Appendix L:
CTP Stormwater Technical Memo

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

ADVANCED PLANNING TECHNICAL MEMO #24

STORMWATER IMPACTS OF THE CONSOLIDATED TERMINAL PROGRAM

1 INTRODUCTION

The purpose of this technical memorandum is to analyze the stormwater impacts of the proposed Consolidated Terminal Program (CTP) and provide conceptual alternatives to mitigate these impacts. Analyses include evaluation of the CTP impacts on runoff flow rates, pipe and culvert capacities, water quality, and the utility conflicts associated with the proposed alternatives.

As shown in **Figure 1**, the proposed CTP area includes construction of the new Consolidated Terminal, expanded Parking Garage, new Airfield Apron, enclosure of a portion of Coldwater Creek upstream of Taxiway C, Landside Infrastructure Improvements to roads and bridges, and modifications to pavement connecting Taxiway C and Taxiway D.

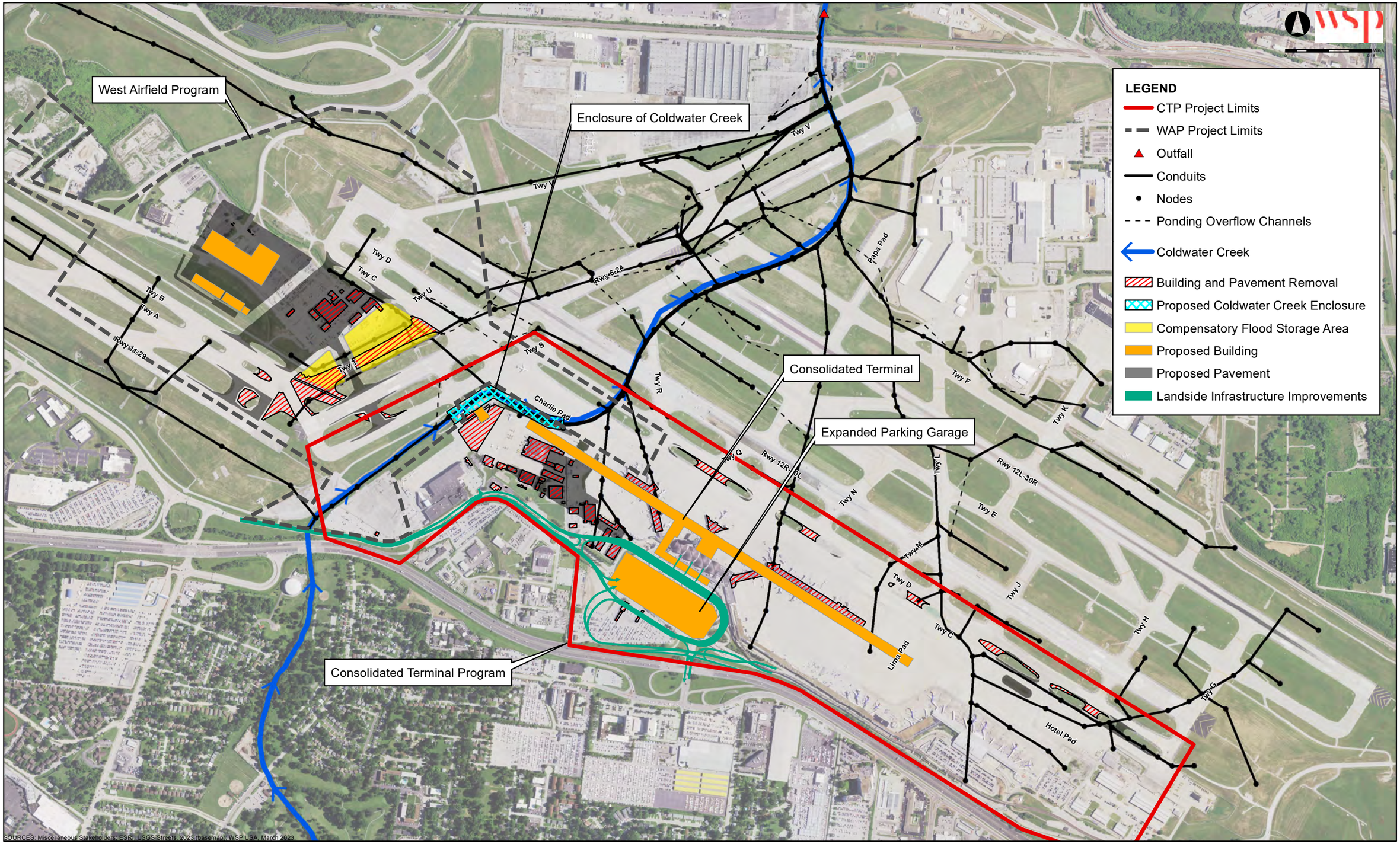
2 STORMWATER IMPACTS

2.1 IMPERVIOUS AREA

The total difference in impervious area was calculated to account for the new surfaces added for the new Consolidated Terminal, expanded Parking Garage, new Airfield Apron, the enclosure of a portion of Coldwater Creek upstream of Taxiway C, Landside Infrastructure Improvements to roads and bridges, and the impervious areas removed as part of the demolition of the pavement in select connections between Taxiway C and Taxiway D.

- The total existing impervious area in the CTP area is 1790.5 acres.
- The proposed impervious area in the CTP area is 1796.0 acres.
- The result of these proposed changes is a net increase of 5.5 acres of impervious area.

Figure 1
Consolidated Terminal Program - Site Map



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (baseman); WSP USA, March 2023.

2.2 STORMWATER RUNOFF

The changes in impervious area resulted in the following total runoff values from the area impacted by the CTP during a 15-year, 3-hour cloudburst storm event.

- The total existing runoff from the CTP area is 9770.9 cfs.
- The total proposed runoff from the CTP area is 9796.2 cfs.
- These changes result in a net increase of 25.3 cfs in peak stormwater runoff rate.

3 REGULATORY REQUIREMENTS

3.1 METROPOLITAN ST. LOUIS SEWER DISTRICT

Metropolitan St. Louis Sewer District's (MSD) *Rules and Regulations and Engineering Design Requirements for Sanitary Sewer and Stormwater Drainage Facilities* states that stormwater quality compliance is required for all new development and redevelopment projects that disturb an area greater than or equal to one acre, including smaller projects that are part of a larger common parcel or project that is greater than one acre. In order to comply, projects must include water quality best management practices (BMPs). No existing detention basin is known to serve the tributary area of the CTP, and space is limited for providing a basin for this purpose.

