# APPENDIX 5

## TECHNICAL MEMORANDUM 5 – DETAILED PREFERRED ALIGNMENT

# Northern Parkway/ Tonopah Parkway Corridor Feasibility Study

Contract 2010-004
Project TT005

# FINAL
## Technical Memorandum 5
## Detailed Preferred Alignment

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June 2011
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# TABLE OF CONTENTS

DETAILED PREFERRED ALIGNMENT


**1. INTRODUCTION ..... 1**

**1.1 Background and Study Need ..... 1**
**1.2 Project Study Area ..... 2**

**2. DEVELOPMENT OF PREFERRED ALTERNATIVES ..... 4**

**2.1 Process for Selecting the Preferred Alternatives ..... 4**
**2.2 Special Analysis Areas ..... 5**
**2.3 Description of the Preferred Alternatives ..... 5**

**3. PREFERRED ALIGNMENT DESIGN CONSIDERATIONS ..... 8**

**3.1 Parkway Design Guidelines and Typical Cross-Sections ..... 8**
**3.2 Crossing Features ..... 8**
**3.3 Access Management Guidelines ..... 9**

**4. PREFERRED ALIGNMENT IMPLEMENTATION ..... 10**

**4.1 Detailed Preferred Alignment Drawings ..... 10**
**4.2 Planning-Level Construction Cost Estimates ..... 10**
**4.3 Implementation Strategies ..... 12**
**4.4 Next Steps ..... 13**

# TABLE OF CONTENTS

DETAILED PREFERRED ALIGNMENT

## LIST OF FIGURES

Figure 1 – Project Study Area ..... 3
Figure 2 – Preferred Alternatives ..... 7

## LIST OF TABLES

Table 1 – Planning-Level Construction Cost Estimates ..... 11
Table 2 – Anticipated Drainage Crossings ..... 12

## LIST OF APPENDICES

Appendix TM5-01: Arizona Parkway Cross-sections and Layouts
Appendix TM5-02: Proposed Laneage for Arizona Parkway Segments
Appendix TM5-03: Freeway-to-Parkway Templates
Appendix TM5-04: Detailed Preferred Alignment Drawings

# 1. INTRODUCTION

Technical Memorandum 5 (TM 5), entitled *Detailed Preferred Alignment*, provides detailed information on the proposed alignments and design considerations of the preferred alternatives for Northern Parkway and Tonopah Parkway as part of the *Northern Parkway: Tonopah Parkway to Turner Parkway and Tonopah Parkway: Northern Parkway to Interstate 10 Corridor Feasibility Study* (hereafter referred to as the *Northern Parkway/Tonopah Parkway CFS*, or "the project"). Specifically, TM 5 provides a summary of the study background and study area; a description of the preferred alternatives; standard cross-sections and design considerations for the preferred alignment of the parkway facilities; and plan view drawings on aerial photographs showing the preferred alignment centerline and right-of-way limits at a scale of 1 inch = 200 feet.

The preferred alignment centerline and right-of-way limits are subject to more detailed design work that may necessitate some adjustments as roadway profiles, drainage requirements, and land development plans are further defined. Additional detailed information is included in the following companion documents: *Existing and Future Corridor Features* (TM 1), *Environmental Overview* (TM 2), *Conceptual Drainage Report* (TM 3), and *Candidate Alternative Alignments and Evaluation* (TM 4).

## 1.1 Background and Study Need

In July 2008, the Maricopa Association of Governments (MAG) completed the *Interstate 10/Hassayampa Valley Transportation Framework Study* (known as the *Hassayampa Framework Study*), that recommended a comprehensive roadway network to meet the future traffic demands that result when the area west of the White Tank Mountains is completely developed (hereafter referred to as buildout travel demand). This long-range regional transportation network includes the "Arizona Parkway" as a new facility type to supplement more traditional roadway classifications in meeting projected travel demand.

The Arizona Parkway utilizes a distinct intersection treatment that prohibits left turns at major cross-street intersections and controls intersection traffic movements with two-phased traffic signal control. Left-turn movements are made indirectly using directional left-turn crossovers in the median immediately downstream of cross-street intersections. The typical right-of-way width for an Arizona Parkway is 200 feet.

The *Hassayampa Framework Study* demonstrated the need for both Northern Parkway and Tonopah Parkway to meet buildout travel demands and provide a continuous parkway network. Although today's land development and travel demands in the project study area do not warrant major new high capacity roadways in the near-term future, the buildout forecast for future land development and travel demands does warrant major new high capacity roadways in the long-term future. Plans are already underway to convert some of the vacant lands within the project study area to land uses that will generate future traffic.

To preserve sufficient public right-of-way for the future Northern Parkway and Tonopah Parkway, the planning process needs to identify right-of-way requirements for buildout conditions. This study is the first step in the roadway development process and is meant to aid Maricopa County and the Town of Buckeye in defining and protecting the right-of-way that will be needed for Northern Parkway and Tonopah Parkway.

The project scope of work for this study included the tasks necessary to prepare a corridor feasibility report that will provide the Maricopa County Department of Transportation (MCDOT), the Town of Buckeye, area property owners, developers, and other stakeholders with planning

guidelines for future growth and development that will lead to the preservation of a 200-foot wide right-of-way corridor to accommodate the typical Arizona Parkway design. This required significant coordination with various governing bodies, other public agencies, development interests, and the general public.

## 1.2 Project Study Area

The project study area includes the planned Northern Parkway, an east-west corridor centered on the Northern Avenue section line, from the planned Tonopah Parkway (411th Avenue alignment) to the planned Turner Parkway (267th Avenue alignment). The Northern Parkway corridor within the project study area is approximately 18 miles long and two miles wide. This section of Northern Parkway is referred to as the Northern Parkway Hassayampa section to distinguish it from other planned Northern Parkway sections east of the White Tank Mountains.

The project study area also includes the planned Tonopah Parkway, a north-south corridor centered on the 411th Avenue section line, from Interstate 10 (I-10) to the planned Northern Parkway. The Tonopah Parkway corridor within the project study area is approximately 3.75 miles long and two miles wide.

The project study area boundaries are shown in **Figure 1**.

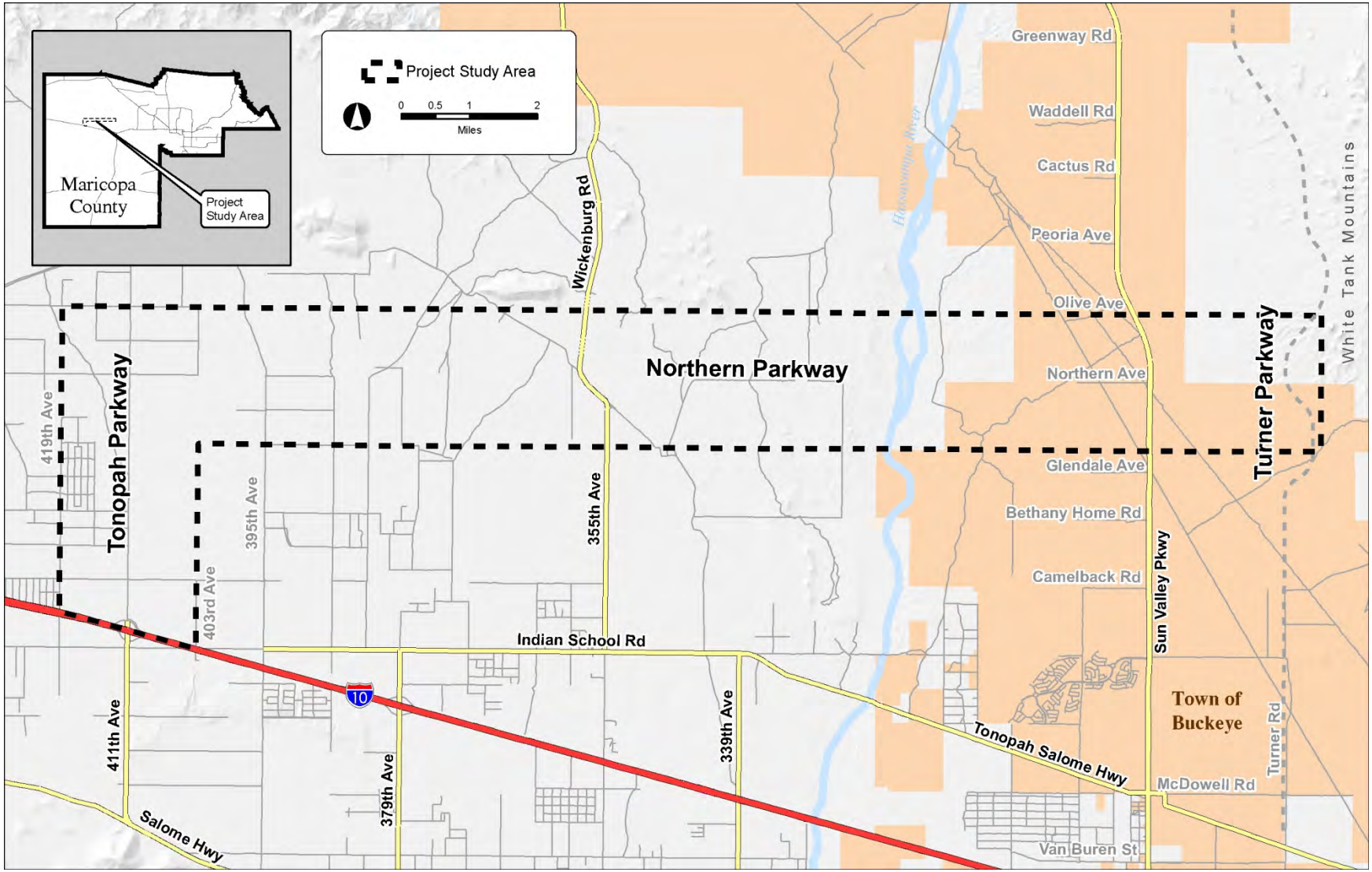



**Figure 1 – Project Study Area**

# 2. DEVELOPMENT OF PREFERRED ALTERNATIVES

## 2.1 Process for Selecting the Preferred Alternatives

Selection of the preferred alternatives was accomplished through a two-step process. The first step was to identify a series of conceptual alternatives that were subjected to a "fatal flaw" analysis. The conceptual alternatives were developed only to the extent necessary to conduct a meaningful comparative analysis that would produce up to three candidate alternatives that could be defined and evaluated in greater detail. The second step was to perform a more in-depth evaluation of the candidate alternatives and identify preferred alternatives. This process is discussed in greater detail in *Technical Memorandum No. 4 – Candidate Alternative Alignments and Evaluation*. The conceptual alternatives, candidate alternatives, and evaluation criteria were all developed in consultation with the Technical Advisory Committee (TAC) and stakeholders and were presented for general public input at public open house meetings.

For alternatives development and evaluation purposes, the study area was divided into two separate segments: the Tonopah Parkway segment and the Northern Parkway segment. The Tonopah Parkway segment alternatives commence at the existing I-10 interchange and proceed north to connect with the Northern Parkway alignment. The Northern Parkway segment alternatives commence at the Tonopah Parkway alignment (411$^{th}$ Avenue) and proceed east to connect with the Turner Parkway alignment.

After identifying the conceptual alternatives and then narrowing the conceptual alternatives to three candidate alternatives for the Tonopah Parkway segment and two candidate alternatives for the Northern Parkway segment, the candidate alternatives, along with a "No-Build" alternative, were evaluated using the following evaluation criteria:

- Future development compatibility;
- System continuity and capacity;
- Drainage impacts;
- Irrigation impacts;
- Building/property impacts;
- Wildlife impacts;
- Cultural/archaeological impacts;
- Utility impacts;
- Public acceptability; and
- Cost.

Most of the evaluation criteria do not lend themselves to numerical quantification, so the candidate alternatives evaluation was performed on a "qualitative" basis. After considering the evaluation results, preliminary preferred alternatives were identified for presentation to TAC members and stakeholders.

The evaluation results and preliminary preferred alternatives were discussed with TAC members and stakeholders in advance of soliciting public input at the project's third open house. There was general consensus from TAC members and stakeholders that the evaluation results are reasonable and valid and that the preliminary preferred alternatives should be presented at the third public open house.

Public input from the open house was generally positive and in concurrence with the evaluation results and the preliminary preferred alternatives. Based on the input received, the preliminary preferred alternatives were selected as the project's recommended preferred alternatives.

## 2.2 Special Analysis Areas

Two "Special Analysis Areas" were identified and analyzed for potentially advantageous options within the Northern Parkway study area:

- The Hassayampa River Special Analysis Area, located where Northern Parkway crosses the Hassayampa River; and
- The Sun Valley Parkway Special Analysis Area, where electrical line towers exist close to the Northern Avenue section line near Sun Valley Parkway.

For the Hassayampa River Special Analysis Area, the recommended preferred alignment shifts the parkway's 200-foot-wide corridor 100 feet south of the Northern Avenue section line between 323rd Avenue and Johnson Road. This shift eliminates the creation of an unusable remnant parcel by fully utilizing the existing 200-foot-wide parcel south of the Northern Avenue section line between 315th Avenue and Johnson Road.

For the Sun Valley Parkway Special Analysis Area, the recommended preferred alignment remains on the Northern Avenue section line (Alternative A) as it intersects Sun Valley Parkway. This alignment will require relocation of one or more electrical line towers to keep Northern Parkway centered on the Northern Avenue section line and avoid introducing additional curvature in the parkway alignment.

## 2.3 Description of the Preferred Alternatives

Alternative A is recommended as the preferred alternative for Tonopah Parkway. Alternative A is centered on the 411th Avenue alignment. Alternative A is also recommended as the preferred alternative for Northern Parkway. Alternative A is centered on the Northern Avenue section line alignment except for a half-mile shift to the south between 363rd Avenue and 339th Avenue and a 100-foot shift to the south across the Hassayampa River. These shifts are compatible with the Belmont master planned community and with property lines near the Hassayampa River.

The recommended preferred alternatives have the least impact on existing subdivided properties, are most compatible with planned developments and prior planning studies, and have received the most TAC, stakeholder, and public support.

The recommended Tonopah Parkway preferred alternative is not anticipated to impact any existing buildings or require any residential or commercial relocation. Partial acquisitions are expected on 53 adjacent parcels, and full acquisition will be required on three adjacent vacant parcels. The recommended alternative will likely require relocation or reconfiguration of small sections of two irrigation canals and relocation of several wells.

The recommended Northern Parkway preferred alternative will likely require acquisition and relocation of one existing residential property and partial acquisition of 67 adjacent parcels. Much of the required right-of-way is already in place or will be dedicated though the land development process. A bridge or siphon will be required at the Tonopah Canal and major bridge crossings will be required at the Hassayampa River and at Jackrabbit Wash.

The preferred alternatives for Tonopah Parkway and Northern Parkway are shown in **Figure 2**. Also included in this figure are the proposed interchange locations where other freeways and

parkways are expected to intersect Tonopah Parkway and Northern Parkway per the *Hassayampa Framework Study*. These interchange locations are preliminary and will require additional study to identify more precise locations and design features.

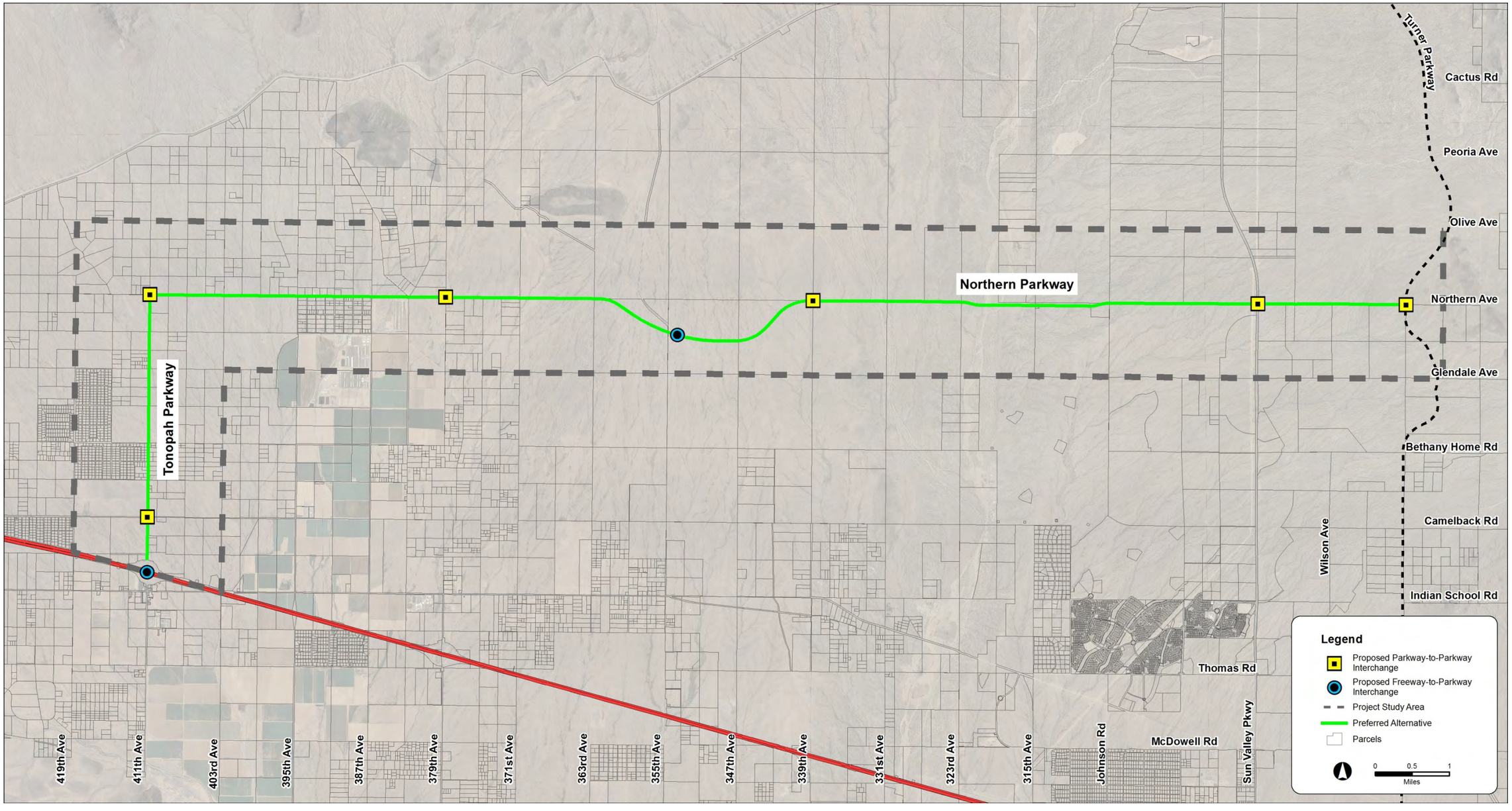



**Figure 2 – Preferred Alternatives**

# 3. PREFERRED ALIGNMENT DESIGN CONSIDERATIONS

Once the preferred alternatives were selected, the preferred alignment was defined in greater detail in light of the following design considerations.

## 3.1 Parkway Design Guidelines and Typical Cross-Sections

Guidelines to be followed for implementation of a parkway such as Northern Parkway or Tonopah Parkway are documented in the MCDOT publications *Enhanced Parkway Study (August 2007)*, *Design Guideline Recommendations for the Arizona Parkway (August 2008)*, and *Arizona Parkway Intersection/Interchange Operational Analysis and Design Concepts Study (August 2009)*.

Design guidelines for the Arizona Parkway are intended to provide a higher level of service than an arterial street but less than a freeway facility. Basic cross-section elements and design guidelines for the typical urban parkway are summarized as follows:

- A 200-foot-wide minimum right-of-way is recommended. Additional right-of-way and/or easements may be needed for intersections, turn lanes, bus bays, drainage structures, drainage facilities, side slopes, utilities, and landscaping;
- Twelve-foot-wide lanes are recommended for the outside travel lanes;
- Fourteen-foot-wide lanes are recommended for the inside lanes adjacent to the median;
- A six-foot-wide bicycle lane is recommended adjacent to the outside travel lane;
- Curb, gutter, and a detached six-foot-wide sidewalk are recommended;
- Median width varies based on the number of lanes;
- Minimum design speeds are 50 miles per hour (mph) for rolling terrain and 55 mph for level terrain; and
- WB-50 is the recommended design vehicle.

Parkway typical cross-sections and layouts from the *Design Guideline Recommendations for the Arizona Parkway* are shown in **Appendix TM5-01**. The basic Northern Parkway and Tonopah Parkway design configuration will be a four-lane parkway, with the segment of Northern Parkway between Sun Valley Parkway and Turner Parkway ultimately becoming a six-lane parkway to accommodate projected traffic volumes per the *Proposed Laneage for Arizona Parkway Segments* exhibit provided by MAG (see **Appendix TM5-02**).

