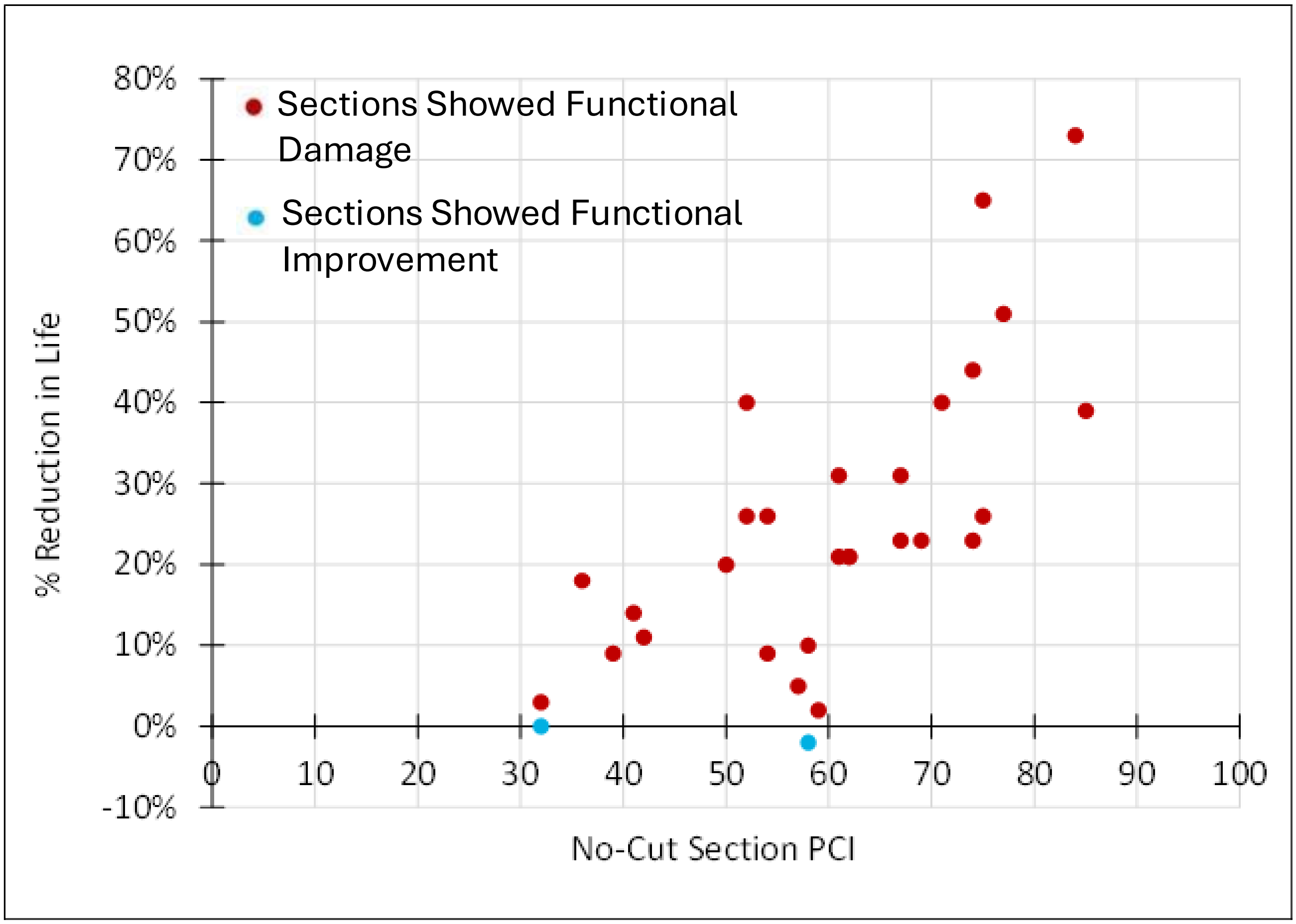

Figure 7. PCI for Sections Without Utility Cuts vs. Percent Reduction in Service Life

3.1.4 Damage Cost

To calculate the costs of the reduction in service life due to utility cuts, the estimated percent reduction in service life was multiplied by typical pavement rehabilitation (2"-3" mill and overlay) cost for the City as obtained from the City's 2023 PMP report:

- Arterials/Collectors: $62.80 per square yard or $6.98 per square foot
- Residentials: $52.60 per square yard or $5.84 per square foot

For example, the residential test site on Rivera Street (RS) had a 31% reduction in service life due to a utility cut. For a residential pavement section, the typical cost of pavement rehabilitation is $5.84 per square foot. Therefore, the cost corresponding to the reduction in service life due to the cut is $1.81 per square foot (0.31 × $5.84/sq. ft) for the site. Table 3 summarizes the percent reduction in service life due to cuts and the corresponding equivalent cost for all test sites rounded to the nearest 50 cents.

Table 3. Percent Reduction in Service Life and Equivalent Damage Cost

Functional Class	Site Name	PCI No-Cut Section	PCI Cut Section	% Reduction In Pavement Life	Cost, $/SF
Arterials/Collectors	IN	77	44	51%	$4.00
	AC	75	60	26%	$2.00
	MS	74	61	23%	$2.00
	TS	67	52	23%	$2.00
	MB	61	46	21%	$1.50
	CA	59	58	2%	$0.50
	IA	58	60	-2%	$-
	CS	57	54	5%	$0.50
	PA-1	54	32	26%	$2.00
	MA	52	29	26%	$2.00
	PA-2	42	32	11%	$1.00
	SA	41	27	14%	$1.00
	ML	36	16	18%	$1.50
	HA	32	29	3%	$0.50
	BS	32	33	0%	$-
Residentials	PL	85	65	39%	$2.50
	MI	84	36	73%	$4.50
	SD	75	24	65%	$4.00
	KD	74	44	44%	$3.00
	MO	71	43	40%	$2.50
	BA-1	69	54	23%	$1.50
	RS	67	45	31%	$2.00
	BA-3	62	46	21%	$1.50
	BU	62	46	21%	$1.50
	BA-2	61	35	31%	$2.00
	10S	58	51	10%	$1.00
	WS	54	47	9%	$1.00
	ED	52	8	40%	$2.50
	06S	50	31	20%	$1.50
	RA	39	30	9%	$1.00

3.2 Structural Deterioration

The following subsections detail the process and findings related to structural deterioration in this study. This includes the process and results of collecting, analyzing, and comparing deflection measurements and required overlay thicknesses. This data were used to calculate the corresponding cost of structural damage to pavements caused by utility cuts.

3.2.1 Field Data Collection

At each test site, NCE performed FWD testing in accordance with the California Test Method 356 (Caltrans 2020). During testing, the FWD delivered a nominal 9,000-pound impulse load to the pavement surface and measured the resulting pavement deflection using a geophone directly under the load. A minimum of 21 deflection measurements were taken at each of 4 measurement locations for each test site (Figure 8):

1. On the utility cut- along the centerline of the cut (1)
2. Two feet within the cut - “T-Arm” (2)
3. Two feet away from the cut - “Zone of Influence” (3)
4. Within the No-Cut Section - at least 10 feet away from the cut

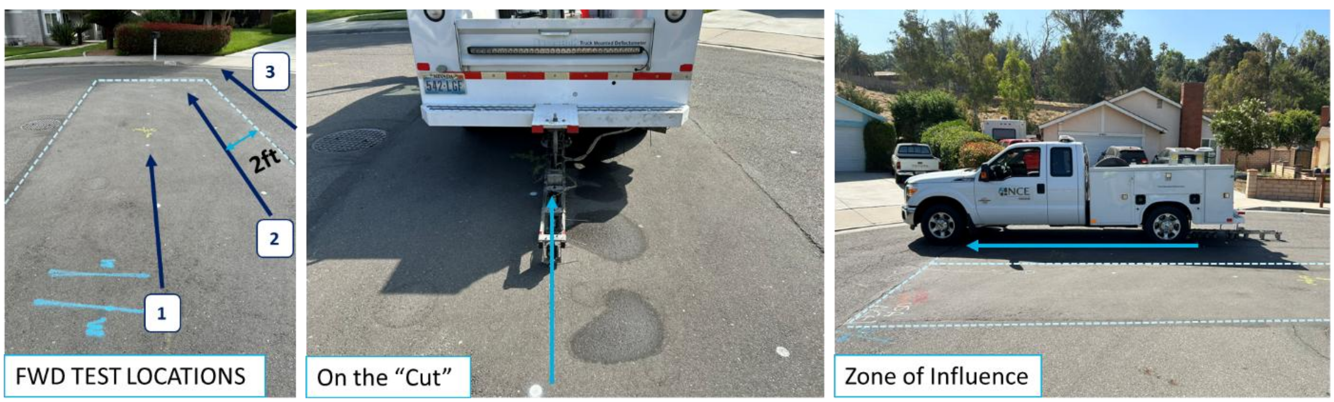

Figure 8. Falling Weight Deflectometer Testing Locations

Since the City’s restoration standard requires a T-cut patch, the exact edge of the utility cut was unknown. NCE therefore tested 2 feet outside and inside of the edge of the patch to see if structural damage occurred around the restoration area near the edge. Additionally, coring was performed in the No-Cut Section, and the original asphalt pavement thickness was cored and measured.

3.2.2 Deflection Results

Comparing the deflection data across the 4 measurement locations shows the relative loss of structural capacity resulting from utility cuts. Figure 9 shows the average deflections for each test site labelled with the PCIs of each site’s No-Cut Section. Sites at which the deflections in the No-Cut Section and zone of influence were lower than the deflections in the Cut Section exhibited damage due to cuts, and are represented by red lines. Sites at which the deflections in the No-Cut Section and zone of influence were higher than the deflections in the Cut Section did not exhibit damage due to cuts, and are represented by green lines. At these sites the repair and restoration were performing well at the time of testing. Deflection in the zone of influence may be higher than on the cuts themselves because structure may not be adequately supported laterally, as explained in Section 1.1.

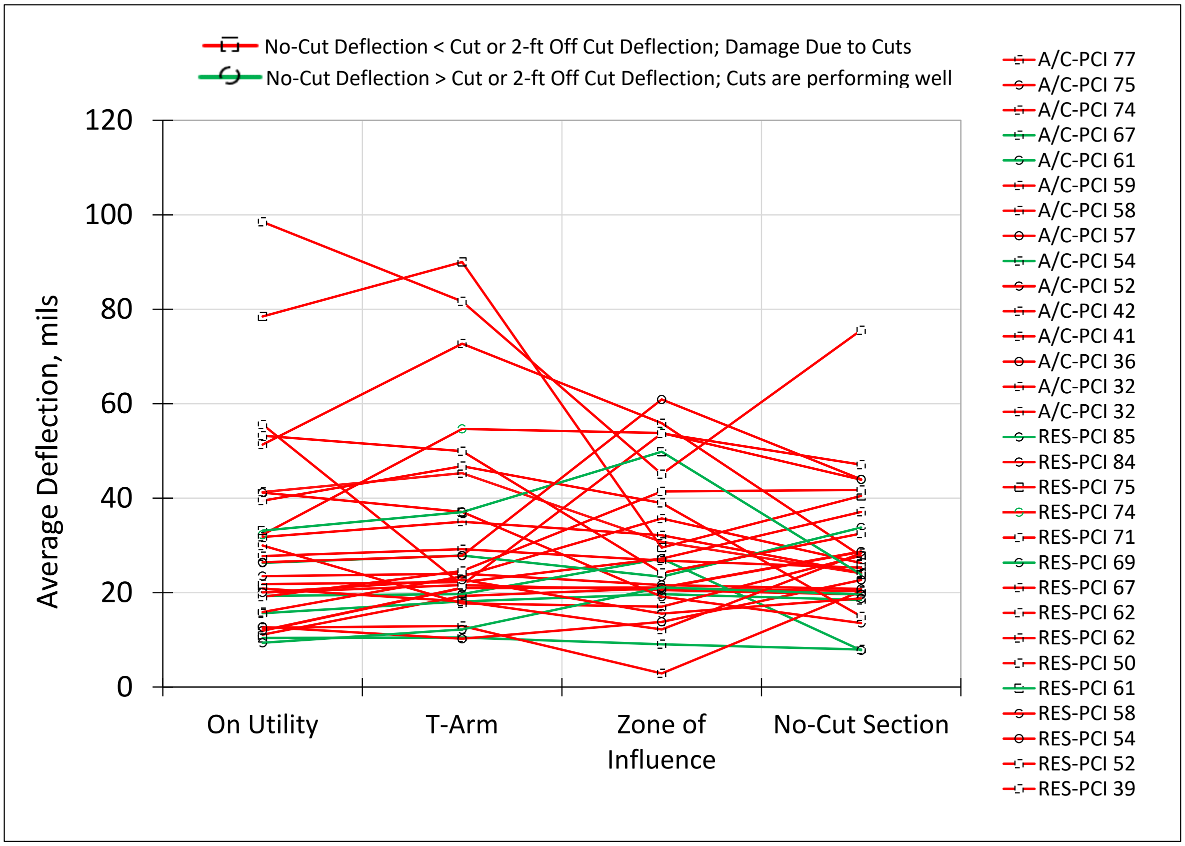

Figure 9. Deflection Trends Organized by PCI of Sections Without Utility Cuts

Based on the deflection data, 76.7% of test sites showed structural damage within the cut or zone of influence (red lines in Figure 9) while the remaining 23.3% showed structural improvement in the cut and zone of influence (green lines in Figure 9).