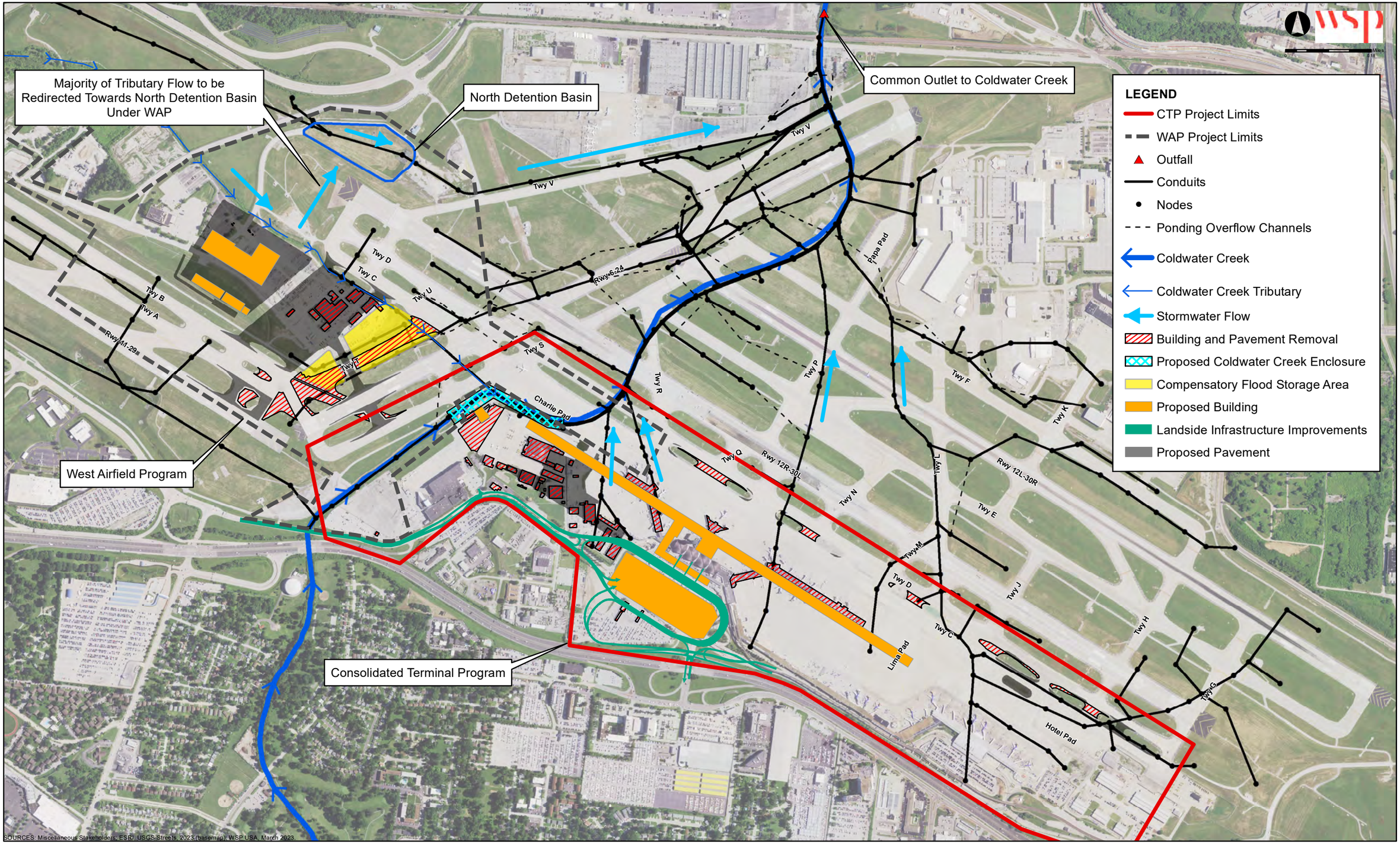
3.1.1 WATER QUALITY

Water Quality BMPs were evaluated for the CTP redevelopment since it exceeds the 1-acre threshold. MSD established a water quality volume (WQv) to be stored in BMPs based on the storage needed to capture and treat runoff from 90% of recorded daily rainfall events. MSD's formula for calculating WQv is:

WQv (in acre-feet) = [(P)(Rv)(A)]/12
Where P = rainfall depth of 1.14 inches
Rv = 0.05 + 0.009 (I) where I is the percent impervious cover for the tributary area
A = tributary drainage area to the water quality BMP in acres

The MSD water quality volume (WQv) was calculated as 39.3 acre-feet of retention volume for the proposed tributary area of the CTP. No available areas for a water quality basin are known unless the proposed area north of the Cell Phone Lot and east of Coldwater Creek can be utilized. Providing WQv within the existing North Detention Basin is proposed as a means to provide water quality for the CTP and WAP development projects. Providing WQv as part of the WAP project is expected to be acceptable to MSD given the CTP and WAP developments are both within the airport property and drain to the same Coldwater Creek outlet point leaving the property as shown in **Figure 2**.

Figure 2
Consolidated Terminal Program - Drainage Map



SOURCES: Miscellaneous Stakeholders, ESRI, USGS Streets, 2023.(baseman); WSP USA, March 2023.

3.1.2 WATER QUANTITY

Rerouting flow to the North Detention Basin improvements as part of the WAP is proposed to account for development of the CTP in order to meet MSD water quantity requirements. MSD stormwater quantity compliance requires detention storage when the proposed development causes an increase in peak runoff of 2 cfs or greater. As previously stated and shown in Figure 2, the WAP and CTP contribute to a common Coldwater Creek outfall point before exiting the Airport property. Therefore, detaining flows from the WAP mitigates the increase in impervious area and runoff associated with the CTP improvements. The existing North Detention Basin was originally designed to receive runoff from a midfield terminal that was never constructed. Utilizing PCSWMM software, the basin was modeled and determined to have the capacity to receive and detain additional flow. The basin has a total capacity of about 118 acre-feet of volume, and about 40% of this is currently utilized during the 100-year 24-hour storm event. Water quantity requirements include detaining a Channel Protection Volume (CPv) and Flood Protection Volume (FPv). The CPv is the 24-hour extended detention of the post-developed one-year, 24-hour storm event. The FPv is the required storage volume to achieve a post-developed peak flow that does not exceed the existing routed peak flow. A 5' wide x 2' high orifice was modeled to pass the CPv and FPv. The hydraulic results of the combined development of the CTP and WAP are summarized in **Table 1**. The summary shows a net decrease in flow leaving the Airport property through Coldwater Creek for both the 2-year and 100-year storm.