## 3.2 Crossing Features

There are a number of locations where major roadways, utilities, drainage washes, and other features will cross Northern Parkway and Tonopah Parkway that will require more detailed analyses during design. The following design considerations relate to these crossing features:

- Minimum right-of-way width for at-grade parkway-to-parkway intersections is 225 feet on each approach for a distance of 300 feet to accommodate dual right-turn lanes on both parkways;
- There are six anticipated at-grade parkway-to-parkway intersections within the project study area:
  - Tonopah Parkway/Camelback Parkway;
  - Tonopah Parkway/Northern Parkway;
  - Northern Parkway/Wintersburg Parkway;

  - Northern Parkway/Hidden Waters Parkway;
  - Northern Parkway/Sun Valley Parkway; and
  - Northern Parkway/Turner Parkway.

- The Arizona Department of Transportation (ADOT) *Freeway-to-Parkway Interchange Templates (October 2010)* publication contains guidelines and ten potential design templates for grade-separated freeway-to-parkway interchanges. For purposes of this study, the four templates that support the Arizona Parkway concept and its two-phase signal cycle are considered appropriate potential solutions for the two anticipated freeway-to-parkway interchanges within the study area at Tonopah Parkway/I-10 (existing freeway) and at Northern Parkway/Hassayampa Freeway (planned freeway). These four design templates are shown in **Appendix TM5-03**.
- A railroad grade separation will be required west of Wintersburg Parkway where Northern Parkway crosses a proposed new rail line;
- There are numerous washes throughout the project study area that will require pipe culverts, box culverts, or bridges, which may result in the need for additional right-of-way. For purposes of this study, pipe culverts are assumed to be needed where the peak 100-year flood drainage flows are less than 350 cubic feet per second (cfs), box culverts are assumed to be needed for flows between 350 cfs and 1,400 cfs, and bridges are assumed to be needed for flows greater than 1,400 cfs; and
- Grade-separated crossings within wildlife linkage zones should be considered to enhance wildlife movement through the area, where feasible.

### 3.3 Access Management Guidelines

To preserve the operating efficiency of the parkway facilities, a higher level of access management than what is applied to arterial streets is recommended. Because MCDOT will not have operational control over all parkway facilities, it will be up to the agencies with jurisdiction over the roadway to apply and enforce access management policies. The following are recommended as minimum access management guidelines (per the *Design Guideline Recommendations for the Arizona Parkway*) that may be supplemented by the responsible agency with jurisdiction over the roadway:

- Intersections (full median breaks) will preferably be restricted to one-mile spacing, with a minimum spacing of one-half mile, and are only recommended where intersecting with parkway, arterial, or major collector streets;
- Left turns in any direction are prohibited at all intersections;
- Left turns from a side-street or driveway onto the parkway are prohibited;
- Left turns from the parkway to a cross-street or driveway are discouraged due to conflicts between u-turns and right turns;
- U-turn directional crossovers are recommended to be restricted to a maximum of eight per mile; and
- Recommended minimum driveway spacing is 165 feet for low-volume segments and 330 feet for high-volume segments. The typical driveway will be limited to right-in/right-out maneuvers.

# 4. PREFERRED ALIGNMENT IMPLEMENTATION

## 4.1 Detailed Preferred Alignment Drawings

The design considerations described previously were applied in developing the preferred alignment for Northern Parkway and Tonopah Parkway. Detailed preferred alignment drawings were then created that show the parkway centerlines and right-of-way limits at a scale of 1 inch = 200 feet. The detailed preferred alignment drawings are provided in **Appendix TM5-04**. The preferred alignment centerlines and right-of-way limits are subject to more detailed design work that may necessitate some adjustments as roadway profiles, drainage requirements, and land development plans are further defined.

In developing the detailed preferred alignment drawings, existing roadway centerlines, section lines, right-of-way lines, and property lines were reviewed to determine the feasibility of following some or all of these lines to the greatest extent possible. At major roadway and drainage wash crossings along the parkways, additional right-of-way will likely be required that will expand the right-of-way limits beyond the basic 200-foot-wide parkway footprint. Areas that may potentially require additional right-of-way are noted in the detailed preferred alignment drawings as being subject to further study as land development and roadway improvement plans are further defined.

## 4.2 Planning-Level Construction Cost Estimates

Planning-level construction cost estimates were developed for the preferred Northern Parkway and Tonopah Parkway alignments. Because this study does not include preparation of an "engineered" roadway alignment and does not address detailed design issues for various features, the construction cost estimate was based on generalized unit costs. The planning-level unit cost estimates were applied to the Northern Parkway and Tonopah Parkway preferred alignment characteristics and are summarized in **Table 1**.

The estimated construction cost for Tonopah Parkway is $30 million and for Northern Parkway is $175 million, excluding the construction costs of a railroad overpass for the proposed new rail line west of Wintersburg Parkway and freeway-to-parkway interchanges at I-10 and the planned Hassayampa Freeway, which are subject to further study and design. Right-of-way acquisition and relocation expenses are also not included in the construction cost estimate because it is expected that much of the required right-of-way will be dedicated through the land development process.

A roadway construction unit cost estimate of $9.6 million per mile in 2011 dollars was used for the six-lane segment of Northern Parkway between Sun Valley Parkway and Turner Parkway. The unit cost for a six-lane parkway was developed for the *Turner Parkway Corridor Feasibility Study*, completed by MCDOT in 2010, and is utilized for this study with no inflation factors applied.

A roadway construction unit cost estimate of $7.4 million per mile in 2011 dollars was used for the four-lane parkway segments in the study area (i.e., Tonopah Parkway and Northern Parkway between Tonopah Parkway and Sun Valley Parkway). The unit cost for a four-lane parkway was developed by calculating the per-lane-mile cost of the six-lane parkway unit cost, multiplying it by the number of lanes in the four-lane parkway, and then applying a 15 percent increase to account for the loss of cost efficiency between a six-lane parkway and a four-lane parkway.

**Table 1 – Planning-Level Construction Cost Estimates**

| Facility Characteristic | Tonopah Parkway | Northern Parkway |
|---|---|---|
| 6-lane Parkway Segment Length (miles) | - | 2.0 |
| 4-lane Parkway Segment Length (miles) | 3.7 | 15.3 |
| Roadway Construction Cost (in millions) | $30 | $135 |
| Major Structural Elements Bridge Construction Cost (in millions) | | |
| Hassayampa River Bridge | - | $25 |
| Jackrabbit Wash Bridge | - | $15 |
| **Total Estimated Project Construction Cost (in millions)** | **$30** | **$175** |

*Notes:*

1) *The estimated roadway construction unit cost for a 6-lane parkway is $9.6 million per mile and for a 4-lane parkway is $7.4 million per mile. Per the Proposed Laneage for Arizona Parkway Segments exhibit provided by MAG, a 6-lane parkway will ultimately be needed on Northern Parkway between Sun Valley Parkway and Turner Parkway.*
2) *The estimated bridge construction unit cost is $150 per square foot of bridge.*
3) *Major structural elements do not include a railroad overpass for the proposed rail line west of Wintersburg Parkway and freeway-to-parkway interchanges at I-10 and the planned Hassayampa Freeway, which are subject to further study and design.*
4) *Estimated project costs are rounded to the nearest $5 million and are in 2011 dollars.*

The roadway construction unit cost excludes major structural elements for crossing features but does include 20 percent contingencies for addressing drainage requirements. To give a sense of the amount of required drainage facilities anticipated in the study area, the number of anticipated drainage crossings in the study area, along with their relative size and type, were estimated based off aerial photography and required flow capacities and are summarized in **Table 2**.

The major structural elements in the study area are anticipated to include new all-weather bridges over the Hassayampa River and Jackrabbit Wash along Northern Parkway. Bridge costs were developed by multiplying the anticipated area of each bridge (in square feet) by a bridge construction unit cost estimate of $150 per square foot. The unit cost for bridge construction was derived from typical bridge construction costs on other recently completed projects.

**Table 2 – Anticipated Drainage Crossings**

| Drainage Crossings | Tonopah Parkway | Northern Parkway |
|---|---|---|
| Small (pipe culverts) | 3 | 71 |
| Medium (box culverts) | 1 | 7 |
| Large (bridge) | 1 | 10 |
| **Total Drainage Crossings** | **5** | **88** |

*Notes:*

1) *Pipe culverts are assumed to be needed where the peak 100-year flood drainage flows are less than 350 cubic feet per second (cfs).*
2) *Box culverts are assumed to be needed for flows between 350 cfs and 1,400 cfs.*
3) *Bridges are assumed to be needed for flows greater than 1,400 cfs.*

## 4.3 Implementation Strategies

It is important to recognize that the *Northern Parkway/Tonopah Parkway CFS* is a long-range transportation planning study and is therefore the earliest phase of project development. This study is intended to identify the feasibility of constructing parkway facilities at some future date to accommodate traffic demands that will be associated with future land development within and in close proximity to the project study area.

No public funding is currently allocated for design, right-of-way acquisition, or construction of any elements of Northern Parkway and Tonopah Parkway. The recommended centerlines and right-of-way limits will be used to guide future planning efforts and ensure that subsequent land development proposals and transportation system plans are compatible with future construction of Northern Parkway and Tonopah Parkway. Some refinement and negotiation of the parkway centerlines and right-of way requirements may occur in later phases of the project as properties are developed and as transportation improvements are implemented.

The following are key issues captured during this study's stakeholder and public involvement process that should be taken into consideration as the recommendations of this study are carried forward into design and construction:

- *Developer Participation* – It is anticipated that land developers will participate in dedicating right-of-way and participating in project design and construction costs;
- *Funding Strategies* – Long-term funding strategies need to be developed that will assist in positioning the parkway corridors to take advantage of future funding opportunities. When and how much funding is needed will be dependent on when and where development occurs, how much developer participation happens, and what the detailed designs call for;
- *Access Management Strategies* – Access management strategies that are consistent with the Arizona Parkway design guidelines should be implemented to ensure the parkways provide efficient traffic flow, safe operations, and reasonable local land access;
- *Environmental Impacts* – Specific impacts on environmental features, such as natural resources, wildlife habitats, cultural and archaeological resources, noise mitigation, and air quality will require further evaluation during future project development. Wildlife

crossing features should be considered in the final project design where appropriate and feasible;

- *New Right-of-Way Requirements* – Final roadway configurations will need to be developed through a more detailed design process to determine exactly how much land will need to be acquired to accommodate the future parkways;
- *Landscaping Plans* – Final project design should specify the type of landscaping to be used;
- *Drainage Structures* – Bridges and culverts along the new roadways should be designed during subsequent design efforts that ensure that the roadways are designed to provide all-weather crossings during major storm events. Opportunities to create drainage structures that also accommodate wildlife movements across the parkways should be considered where appropriate and feasible;
- *Bicycle, Pedestrian, and Transit Access* – Future projects should be designed to accommodate alternative modes of travel and provide access to planned trails and neighborhoods in the area;
- *Coordination with Other Planned Transportation Facilities* – Implementation of the parkways should be coordinated with the implementation of other planned transportation facilities that intersect or impact the parkways (e.g., intersecting freeways, parkways, and arterials);
- *Corridor Traffic Management* –Intelligent Transportation Systems (ITS) should be implemented in conjunction with roadway construction to promote efficient traffic operations and management through the parkway corridors; and
- *Jurisdictional Coordination* – Implementation of corridor improvement, traffic management, and access management concepts should be coordinated among the responsible jurisdictions to ensure safe, seamless, and efficient transportation facilities.

### 4.4 Next Steps

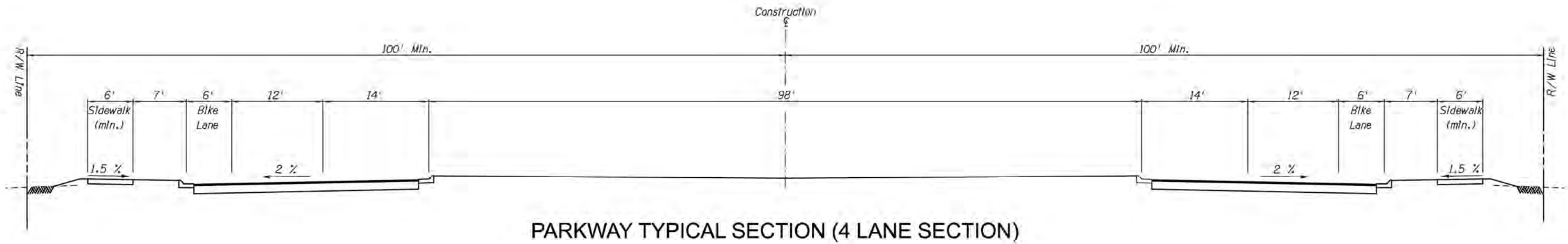
Agencies with primary responsibility for implementing the recommendations of this study are Maricopa County (Transportation, Planning, and Flood Control), Town of Buckeye, and ADOT. Among the critical long-range planning actions that need to commence are:

- Maricopa County and Town of Buckeye adoption of the Arizona Parkway designation and general preferred alignment for Northern Parkway and Tonopah Parkway;
- Right-of-way preservation in developing areas as needed to protect the long-term viability of the parkway facilities;
- Preparation of Design Concept Reports for consideration in project programming;
- Appropriation of funding for design, right-of-way acquisition, and construction as needed for joint participation with land developers; and
- Coordination among the jurisdictions and key stakeholders on planning, right-of-way preservation, and design.

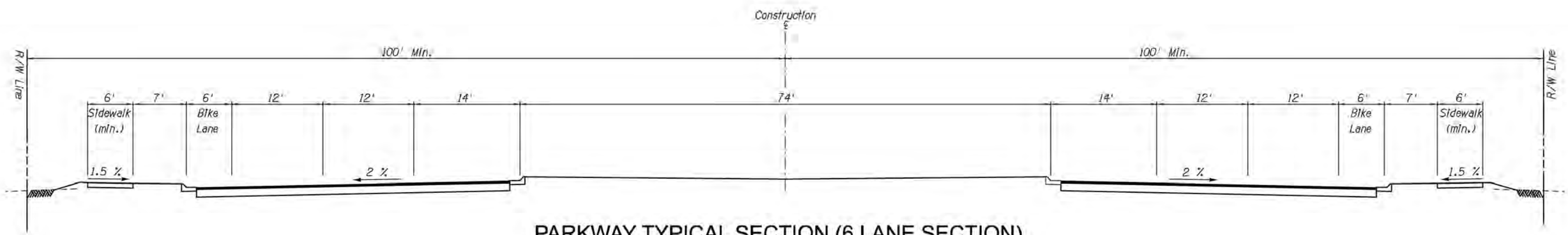
While implementation timing of Northern Parkway and Tonopah Parkway will be driven by land development, it is up to the public sector agencies to establish the transportation system planning framework now to be responsive to future land development interests while also protecting the broader long-term public interests.

# APPENDIX TM5-01

## ARIZONA PARKWAY CROSS-SECTIONS AND LAYOUTS

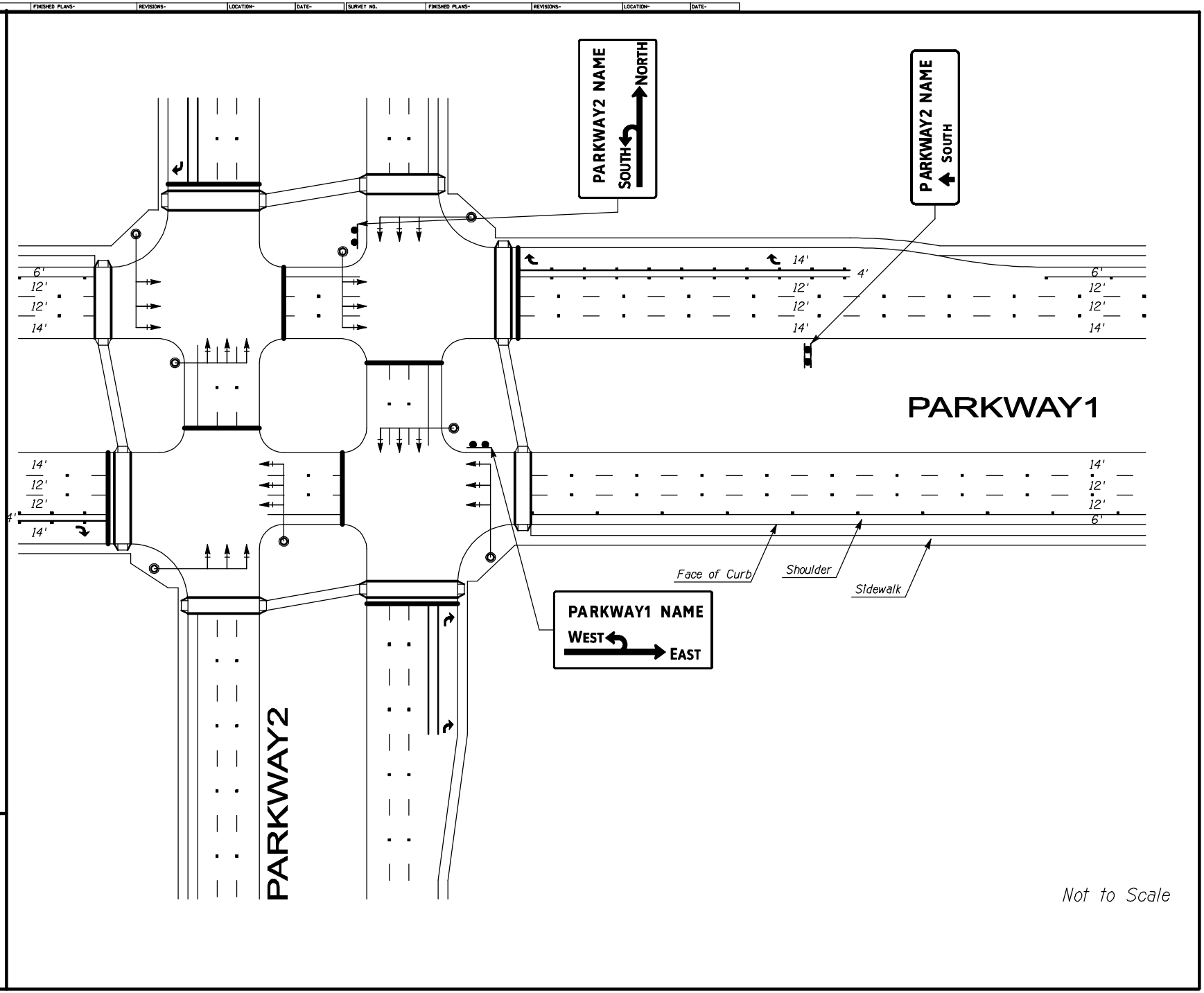



PARKWAY TYPICAL SECTION (4 LANE SECTION)




PARKWAY TYPICAL SECTION (6 LANE SECTION)

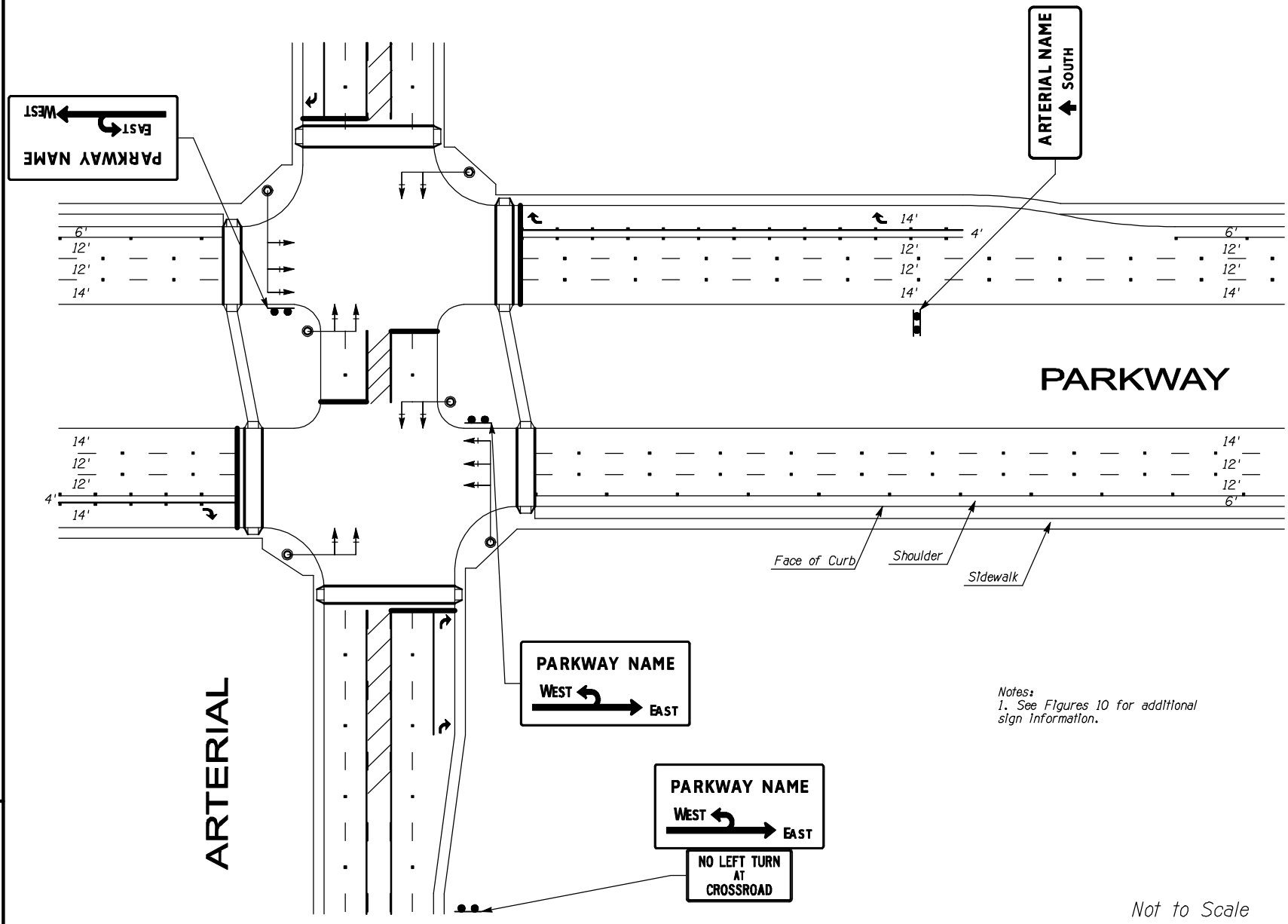
Source: Design Guideline Recommendations for the Arizona Parkway - MCDOT - August 2008