3.2.3 Required Overlay Thickness

Asphalt overlays are used to repair functional and structural deficiencies and restore pavement life. Existing pavement conditions and estimates of future traffic dictate the thicknesses of these overlays. Functional deficiency arises from any conditions that adversely affect the pavement user. These include poor surface friction and texture, hydroplaning and splash from wheel path rutting, and excessive weathering, raveling, and block cracking. Structural deficiency arises from any conditions that adversely affect the load-carrying capability of the pavement structure. These include inadequate thickness, loss of base or subgrade support, and moisture damage.

This section focuses on the structural deficiency of the sites due to the cuts. The required overlay thickness was calculated for each of the 4 measurement locations at each test site per the Caltrans Highway Design Manual (Caltrans 2020). Design inputs were as follows:

- TI – specific to each test site and based on the map that was provided by the City (Appendix B).
- Existing AC thickness
    - No-Cut Section – measured core thickness
    - T-Arm Section – measured core thickness of the No-Cut Section
    - Zone of Influence – measured core thickness of the No-Cut Section
    - Cut Section – One inch thicker than measured core thickness of the No-Cut Section (based on City's restoration standard)
- Deflection data – obtained through FWD testing

An example of a section exhibiting damage due to utility cuts is provided in Figure 10. Note that if a cut damages a pavement structure, then the Cut Section and/or zone of influence will require a thicker overlay than the No-Cut Section.

Figure 10 shows the results for the arterial Buchanan Street, where the Cut Section and its surrounding areas require thicker overlay than does the No-Cut Section. The zone of influence and the cut section require a 7-inch-thick overlay to withstand a TI of 8.0. The T-Arm showed the most structural damage at this test site.

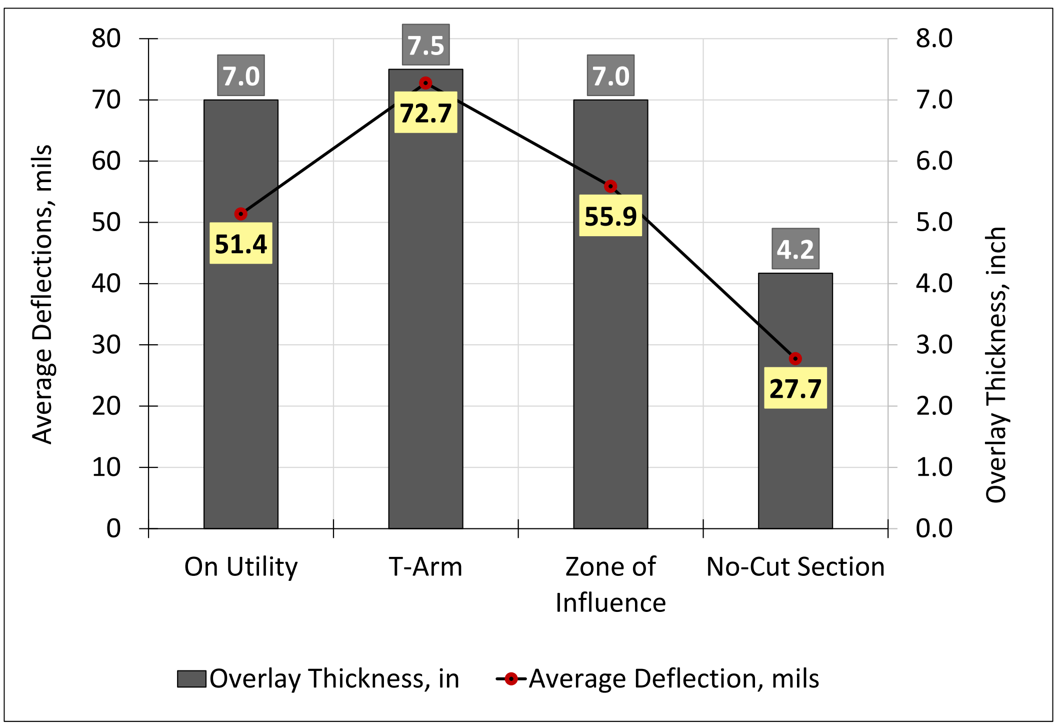

Figure 10. Deflection and Required Overlay Thickness for Buchanan Street

Figure 11 summarizes the differences in overlay thickness between the No-Cut Sections and either the Cut Sections, the T-Arms, or the zones of influence, whichever was greatest, for all test sites. The data are organized by the PCIs of the No-Cut Sections. The X-axis shows the functional class associated with the PCIs of the No-Cut Sections ranging from high to low.

- Red bars indicate test sites that require a thicker overlay at the cut, T-arm, or the zone of influence compared with the No-Cut Section, and indicate a loss in structural capacity.

- Blue bars indicate test sites that do not require a thicker overlay at the cut or the zone of influence compared with the No-Cut Section. This indicates that the restored cut is performing better than the No-Cut Section.
- Test sites shown without bars indicate that overlays of the same thicknesses (or no overlay) are required at all measurement locations.

The deflection measurements from Cut Sections and No-Cut Sections provide an initial comparative measure of structural deficiency. However, the required overlay thickness depends on the existing pavement thickness to support ongoing/future traffic under current deflection. The average core thickness among all test sites was found to be 7.3 inches for arterials/collectors and 4.9 inches for residentials, indicating a reasonably sound structural foundation for the design TI. Consequently, even though 76.7% of the 30 sites showed structural damage based on deflection data, the substantial *in situ* pavement thickness and the presence of a 6 inch layer (restoration standards) in the cut area necessitated a thicker overlay at only 67.0% of the sites to compensate for structural deficiencies. These 67.0% (20) of sites required an additional overlay of approximately 4-inches within the cut, T-Arm, or zone of influence to address the loss in structural capacity resulting from utility cuts.

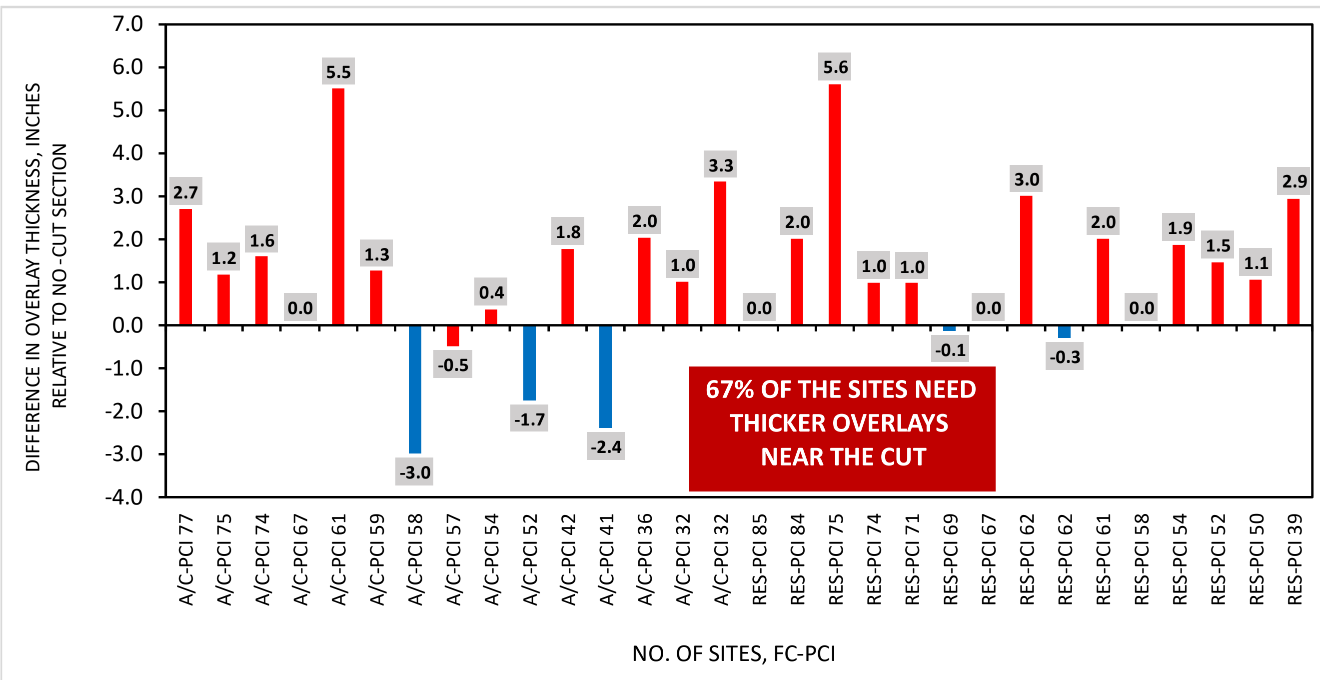

Figure 11. Differences in Overlay Thickness

3.2.4 Damage Cost

lists the thicknesses of additional overlays required for all test sites. This represents the difference between the overlay thickness for the No-Cut Section and the maximum overlay thickness at the cut, T-arm, or zone of influence. The additional overlay thickness is zero if no overlay was required at any of the measurement locations or if the Cut Section and its surrounding areas were performing better than the No-Cut Section. The cost of the additional overlay is also provided in Table 4, and was calculated using the following typical costs based on rehabilitation projects performed in the City in year 2023:

- Hot Mix Asphalt: $120.0 per ton
- Cold Plane Milling: $1.0 per square foot
- Other Costs (e.g., concrete repairs, ADA upgrades):
  - Arterials/Collectors – 30% construction cost, 15% admin/construction management/design cost, and 10% contingency
  - Residentials – 25% construction cost, 10% admin/construction management/design cost, and 10% contingency

Table 4. Additional Overlay Thickness and Corresponding Equivalent Cost

Functional Class	Site Name	PCI No-Cut	Structural Damage	Overlay Needed at No-Cut Section	Max Overlay Needed at Or Near Cut	Overlay Needed Due to Structural Damage	Cost Of Overlay, $/SF
Arterials/ Collectors	IN	77	Yes	4.8	7.5	Thicker	$5.50
	AC	75	Yes	0.3	1.5	Thicker	$3.50
	MS	74	Yes	2.9	4.5	Thicker	$4.00
	TS	67	Yes	0.0	0.0	-*	$-
	MB	61	Yes	0.0	5.5	Thicker	$9.00
	CA	59	Yes	5.2	6.5	Thicker	$3.50
	IA	58	No	7.5	4.5	Thinner**	$-
	CS	57	No	0.5	0.0	Thinner**	$-
	PA-1	54	Yes	1.1	1.5	Thicker	$2.50
	MA	52	No	5.7	4.0	Thinner**	$-
	PA-2	42	Yes	3.2	5.0	Thicker	$4.00
	SA	41	No	2.4	0.0	Thinner	$-
	ML	36	Yes	2.0	4.0	Thicker	$4.50
	HA	32	Yes	3.0	4.0	Thicker	$3.00
	BS	32	Yes	4.2	7.5	Thicker	$6.00
Residentials	PL	85	Yes	0.0	0.0	-	$-
	MI	84	Yes	0.0	2.0	Thicker	$4.00
	SD	75	Yes	0.9	6.5	Thicker	$8.50
	KD	74	Yes	1.0	2.0	Thicker	$3.00
	MO	71	Yes	2.5	3.5	Thicker	$3.00
	BA-1	69	No	0.1	0.0	Thinner**	$-
	RS	67	Yes	0.0	0.0	-	$-
	BU	62	No	0.3	0.0	Thinner**	$-
	BA-3	62	Yes	0.0	3.0	Thicker	$5.50
	BA-2	61	Yes	0.0	2.0	Thicker	$4.00
	10S	58	Yes	0.0	0.0	-*	$-
	WS	54	Yes	0.1	2.0	Thicker	$4.00
	ED	52	Yes	4.5	6.0	Thicker	$3.50
	06S	50	No	0.9	2.0	Thicker	$3.00
	RA	39	Yes	0.6	3.5	Thicker	$5.00

*No overlay thickness is required at the cut, T-arm, zone of influence, or No-Cut Section
** Thicker overlay is required at No-Cut Sections than at the Cut Section or its surrounding areas

3.2.5 Damage Location Assessment Around Utility Cuts

Based on the deflection data measured at the 4 different locations for each site, most of the damage in utility cut areas is observed within the T-Arm, which is located 2 feet within the cut. This pattern of damage can be attributed to several factors related to the structural disruption caused by the utility cut itself. When a utility cut is made, the original pavement layers are disturbed, weakening the surrounding material's ability to effectively distribute loads. The T-Arm area, positioned at the transition zone between the undisturbed pavement and the repaired section, experiences significant stress concentrations as it absorbs most of the load transfer.