Table 1: CTP Stormwater Quantity Summary

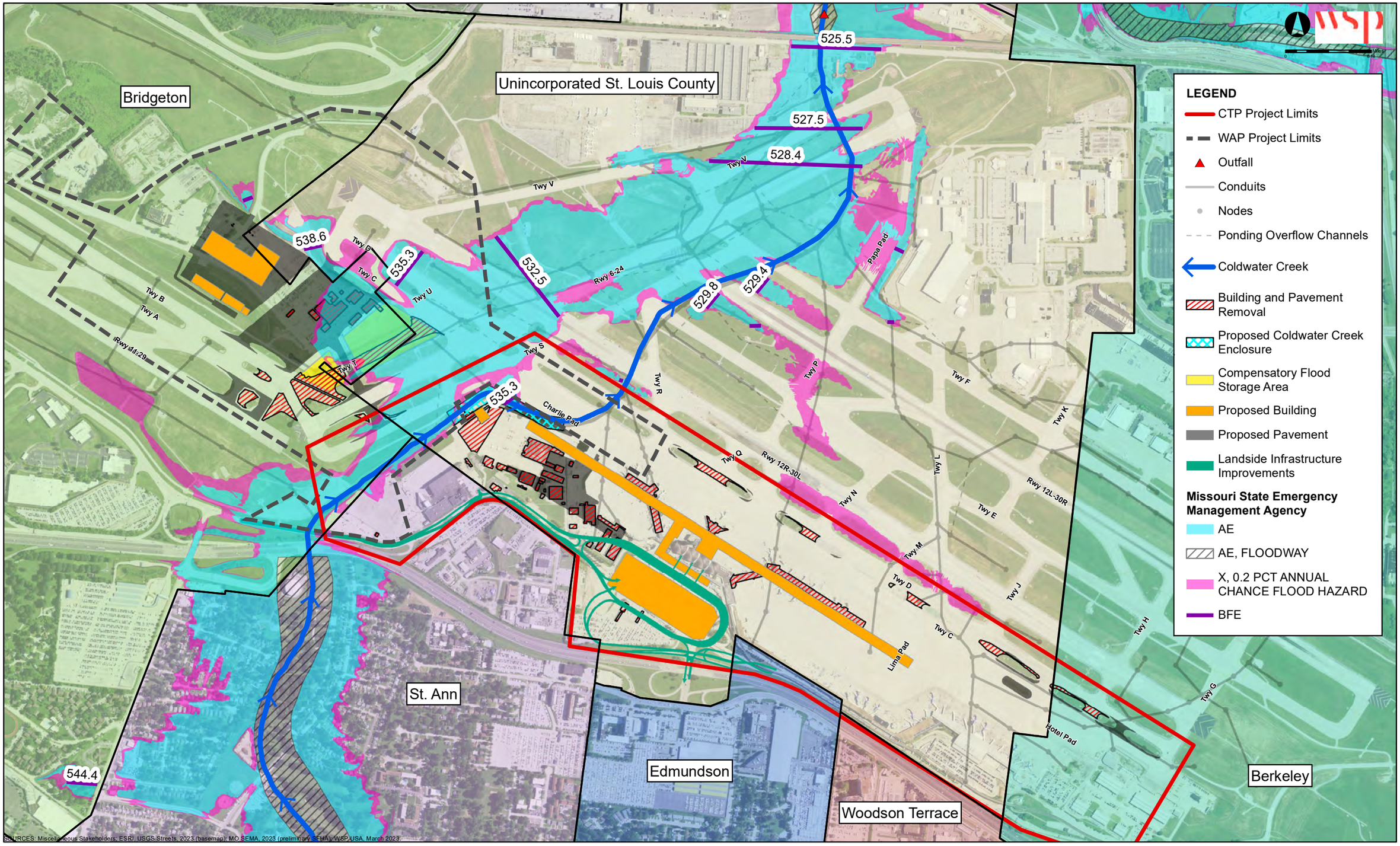
	HYDRAULIC MODEL RESULTS		
Model Scenario	**Stormwater Storage in Basin (acre-feet)**	**Peak Release Rate at Detention Basin Outlet (cfs)**	**Peak Coldwater Creek Flow Rate at Airfield Outlet (Near Banshee Rd) (cfs)**
Existing Conditions: 2-year 24-hour Storm (FPv)	5.08	76.5	4768.0
Proposed Conditions: 2-year 24-hour Storm (FPv)	13.27	99.6	4611.1
Existing Conditions: 100-year 24-hour Storm (FPv)	37.3	156.1	6174.6
Proposed Conditions: 100-year 24-hour Storm (FPv)	76.9	218.4	6093.2

Source: M3 Engineering Group, 2023.

3.2 FEDERAL EMEGENCY MANAGEMENT AGENCY

A flood study will be required to determine the impacts of the CTP on the base flood elevations for Coldwater Creek. **Figure 3** shows the revised FIRM boundaries in the CTP area which falls in the floodplain, but not the regulatory floodway. The expectation is that the proposed section of Coldwater Creek to be enclosed and any proposed fill in the floodplain proposed as part of the CTP will require compensatory excavation within the floodplain to avoid a rise in the base flood elevation. The WAP will also provide benefits to the CTP through compensatory storage and flow diversion to the existing North Detention Basin. This flood study will be completed as a future task of this project.

Figure 3
Consolidated Terminal Program - Preliminary FIRM and Muncipal Boundaries



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (basemap); MO SEMA, 2023 (preliminary SFHA); WSP USA, March 2023

4 PROPOSED ALTERNATIVES

4.1 ALTERNATIVE 1 - REROUTE CTP CULVERT 1 AND REUSE EXISTING CTP CULVERT 2

The purpose of Alternative 1 is to provide routes for existing drainage to continue to flow to Coldwater Creek while working with the footprint of the new Consolidated Terminal. As shown in **Figure 4**, Alternative 1 consists of installing 1,644 feet of 54-inch to 60-inch storm sewer (CTP Culvert 1) around the west end of the proposed terminal, while using the existing 4'9" x 6' arch sewer in place. Storm sewer inspections from 2021 indicate the existing arch sewer to be in good condition. To accommodate CTP Culvert 2 remaining within the footprint of the new terminal, a 66-foot-wide opening in the apron level building will be provided to retain the ability to maintain or reconstruct the existing sewer in the future without impacts to the new terminal.