# FIGURE 18 - TYPICAL PARKWAY INTERSECTION



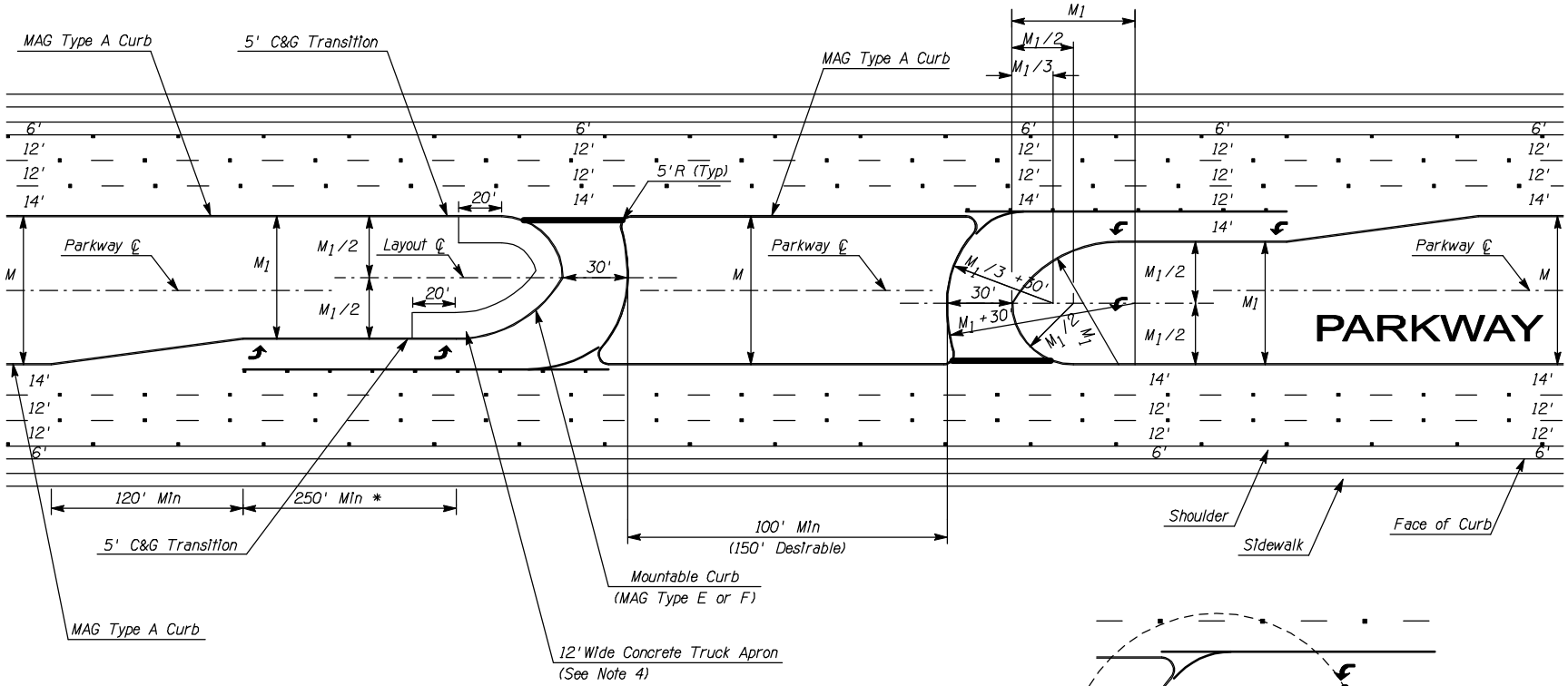
Source: Design Guideline Recommendations for the Arizona Parkway - MCDOT - August 2008

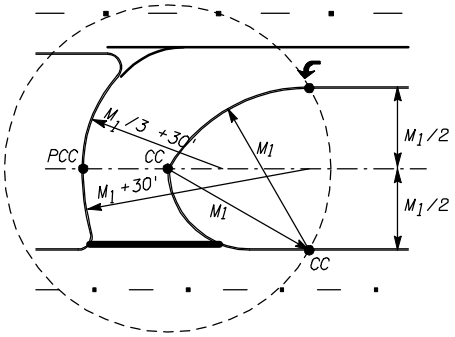



# FIGURE 17 - TYPICAL ARTERIAL INTERSECTION



Source: Design Guideline Recommendations for the Arizona Parkway - MCDOT - August 2008




Note:

1. Dimensions to Face of Curb
2. See Figure 2 and Table 1-1 regarding "M"
3. $M_1 = M - 12$
4. Pavement section to be determined by Geotechnical/Pavement Engineer. 10" PCCP over 4" AB typical.

* - LENGTH TO BE DETERMINED BY TRAFFIC ANALYSIS

Not to Scale

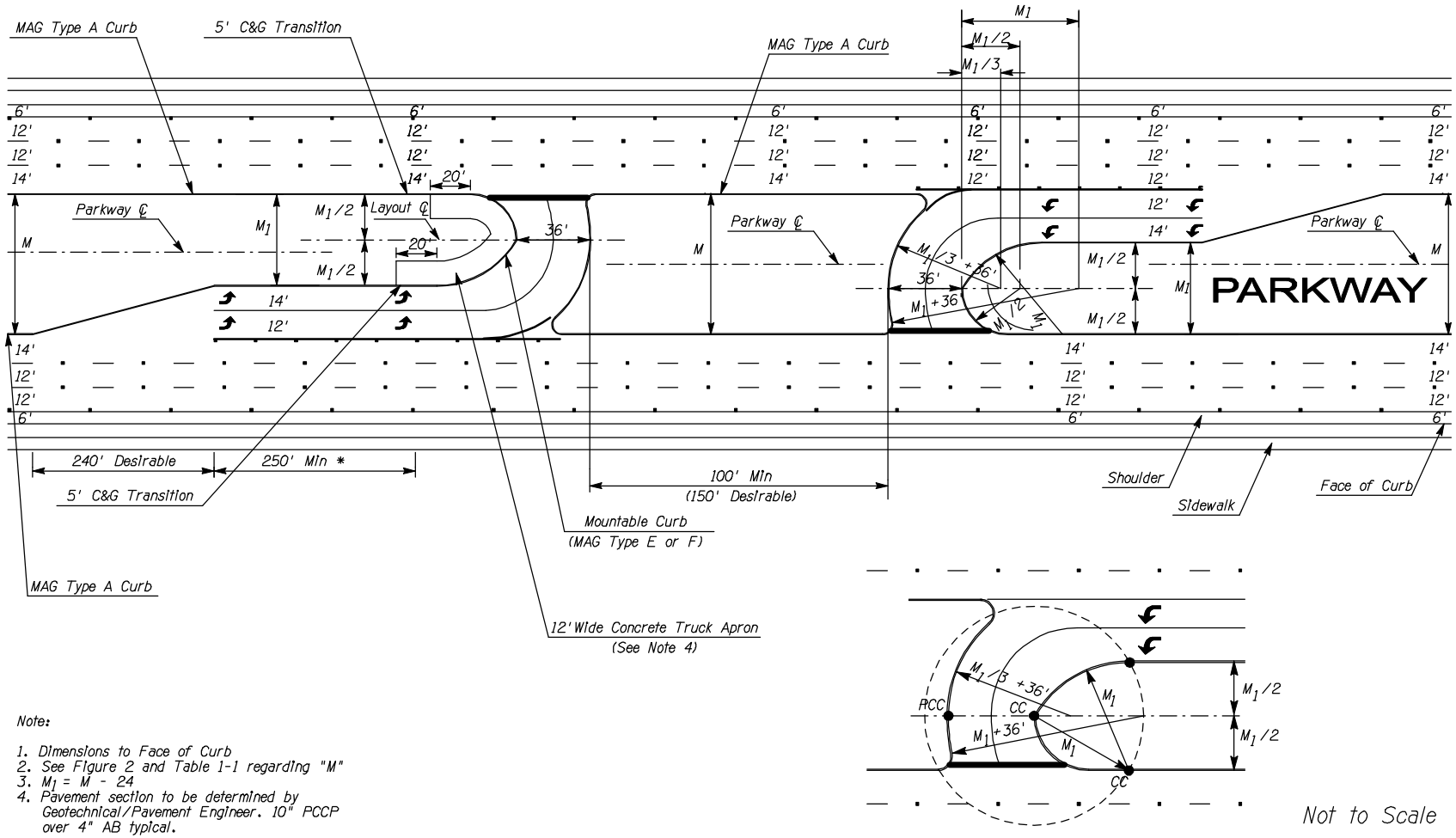
# GEOMETRICS FOR TYPICAL SINGLE-LANE DIRECTIONAL CROSSOVERS

DATE: 08/08

SHEET NO: S-3

DESIGN FILE: n:\60040833\Prod\civ\AppenGm05.dgn

Source: Design Guideline Recommendations for the Arizona Parkway - MCDOT - August 2008




Note:

1. Dimensions to Face of Curb
2. See Figure 2 and Table 1-1 regarding "M"
3. $M_1 = M - 24$
4. Pavement section to be determined by Geotechnical/Pavement Engineer. 10" PCCP over 4" AB typical.

# GEOMETRICS FOR TYPICAL DUAL-LANE DIRECTIONAL CROSSOVERS

DATE: 08/08

SHEET NO: S-4

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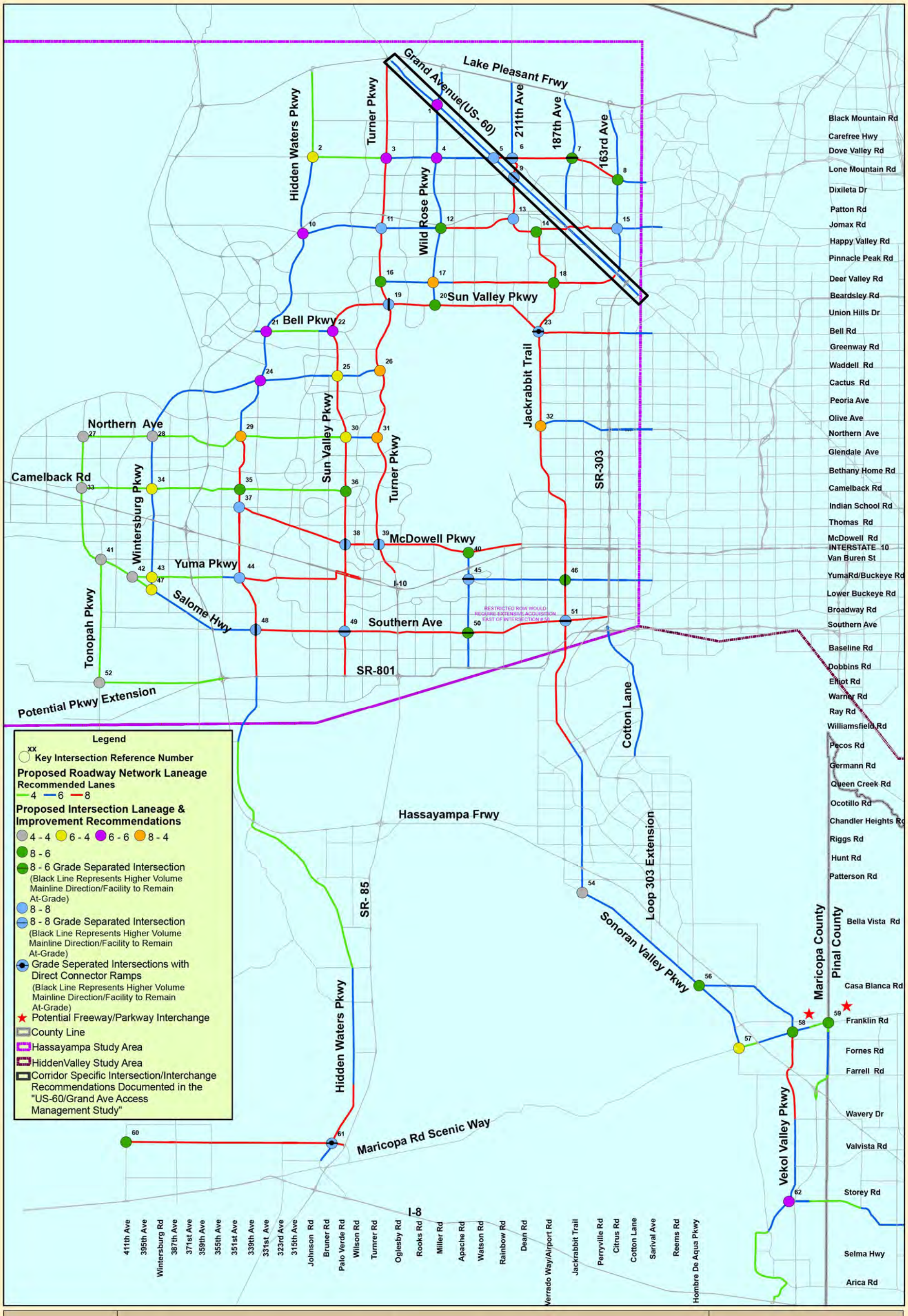
Source: Design Guideline Recommendations for the Arizona Parkway - MCDOT - August 2008

# APPENDIX TM5-02

## PROPOSED LANEAGE FOR ARIZONA PARKWAY SEGMENTS




Prepared by:
Wilson & Company,
Dated: 06/02/2009

**Proposed Laneage for Arizona Parkway Segments**
**&**
**Intersection/Interchange Improvement Recommendations**

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0 2 4 6 8 Miles

Source: Proposed Laneage for Arizona Parkway Segments & Intersection/Interchange Improvement Recommendations - MAG - June 2009

# APPENDIX TM5-03

## FREEWAY-TO-PARKWAY TEMPLATES

## Figure 3.1 Interchange Template 1: Diamond Interchange - No Left Turn from Arizona Parkway

This template is based on the design of a standard diamond interchange. The short spacing between ramp terminals would make it classified as a *tight* or *compact* diamond interchange typical of urban areas. The ramp terminal spacing could be increased to a *spread* condition typical of rural areas.

This template differs from a standard diamond interchange at the ramp terminal intersections as left turns from the Arizona Parkway onto the freeway ramps have been restricted. This restriction allows the signals to operate as two-phase signals (as shown in the signal phasing diagram). Traffic exiting the freeway would be allowed to make a direct left or right turn onto the Arizona Parkway. This setup makes the interchange relatively normal when considering driver expectancy for the freeway and Arizona Parkway facilities. Additionally, traffic exiting the freeway would be able to negotiate the interchange and continue on the freeway in the same or opposite directions with no major obstruction.

Each of the interchange ramp terminals would be signalized. The median u-turns immediately adjacent to the interchange could either be stop-controlled or signal-controlled, as determined by traffic needs. Because traffic from the freeway is able to make all turns, the signing for the ramps and Arizona Parkway would be relatively standard for each facility.

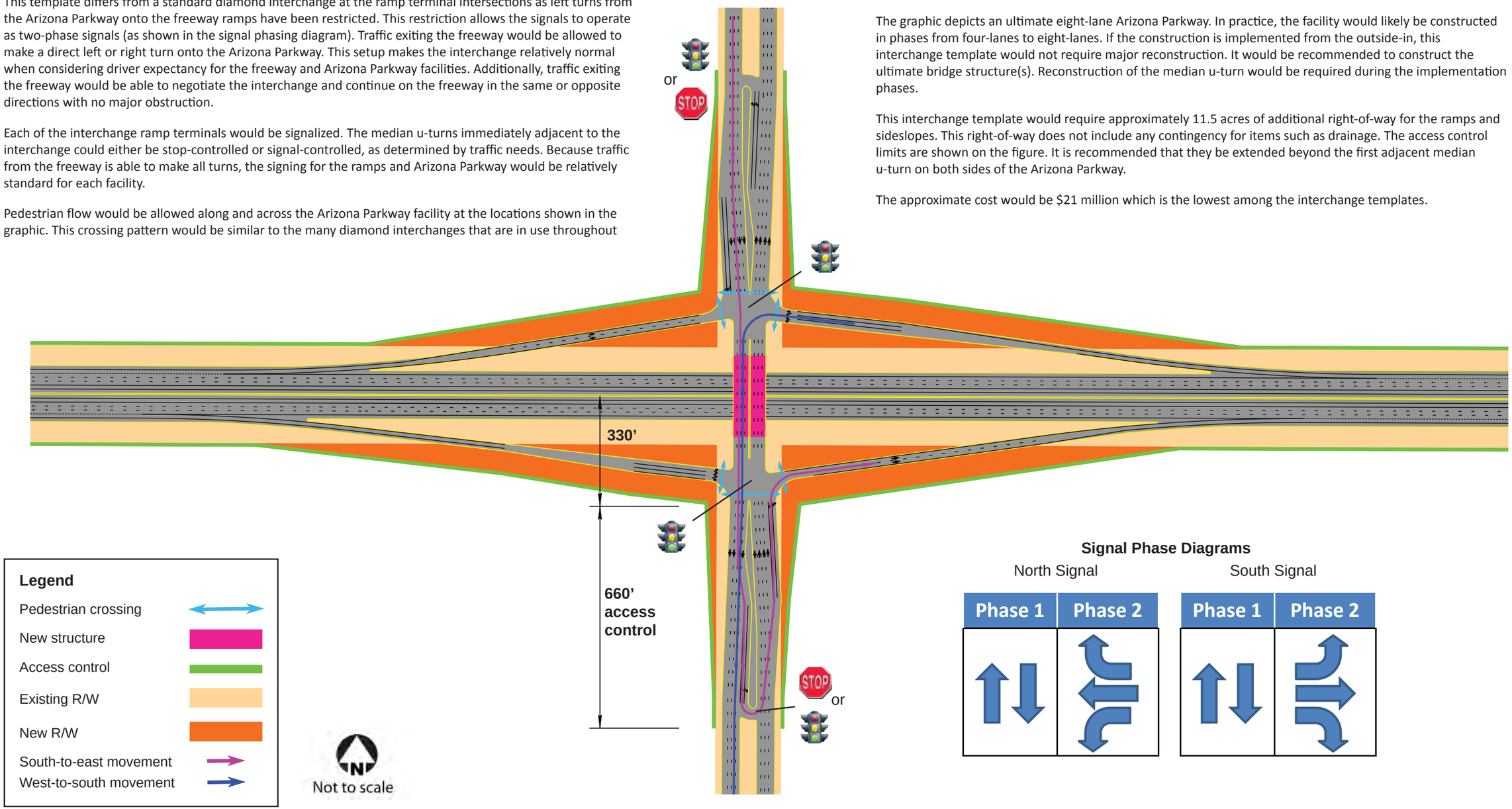
Pedestrian flow would be allowed along and across the Arizona Parkway facility at the locations shown in the graphic. This crossing pattern would be similar to the many diamond interchanges that are in use throughout Arizona. The movement across the Arizona Parkway could be enhanced by adding a right-turn island that would serve as a refuge for pedestrians and minimize the conflict with right-turning traffic.

The grade separation between the two facilities would require a single underpass bridge structure or two side-by-side overpass bridge structures. The underpass (as shown in the graphic) would be constructed as a two-span bridge while an overpass could be constructed as a single-span or two-span bridge.

The graphic depicts an ultimate eight-lane Arizona Parkway. In practice, the facility would likely be constructed in phases from four-lanes to eight-lanes. If the construction is implemented from the outside-in, this interchange template would not require major reconstruction. It would be recommended to construct the ultimate bridge structure(s). Reconstruction of the median u-turn would be required during the implementation phases.

This interchange template would require approximately 11.5 acres of additional right-of-way for the ramps and sideslopes. This right-of-way does not include any contingency for items such as drainage. The access control limits are shown on the figure. It is recommended that they be extended beyond the first adjacent median u-turn on both sides of the Arizona Parkway.