The analysis shown in Table 5 shows the number of damaged sites that controlled by the cut, the T-Arm and the Zone of Influence, where 39% of the sections exhibited damage at the T-Arm, followed by the Zone of Influence (30%) and on the cut conditions (30%) for a total of 23 sections.

Table 5. Damage Control Location Assessment

Deflection Measurement Location	Damage Count	Percent Contribution
On Cut	7	30%
T-Arm	9	39%
Zone of Influence	7	30%

4 Fee Development

4.1 Statistical Analysis

A statistical analysis was performed on field evaluations to assess whether the difference in pavement performance between Cut Sections and No-Cut Sections was statistically significant. Specifically, for the field evaluation, NCE used paired t-tests to compare the PCIs and deflections of Cut Sections and No-Cut Sections within each PCI group. A statistically significant difference indicates that the pavement is likely to be impacted by utility cuts.

- A P-value < 0.05 (95% confidence level) indicates that the PCIs or deflections of the sections with cuts were significantly lower than the PCIs or deflections of sections without cuts. This means that there is a high probability that utility cuts are correlated with poorer pavement conditions. A P-value of ≥ 0.05 indicates that the differences in the PCIs or deflections of the sections with cuts and without cuts were not statistically significant.

Various PCI values were used to classify sections into PCI groups and these groups were analyzed to identify which, if any, were significantly impacted by utility cuts. Table 6 shows the results of the statistical analysis for the field evaluation. As indicated by the P-values, there is a significant difference either in PCI or deflection between the Cut and No-Cut Sections for all pavements except residentials with PCI below 50. This analysis indicates that pavement damage due to utility cuts is occurring on all test sites. While there is sufficient evidence from the statistical analyses of functional evaluation to support categorizing the data based on functional class and PCI, the same level of confidence is not held for the statistical analyses of the structural evaluation for arterials/collectors. This is because arterials/collectors usually have thicker pavement structures compared to residentials. Residential sections were grouped into PCIs above or below 70 for fee schedule calculations. Arterial/collector sections were grouped into PCIs above or below 60 for fee schedule calculations because only 2 arterial/collector sections had PCIs above 70.

Table 6. Statistical Analysis of Field Evaluation

Criteria		P-value			Significant Difference
		PCI	Deflection	Min. of PCI and Deflection	
All		0.000	0.001	0.000	Yes
Arterials/Collectors		0.000	0.077	0.000	Yes
Residentials		0.000	0.002	0.000	Yes
Arterials/ Collectors	PCI ≥ 70	0.043	0.163	0.043	Yes
	PCI < 70	0.001	0.148	0.001	Yes
	PCI ≥ 60	0.004	0.052	0.004	Yes
	PCI < 60	0.008	0.246	0.008	Yes
	PCI ≥ 50	0.001	0.186	0.001	Yes
	PCI < 50	0.035	0.161	0.035	Yes
Residentials	PCI ≥ 70	0.002	0.043	0.002	Yes
	PCI < 70	0.000	0.016	0.000	Yes
	PCI ≥ 60	0.000	0.017	0.000	Yes
	PCI < 60	0.036	0.025	0.025	Yes
	PCI ≥ 50	0.000	0.004	0.000	Yes
	PCI < 50	0.109	0.255	0.109	No

4.2 Fee Comparison by Evaluation Type

Both structural and functional deterioration caused by utility cuts are essential to evaluate in order to establish a fee for compensating those damages. The fees developed from the field evaluations are presented in Table 7. To address the damage to pavement resulting from utility cuts identified in both evaluations, NCE recommends the maximum fee for each category; the structural evaluation fee is based on the cost of additional overlay thickness required due to the cut, while the functional evaluation fee is derived from the cost equivalent of the reduced functional life. Based on the City's guidance, no fees are required for streets classified as failed (i.e., those with a PCI below 25).

Table 7. Fee ($/SF) Comparison Based on Evaluation

Functional Class	PCI Group	Fees ($/SF*)
Arterials/Collectors	PCI ≥ 60	$ 5.00
	25 ≤ PCI < 60	$ 3.50
	PCI < 25	$ 0.00
Residentials	PCI ≥ 70	$ 4.50
	25 ≤ PCI < 70	$ 3.50
	PCI < 25	$ 0.00

* The total square footage includes the zone of influence (2 ft outside the edge of the cut/T-arm).

4.3 Fee Implementation

4.3.1 Affected Cut Area Fee

The affected area includes the zone of influence (2 ft outside the edge of the cut/T-arm) as shown in Equation 1. Zone of influence is considered for such calculation to capture the damage within the adjacent areas of the cut. The affected cut area fee represents damage cost only for the affected area based on the cut size. The equation for estimating the fees is provided below in Equation 2.

Equation 1

$$Affected\ Area\ (SF)\ = (Cut\ length + 2' + 2')(T\text{-}arm\ width + 2' + 2')$$

Equation 2

$$Total\ Fee\ = Unit\ Cost\ from\ Table\ 7\ x\ Affected\ Area\ (SF)$$

4.3.2 Examples of Fee Implementation

Figure 12 presents examples of fee implementation on a residential street with a PCI ≥ 70. Per our review of the City’s network database, the typical length and width of a residential management section in the City is 750 feet by 30 feet, respectively.

As a part of the example shown in Figure 12, it was assumed that a cut of 10 feet x 10 feet was made within a section. For the second example, it was assumed that it was 10 ft. wide and extended for the entire length of the section (750 ft.). Also, both the cuts were made on a residential street section with a PCI ≥ 70. Thus, they will both be charged at $4.5/SF (per Table 7).

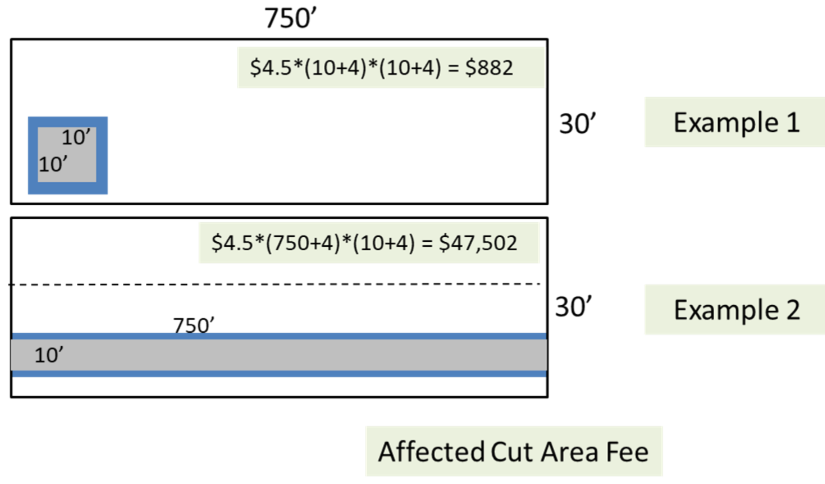

Figure 12. Examples of Fee Implementation for Typical Residential Street with PCI ≥ 70.

* Based on the City’s PMS the typical length and width of a residential management section is 750 feet by 30 feet, respectively.

4.4 Fee Comparison with Other Agencies

Utility cut fees allow local agencies to recover the cost of pavement damage associated with underground utility work as the respective damage reduces the useful life of the damaged streets. Table 8 summarizes utility cut fees for agencies throughout California. These fees are calculated based on functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse). The fees, in dollars per square foot, are typically multiplied by the affected cut area to obtain a dollar value representing the damage done to the pavement. For the City of Riverside, the fees were calculated based on the functional classification and PCI range of the street. The City of Riverside fees are determined based on the total square footage of the cut plus the zone of influence area which is 2 feet outside the edge of the cut/T-arm (See section 4.3.1).

Table 8 shows that the proposed fee range for the City of Riverside aligns very closely with the fees imposed by several of the listed cities and counties. When compared with longitudinal cut fees from other agencies, the proposed utility cut fee for the City is similar to that of many of the other agencies. When comparing fees among different agencies, it is important to consider that the overall pavement condition and structure varies among agencies, and the performance of pavements with cuts is critical to the existing conditions.

Table 8. Utility Cut Fee Comparisons

Agency	Criteria	Fee, $/SF	Study by
Riverside (Proposed Fees)	Functional Class and PCI	3.5-5.0	NCE 2024
Anaheim	PCI	3.60-11.60	NCE 2022
Davis	Functional Class and PCI	1.04-1.51	NCE 2022
Pacifica	Functional Class, Age of the Pavement, Size of the Cut	1.00-4.00	NCE 2021
Ukiah	Functional Class, Age of the Pavement, Size of the Cut	0.50-4.00	NCE 2021
Santa Barbara County (Under Review)	Functional Class, PCI, Size of the Cut	0.25-4.00	NCE 2023
Covina (Under Review)	Functional Class, PCI, Size of the Cut	0.50-6.00	NCE 2024
Monterey Park (Under Review)	Functional Class, PCI, Size of the Cut	0.25-2.00	NCE 2023
South San Francisco (Draft)	Functional Class, PCI, Size of the Cut	0.50-3.50	NCE 2023
San Francisco (City and County)	Age of the Pavement	1.00-3.50	Marcus 1998
Los Angeles	Functional Class	8.24-19.44	Shahin et al. 2017
Sacramento County, Elk Grove, Santa Cruz	Trench Depth, Functional Class, PCI, Type of Cut	1.80-11.82	Shahin et al. 1996
Santa Ana	Functional Class, Age of the Pavement	10.00-36.00	Shahin et al. 1999

5 Conclusion

The purpose of this study was to investigate the structural and functional deterioration of pavements due to utility cuts, quantify the damage, and develop a fee to recover the associated costs.

The field evaluation utilized in this study was based on 30 sites in the City. The following conclusions were determined:

- Ninety-seven percent of the test sites were structurally or functionally damaged because of utility cuts.
- Seventy-three percent of the test sites were both structurally and functionally damaged.
- Of all sites, 76.7% exhibited structural damage and 23.3% exhibited structural improvements.
- An average overlay thickness of 4 inches is needed to compensate for the loss in structural capacity.
- Overall, pavements with cuts deteriorate more rapidly than pavements without cuts. An average condition reduction of 18 PCI points was observed when utility cuts were present.
- Thirty percent of the test sites displayed damage beyond the edge of the cut, known as the "Zone of Influence (2 ft outside the edge of the cut/T-arm).

Finally, a fee schedule was developed using both evaluations to recover the full costs of repair for the damage caused by the cuts. The information required to implement this fee includes the functional class, PCI.

Functional Class	PCI Group	Fees ($/SF*)
Arterials/Collectors	PCI ≥ 60	$ 5.00
	25 ≤ PCI < 60	$ 3.50
	PCI < 25	$ 0.00
Residentials	PCI ≥ 70	$ 4.50
	25 ≤ PCI < 70	$ 3.50
	PCI < 25	$ 0.00

* The total square footage includes the zone of influence (2 ft outside the edge of the cut/T-arm).

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Appendix A

Summary of Utility Cut Studies and Policies

MEMORANDUM

Date:	02/26/2025
To:	City of Riverside
From:	Debaroti Ghosh, Margot Yapp – NCE
Subject:	Summary of Utility Cut Studies and Policies
Job Number:	879.02.30

INTRODUCTION

Utility companies often need to cut existing pavements to access and service their underground equipment. Ideally, all underground utility maintenance would be performed prior to pavement rehabilitation or reconstruction so that cuts are never made in new pavement structures. However, despite the best coordination, utility cuts cannot always be avoided because unanticipated work is often required to maintain essential public services.