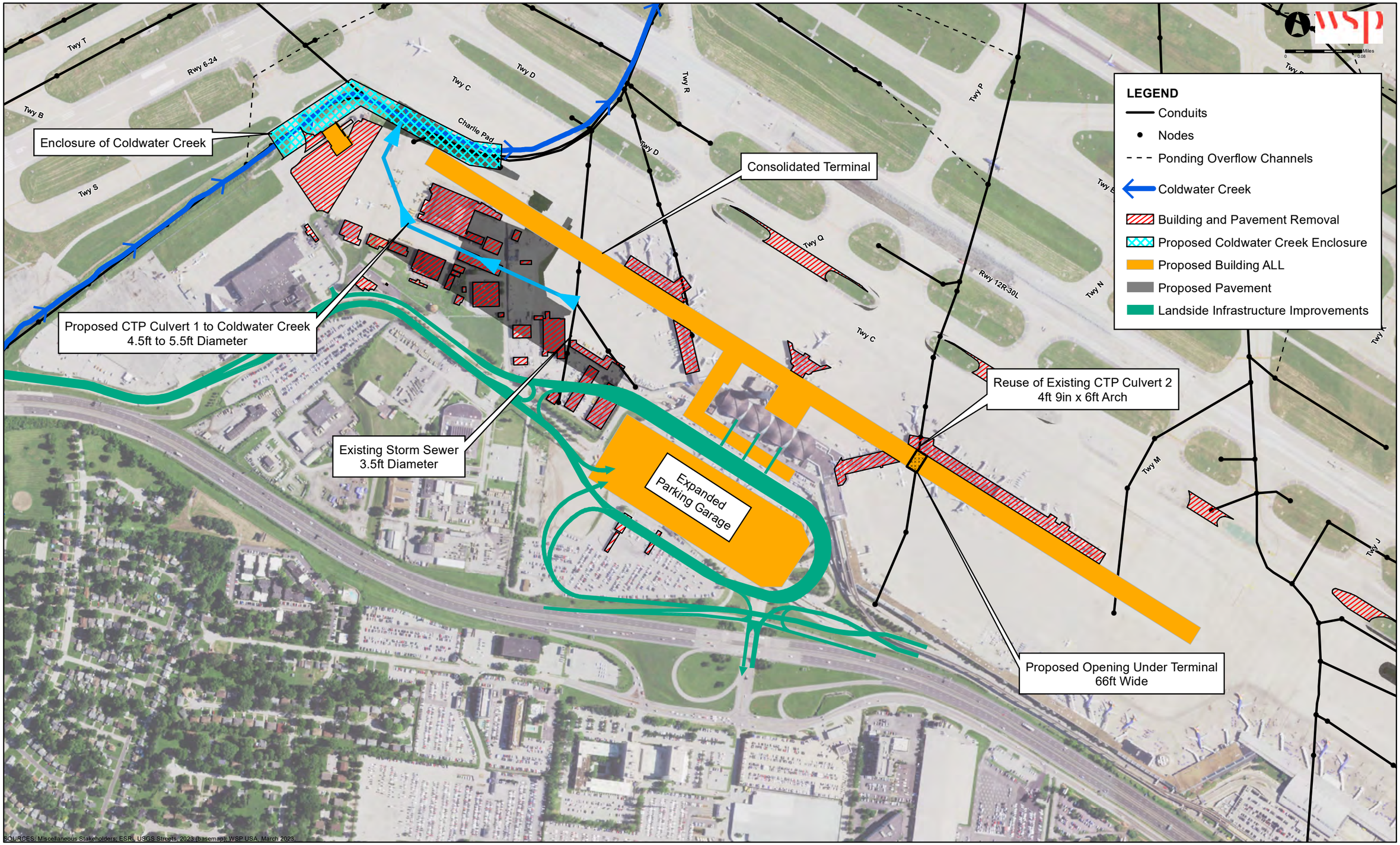
4.1.1 UTILITY CONFLICTS

Plan profile drawings were developed to illustrate risks for utility conflicts for the CTP project. A key map is provided as **Figure 5** to illustrate where each plan and profile figure is located within the CTP area. **Figures 6** and **7** provide the plan and profile of proposed CTP Culvert 1 with no known utility conflicts. **Figure 8** illustrates the plan and profile for using the existing culvert in place under the consolidated terminal. An opening is proposed under the proposed terminal for future maintenance of the culvert.

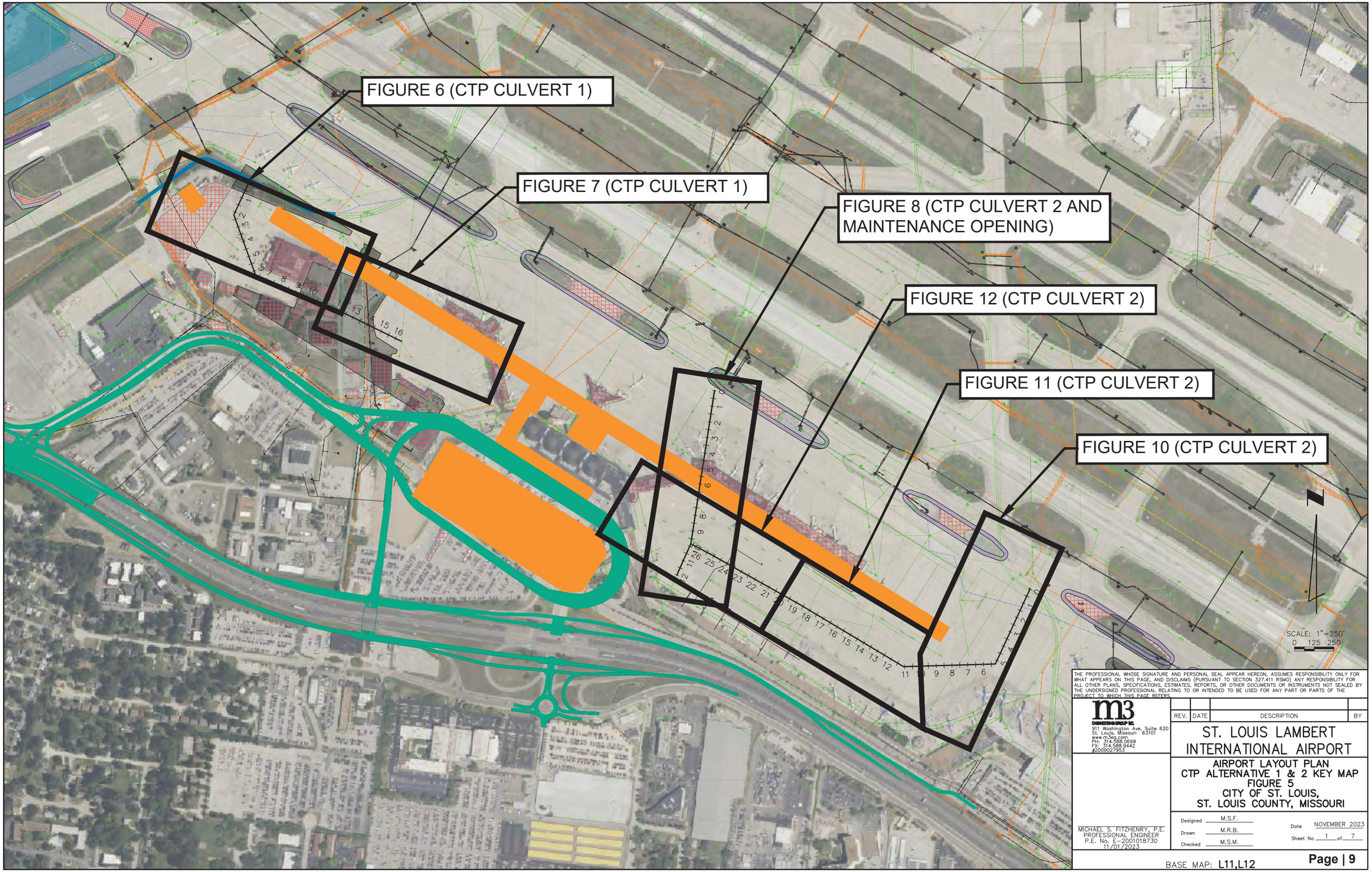
4.1.2 CONSTRUCTION COSTS

The construction costs for Alternative 1 include the cost to construct a new section of 5-foot diameter CTP Culvert 1, an extension of the Coldwater Creek 12-foot x 12-foot double box culvert, and a water quality storage basin at a location to be determined. The total cost is estimated at $17.1 million, including a 30% contingency and accounts for uncertainties in potential utility conflicts that may be encountered during design and construction. **Table 2** below provides a summary of costs for Alternative 1. A breakdown of the costs is provided in more detail in **Appendix A**.

Figure 4
Consolidated Terminal Program - Proposed Improvements
Alternative 1



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (basemap); WSP USA, March 2023.