The approximate cost would be $21 million which is the lowest among the interchange templates.






Source: Freeway-to-Parkway Interchange Templates - ADOT - October 2010

## Figure 3.4 Interchange Template 4: SPUI - No Left Turn from Arizona Parkway

This template is based on the design of a standard SPUI. The ADOT *Roadway Design Guidelines* includes a section on the geometrics for the ramp and crossroad intersection associated with a SPUI that could be adapted to this configuration.

This template differs from a standard SPUI because the left turns from the Arizona Parkway onto the freeway ramps have been removed at the interchange. This restriction allows the signal to operate as a two-phase signal (as shown in the signal phasing diagram). Traffic exiting the freeway would be allowed to make a direct left or right turn onto the Arizona Parkway. However, it should be noted that the yield-controlled right-turn onto the Arizona Parkway would be in conflict with both phases of the signal. Therefore, turners would need to find gaps in the opposing traffic flow or use the outside lane (in the four-lane condition).

Overall, the interchange is relatively normal when considering driver expectancy for the freeway and Arizona Parkway facilities. Traffic exiting the freeway that wishes to continue along the freeway in the same direction would need to make a right-turn, followed by a u-turn to return to the interchange while traffic wishing to continue in the opposite direction would need to make a left turn, followed by a u-turn, to return to the interchange.

The interchange would be signalized. The median u-turns immediately adjacent to the interchange could either be stop-controlled or signal-controlled. Because traffic from the freeway is able to make all turns, the signing for the ramps and Arizona Parkway would be relatively standard for each facility.

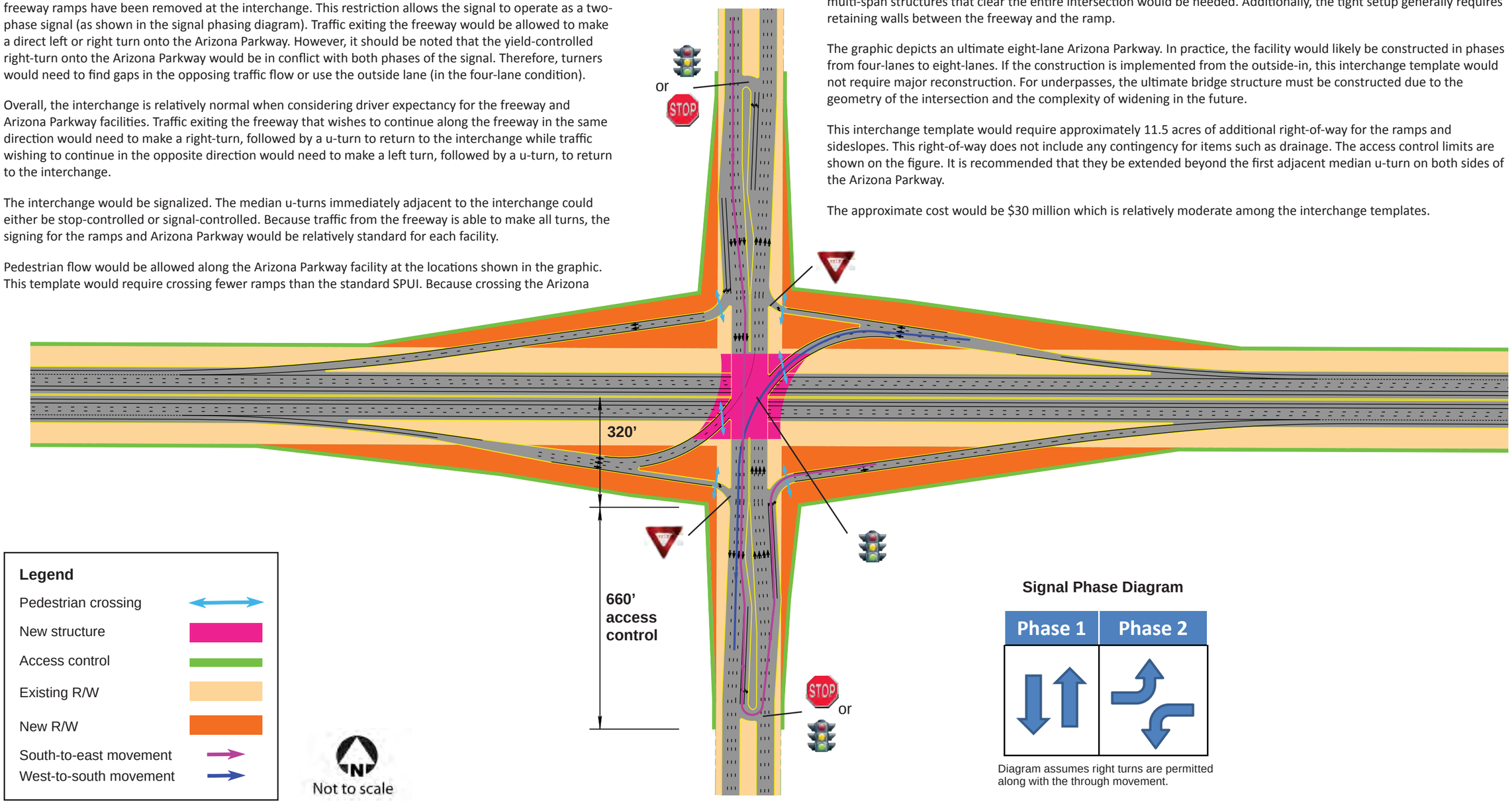
Pedestrian flow would be allowed along the Arizona Parkway facility at the locations shown in the graphic. This template would require crossing fewer ramps than the standard SPUI. Because crossing the Arizona Parkway is opposed by both phases at the interchange, a separate pedestrian phase of the signal would be needed to safely cross the Arizona Parkway at grade.

An underpass grade separation (as shown in the graphic) between the two facilities would require a single two-span bridge structure. This bridge structure would be relatively complex due to the asymmetrical ramps converging on the center of the interchange and the clear interchange area. With the freeway over the Arizona Parkway, a pair of single- or multi-span structures that clear the entire intersection would be needed. Additionally, the tight setup generally requires retaining walls between the freeway and the ramp.

The graphic depicts an ultimate eight-lane Arizona Parkway. In practice, the facility would likely be constructed in phases from four-lanes to eight-lanes. If the construction is implemented from the outside-in, this interchange template would not require major reconstruction. For underpasses, the ultimate bridge structure must be constructed due to the geometry of the intersection and the complexity of widening in the future.

This interchange template would require approximately 11.5 acres of additional right-of-way for the ramps and sideslopes. This right-of-way does not include any contingency for items such as drainage. The access control limits are shown on the figure. It is recommended that they be extended beyond the first adjacent median u-turn on both sides of the Arizona Parkway.

The approximate cost would be $30 million which is relatively moderate among the interchange templates.






Source: Freeway-to-Parkway Interchange Templates - ADOT - October 2010

## Figure 3.7 Interchange Template 7: Diverging Diamond Interchange

The diverging diamond interchange (DDI), also known as the double crossover diamond interchange, is a new interchange concept that includes a crossover on the Arizona Parkway facility in which the traffic moves to the left side of the road between the signalized ramp intersections. This allows drivers of vehicles on the Arizona Parkway who want to turn left onto the ramps the chance to continue to the ramps without conflicting with opposing through traffic and without stopping. The short spacing between ramp terminals would make it classified as a *tight* or *compact* interchange typical of urban areas. The first DDI interchange in operation in the United States is located in Springfield, Missouri, and there are several others in various stages of planning and construction. At this location, it has been observed that motorists generally use speeds 10 to 15 mph less than the speed limit as they travel through the crossover area.

The DDI design accommodates left-turning movements onto the freeway while eliminating the need for a left-turn signal phase at signalized ramp terminal intersections. The two signalized intersections at the crossover points operate with two phases (as shown in the signal phasing diagram), with each phase dedicated to the alternative opposing movements. The freeway ramp left-turn movements could be signal-controlled or yeild-controlled at the intersection with the Arizona Parkway facility. If signalized, all four would be operated in a coordinated system.

Since all movements are provided at the interchange, median u-turns adjacent to the interchange are not required. The signing of the interchange would be unique to this interchange type. Similarly, the traffic operations would not be familiar to drivers because this is not a common interchange. Traffic exiting the freeway that wishes to continue along the freeway in the same direction would need to make a right-turn, followed by a u-turn to return to the interchange, while traffic wishing to continue in the opposite direction could make a u-turn within the interchange.

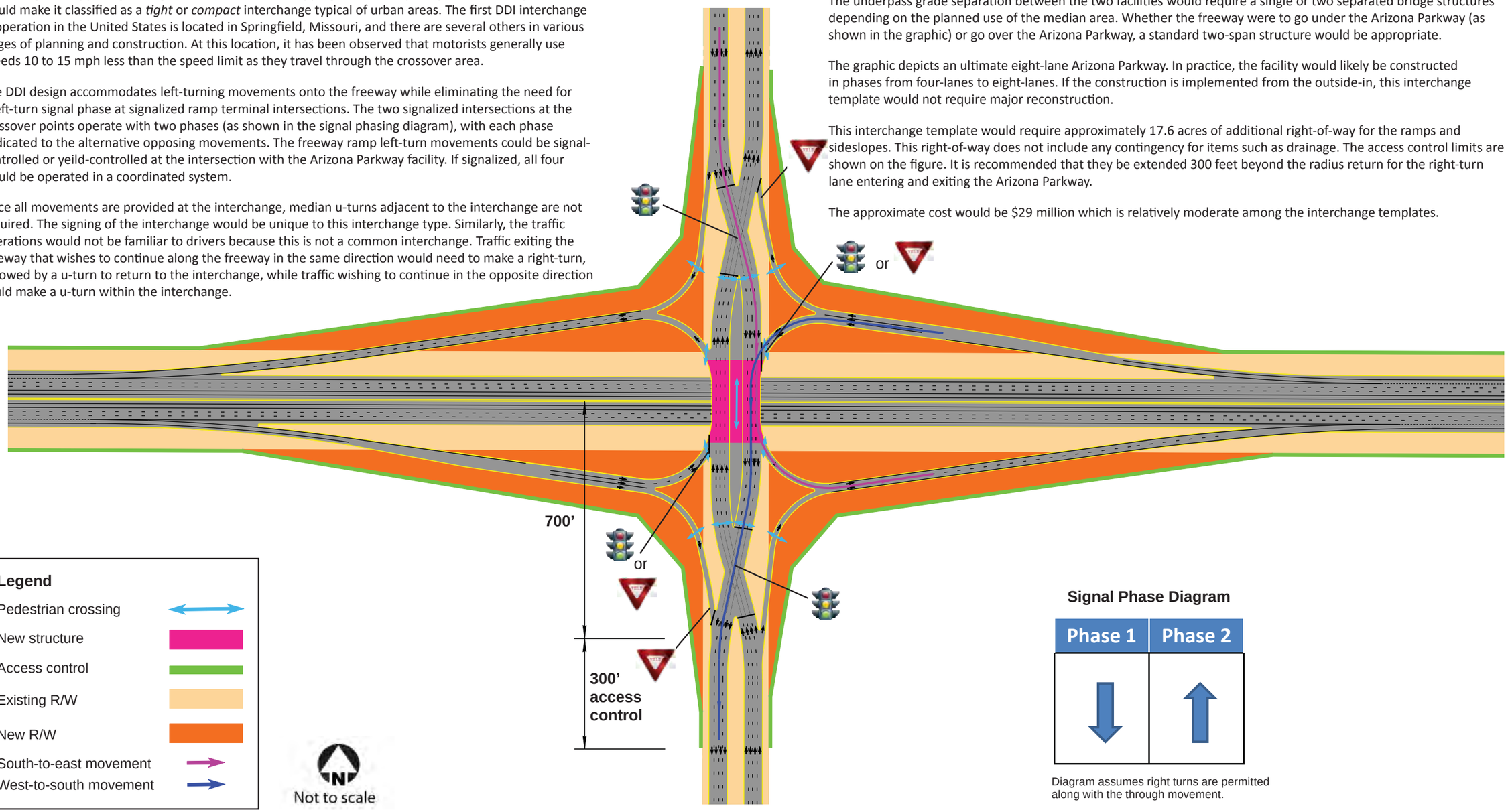
Pedestrian flow would be allowed along and across the Arizona Parkway facility at the locations shown in the graphic. The pedestrian flow along the Arizona Parkway could be accommodated in the median or on the outside of the travel lanes. The pedestrian flow across the Arizona Parkway would be made in stages as each through movement is stopped. Although some ramps would be signalized, thereby providing protection for pedestrian flow, most of them would be free-flow or yield-controlled. The proposed crossing pattern would be unique to this interchange type.

The underpass grade separation between the two facilities would require a single or two separated bridge structures depending on the planned use of the median area. Whether the freeway were to go under the Arizona Parkway (as shown in the graphic) or go over the Arizona Parkway, a standard two-span structure would be appropriate.

The graphic depicts an ultimate eight-lane Arizona Parkway. In practice, the facility would likely be constructed in phases from four-lanes to eight-lanes. If the construction is implemented from the outside-in, this interchange template would not require major reconstruction.

This interchange template would require approximately 17.6 acres of additional right-of-way for the ramps and sideslopes. This right-of-way does not include any contingency for items such as drainage. The access control limits are shown on the figure. It is recommended that they be extended 300 feet beyond the radius return for the right-turn lane entering and exiting the Arizona Parkway.

The approximate cost would be $29 million which is relatively moderate among the interchange templates.






Source: Freeway-to-Parkway Interchange Templates - ADOT - October 2010

## Figure 3.10 Interchange Template 10: Three-level Diamond Interchange

The three-level diamond interchange is an interchange concept that separates freeway, Arizona Parkway, and ramp traffic onto three grade separated levels. This allows the Arizona Parkway traffic to continue free-flow across the freeway. The traffic interacting between the Arizona Parkway and the freeway use ramps and a series of one-way platform roads to complete their movements. The size of the platform would be dependent on the storage lengths needed to meet the traffic demand.

The three levels can be ordered in any manner, but it is desirable to have the ramp traffic in the middle level to reduce the change in elevation between the platform roads and either the freeway or Arizona Parkway. There are variations or hybrids, such as a platform SPUI, that would operate in a similar manner.

The platform roads create four intersections. The four signalized intersections at the ramp terminals operate with two phases (as shown in the signal phasing diagram). All of the signals would be operated by a single controller.

Since all movements are provided at the interchange, median u-turns adjacent to the interchange are not required. The signing of the interchange would be unique to this interchange type, but would be similar to a diamond interchange. Traffic exiting the freeway that wishes to continue along the freeway in the same direction or the opposite direction could complete the movement using the platform roads.

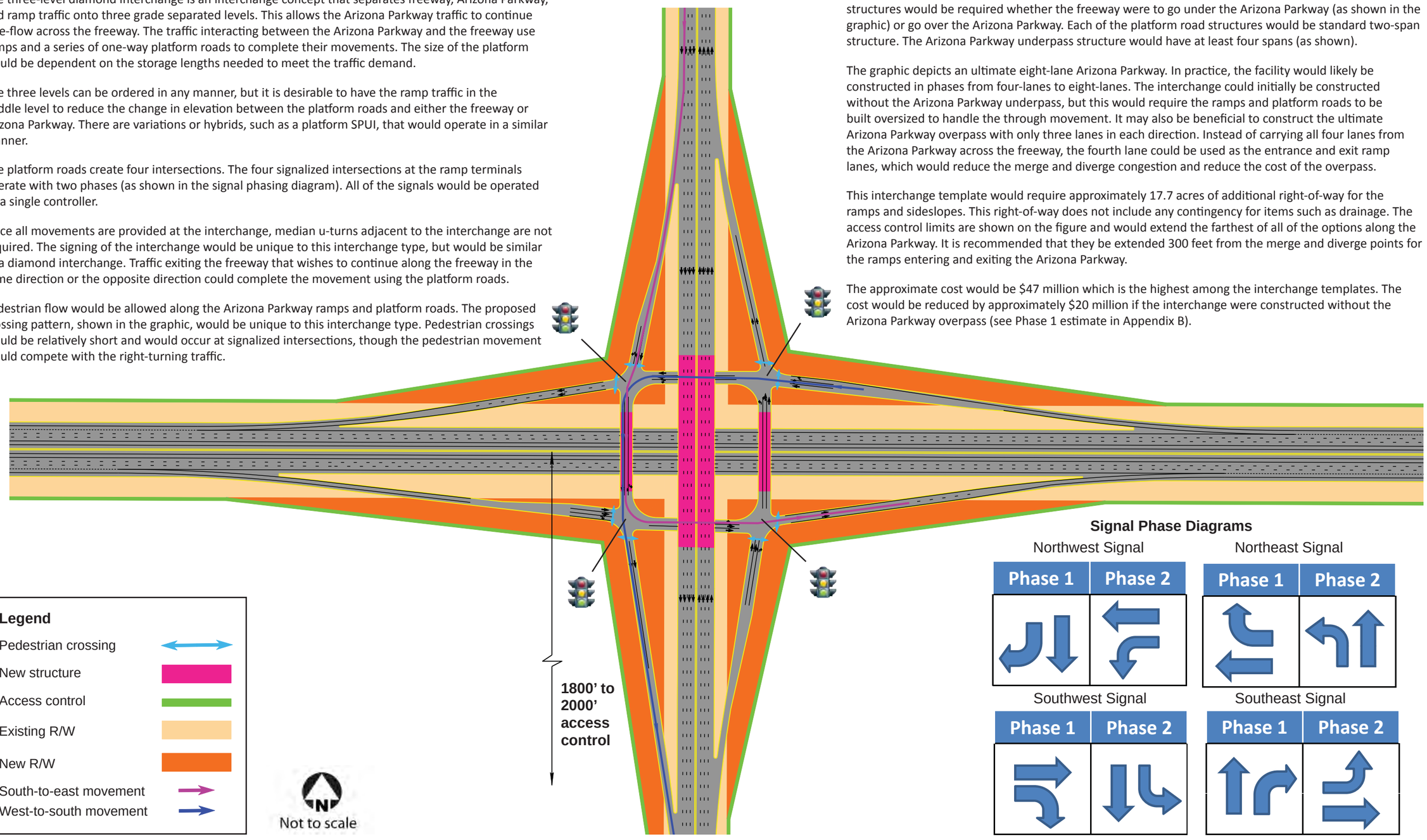
Pedestrian flow would be allowed along the Arizona Parkway ramps and platform roads. The proposed crossing pattern, shown in the graphic, would be unique to this interchange type. Pedestrian crossings would be relatively short and would occur at signalized intersections, though the pedestrian movement would compete with the right-turning traffic.

The interchange includes two structures to grade-separate the platform roads and the freeway and another structure to grade-separate the Arizona Parkway from the platform roads and the freeway. Three structures would be required whether the freeway were to go under the Arizona Parkway (as shown in the graphic) or go over the Arizona Parkway. Each of the platform road structures would be standard two-span structure. The Arizona Parkway underpass structure would have at least four spans (as shown).

The graphic depicts an ultimate eight-lane Arizona Parkway. In practice, the facility would likely be constructed in phases from four-lanes to eight-lanes. The interchange could initially be constructed without the Arizona Parkway underpass, but this would require the ramps and platform roads to be built oversized to handle the through movement. It may also be beneficial to construct the ultimate Arizona Parkway overpass with only three lanes in each direction. Instead of carrying all four lanes from the Arizona Parkway across the freeway, the fourth lane could be used as the entrance and exit ramp lanes, which would reduce the merge and diverge congestion and reduce the cost of the overpass.

This interchange template would require approximately 17.7 acres of additional right-of-way for the ramps and sideslopes. This right-of-way does not include any contingency for items such as drainage. The access control limits are shown on the figure and would extend the farthest of all of the options along the Arizona Parkway. It is recommended that they be extended 300 feet from the merge and diverge points for the ramps entering and exiting the Arizona Parkway.

The approximate cost would be $47 million which is the highest among the interchange templates. The cost would be reduced by approximately $20 million if the interchange were constructed without the Arizona Parkway overpass (see Phase 1 estimate in Appendix B).