Over the last 30 years, local agencies have been interested in understanding and quantifying the impact of utility cuts on pavement performance as well as the corresponding financial impacts. To obtain this information, public agencies, as well as utility companies, have sponsored engineering investigations and studies (Todres and Baker 1996). Many such studies are performed in-house or by consulting companies and are therefore unpublished or difficult to access. These studies often use deflection testing, condition surveys, and statistical analyses to quantify reduced pavement performance as a loss in structural capacity and a decrease in pavement condition. To manage the identified impacts, many studies have recommended restoring additional area surrounding the cut, increasing the overlay thickness, or imposing a restoration fee on utility companies.

These studies and recommendations have led to an increase in public policies that 1) compensate local agencies for the loss of pavement life caused by utility cuts through a utility cut fee, and 2) achieve more acceptable performance of repair work following underground utility access and maintenance through rigorous utility cut restoration standards and moratoria, or "no cut", periods.

This technical memorandum discusses the impact of utility cuts on pavement performance, details the importance of adequate utility cut restoration, and summarizes the policies in place by various California agencies to address pavement degradation caused by utility cuts.

IMPACT OF UTILITY CUTS

The impact of utility cuts on pavement performance can vary significantly based on site- and agency-specific information. Such variables can include the existing pavement condition, structure, and age; location, orientation, and extent of the utility cut; environmental factors; traffic loads; and restoration practices and standards. Quantification of utility cut impacts further depend on local maintenance treatments and costs. Therefore, to really understand the impact of utility cuts on roadway performance for a particular agency, a site-specific study and analysis must be performed.

That said, underground utility work can damage pavements in three general ways as illustrated in Figure 1. First, the act of cutting a pavement structure creates an easy-access point for water to enter the pavement structure and damage the underlying pavement layers. Second, the removal of the pavement layers creates a plane of weakness where the pavement structure may not be adequately supported laterally – particularly during underground utility maintenance, but also after restoration. Third, the quality of the repair may not match the adjacent pavement structure, thus introducing roughness into the pavement. Rough pavements can cause vehicles to bounce, which creates greater loads on the pavement and leads to more rapid deterioration (Tarakji 1995; Wilde et al. 2002).

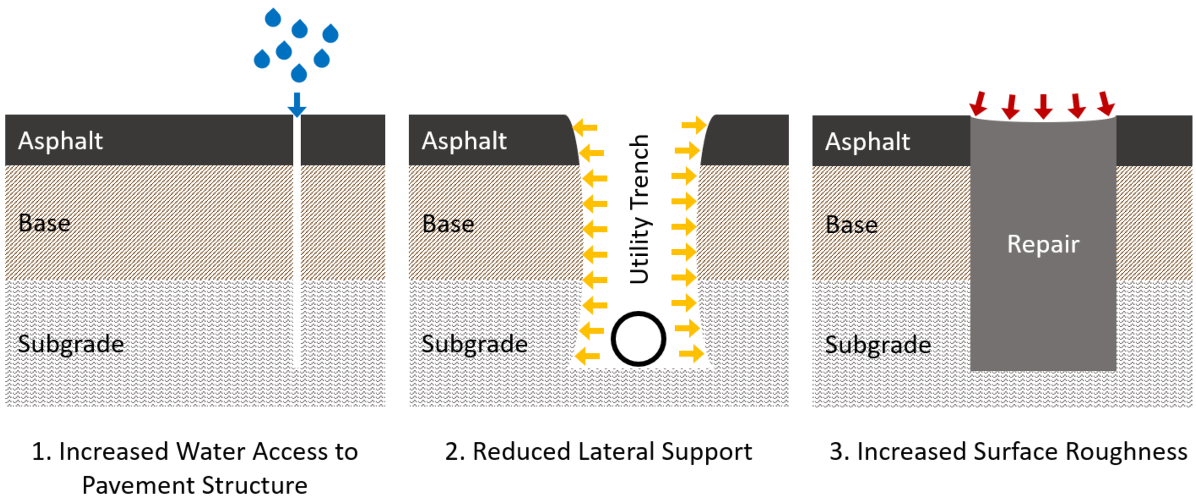

Figure 1. Utility Cut Damage Mechanisms

These deterioration mechanisms reduce the condition and structural capacity of a pavement, which reduces the life of the pavement within and adjacent to the utility cut (Stevens et al. 2010). Multiple utility cuts on the same street or within a small area can magnify this impact (Department of Public Works 1998, Tarakji 1995).

Reduction in Pavement Life

In the mid-1990s, San Francisco completed a study on the effect of utility cuts on the life of pavement (Tarakji 1995) and confirmed that additional damage was caused. Other cities, including Austin, Cincinnati, Salt Lake City, Philadelphia, and Phoenix, conducted similar foundational studies and found that utility cuts not only reduced the expected life of the streets but consequently cost local agencies millions of dollars in premature street repair and remediation expenses (Arudi et al. 2000; Bodocsi et al. 1995; ERES 1990; NCE 2003; Peters 2002; Wilde et al. 1996).

For example, Bodocsi et al. (1995) reported that new asphalt pavements, which are typically designed to last between 15 and 20 years, once cut can lose as much as 8 years of pavement life. Other studies performed in Austin, Anaheim, Los Angeles, Sacramento, and Phoenix estimated between 15 and 20 percent reductions in pavement life due to utility cuts (AMEC 2002; CHEC 1997; IMS 1994; Shahin and Associates 2017; Wilde et al. 1996). For a typical pavement design life of 20 years, this represents a loss of 3-4 years of pavement life.

Additional factors such as cold climates and multiple excavations can increase the impact of utility cuts. For example, utility cuts in areas subject to freeze-thaw conditions were estimated to reduce pavement life by 20 percent (AMEC 2002; Stevens et al. 2010). Streets with multiple excavations for utility work were estimated to reduce a pavement's life by 30 to 55 percent (Shahin and Associates 2017; Tarakji 1995; Tiewater 1997).

Statistical data reported by the Department of Public Works in San Francisco (1998) showed that the pavement condition rating decreases as the number of utility cuts increases. For example, the pavement condition index (PCI) for a newer pavement was reduced from 85 to 64 as the number of utility cuts increased to 10 or more.

Zone of Influence

As previously mentioned, a utility cut can result in a loss of lateral support to the existing pavement structure surrounding the perimeter of the trench. This can cause the trench sidewalls to bulge into the trench and weaken the material under the existing pavement. This weakened area is termed the zone of influence, is illustrated in Figure 2.

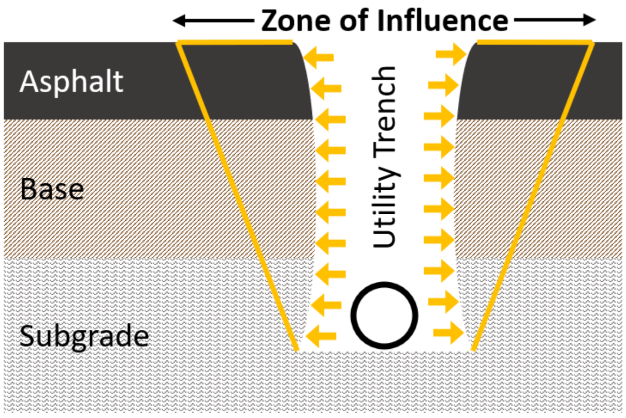

Figure 2. Zone of Influence

Various studies have used deflection testing to investigate the loss of pavement strength near utility cuts, estimate the zone of influence, and provide recommendations on restoration (Bodosci et al 1995; Shahin 1999; CHEC 1997, 1998, 1999, 2000; NCE 2000, 2003). Such studies showed a substantial loss of strength in the zone of influence around the utility cut area (Stevens et al. 2010). For example, studies performed in Union City and Los Angeles showed that the deflection values within the zone of influence were 41-74 percent higher than in uninfluenced pavement (CHEC 1998; Shahin and Associates 2017).

These studies also indicated that the zone of influence varies by agency and location but is most often 4 to 5 feet from the edge of the trench. Table 1 summarizes research estimating the zone of influence.

Table 1. Summary of Zone of Influence Research

Agency	Investigator	Publication Year	Zone of Influence from Trench Edge (feet)
Alameda Co, CA	CHEC Consulting Engineers, Inc.	2000	5.5
Calgary, Canada	Karim et al.	2014	3.3
Cincinnati, OH	Bodosci et al.	1995	3
Iowa Department of Transportation	Stevens et al.	2010	4
Los Angeles, CA	Shahin and Associates	2017	2.5 to 10 (average of 5.2)
San Mateo Co, CA	CHEC Consulting Engineers, Inc.	1999	5
Seattle, WA	Nichols Consulting Engineers	2000	At least 2
Springville, UT	Guthrie et al.	2015	4
Union City	CHEC Consulting Engineers, Inc.	1998	4 to 7

An extensive field and laboratory study by Iowa State University researchers concluded that the loss of lateral support in the zone of influence is a critical factor in the restoration of utility trenches (Jensen et al. 2005).

IMPORTANCE OF UTILITY CUT RESTORATION

As discussed previously, utility cuts can affect pavement performance in and adjacent to the cut area. The excavation equipment and process can also damage the pavement adjacent to the cut (Stevens et al. 2010). Simply backfilling the excavated area will not restore and match the strength and performance of the original material. Therefore, for long-term pavement performance within and adjacent to utility cuts, adequate repair and restoration is necessary.

It is difficult to restore cut pavement to a condition and performance level matching the surrounding pavement. When the repaired pavement condition varies from the existing pavement condition, the result can be a rough surface. Even if the pavement surface is smooth and consistent at the time of the repair, the materials may settle and deteriorate differentially over time. This leads to surface roughness, which then leads to more rapid deterioration (Noel and Tevlin 2012; PEI 1996; Stevens et al. 2010; Wilde et al. 1996).

Utility cut restoration involves performing a treatment, in addition to adequate filling and compaction of the excavated area, to restore the pavement life and maintain the pavement's structural capacity and performance. Restoration often includes a T-Cut as well as another treatment, such as an overlay or surface seal, that extends beyond the length of the T-Cut arm. This restoration combination is illustrated in Figure 3.

T-Cuts involve cutting back a portion of the pavement surface beyond the edge of the trench to better protect the zone of influence and bridge the plane of weakness. Such repairs have been found advantageous in the restoration of utility cut trenches by alleviating the effects of the lateral support loss due to the excavation (Peters 2002; Stevens et al. 2010). Research has shown that the thickness of the restoration, the quality of materials used, and the placement and compaction methods of fill materials are key factors in ensuring strong pavement performance in future years (Jensen et al. 2005; Stevens et al. 2010 Todres and Baker 1996).

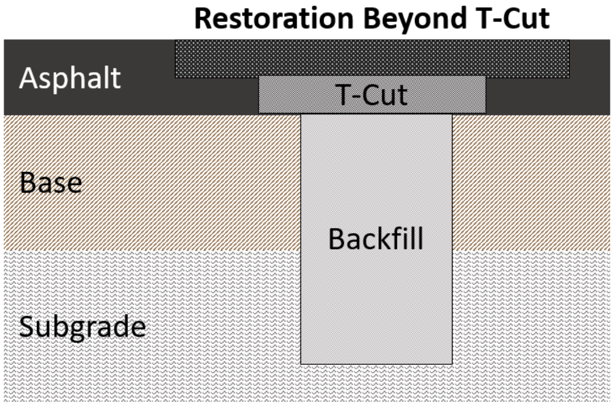

Figure 3. Example Restoration Plan.

Restoration Standards in California

Table 2 summarizes the restoration standards held by several city and county agencies throughout California. The specific restoration requirements vary depending on the length of the utility cut, existing PCI, functional classification, and age of the pavement.

Although the use of the T-Cut is widespread among these standards, the additional surface restoration requirements range from no additional treatment beyond the T-Cut to full lane replacements for the entire affected block. For example, the cities of Oakland and San Francisco require a full block restoration depending on the length of the utility cut. Other agencies require only 6 to 24 inches of restoration beyond the edge of the T-Cut. The most common restoration treatment in California is a mill and overlay to a minimum specified depth.

The final required restored pavement thickness also varies among agencies. These final thickness standards are included in Table 2 as the final asphalt thickness over the trench and provide insight into how standards vary throughout California. The typical requirement is for the new restored pavement to conform to the existing pavement thickness over the trench, but additional thickness is sometimes required.