THE PROFESSIONAL WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON, ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE, AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS, OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED PROFESSIONAL RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

m3 ENGINEERING GROUP INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eg.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

REV.	DATE	DESCRIPTION	BY

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

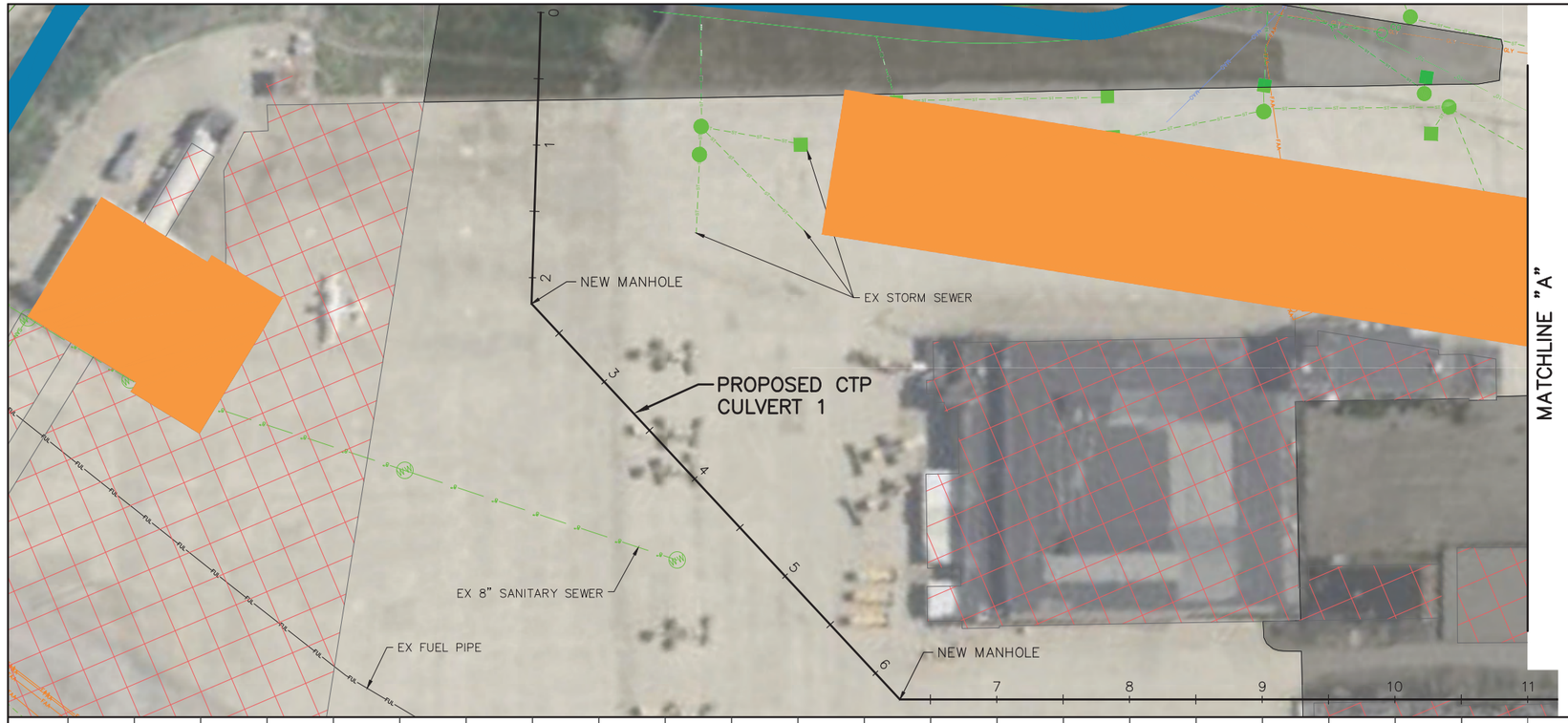
AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 1 & 2 KEY MAP
FIGURE 5
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

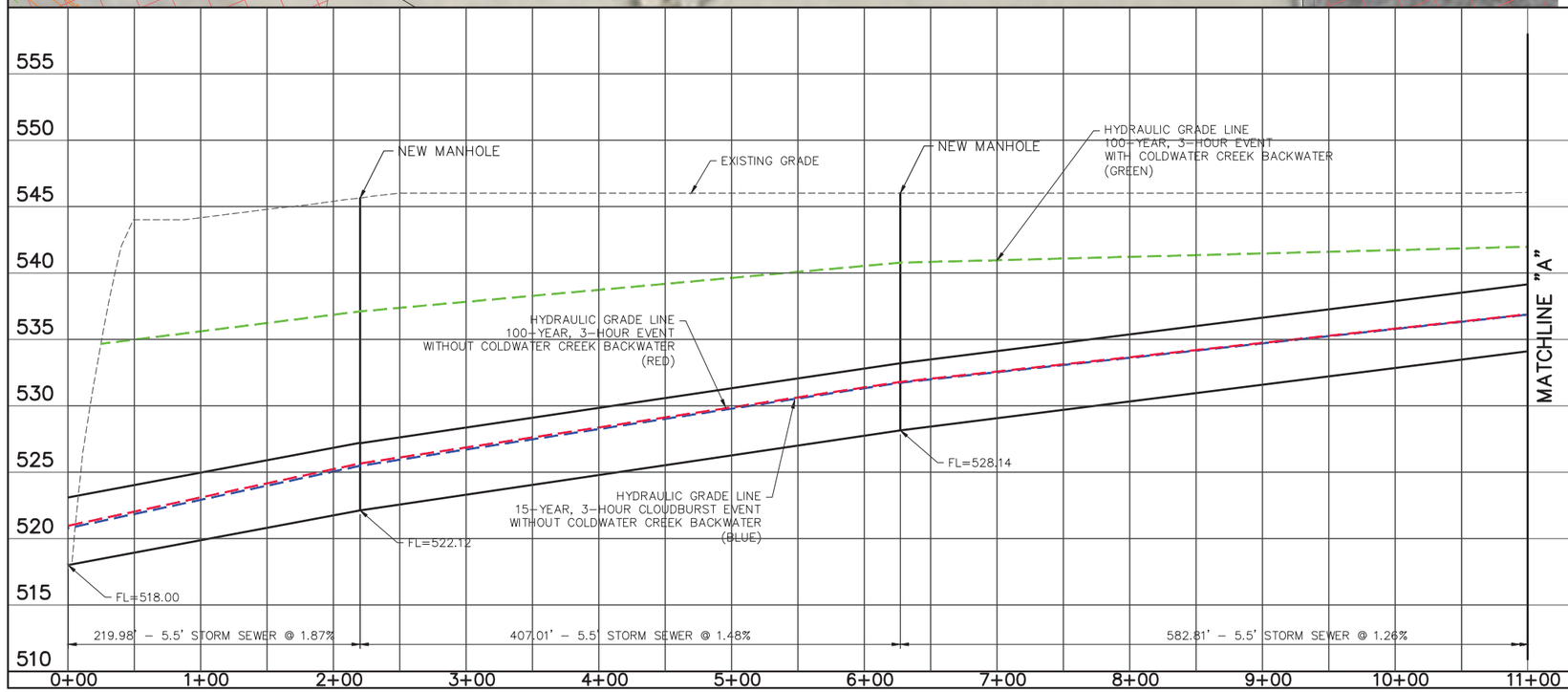
MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 1 of 7

BASE MAP: L11,L12





SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

THE PROFESSIONAL WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON, ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE, AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS, OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED PROFESSIONAL RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

m3 ENGINEERING GROUP INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eg.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