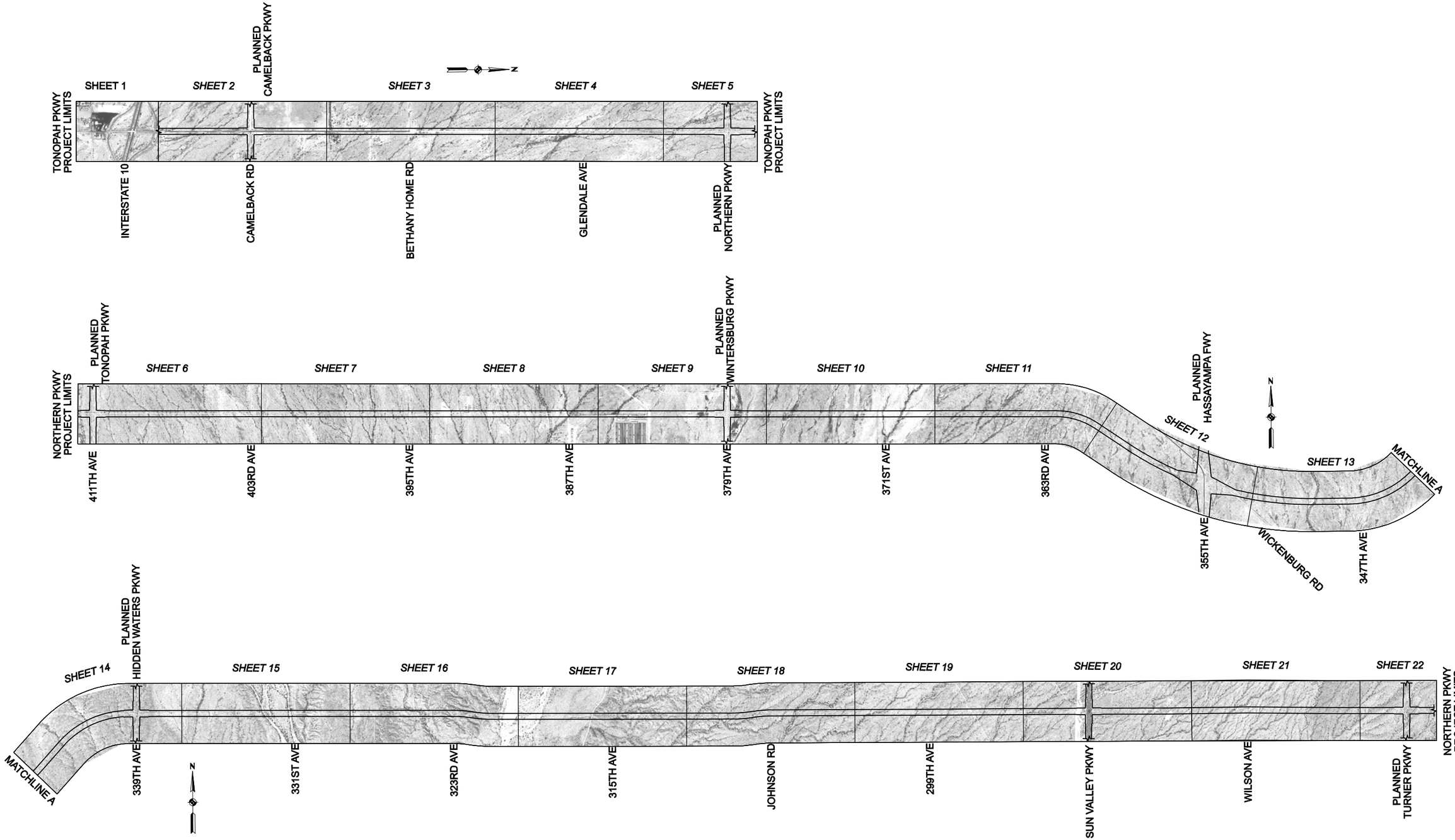





Source: Freeway-to-Parkway Interchange Templates - ADOT - October 2010

# APPENDIX TM5-04

## DETAILED PREFERRED ALIGNMENT DRAWINGS

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# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE RIGHT-OF-WAY CORRIDOR

KEY MAP

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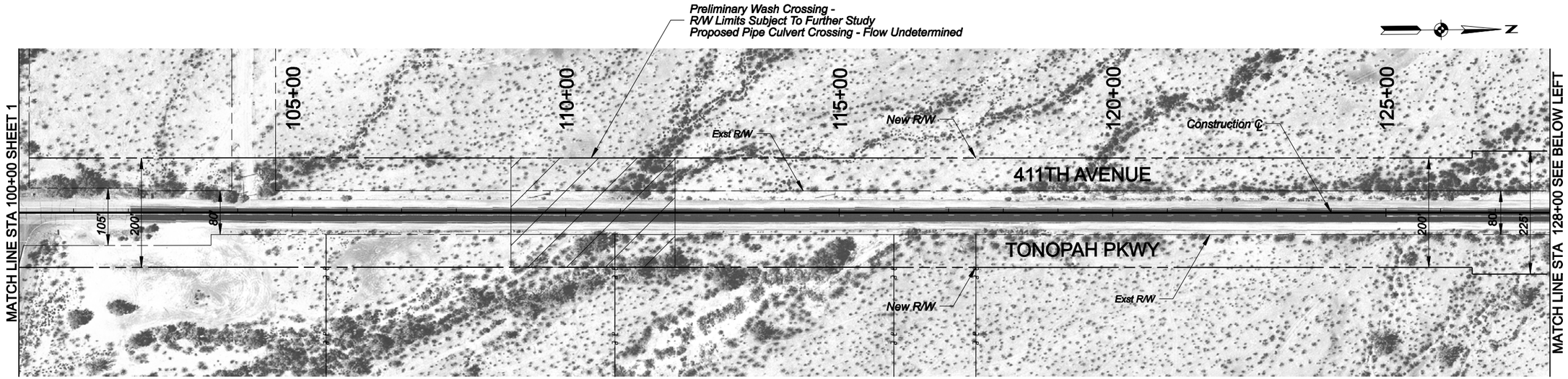


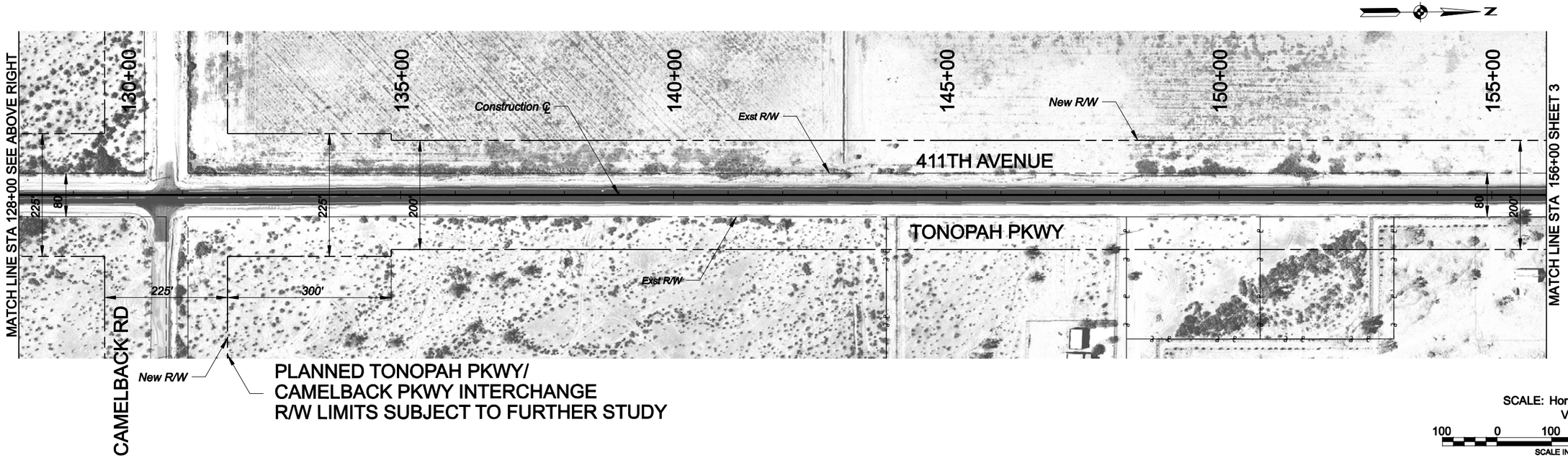


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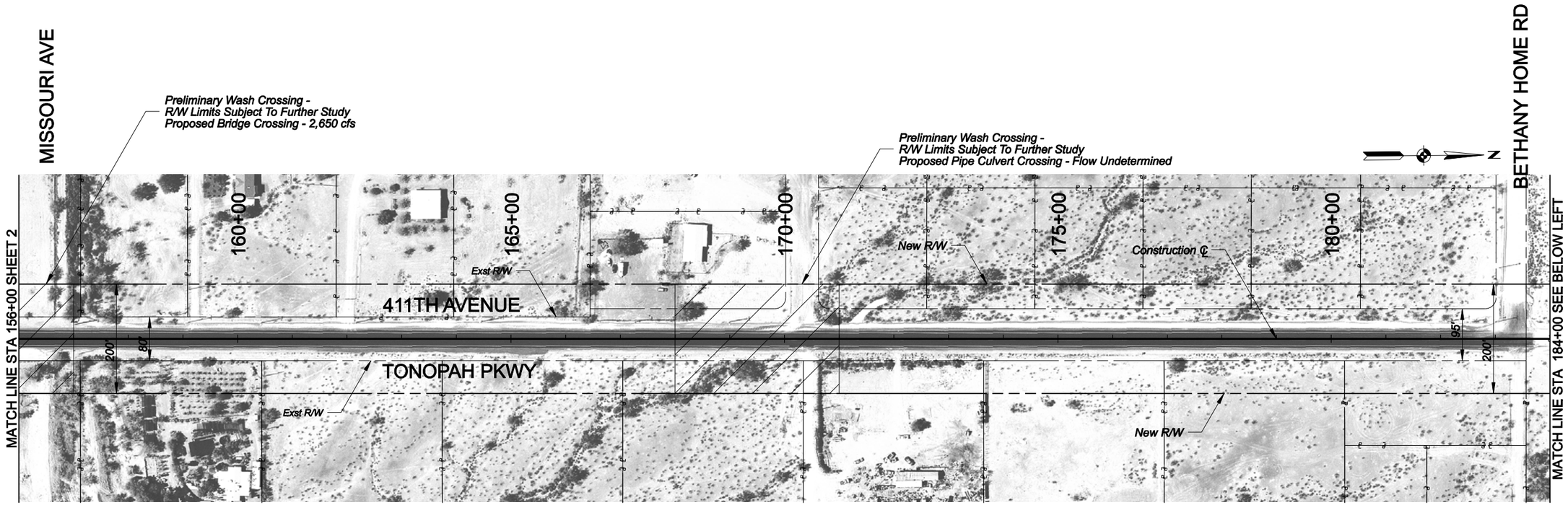


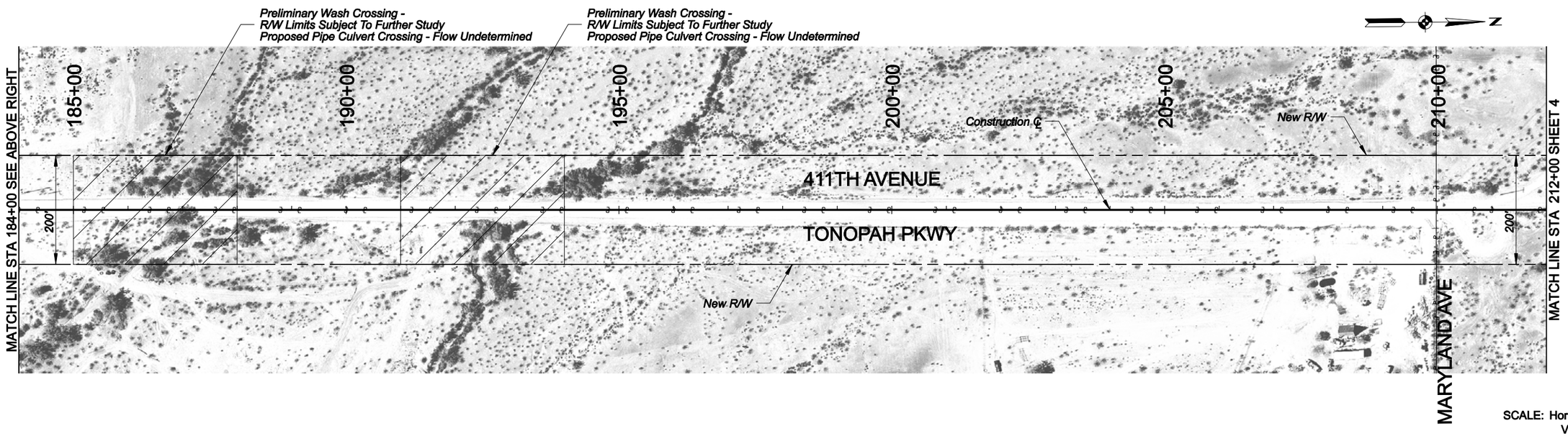


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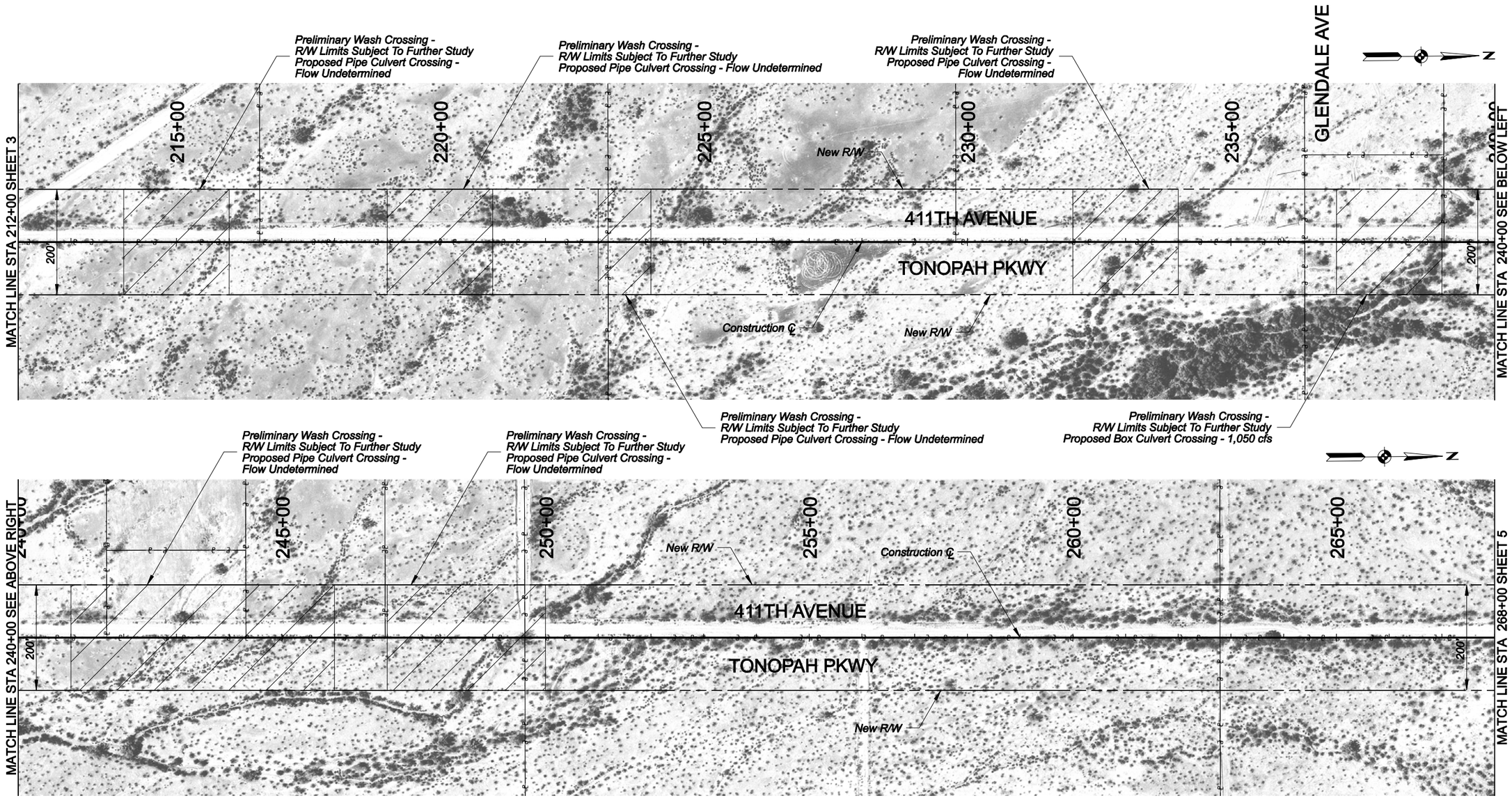


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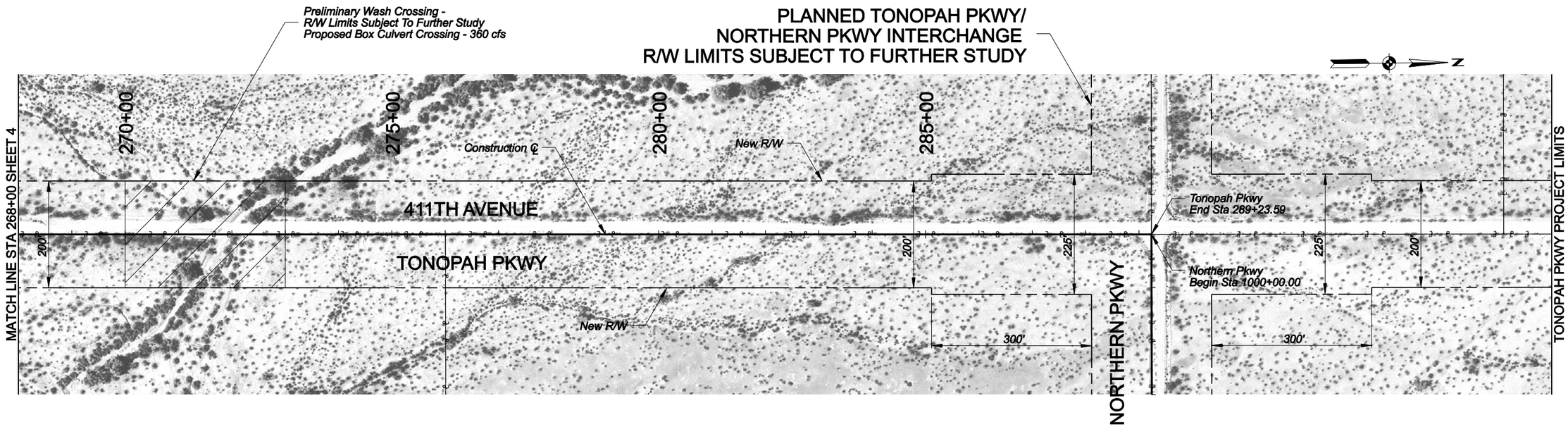


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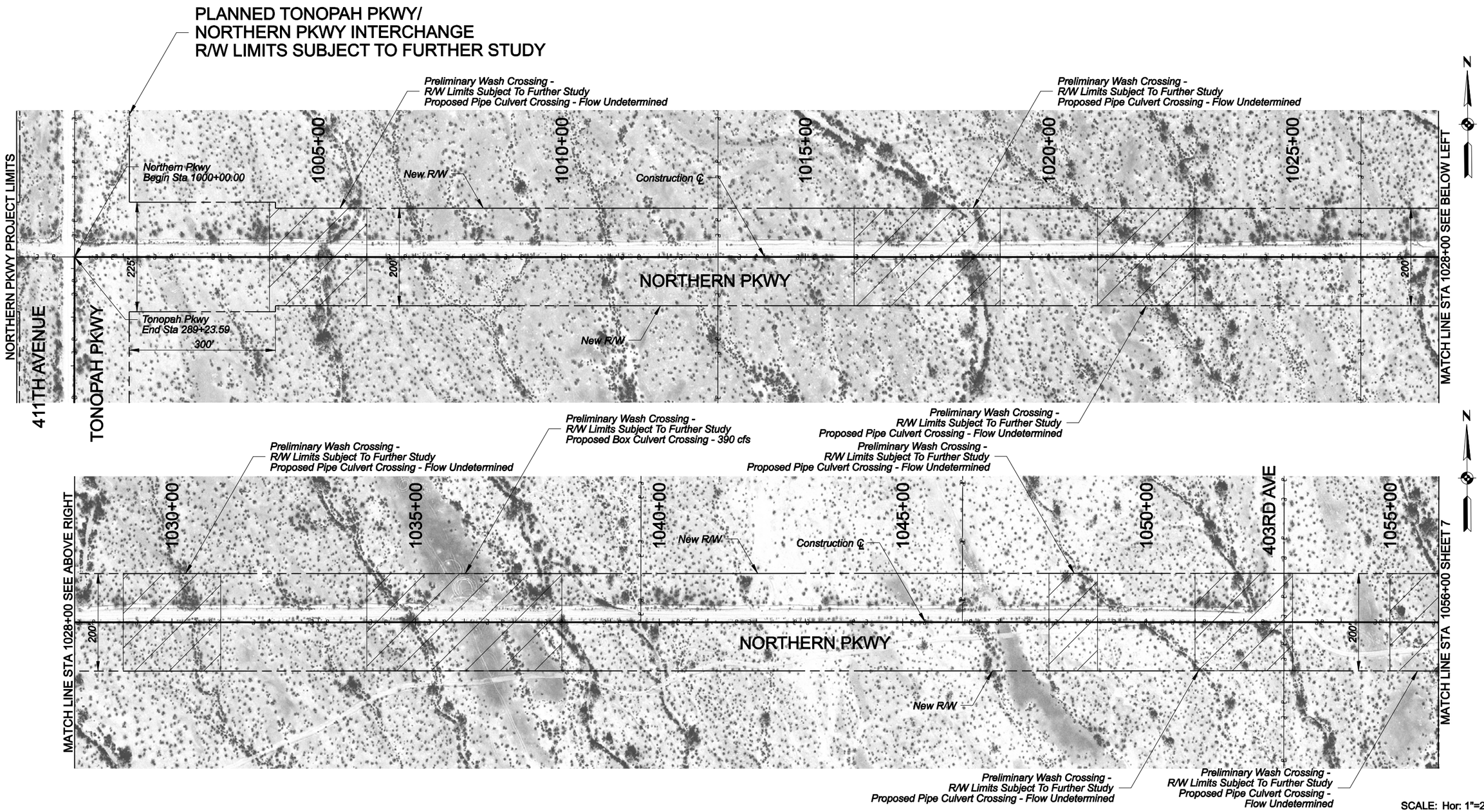