Table 2. Summary of Restoration Standards in California Agencies

Agency	T-Cut Required	T-Cut Arm Width (in.)	Surface Restoration Requirement Beyond T-Cut	Restoration Treatment	Final Asphalt Thickness Over Trench (in.)
Alameda Co	Yes	12	None	NA	Existing thickness
Anaheim	Yes	Arterials: full-lane width Locals: 12	Locals with cut length <650 ft: None Locals with cut length >651 ft: As indicated in Restoration Treatment Column	PCI ≥ 60: Slurry Seal from curb to curb PCI<60: 2-in. Mill and Overlay from gutter to trench limit	Existing thickness + 1.25 or Match existing thickness if ≥ 16 in.
Contra Costa Co	Yes	12	None	NA	Existing thickness + 1.25
Davis	Yes	10	Restoration shall extend 10’ before first patch and 10’ beyond last patch and be the full width of the affected lanes	Slurry Seal	Existing thickness (min of 4)
Fremont	If Trench Width >24 in.	12	None	NA	Existing thickness (min of 6) If no T-Cut, 12-15
Fresno Co	Yes	6	Minimum of 12 in. beyond the edge of the T-Cut	1.25-in. Mill and Overlay	Existing thickness
Long Beach	Yes	12	None	NA	Existing thickness (min of 4)
Los Angeles	Yes	12	If pavement age<8 Yrs, restore 24 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay (or half the existing asphalt thickness, whichever is less)	Existing thickness (min of 6)
Los Angeles Co	Yes	12	None	NA	Existing thickness (min of 4)

Table 2 Cont. Summary of Restoration Standards for California Agencies

Agency	T-Cut Required	T-Cut Arm Width (in.)	Surface Restoration Requirement Beyond T-Cut	Restoration Treatment	Final Asphalt Thickness Over Trench (in.)
Oakland	Yes	12	If cut length >0.25*block length, restore all affected lanes for the entire block	PCI >65: Slurry Seal PCI ≤ 65: Mill and Overlay	Existing thickness (min of 6)
Sacramento	Yes	6	None	NA	Existing thickness (min of 4)
Sacramento Co	Yes	8	If pavement age<5 Yrs, restore a minimum of 12 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay	Existing thickness (min of 6 on major streets) (min of 4 on minor streets)
San Francisco	Yes	12	Minimum of 12 in. beyond the edge of the T-Cut or If cut length >0.25*block length, restore all affected lanes for the entire block	2-in. Mill and Overlay	Existing thickness (min of 2)
San Diego Co	Yes	6-12 (Based on Trench Width)	6 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay	Existing thickness +1 (min of 4)
San Jose	Yes	12	None	NA	Existing thickness +3
Santa Clara	Yes	6	None	NA	Existing thickness (8-10)

UTILITY CUT POLICIES

A detailed 2002 report prepared for the Federal Highway Administration provided methods that agencies can use to reduce and minimize the damage to streets due to the ever-increasing installation and maintenance activities of utility companies (Wilde et al. 2002). Specifically, the report presents three types of policies local agencies can use to improve the quality of utility cut repairs and promote coordination of facilities. These strategies are 1) incentive-based policies, 2) fee-based policies, and 3) regulation-based policies.

Incentive-based policies provide financial or other incentives for using trenchless technology where technically suitable, performing higher-quality pavement cut repairs, making smaller or less-damaging cuts, and coordinating with other utility companies to share trenches or underground resources.

Examples of fee-based policies include requiring a deposit prior to beginning work to protect against poor repairs, assessing financial penalties for non-compliance with restoration standards or for failed repairs within a specified period, implementing a time-based lane rental fee to encourage utility companies to restore traffic access as quickly as possible, and collecting flat-rate or area-based fees to compensate for increased degradation associated with cutting and excavating pavement.

Regulation-based policies do not require fees or provide incentives, but place requirements on the contractor regarding quality of work, and/or restrictions on when and where trenching can be done. Examples include establishing moratorium periods that restrict utility cuts in newly resurfaced pavements for a specified time, requiring pavement restorations to encompass an area larger than the trench area, enhancing inspections, and enforcing restoration specifications.

Utility Cut Fees in California

Fee-based policies have been growing in popularity throughout California as way for local agencies to recoup the cost of pavement damage associated with poor performing underground utility work. Table 3 summarizes several utility-cut fee schedules for various agencies throughout California. These fees are based on factors including functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse). The fees, in dollars per area, are typically multiplied by the utility cut area to obtain a dollar value that represents the damage done to the pavement. In contrast to having a utility cut fee per unit area, the cities of Sacramento and Santa Barbara have fees per linear foot. This fee is multiplied by the length of linear feet cut rather than the affected area to obtain the total fee value.

Table 3. Summary of Utility Cut Fees for California Agencies

Agency	Criteria			Fee ($/SF)
Elk Grove	Trench Depth < 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 70-100	3.90 (long.)
				7.80 (trans.)
			PCI 26-69	2.20 (long.)
				4.40 (trans.)
			PCI 0-25	-
		All Other	PCI 70-100	2.41 (long.)
				4.82 (trans.)
			PCI 26-69	1.18 (long.)
				2.36 (trans.)
			PCI 0-25	-
	Trench Depth > 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 70-100	5.91 (long.)
				11.82 (trans.)
			PCI 26-69	3.34 (long.)
				6.68 (trans)
			PCI 0-25	-
		All Other	PCI 70-100	3.66 (long.)
				7.32 (trans.)
			PCI 26-69	1.80 (long.)
				3.60 (trans.)
			PCI 0-25	-
Los Angeles	Select Streets			19.44
	Local Streets			8.24
Modesto	All Streets		PCI 70-100	2.50
			PCI 26-69	1.25
			PCI 0-25	-
Patterson	All Streets		PCI 70-100	7.30
			PCI 50-69	5.25
			PCI 0-49	-
Sacramento (Under revision – update anticipated 2022)	Longitudinal Cut		Age <5	3.50*
			Age 5 to 10	3.00*
			Age 10 to 15	2.00*
			Age Over 15	1.00*
	Transverse Cut		Age <5	7.00*
			Age 5 to 10	6.00*
			Age 10 to 15	4.00*
			Age Over 15	2.00*

*Fee is per lineal ft instead of per square foot.

Table 3 Cont. Summary of Utility Cut Fees for California Agencies

Agency	Criteria			Fee ($/SF)
Sacramento Co	Trench Depth < 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 70-100	3.90 (long.)
				7.80 (trans.)
			PCI 26-69	2.20 (long.)
				4.4 (trans.)
			PCI 0-25	-
		All Other	PCI 70-100	2.41 (long.)
				4.82 (trans.)
			PCI 26-69	1.18 (long.)
				2.36 (trans.)
			PCI 0-25	-
	Trench Depth > 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay.	PCI 70-100	5.91 (long.)
				11.82 (trans.)
			PCI 26-69	3.34 (long.)
				6.68 (trans)
			PCI 0-25	-
		All Other	PCI 70-100	3.66 (long.)
				7.32 (trans.)
			PCI 26-69	1.80 (long.)
				3.60 (trans.)
			PCI 0-25	-
San Diego	Arterial Streets	Dry Utilities	Age 0-5	1.95
			Age 6-10	1.39
			Age 11-15	0.84
			Age 16-20	0.28
		Wet Utilities	Age 0-5	2.80
			Age 6-10	2.01
			Age 11-15	1.21
			Age 16-20	0.41
	Major Streets	Dry Utilities	Age 0-5	0.97
			Age 6-10	0.69
			Age 11-15	0.41
			Age 16-20	0.13
		Wet Utilities	Age 0-5	1.93
			Age 6-10	1.38
			Age 11-15	0.74
			Age 16-20	0.28

Table 3 Cont. Summary of Utility Cut Fees for California Agencies

Agency	Criteria			Fee ($/SF)
San Diego Cont.	Collector Streets	Dry Utilities	Age 0-5	1.10
			Age 6-10	0.85
			Age 11-15	0.61
			Age 16-20	0.37
			Age 21-25	0.13
		Wet Utilities	Age 0-5	3.94
			Age 6-10	3.06
			Age 11-15	2.19
			Age 16-20	1.32
			Age 21-25	0.45
	Residential Streets	Dry Utilities	Age 0-5	1.34
			Age 6-10	1.04
			Age 11-15	0.74
			Age 16-20	0.45
			Age 21-25	0.15
		Wet Utilities	Age 0-5	1.67
			Age 6-10	1.30
			Age 11-15	0.93
			Age 16-20	0.56
			Age 21-25	0.19
City and County of San Francisco	All streets		Age 0-5	3.50
			Age 6-10	3.00
			Age 11-15	2.00
			Age 16-20	1.00
Santa Ana	Arterials Streets Age of street since last repaving		Age 0-5 Years	13.68
			Age 6-10 Years	12.11
			Age 11-15 Years	11.39
			Age 16-20 Years	9.11
	Local Streets Age of street since last repaving		Age 0-5 Years	9.27
			Age 6-10 Years	8.24
			Age 11-15 Years	7.74
			Age 16-20 Years	6.98
			Age 21-25 Years	6.21
Santa Barbara Co	Flat fee			$0.75*

*Fee is per lineal ft instead of per square foot.

Table 3 Cont. Summary of Utility Cut Fees for California Agencies

<table>
<tr><th>Agency</th><th colspan="3">Criteria</th><th>Fee ($/SF)</th></tr>
<tr><td rowspan="20">Santa Cruz</td><td rowspan="10">Trench Depth < 4 ft</td><td rowspan="5">Major Streets or All Streets within 5 years of Construction or Structural overlay</td><td rowspan="2">PCI 100 and 70</td><td>3.9 (long.)</td></tr>
<tr><td>7.8 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>2.2 (long.)</td></tr>
<tr><td>4.4 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="5">All Other Streets</td><td rowspan="2">PCI 100 and 70</td><td>2.41 (long.)</td></tr>
<tr><td>4.82 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>1.18 (long.)</td></tr>
<tr><td>2.36 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="10">Trench Depth > 4 ft</td><td rowspan="5">Major Streets or All Streets within 5 years of construction or structural overlay.</td><td rowspan="2">PCI 100 and 70</td><td>5.91 (long.)</td></tr>
<tr><td>11.82 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>3.34 (long.)</td></tr>
<tr><td>6.68 (trans)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="5">All Other Streets</td><td rowspan="2">PCI 100 and 70</td><td>3.66 (long.)</td></tr>
<tr><td>7.32 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>1.80 (long.)</td></tr>
<tr><td>3.60 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td>Union City</td><td colspan="3">Flat fee</td><td>17.3</td></tr>
</table>

Some agencies allow fee exemptions if the utility work is performed on older pavement or if the work is performed before an upcoming rehabilitation. For example, the City and County of San Francisco waive the fee for utility work performed on pavements with PCIs less than 53 or a pavement age of at least 20 years. The City of Los Angeles does not require utility cut fees on pavements with rehabilitation scheduled within the next year.

Moratorium Standards in California

Regulation-based policies, particularly moratoria, have been passed by cities and counties to protect public infrastructure and preserve the life of streets (Wilde et al. 2002). Moratoria impose a time period after treatment during which utility or other companies may not perform trenching activities. Table 4 summarizes several California agencies with slurry and rehabilitation moratorium standards. If for some reason utility work during a moratorium period is deemed necessary, agencies often impose higher restoration standards and limits than those required after the moratorium period has expired.

For example, Los Angeles County only requires a surface restoration of 24 inches beyond the edge of the T-Cut for non-moratorium streets but requires that the whole block be repaved for moratorium streets. Such strict moratorium restoration standards encourage utility companies to perform underground utility maintenance prior to pavement rehabilitation or reconstruction and discourages utility work in new pavement structures.

Table 4. Summary of Moratorium Standards for California Agencies

Agency	Slurry Moratorium (years)	Rehabilitation Moratorium (years)	Restoration Details if Moratorium Work Approved
Anaheim	1	3	Extensive pavement restoration according to the utility cut standard Limits shall be determined by the City Engineer
Commerce	2	5	Pavement restoration shall be a length of not less than 50 ft either side of the trench edge lines, either perpendicular or parallel to the curb line
Encinitas	3	5	Resurface at least the length of excavation from curb to curb or from curb line to the raised median Longitudinal trenches – Extend T-Cut, grind and overlay over the entire affected lane or lanes (from curb to curb or from curb to median curb) Transverse trenches - Extend T-Cut, grind and overlay to 10 feet beyond each side of the trench and over the entire affected lane
Los Angeles	None	1	Repave the whole block
Los Angeles Co	2	2	Resurface the entire lane width
Oakland	5	5	Pavement restoration shall match or exceed the most recent resurfacing pavement section depth and material or as directed by the Engineer
Sacramento Co	3	3	Slurry seal half of the roadway at locations affected by the excavation for a minimum total length of 1,000 feet
San Diego	3	5	Resurface the entire lane width from street intersection to intersection and from curb to curb
San Diego Co	3	3	Resurface the entire width of the affected road and the method of resurfacing shall be the same as adjacent pavement
San Francisco	5	5	Resurface all affected lanes for entire width of affected property frontages

SUMMARY AND CONCLUSION

Interest in studying and quantifying the impact of utility cuts on road and street performance has increased over the last 30 years. Consequently, public agencies, as well as utility companies, have sponsored engineering investigations and studies to quantify the impact of utility cuts on pavement performance and estimate the corresponding financial impacts.