REV.	DATE	DESCRIPTION	BY

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

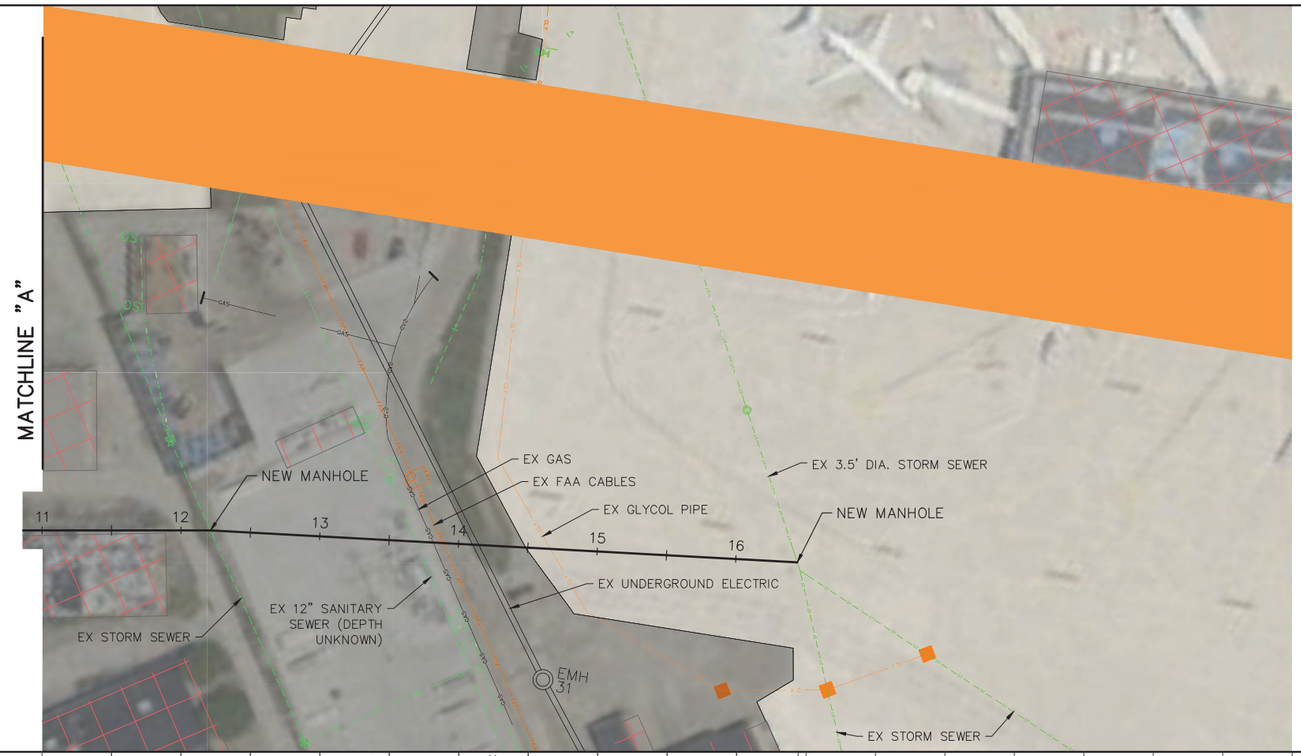
AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 1
FIGURE 6
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

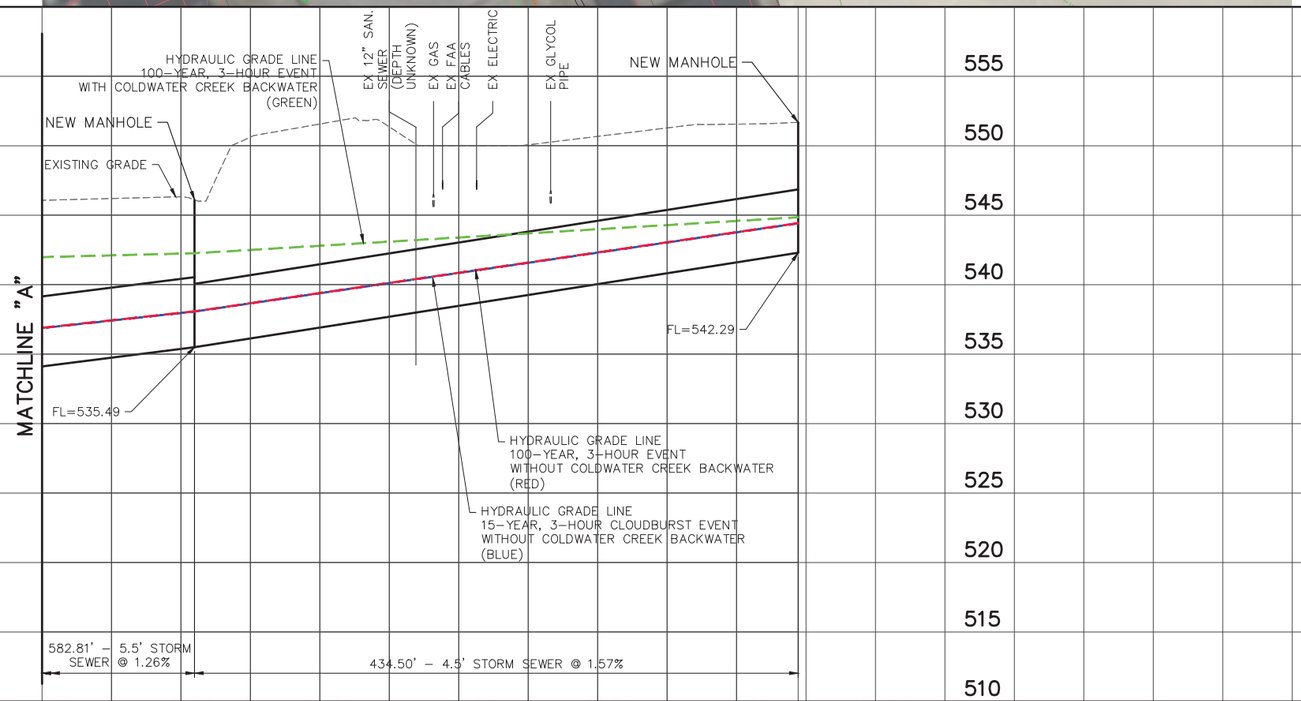
MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 2 of 7

BASE MAP: L11,L12





SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

m3 ENGINEERING & TECHNOLOGY, INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eng.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

REV.	DATE	DESCRIPTION	BY

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

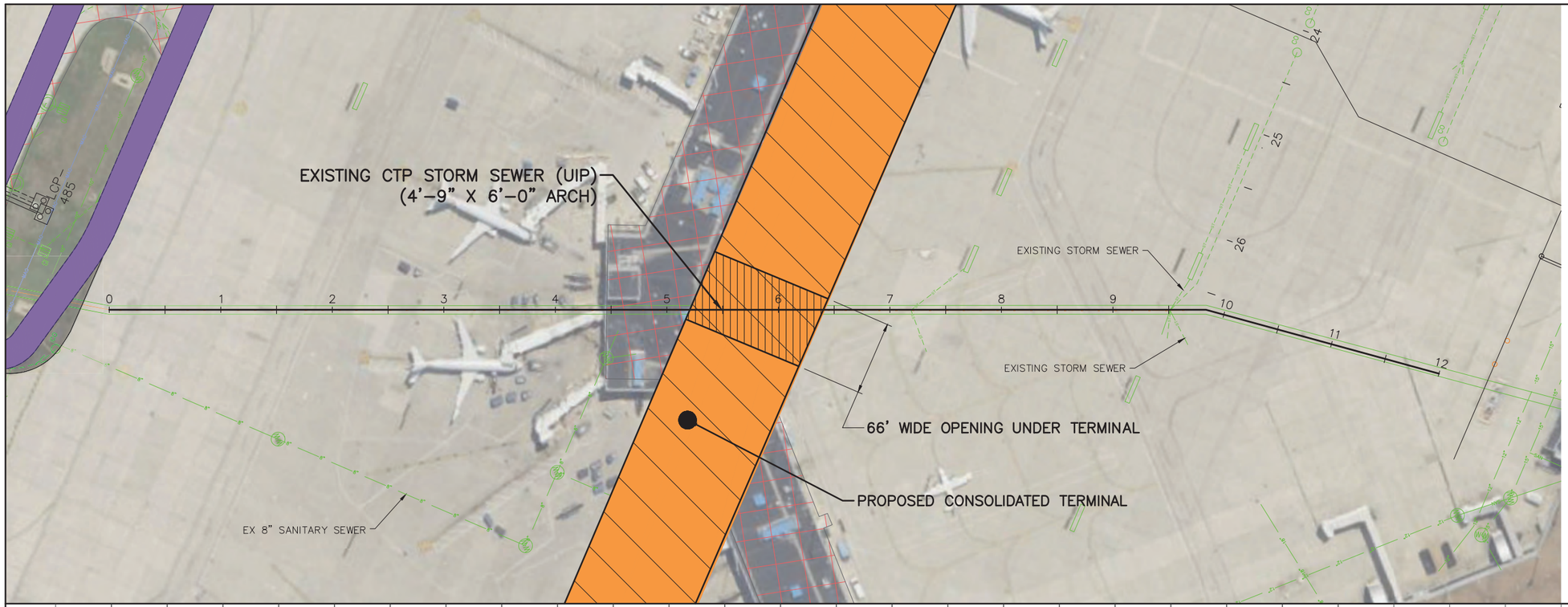
AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 1
FIGURE 7
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