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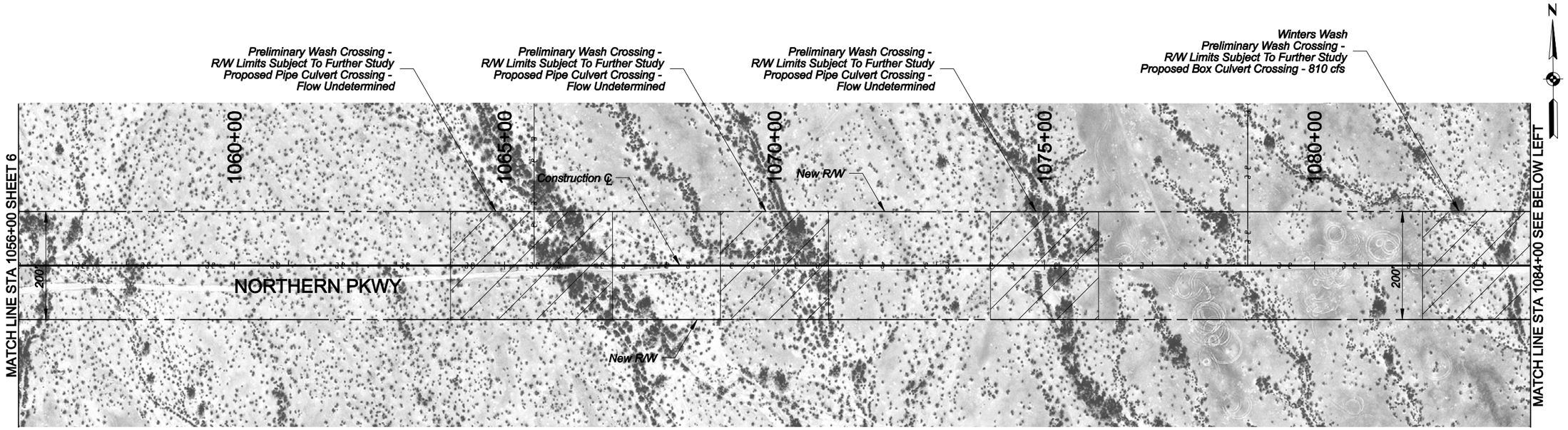


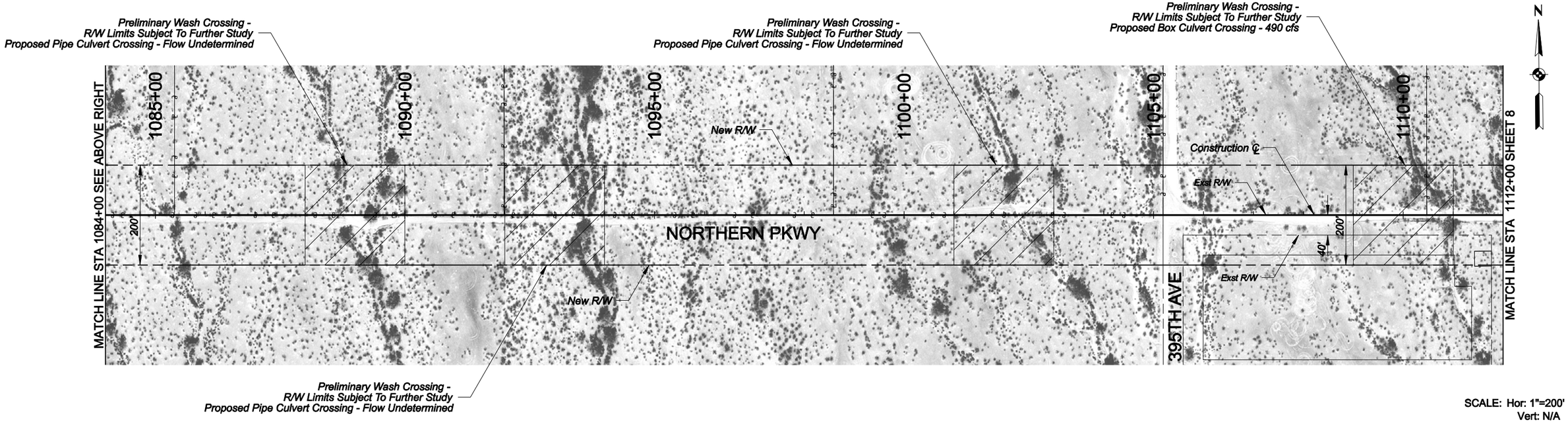


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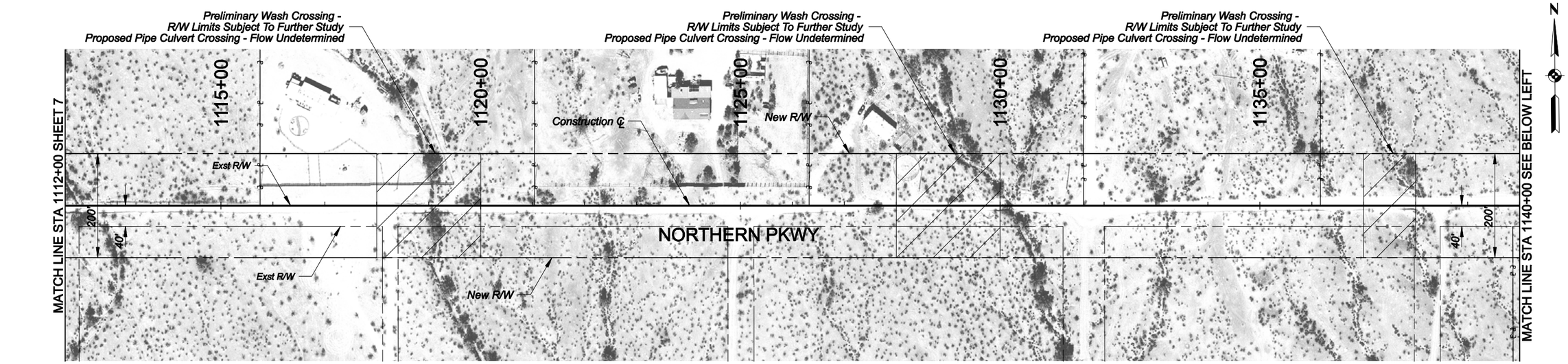


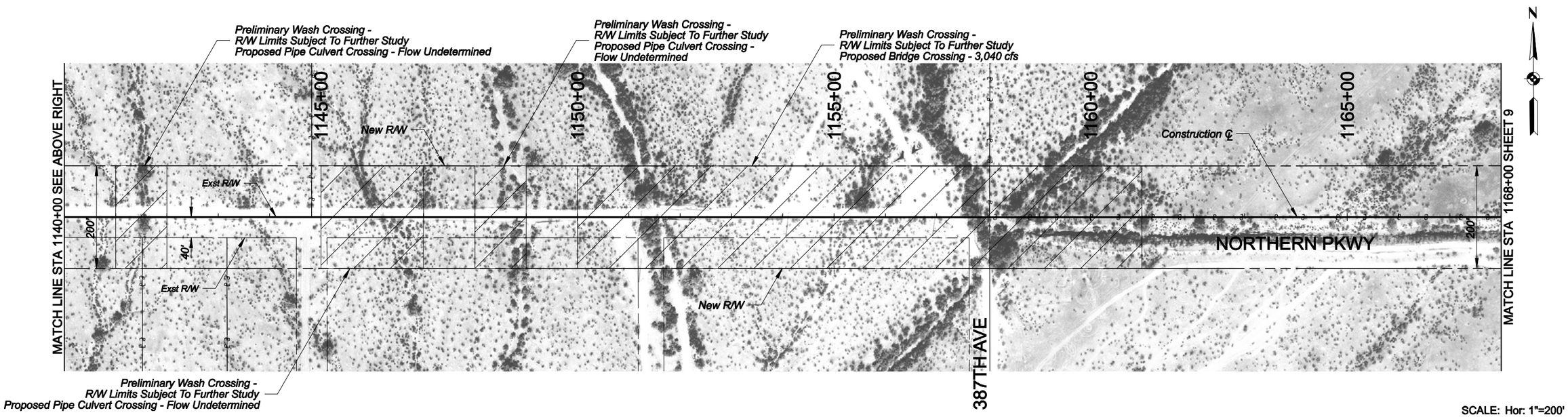


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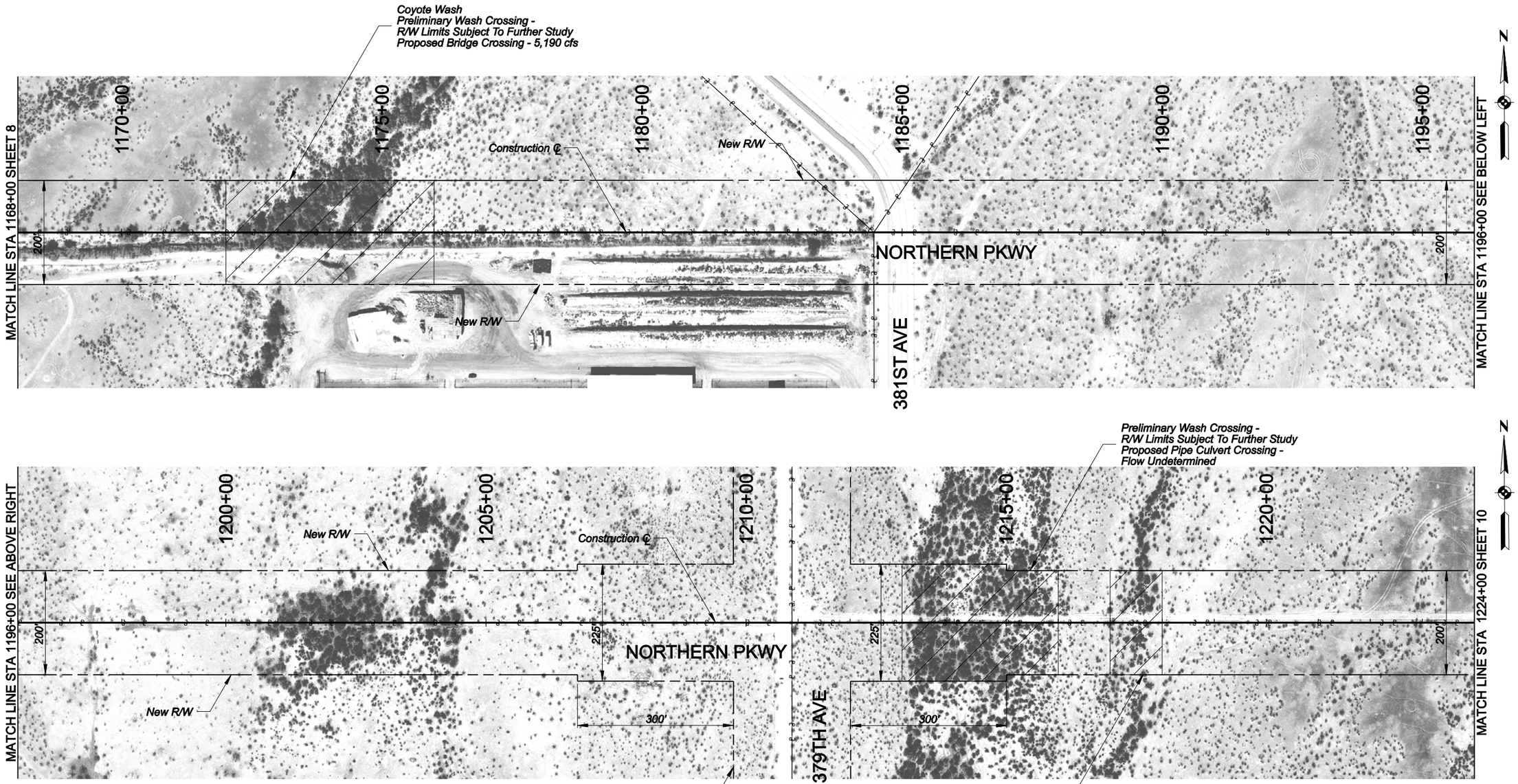


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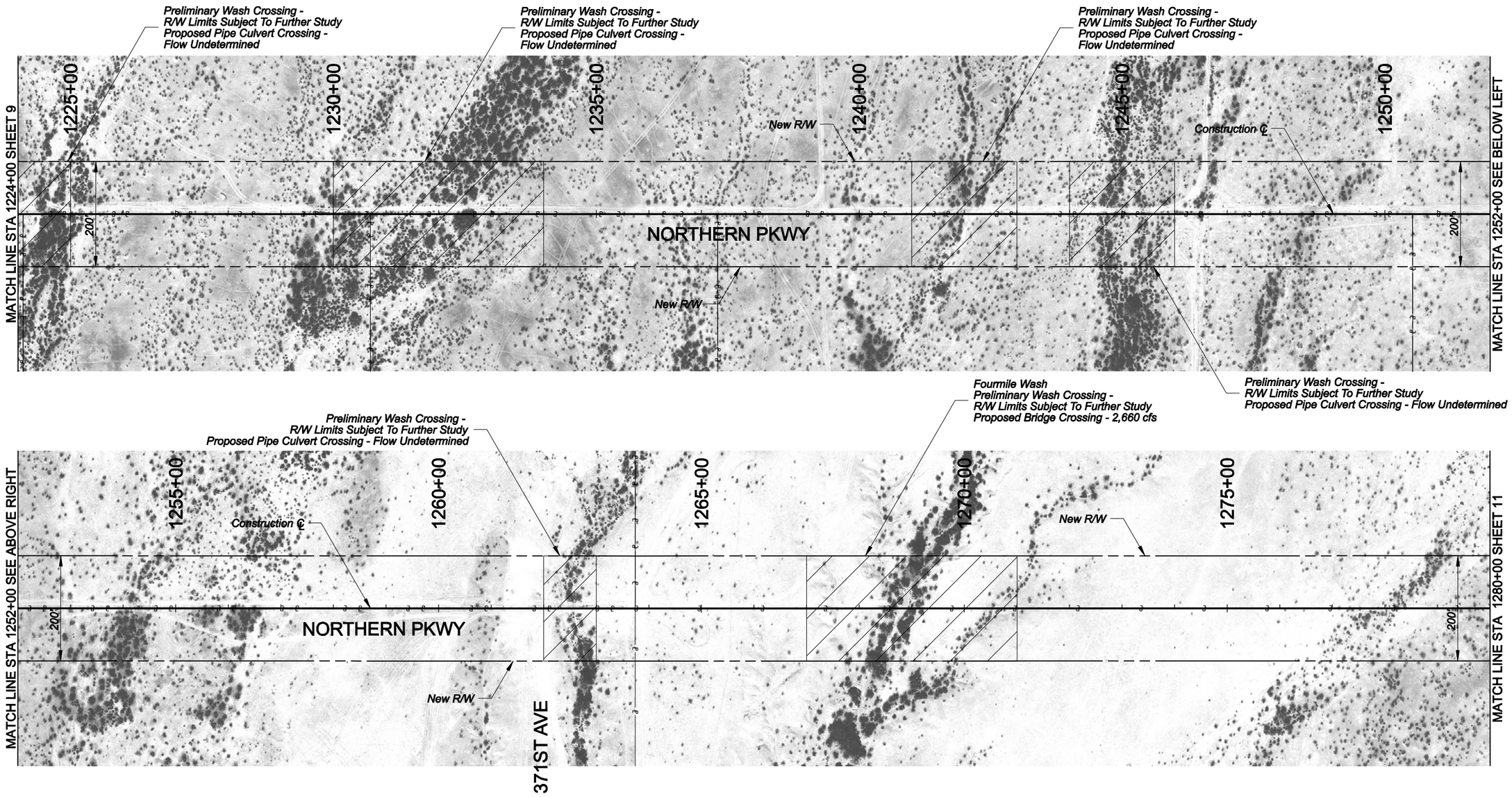


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DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE RIGHT-OF-WAY CORRIDOR

SHEET 10 OF 22

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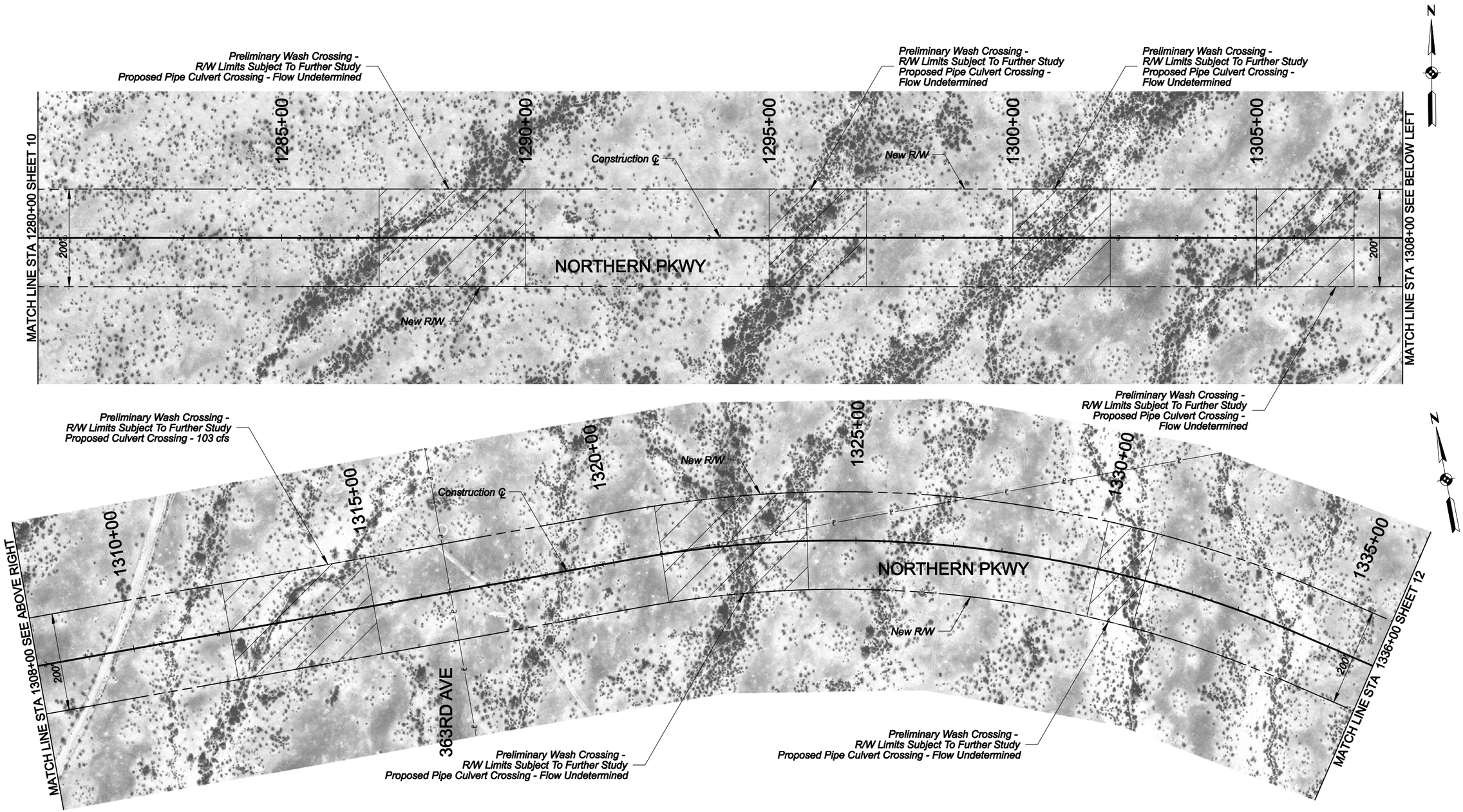