Research has shown that utility cuts can reduce pavement life by 15 to 55 percent, which consequently costs local agencies millions of dollars in premature street repair and remediation expenses. Studies have also shown that underground utility work affects not only the excavated area, but often weakens the adjacent pavement. The affected pavement varies based on agency and location but is typically 4 to 5 feet from the edge of the trench.

To help restore some of the lost structural capacity and performance due to cutting the pavement, many agencies have set restoration standards. Restoration standards in California typically include a T-Cut along with a restoration treatment that may be as extensive as replacing the full lane for the entire affected block.

To recover the cost of pavement damage associated with performing underground utility work, many agencies impose utility cut fees. In California, these fees are typically based on factors including functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse).

As evidenced by the variety of studies, standards, policies, and fees, the impact of utility cuts on roadway performance can vary significantly based on site-and agency-specific information. Therefore, to really understand and quantify the impact of utility cuts on roadway performance for a particular agency, a site-specific study and analysis must be performed. In addition, utility cut fees should be updated regularly to reflect accurate and current damage costs.

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Wilde, W.J., Grant, C.A., and Nelson, P.K. 2002. *Manual for Controlling and Reducing the Frequency of Pavement Utility Cuts.* FHWA Report No. FHWA-RD-02-%%%

Table R.1 References

Agency	Reference	Date Accessed
Alameda Co	https://static1.squarespace.com/static/57573edf37013b15f0435124/t/5b2434326d2a734942eb80b7/1529099326535/Design+Guidelines+SD-2018Jun06.pdf	3/10/2021
Anaheim	https://www.anaheim.net/DocumentCenter/View/22954/132	3/10/2021
Contra Costa Co	https://www.contracosta.ca.gov/DocumentCenter/View/29792/CU01-PDF?bidId=	3/10/2021
Davis	https://www.cityofdavis.org/home/showpublisheddocument?id=8217	3/10/2021
Fremont	https://www.fremont.gov/DocumentCenter/View/307/sd-28_LongitudinalTrenchTransverseTrench?bidId=	3/10/2021
Fresno Co (Page 293)	http://www.fresnofloodcontrol.org/wp-content/uploads/2014/08/Std-Specifications-April-1-2011-approved-amended-1-1-12.pdf	3/10/2021
Long Beach	http://longbeach.gov/globalassets/pw/media-library/documents/resources/engineering/standard-plans/100-general-roadwork/section-127---trench-requirements-in-street-right-of-way--as-of-11-13-17-	3/10/2021
Los Angeles	https://eng2.lacity.org/techdocs/stdplans/s-400/S-477-2_B4778_%20_.pdf	3/10/2021
Los Angeles Co (Page 129)	https://pw.lacounty.gov/des/design_manuals/StandardPlan.pdf	3/10/2021
Oakland	http://www2.oaklandnet.com/government/o/PWA/o/EC/s/DGP/index.htm (See City of Oakland Guidelines and Standards: Street Excavation Rules)	3/10/2021
Sacramento (Page 42)	https://www.cityofsacramento.org/~/media/Corporate/Files/DOU/Specs-Drawings/Addendum%202_Final_042412.pdf	3/10/2021
Sacramento Co (Page 17)	https://saccountyspecs.saccounty.net/Documents/PDF%20Documents%202008/Drawings/Drawings.pdf	3/10/2021
San Francisco (Page 27)	https://sfpublicworks.org/sites/default/files/PW-Order-187005-Signed.pdf	3/10/2021
San Diego Co (Page 38)	https://www.sandiegocounty.gov/content/dam/sdc/sdcfa/documents/prevention/design-standards.pdf	3/10/2021
San Jose	https://www.sanjoseca.gov/home/showdocument?id=37037 (Cross Section data from personal correspondence with Lorina Popescu, City of San Jose)	3/10/2021
Santa Clara (Page 31)	https://www.santaclaraca.gov/home/showpublisheddocument?id=70118	3/10/2021

Table R.2 References

Agency	Reference	Date Accessed
Elk Grove	https://www.codepublishing.com/CA/ElkGrove/html/ElkGrove12/ElkGrove1209.html	3/11/2021
Los Angeles	https://eng2.lacity.org/StdFeeList/StdFeeList.pdf	3/11/2021
Modesto	https://www.modestogov.com/DocumentCenter/View/4817/Development-Fee-Schedule---Engineering_Encroachment	3/11/2021
Patterson	https://www.ci.patterson.ca.us/823/Trench-Cut-Permit-and-Program-Informatio	3/11/2021
Sacramento	Resolution No. 97-537 A Resolution Establishing Trench Cut Cost Recovery Fees	-
Sacramento Co	http://qcode.us/codes/sacramentocounty/view.php?topic=12-12_09-12_09_030&frames=on	3/11/2021
San Diego	https://www.sandiego.gov/sites/default/files/stdamagefeeincrease.pdf	1/19/2022
City and County of San Francisco	https://www.sfpublicworks.org/sites/default/files/Excavation_Code.pdf	3/11/2021
Santa Ana	https://www.santa-ana.org/sites/default/files/finance/budget/2020-2021/June%2016/Proposed%20Misc.%20Fees%20Schedule_COMBINED.06.16.20_FINAL.pdf	1/12/2022
Santa Barbara County	https://countyofsb.org/pwd/asset.c/224	3/11/2021
Santa Cruz	http://sccounty01.co.santa-cruz.ca.us/BDS/Govstream2/Bdsvdata/non_legacy_2.0/agendas/2003/20030401-211/PDF/035.pdf	3/11/2021
Union City	CHEC Consulting Engineers, Inc. 1998. Trench Cut Fee Evaluation Study for the City of Union City. City of Union City, Department of Public Works	-

Table R.3 References

Agency	Reference	Date Accessed
Anaheim	https://www.anaheim.net/DocumentCenter/View/22954/132	3/11/2021
Commerce	Personal correspondence with Daniel Hernandez, City of Commerce	3/11/2021
Encinitas	https://www.biasandiego.org/wp-content/uploads/2019/11/Attachment-2-Resolution-Exhibit-A_clean.pdf	3/11/2021
Los Angeles	https://eng2.lacity.org/techdocs/permits/7_3.pdf	3/11/2021
Los Angeles Co	https://pw.lacounty.gov/general/faq/index.cfm?Action=getAnswers&FaqID=JCMtOzVTUCAgCg%3D%3D&Theme=default&ShowTemplate=#:~:text=The%20County%20has%20a%20two,date%20of%20the%20resurfacing%20project.	3/11/2021
Oakland	https://library.municode.com/ca/oakland/codes/code_of_ordinances?nodeId=TIT12STSIPUPL_CH12.12EX	3/11/2021
Sacramento Co	https://sacdot.saccounty.net/Pages/Trenchingandroadcutmoratorium.aspx	3/11/2021
San Diego	https://www.biasandiego.org/wp-content/uploads/2019/11/Attachment-1-San-Diego-County-and-City-Trenching-Moratorium-Information.pdf	3/11/2021
San Diego Co	https://www.biasandiego.org/wp-content/uploads/2019/11/Attachment-1-San-Diego-County-and-City-Trenching-Moratorium-Information.pdf	3/11/2021
San Francisco	https://www.sfpublicworks.org/sites/default/files/Moratorium%20Streets.pdf	3/11/2021

Appendix B

City's Traffic Index (TI) Map

CITY OF RIVERSIDE, CA.

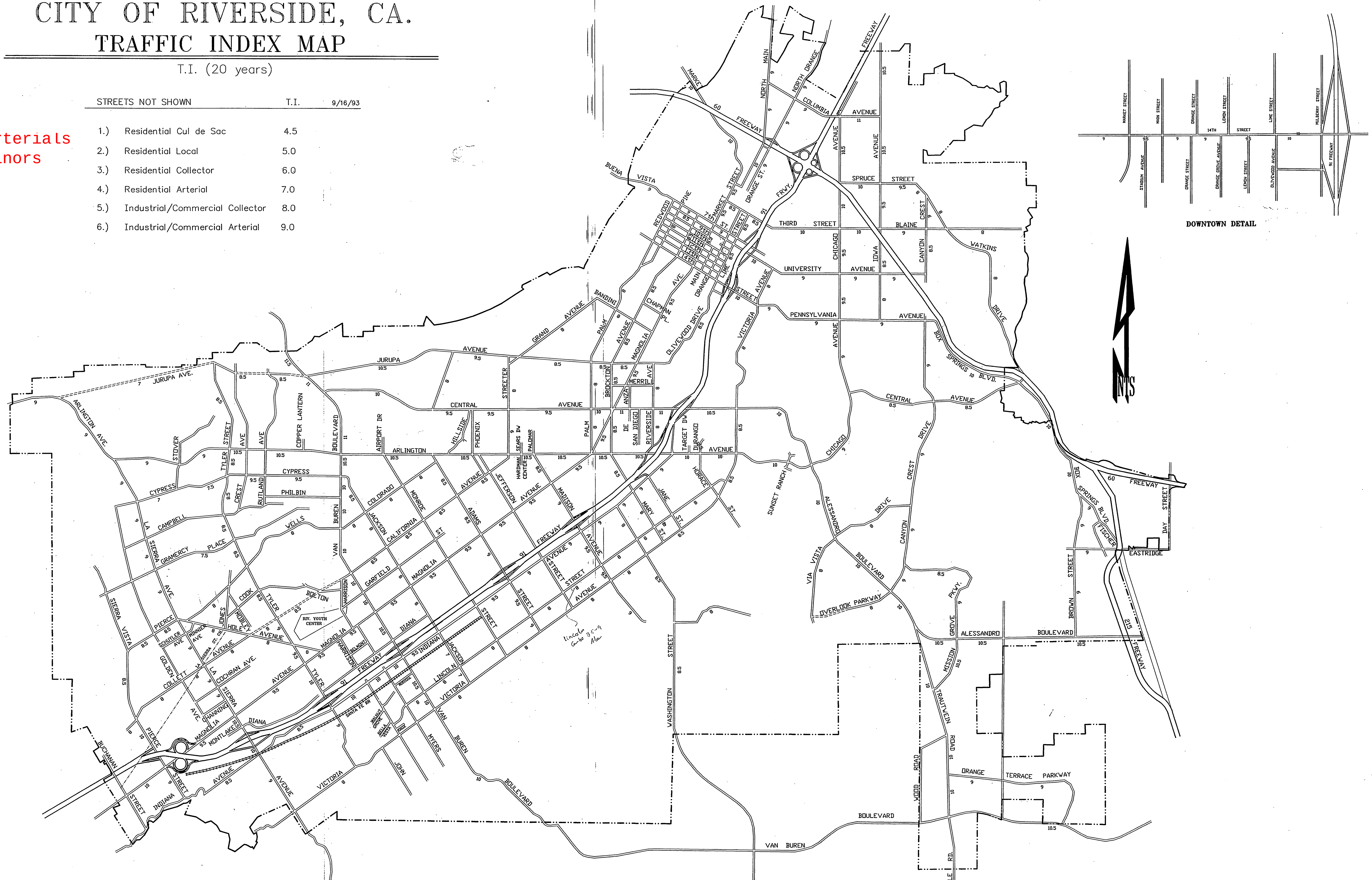
TRAFFIC INDEX MAP

T.I. (20 years)

STREETS NOT SHOWN		T.I.
1.)	Residential Cul de Sac	4.5
2.)	Residential Local	5.0
3.)	Residential Collector	6.0
4.)	Residential Arterial	7.0
5.)	Industrial/Commercial Collector	8.0
6.)	Industrial/Commercial Arterial	9.0

9/16/93

Add 1.0 to Arterials
Add 0.5 to Minors



**** TRAFFIC INDEX NUMBERS ARE NOT TO BE CHANGED EXCEPT BY P.W./ENGINEERING-PLANNING ****

PLEASE SEE THIS SECTION IF YOU HAVE ANY CHANGES THAT NEED TO BE MADE TO THE T.I. NUMBERS.