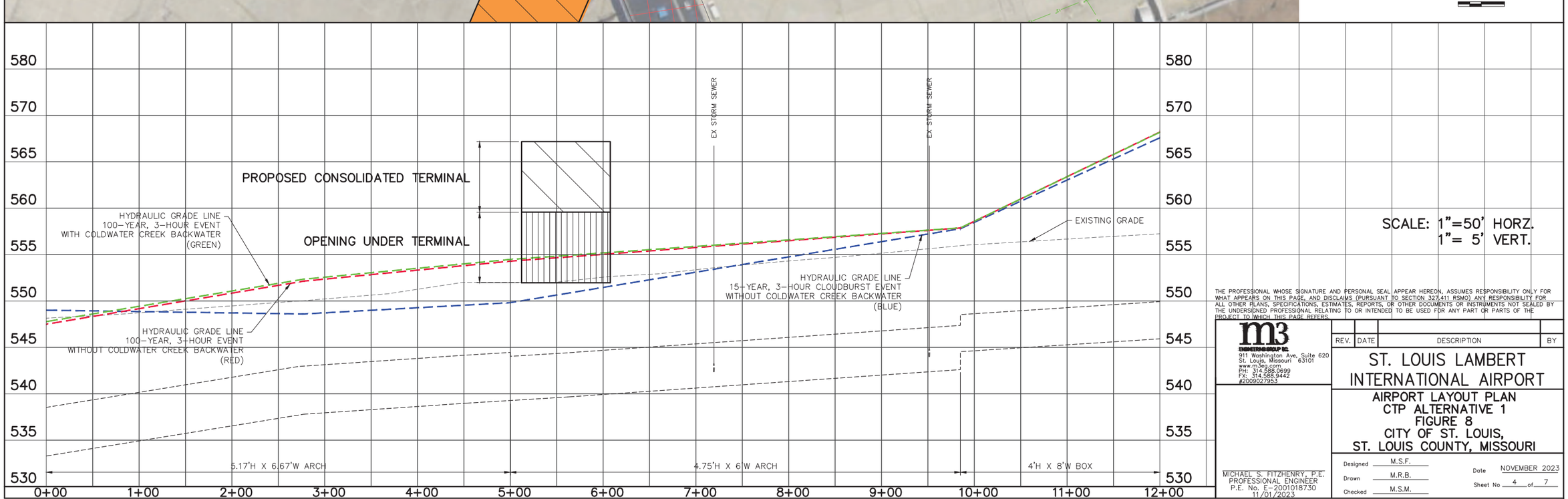
MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 3 of 7

BASE MAP: L11,L12





SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

m3 ENGINEERING GROUP INC.
911 Washington Ave. Suite 620
St. Louis, Missouri 63101
www.m3eg.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E–20010187 30
11/01/2023

REV.	DATE	DESCRIPTION	BY

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 1
FIGURE 8
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 4 of 7

BASE MAP: L11,L12

Table 2: CTP Alternative 1 Construction Cost Summary

	COST ESTIMATE (CURRENT DOLLARS)	
Construction Costs	$	6,000,000
Contingency	$	1,800,000
General Contractor Markups	$	560,000
Owner's Soft Costs	$	1,450,000
Total Including Soft Costs	**$**	**9,810,000**
Environmental Assessment	$	390,000
ROM TOTAL COST ESTIMATE	**$**	**10,300,000**

Note: A cost for constructing a WQv basin is included in the construction costs for Alternative 1.

Source: M3 Engineering Group, 2023.