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

SHEET 11 OF 22

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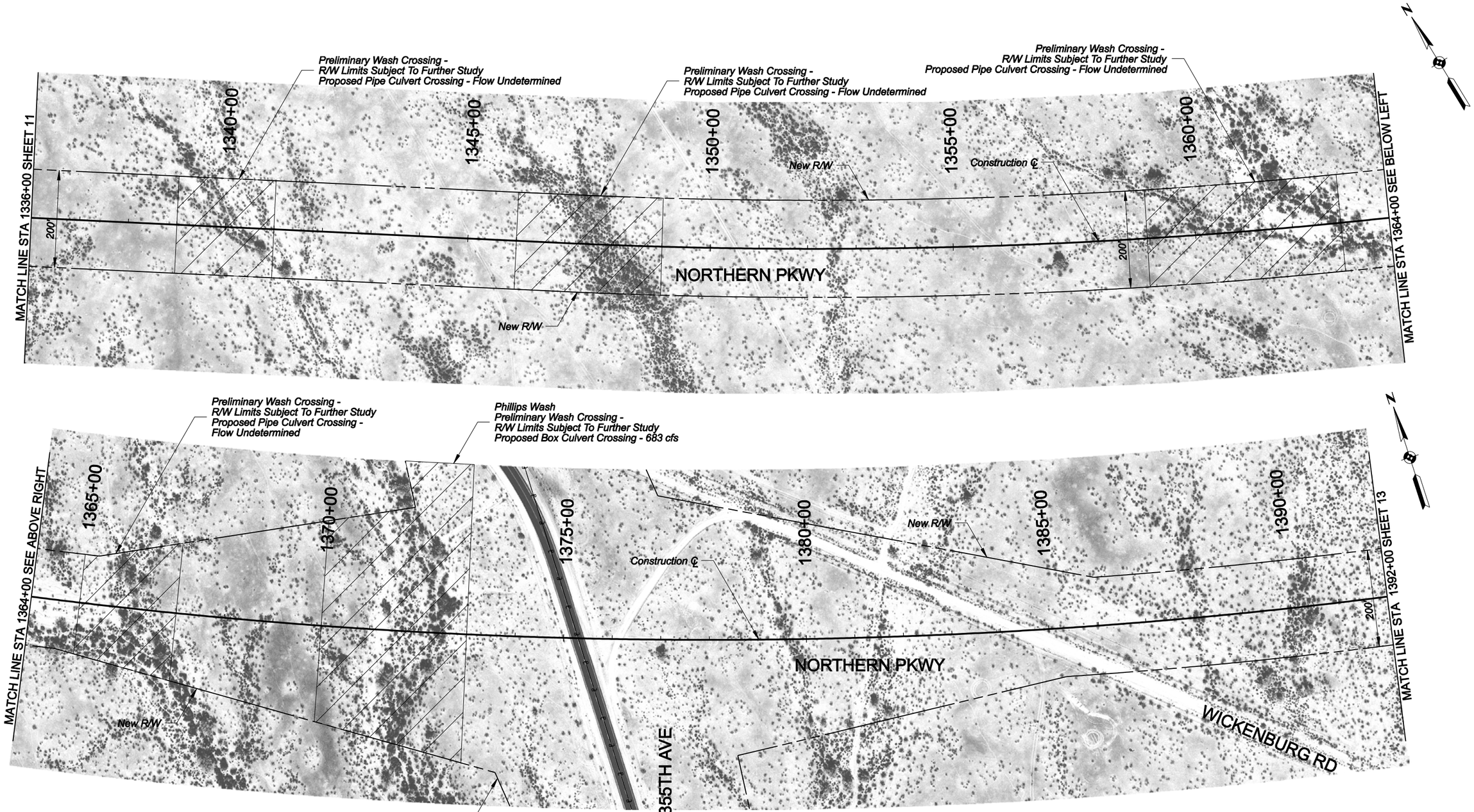


MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

SHEET 12 OF 22

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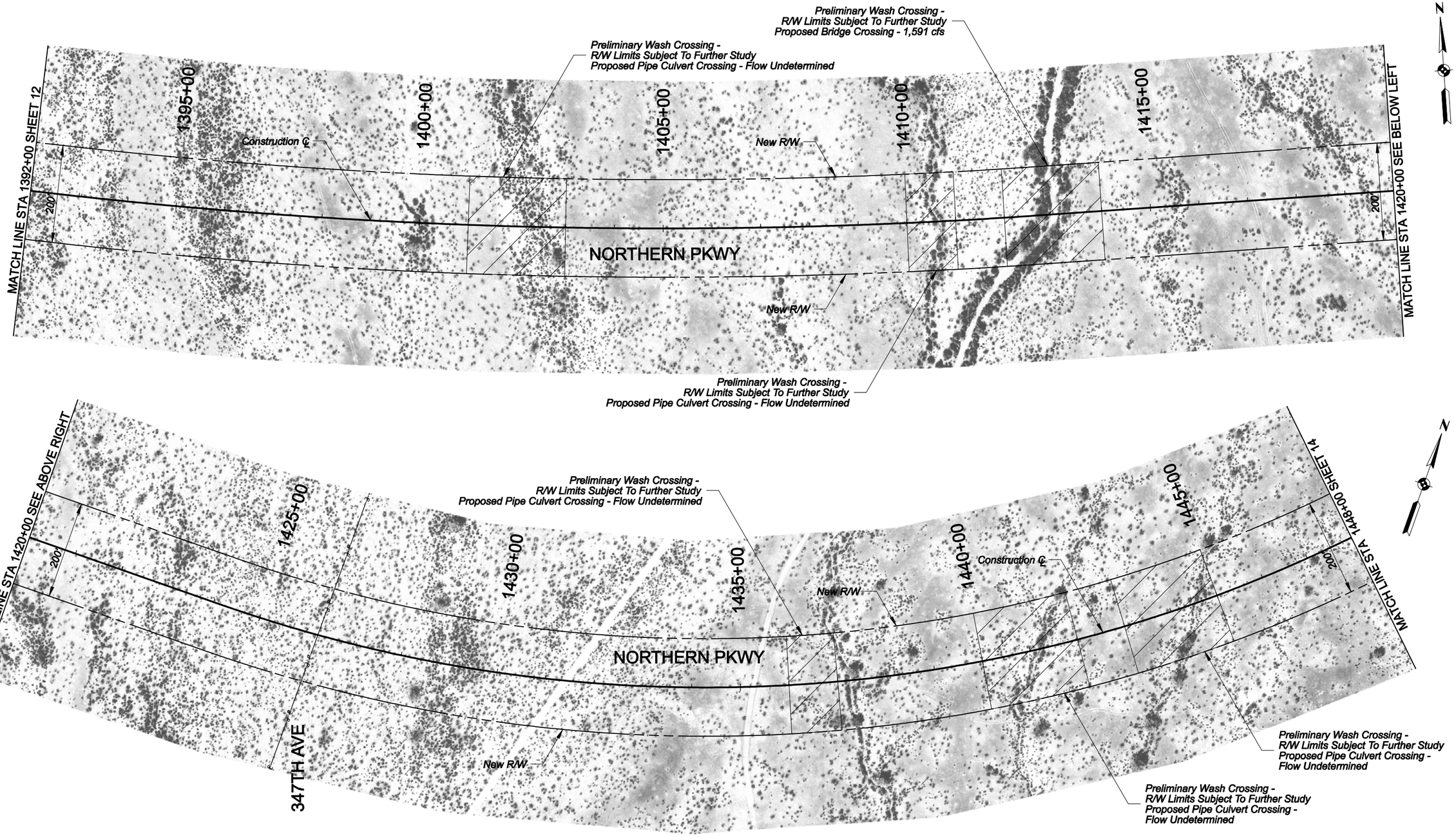


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

SHEET 13 OF 22

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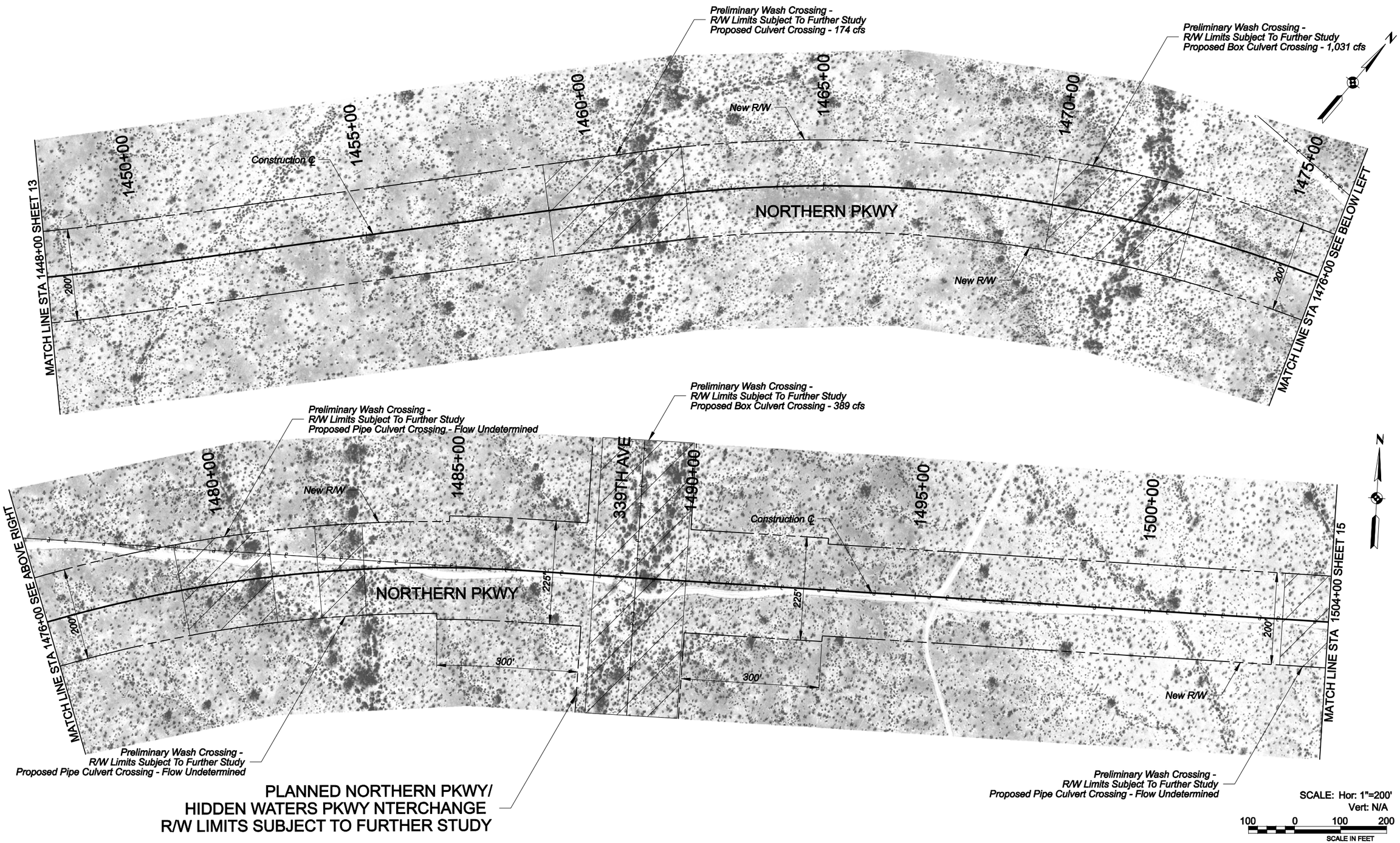


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

NORTHERN PARKWAY / TONOPAH PARKWAY
CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

SHEET 14 OF 22

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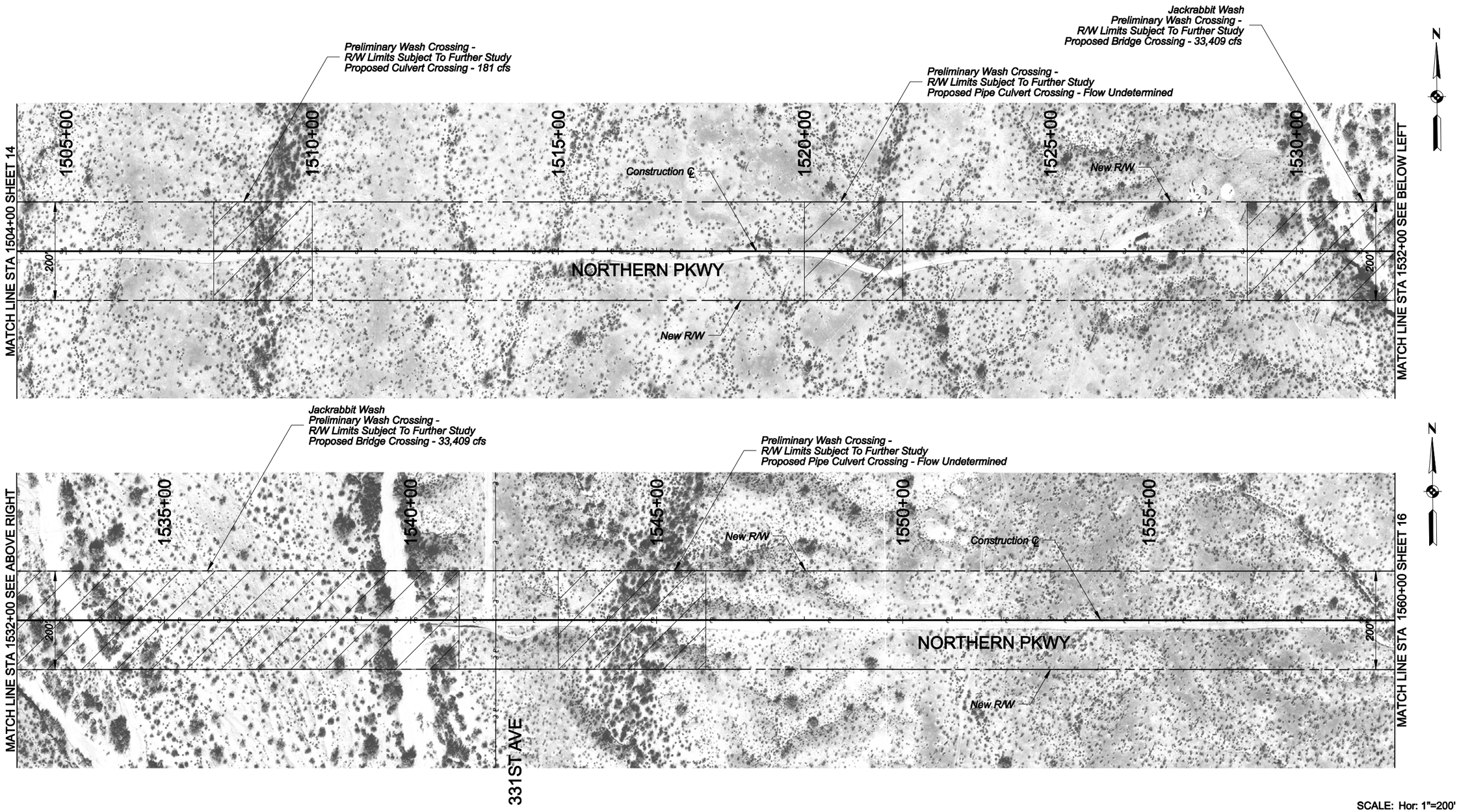


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

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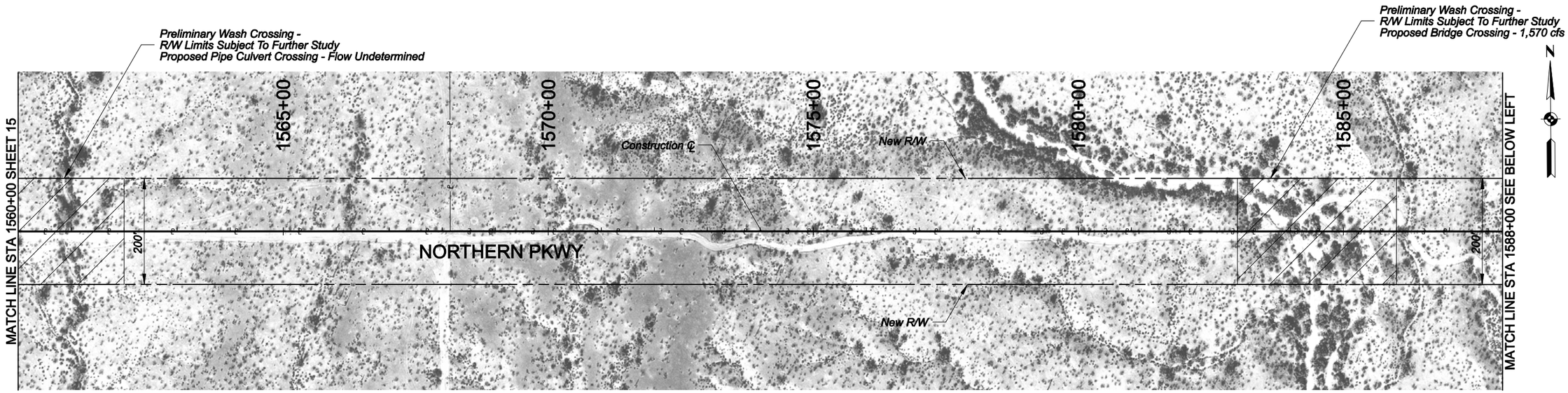


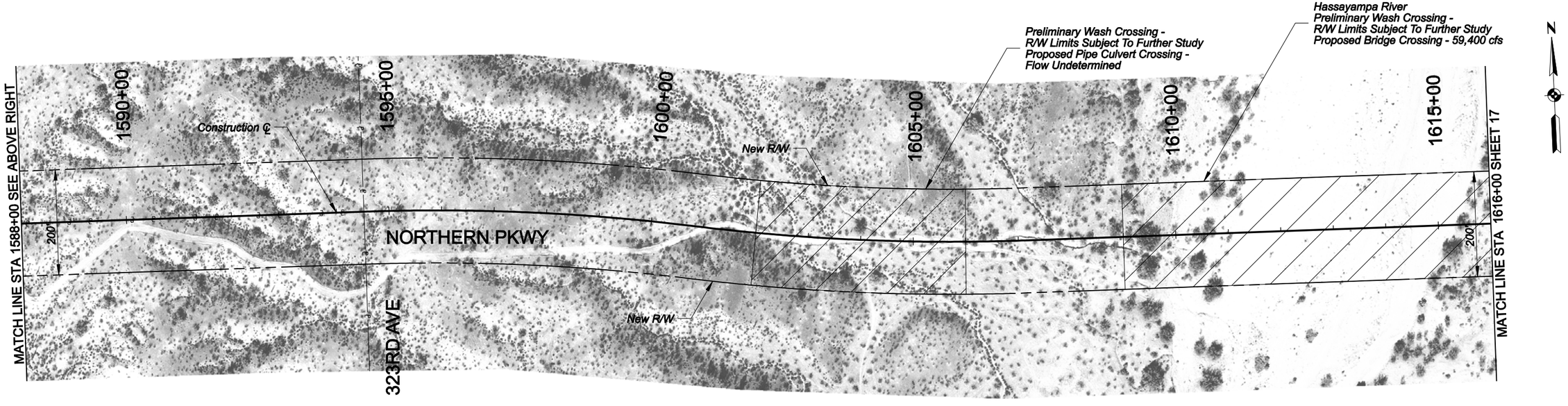


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

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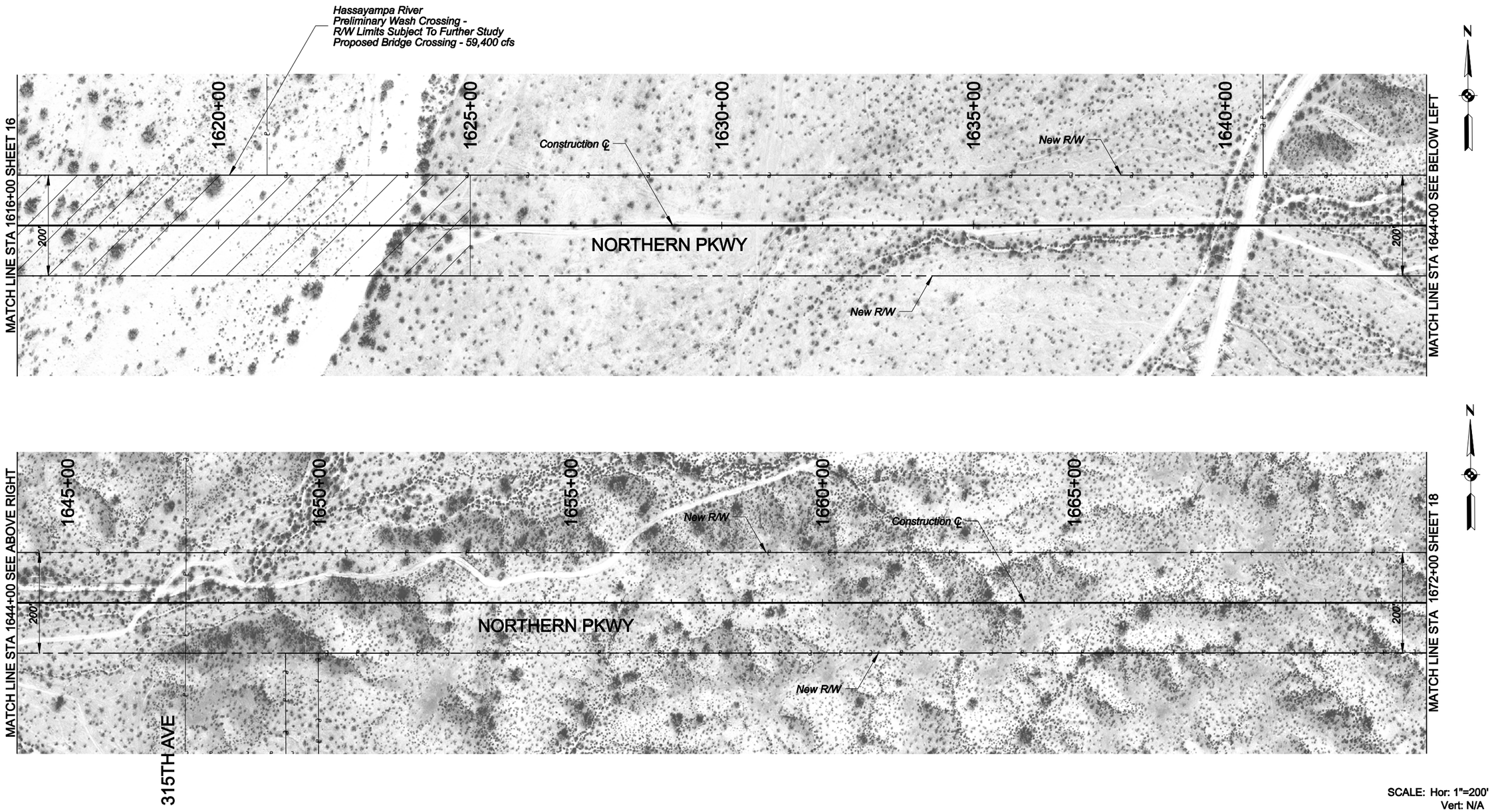