Appendix C

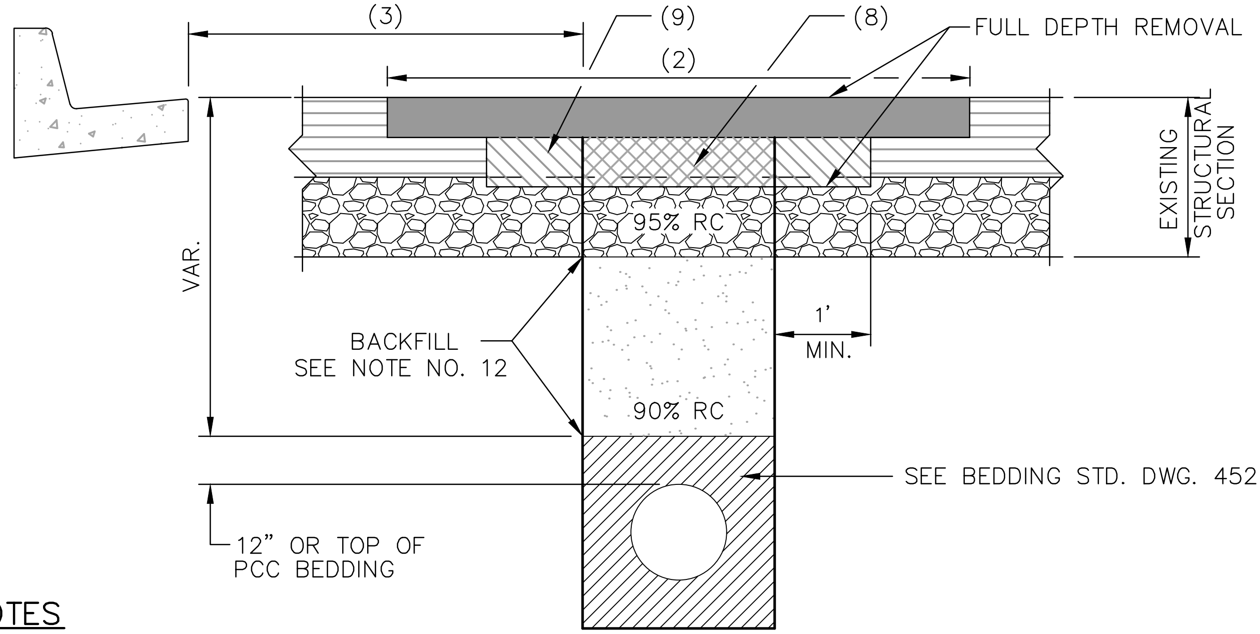
City’s Utility Cut Restoration Standards

PAVEMENT MORATORIUM

FIVE (5) YEAR MORATORIUM FOR NEW PAVEMENT AND ONE (1) YEAR FOR SLURRY SEAL.
MORATORIUM PERIOD BEGINS AFTER NOTICE OF COMPLETION (NOC) HAS BEEN FILED.

TRENCHING IN STREETS UNDER MORATORIUM REQUIRES PRIOR WRITTEN APPROVAL FROM THE CITY ENGINEER.
THE LIMITS OF RESURFACING WILL BE MORE EXTENSIVE FOR STREETS UNDER MORATORIUM AS INDICATED HEREIN.
CONTRACTORS SHALL VERIFY MORATORIUM STATUS PRIOR TO COMMENCING WORK.

CLICK HIGHLIGHTED LINK BELOW OR VISIT THE PUBLIC WORKS WEBPAGE TO CHECK MORATORIUM STATUS
www.riversideca.gov/pavingmap



NOTES

1. NO TRENCHING, CUTTING, POTHOLING, GRADING OR CORING SHALL BE ALLOWED ON STREETS UNDER MORATORIUM UNLESS WRITTEN AUTHORIZATION FROM THE ENGINEER IS PROVIDED, INCLUDING EMERGENCY WORK AND/OR SERVICE CONNECTIONS.
2. WHEN TRENCHING OR CUTTING INTO A STREET, FULL LANE WIDTH (10 FEET WIDE MINIMUM) OF ASPHALT CONCRETE (A.C.) PAVEMENT REPLACEMENT–A.C. COLD MILLING (0.12 FEET THICK MINIMUM) AND A.C. OVERLAY IS REQUIRED. REPLACEMENT OF MULTIPLE LANES IS REQUIRED WHEN WORK AFFECTS MORE THAN ONE LANE. ALTERNATELY, AT THE DISCRETION OF THE ENGINEER, COLD MILL OR GRIND EXISTING A.C. PAVEMENT TO A DEPTH OF 0.12 FEET WITHIN THE TRENCH AREA TO A LEAST 1 FOOT BEYOND THE EDGES OF THE TRENCH, AND SLURRY SEAL THE ENTIRE STREET WIDTH FROM GUTTER LIP TO GUTTER LIP (OR EDGE OF PAVEMENT). **SEE NOTE 25 FOR ADDITIONAL PAVEMENT REQUIREMENTS WHEN AN ARAM INTERLAYER IS IMPACTED.**
3. IF THE TRENCH EDGE IS 4 FEET OR LESS FROM THE EDGE OF PAVEMENT, GUTTER LIP, OR CURB FACE, THE PAVEMENT SECTION (4 FEET IN WIDTH OR LESS) SHALL BE REMOVED AND REPLACED AS PART OF THE TRENCH BACKFILL OR AS DIRECTED BY THE ENGINEER.
4. IF A VEHICULAR LANE IMPACTED BY THE TRENCH IS ADJACENT TO A BICYCLE OR A PARKING LANE, THE PAVEMENT SECTION WITHIN THE BICYCLE OR PARKING LANE SHALL BE COLD MILLED AND RESURFACED WITH 0.12 FEET OF A.C. TO THE EDGE OF THE GUTTER (SEE CASE I OR V ON SHEETS 3 AND 4).
5. FOR TRANSVERSE (PERPENDICULAR) TRENCHES, GRINDING AND RESURFACING WITH 0.12 FEET OF A.C. SHALL EXTEND 15 FEET BEYOND LIMITS OF EACH SIDE OF THE TRENCH, SEE SHEETS No. 3 AND No. 4.
6. GRIND AND RESURFACE A MINIMUM OF 3 INCHES FOR FULL WIDTH OF ANY TRAVEL LANE WITHIN 50 FEET OF INTERSECTIONS (APPROACHES ONLY)
7. SIGNIFICANT TRENCH CUTS DUE TO UTILITY LATERALS REQUIRE GRINDING AND RESURFACING WITH 0.12 FEET OF A.C. (SEE CASE IV, SHEET 3).

APPROVED BY:
CITY ENGINEER — DATE 03/08/2023

MARK	REVISIONS	APPR.	DATE

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT

TRENCH BACKFILL

STANDARD DRAWING NO. 453

NOTES:

8. REPLACEMENT A.C. PAVEMENT THICKNESS WITHIN THE TRENCH LIMITS SHALL BE 1 INCH GREATER THAN EXISTING A.C. PAVEMENT THICKNESS OR 5 INCHES THICK WHICHEVER IS GREATER.
9. ADDITIONAL REPLACEMENT OF A.C. STRUCTURAL SECTION, WITH THE SAME MINIMUM THICKNESS REQUIREMENTS INDICATED IN NOTE 8 ABOVE, WILL BE REQUIRED FOR A MINIMUM OF ONE FOOT OUTSIDE THE TRENCH LIMITS WHERE THE EXISTING A.C. THICKNESS IS LESS THAN 3 INCHES.
10. THE DENSE GRADED ASPHALT CONCRETE (DGAC) USED FOR PERMANENT RESURFACING SHALL BE TYPE B–PG 70–10 FOR THE BASE COURSE AND C2–PG 70–10 FOR THE FINISHED COURSE. WHERE RUBBERIZED ASPHALT IS REQUIRED, THE ASHALT MIX SHALL BE ARHM–GG–C OR ARHM–GG–B. ALL ASPHALT MIXES ARE SUBJECT TO THE APPROVAL OF THE ENGINEER.
11. ALL ASPHALT PAVEMENT REPLACEMENT SHALL HAVE SQUARE AND UNIFORM EDGE(S) THROUGHOUT AS DIRECTED BY THE ENGINEER. TRACKLESS TACK MATERIAL WILL ONLY BE PERMITTED.
12. BACKFILL REQUIREMENTS SHALL BE AS SPECIFIED IN SECTION 306 OF THE MOST CURRENT EDITION OF THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS STANDARDS". CONTRACTOR SHALL PROVIDE TO THE ENGINEER COMPACTION TEST RESULTS CERTIFIED BY AN APPROVED CIVIL OR SOILS ENGINEER FOR ALL WORK DONE INCLUDING ASPHALT PAVEMENT. WHERE NO SURFACE IMPROVEMENTS EXIST, THE TOP OF BACKFILL SHALL BE FLUSH WITH THE EXISTING SURFACE AND 90% RELATIVE COMPACTION SHALL EXTEND TO THE SURFACE. CONTROLLED LOW STRENGTH MATERIAL (CLSM) MAY BE ALLOWED FOR SUB–GRADE BACKFILL IF APPROVED BY THE ENGINEER. ALL COSTS FOR TESTING SHALL BE BORNE BY THE CONTRACTOR.
13. TRENCHES SHALL BE PAVED WITH TEMPORARY A.C. PAVEMENT IMMEDIATELY FOLLOWING WORK. ALL TEMPORARY ASPHALT SHALL BE A MINIMUM 3 INCHES THICK AND SHALL BE PROPERLY COMPACTED FLUSH WITH EXISTING PAVING USING A VIBRATORY ROLLER OR VIBRATORY PLATE. ALL TEMPORARY ASPHALT MUST BE KEPT UP DAILY AT THE CONTRACTOR'S EXPENSE. PERMANENT PAVING IS REQUIRED WITHIN 2 WEEKS OF EXCAVATION. TRAFFIC LOOPS SHALL BE INSTALLED WITHIN 1 WEEK OF PERMANENT PAVING AND STRIPING WORK SHALL COMMENCE WITHIN 2 WORKING DAYS OF LOOP INSTALL COMPLETION.
14. ALL USA OR OTHER MARKINGS MUST BE COMPLETELY REMOVED WITHOUT DAMAGING ANY SURFACES THAT HAVE BEEN MARKED. AREAS OF REMOVAL SHALL BE MARKED BY THE CITY INSPECTOR.
15. ALL REQUIREMENTS IN THIS DRAWING APPLY TO TRENCHES AND EXCAVATIONS IN PUBLIC EASEMENTS, RIGHTS OF ENTRY, CITY PROPERTY AS WELL AS THOSE WITHIN STREET RIGHTS–OF–WAY.
16. SPOT REPAIRS AND/OR POTHOLING REPAIRS SHALL BE COMPLETED PER CITY PUBLIC WORKS STANDARD 454.
17. ANY OTHER TRENCH AND/OR PATCH REPAIR METHODS SHALL BE APPROVED BY THE CITY ENGINEER.
18. NO WORK WILL BE ALLOWED IN THE DOWNTOWN RIVERSIDE AREA BETWEEN THE DATES NOVEMBER 1 AND JANUARY 3. THE DOWNTOWN AREA WILL BE BOUNDED BY FIRST STREET, FIFTEENTH STREET, SR–91, AND BROCKTON AVENUE. NO WORK WILL BE ALLOWED WITHIN 1000 FEET OF THE THE GALLERIA AT TYLER OR THE RIVERSIDE PLAZA DURING THE SAME DATES. ANY EXCEPTIONS SHALL BE APPROVED BY THE ENGINEER.
19. THE CITY MAY REQUIRE FULL DEPTH AC SECTION REPLACEMENT BASED ON STREET CONDITIONS.
20. ALL DAMAGED OR REMOVED STRIPING, PAVEMENT LEGENDS, MARKERS, AND TRAFFIC SIGNAL LOOPS SHALL BE REPLACED IN–KIND. PARTIALLY IMPACTED FACILITIES SHALL BE FULLY REPLACED.
21. MANHOLES, VALVES OR VAULTS IMPACTED BY THE A.C. IMPROVEMENTS SHALL BE LOWERED AND RAISED PER GREENBOOK.
22. CONSTRUCT NEW CRUSHED MISC. BASE MAX 3/4" PARTICLE SIZE, TO A MIN. OF 4" THICK UP TO EXISTING ASPHALT BASE SECTION THICKNESS, WHICHEVER IS GREATER. COMPACT TO 95% OF RELATIVE DENSITY. NO CRUSHED MISC. BASE REQUIRED IF 1–SACK SAND/CEMENT SLURRY BACKFILL IS USED.
23. SAWCUTTING IS REQUIRED AROUND THE PERMITER OF THE FINAL EDGE OF ALL EXCAVATIONS TO PROVIDE CLEAN SIDES. STREETS HAVING MULTIPLE TRANSVERSE (PERPENDICULAR) TRENCHES SHALL ADHERE TO CASE III, IV, OR VII ON SHEETS No. 3 AND No. 4, RESPECTIVELY.
24. FOR STREETS NOT UNDER MORATORIUM, THE CONTRACTOR SHALL NOT BE REQUIRED TO PAVE BETWEEN TRANSVERSE TRENCHES IF THE DISTANCE BETWEEN THE SIDES OF THE TRENCHES IS 60–FEET OR MORE.
25. ON STREETS THAT CONTAIN AN ASPHALT RUBBER AGGREGATE MEMBRANE (ARAM) INTERLAYER, THE CONTRACTOR SHALL EITHER REPLACE THE ARAM INTERLAYER OR PROVIDE COLD MILLING TO A DEPTH OF 0.15 FEET MINIMUM TO REMOVE THE EXISTING ARAM AND REPLACE WITH 0.15 FEET OF NEW ASPHALT WITH A HYBRID GEOSYNTHETIC PAVING MAT SIMILAR TO GLASPAVE®, OR A CITY APPROVED EQUAL, WITHIN THE REQUIRED RESURFACING LIMITS INDICATED IN ALL CASES. CONTRACTORS ARE RESPONSIBLE TO DETERMINE THE PRESENCE OF ARAM.
26. PRIOR TO TRENCHING WORK, THE CONTRACTOR SHALL LOCATE ALL ACTIVE GRAVITY UTILITY PIPES AND THEIR SERVICE LATERALS (I.E. STORM DRAIN PIPES, SEWER PIPES, AND SEWER LATERALS) USING VIDEO TECHNOLOGY. TABULATION OF THE GRAVITY UTILITY PIPES AND THE SERVICE LATERALS LOCATIONS WITHIN THE LIMITS OF EXCAVATION SHALL BE PROVIDED TO THE ENGINEER PRIOR TO THE START OF ANY WORK.

APPROVED BY: [signature]

CITY ENGINEER

03/08/2023

DATE

CITY OF RIVERSIDE

PUBLIC WORKS DEPARTMENT

TRENCH BACKFILL

STANDARD DRAWING NO. 453

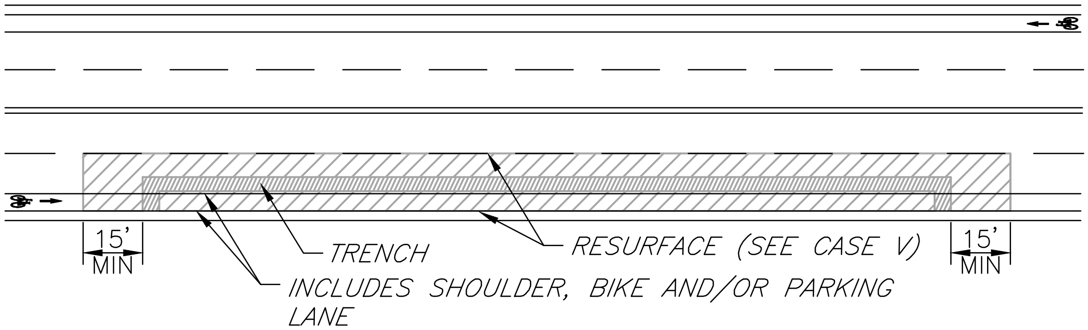
Sheet 2 of 4

MARK	REVISIONS	APPR.	DATE

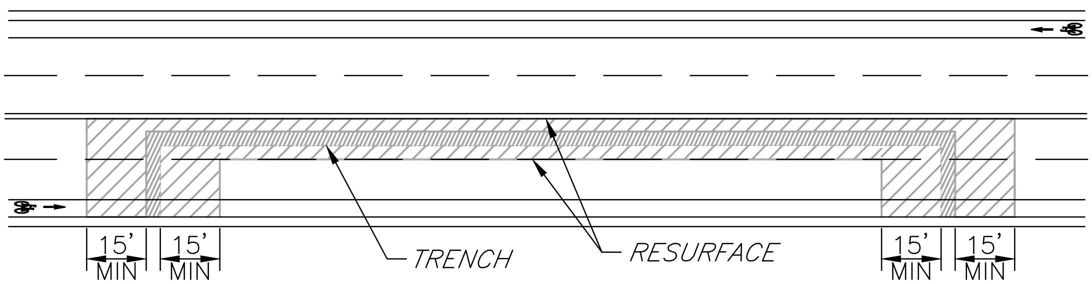
LEGEND:

- TRENCH
- GRIND 0.12' AND REPLACE WITH 0.12' AC.

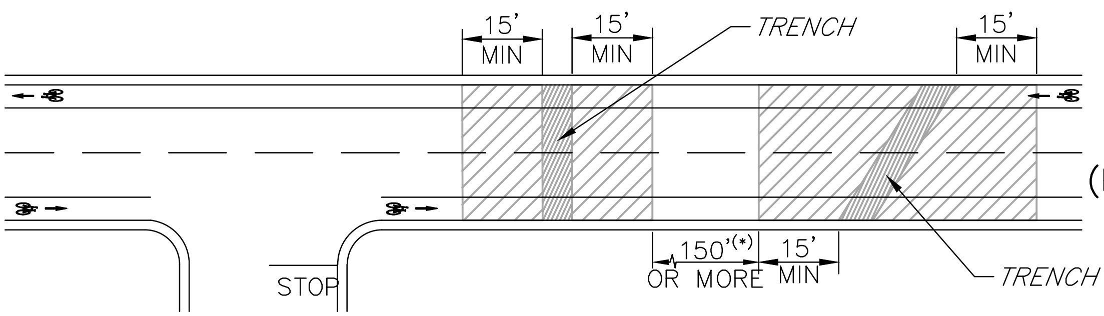
CASE I
LONGITUDINAL (PARALLEL) TRENCH CUT OUTSIDE LANES



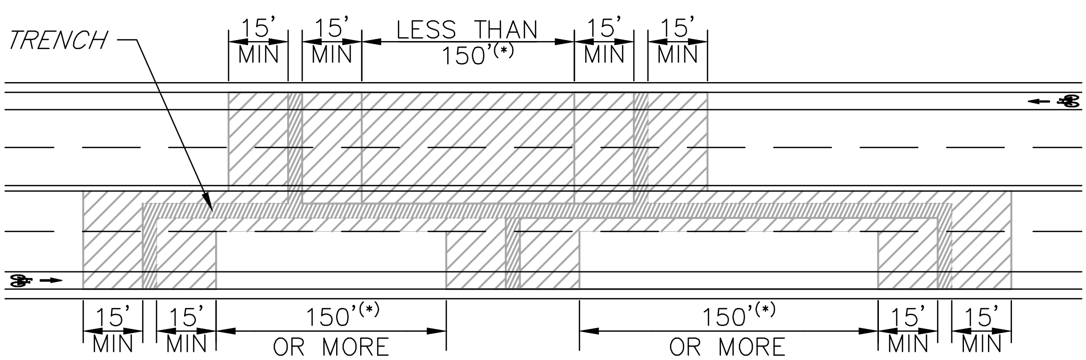
CASE II
LONGITUDINAL (PARALLEL) TRENCH CUT INSIDE LANE



CASE III
TRANSVERSE (PERPENDICULAR) TRENCH CUT



CASE IV
SIGNIFICANT TRENCH CUTS



(*) SEE NOTE 24 FOR STREETS NOT UNDER MORATORIUM

APPROVED BY:

CITY ENGINEER — DATE 03/08/2023

MARK	REVISIONS	APPR.	DATE

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT

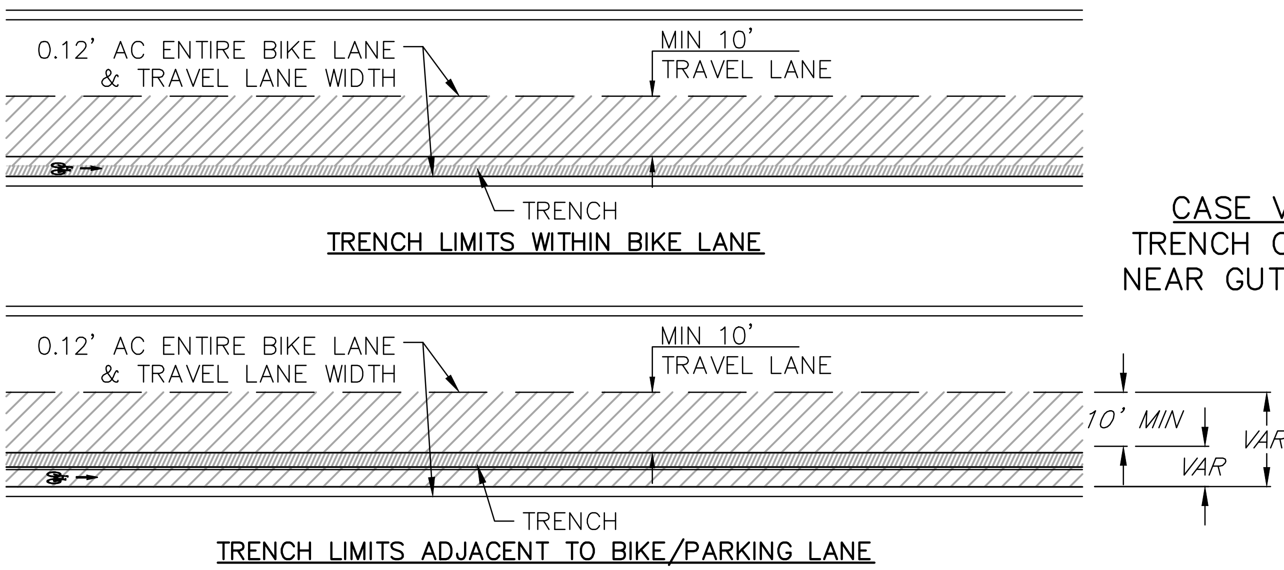
TRENCH BACKFILL

STANDARD DRAWING NO. 453

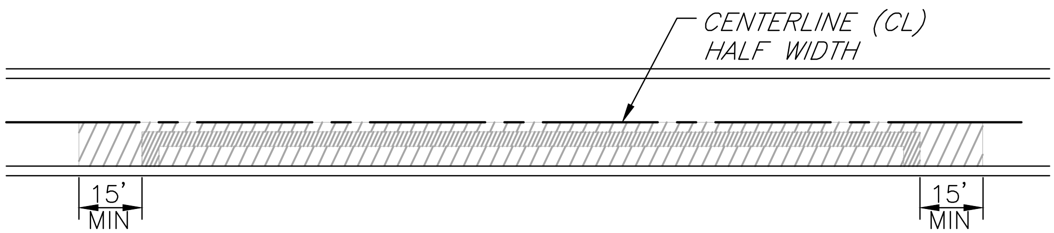
Sheet 3 of 4

LEGEND:

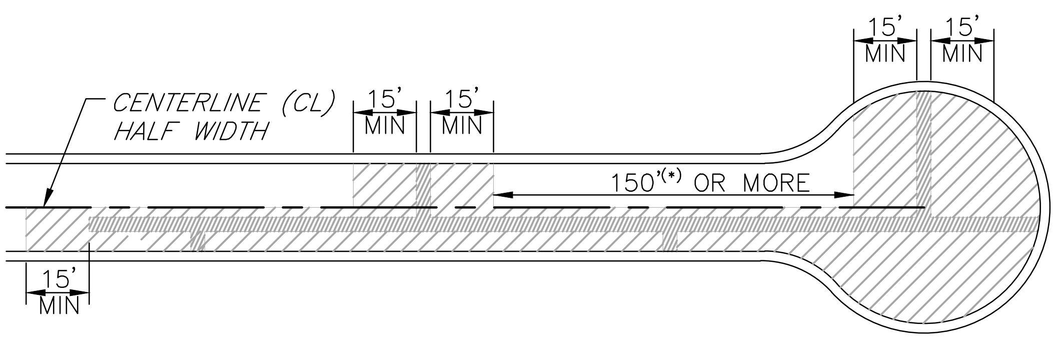
- TRENCH
- GRIND 0.12' AND REPLACE WITH 0.12' AC.



CASE V
TRENCH CUT
NEAR GUTTER



CASE VI
TRENCH CUT
LOCAL STREETS



CASE VII
TRENCH CUT
IN CUL DE SAC

(*) SEE NOTE 24 FOR STREETS NOT UNDER MORATORIUM

APPROVED BY: [signature]

CITY ENGINEER — DATE 03/08/2023

MARK	REVISIONS	APPR.	DATE

CITY OF RIVERSIDE

PUBLIC WORKS DEPARTMENT

TRENCH BACKFILL

STANDARD DRAWING NO. 453

Sheet 4 of 4