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

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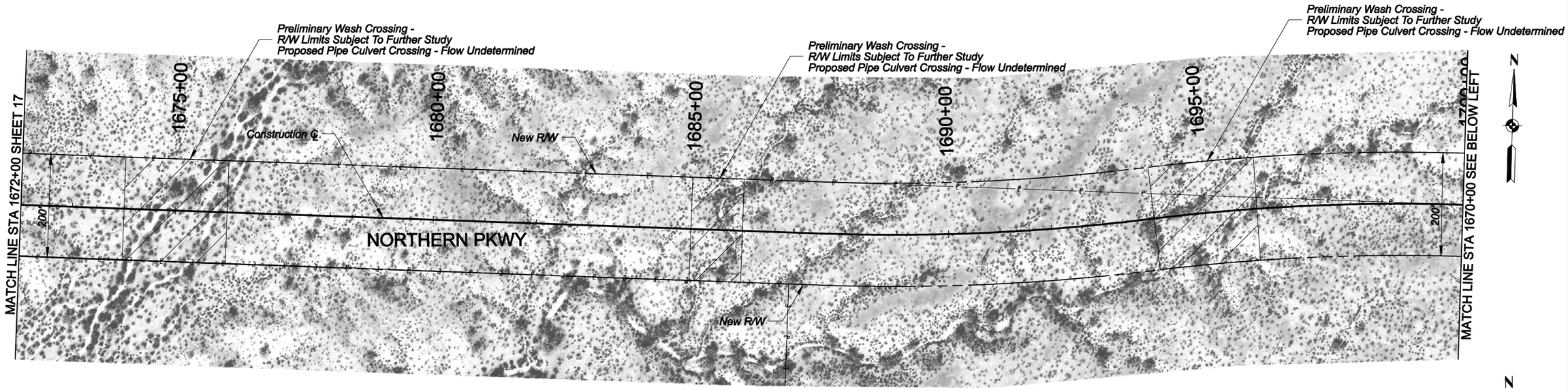


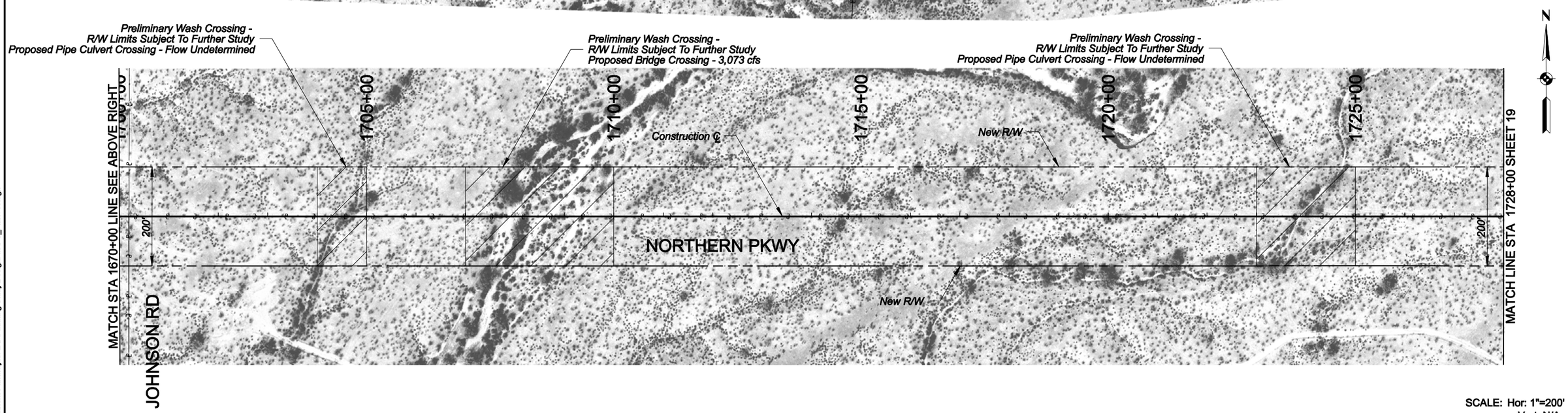


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

# NORTHERN PARKWAY / TONOPAH PARKWAY CORRIDOR FEASIBILITY STUDY

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RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

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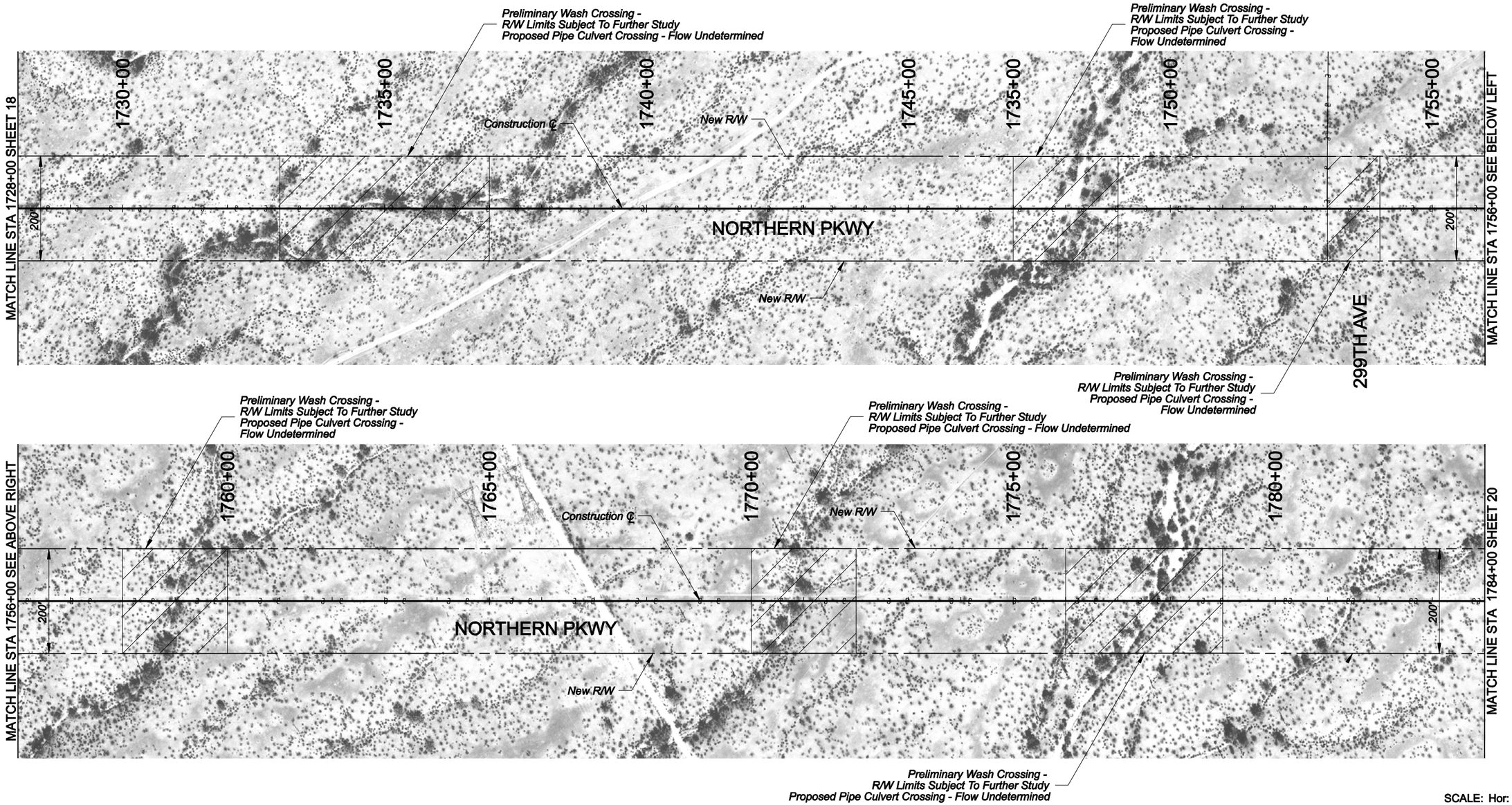


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

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RIGHT-OF-WAY CORRIDOR

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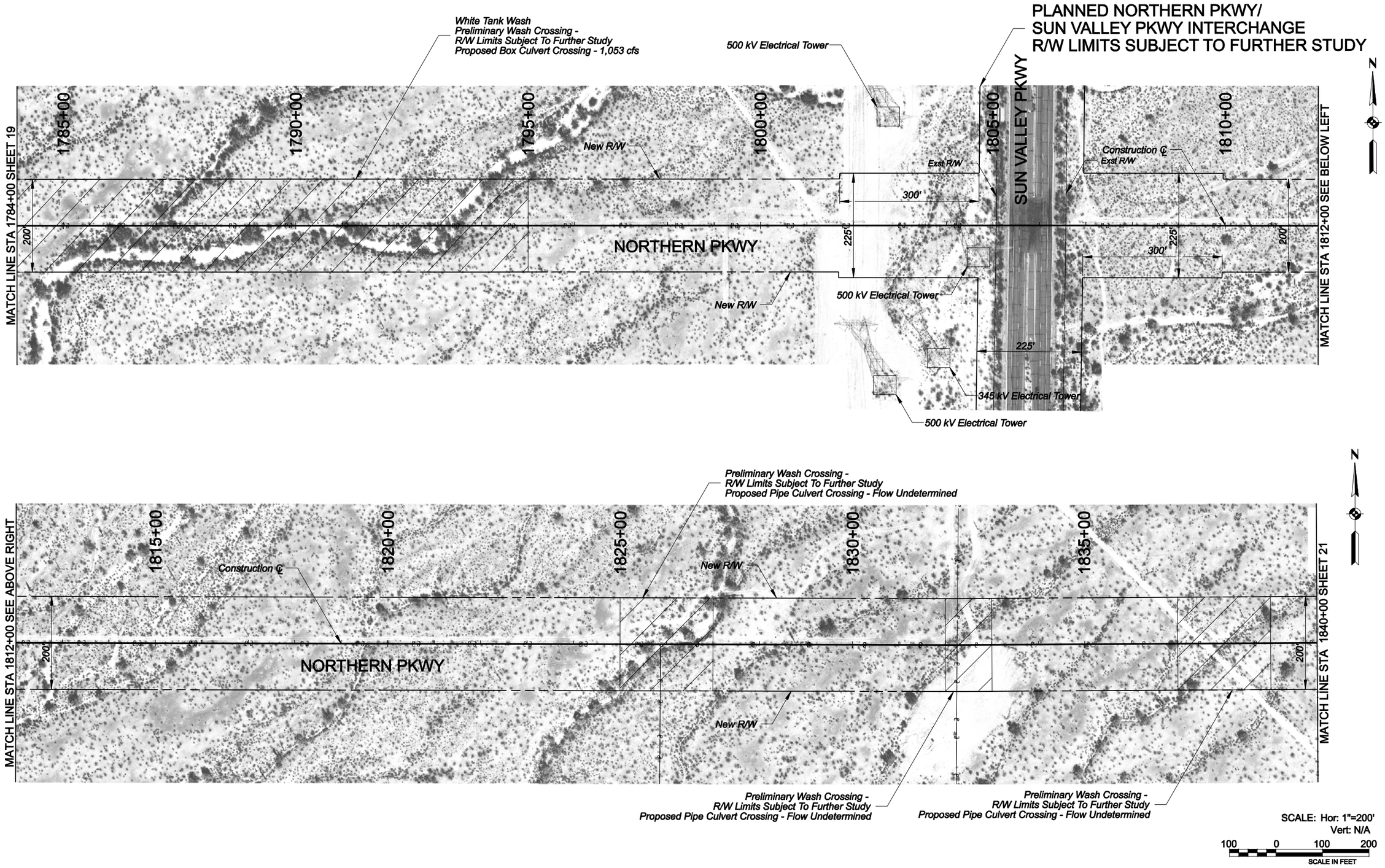


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

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RECOMMENDED FUTURE
RIGHT-OF-WAY CORRIDOR

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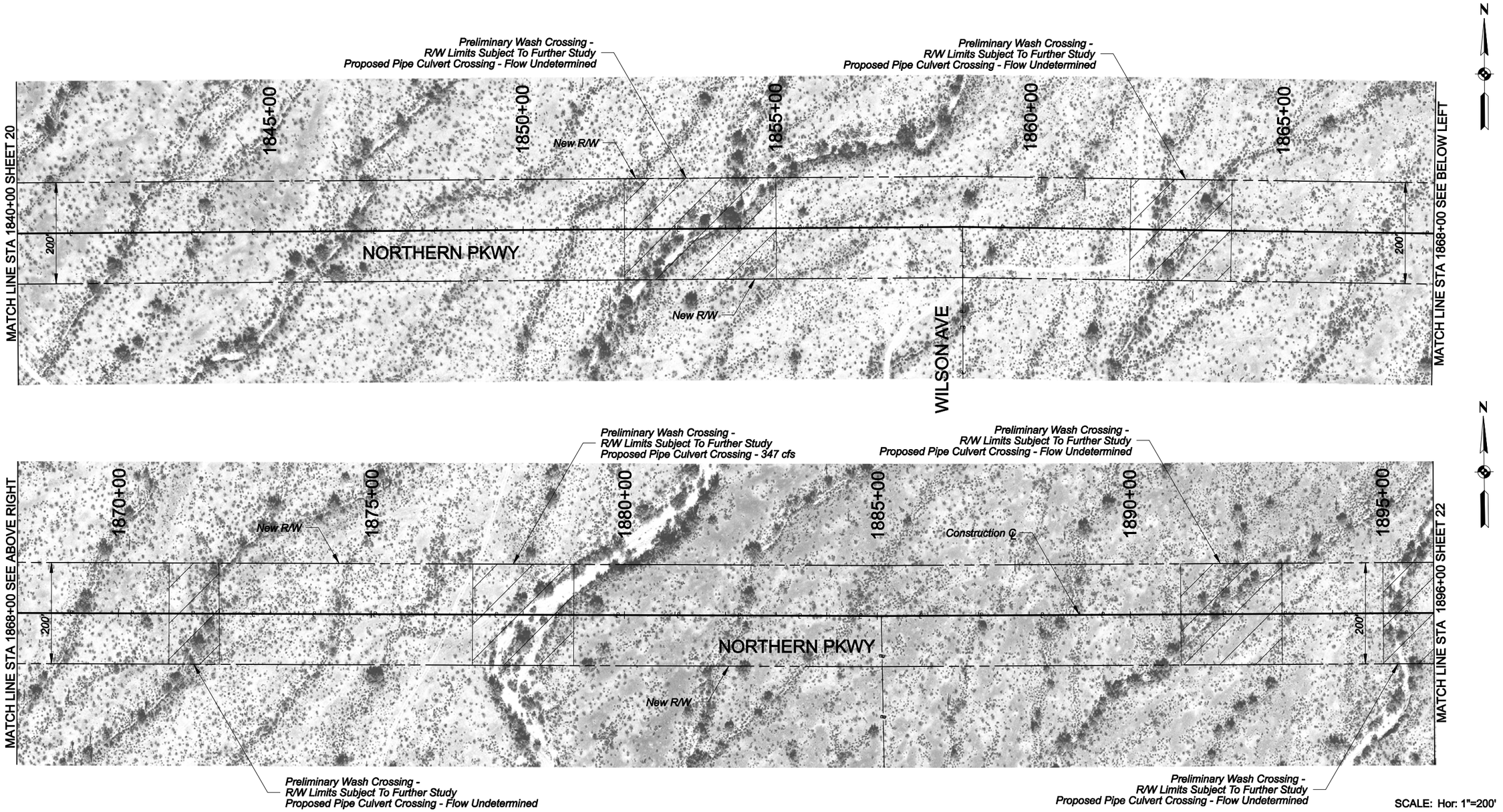


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MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION

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RIGHT-OF-WAY CORRIDOR

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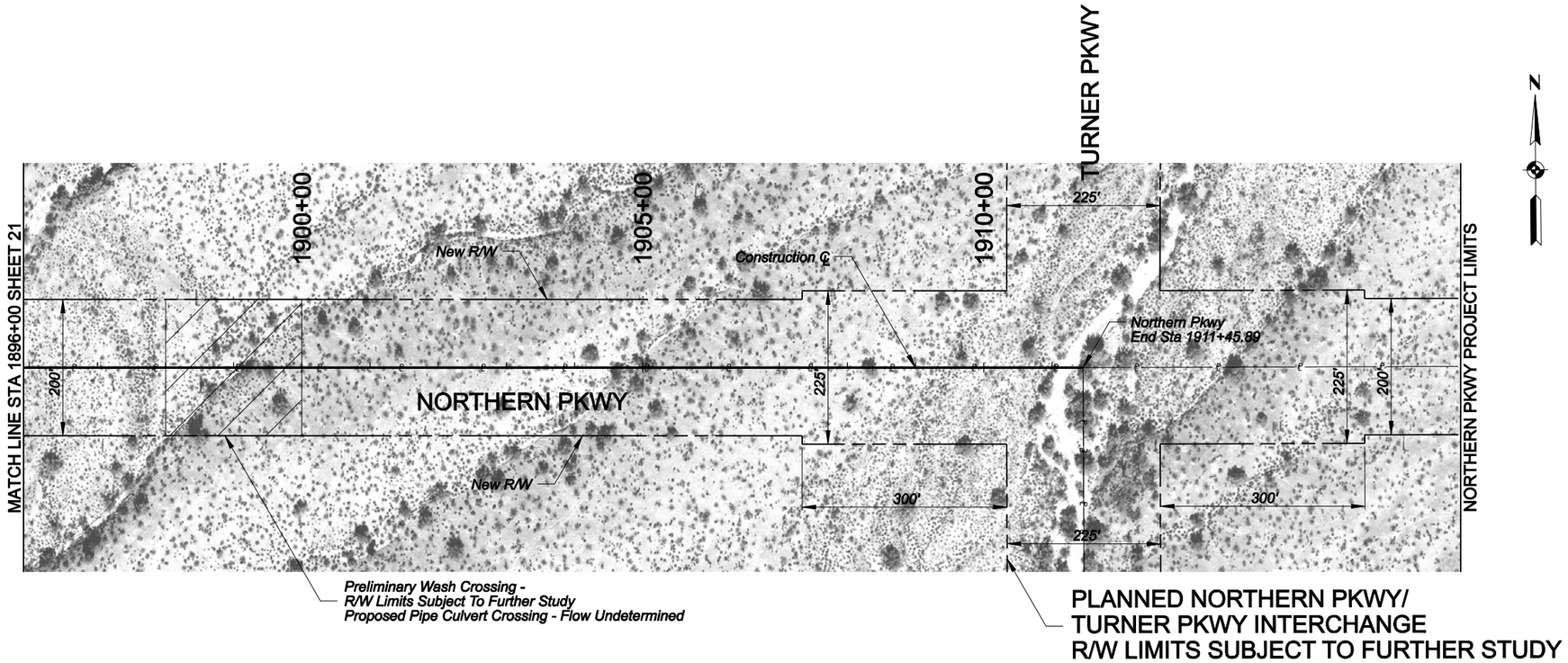


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CORRIDOR FEASIBILITY STUDY
MCDOT PROJECT NO. TT005

RECOMMENDED FUTURE
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