4.2 ALTERNATIVE 2 - REROUTE CTP CULVERT 1 AND CTP CULVERT 2

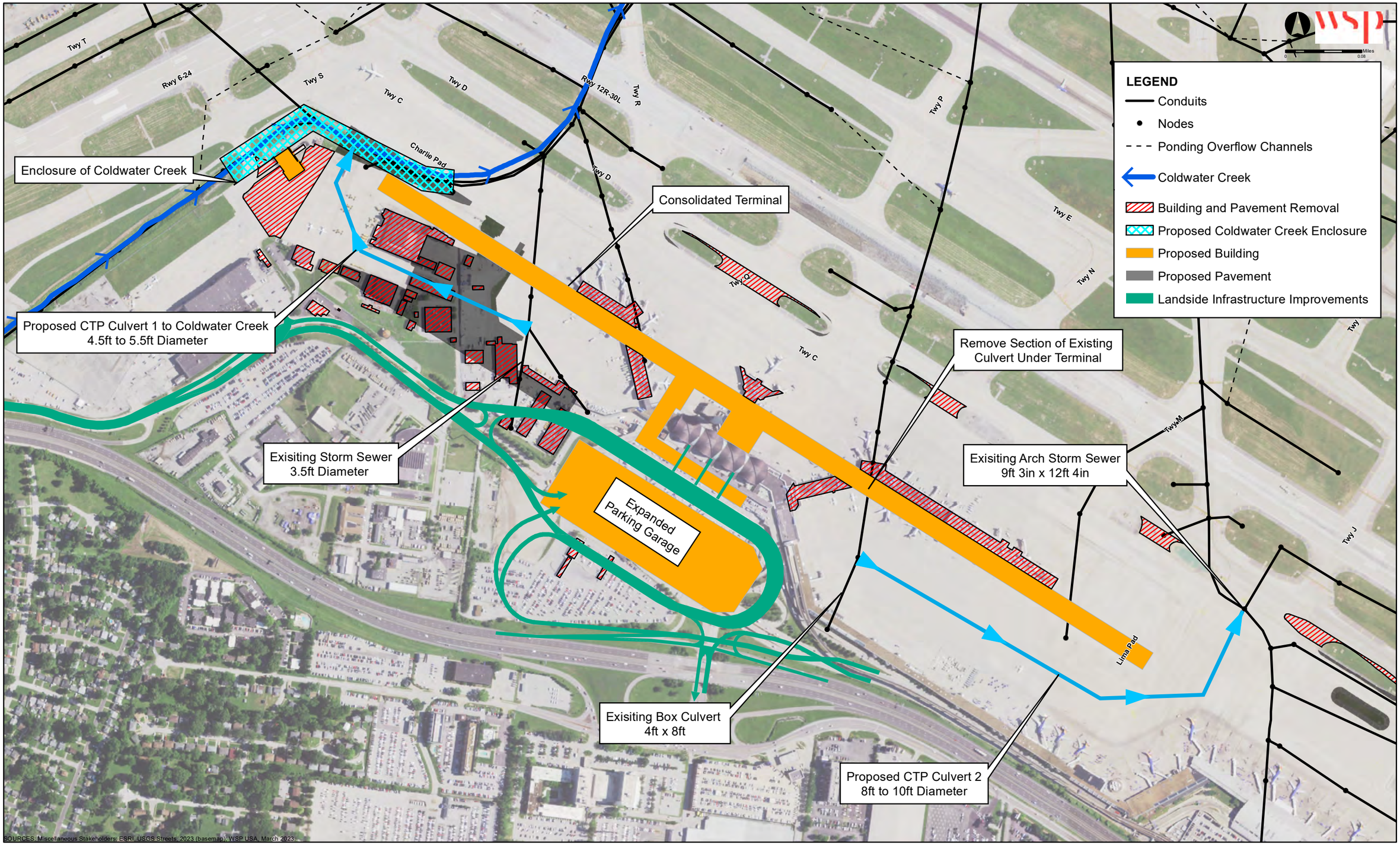
The purpose of Alternative 2 is to evaluate rerouting all existing culverts around the footprint of the new Consolidated Terminal. Alternative 2 consists of installing the same 1,644 feet of 54-inch to 60-inch storm sewer (CTP Culvert 1) around the west end of the terminal as in Alternative 1. In Alternative 2, the existing 4' x 8' arch sewer (CTP Culvert 2) would be rerouted around the east end of the new terminal. CTP Culvert 2 alignment consists of 2,665 feet of 96-inch to 120-inch diameter pipe culvert. Refer to **Figure 9** for the general location of proposed CTP Culvert 1 and 2. A key map is provided as **Figure 5** to illustrate where each plan and profile figure is located within the CTP area. The plan and profile of CTP Culvert 1 is the same for Alternative 2 as Alternative 1 and is shown in **Figures 6 and 7**. The plan and profile of CTP Culvert 2 is shown in **Figures 10** through **12**. For overland flow evaluation of the 100-year storm event, a v-shaped apron with 0.5% v-channel side slopes centered over the proposed culvert was assumed.

During a meeting on April 6, 2023, MSD stated this alternative would be closely reviewed as it reroutes flow from one tributary area to another. MSD indicated the 100-year storm needs to be evaluated with and without Coldwater Creek 100-year backwater conditions. Given the sewers are larger than 36-inch diameter, a blocked culvert condition does not need to be evaluated, but the overland flow path needs to be evaluated to ensure no buildings are flooded by the overland flow. Overland flow from this proposed alternative must be evaluated relative to FAA guidelines for airfield flooding of runways and taxiways.

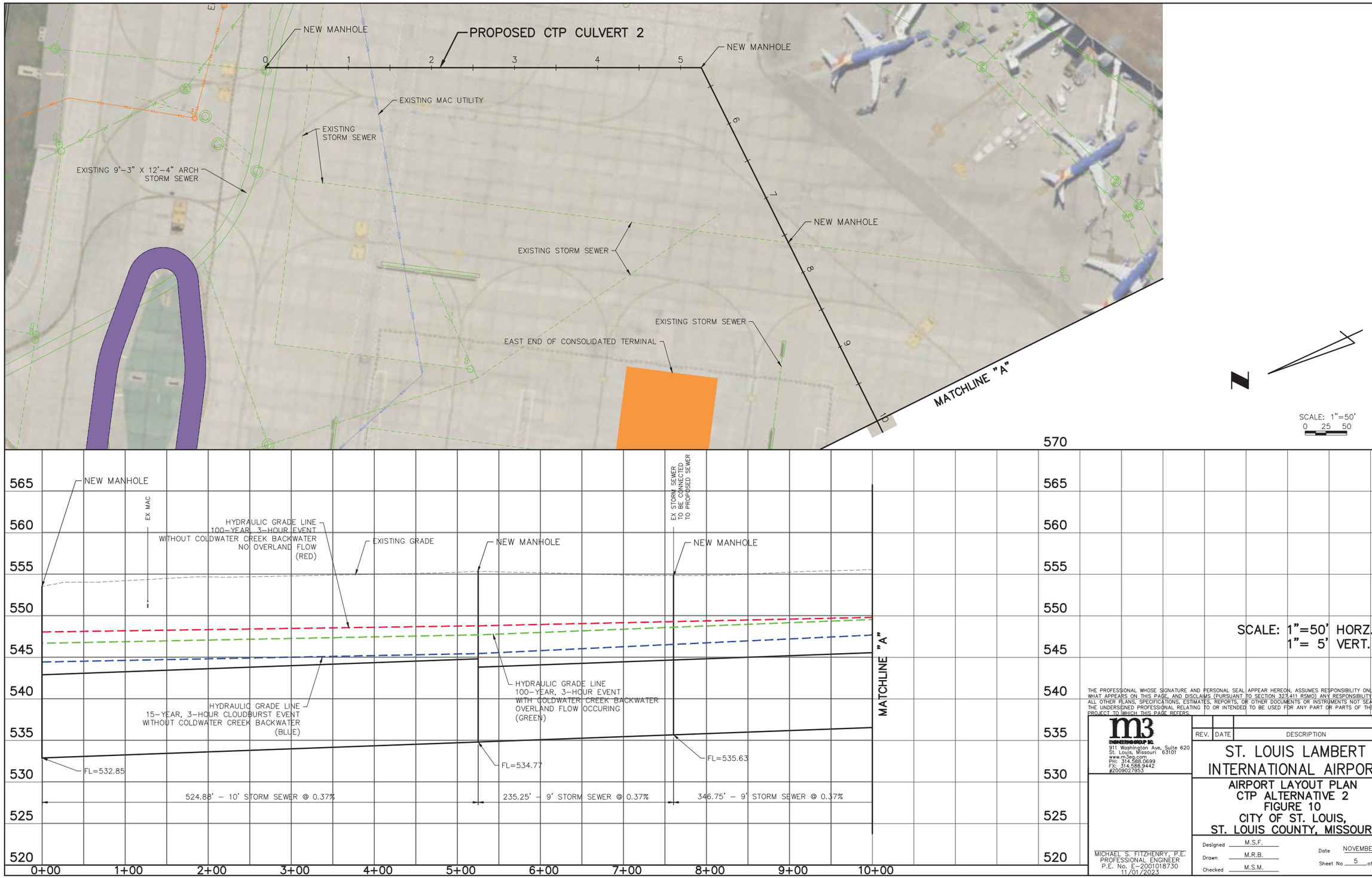
4.2.1 UTILITY CONFLICTS

Alternative 2 has multiple crossing of existing storm culverts and one electrical and water service duct bank. The crossing storm sewers are proposed to be connected to the CTP Culvert 2, and the duct bank is assumed to have a depth of cover of 4 feet which will not conflict with the proposed culvert. CTP Culvert 1, which is also part of Alternative 2, has no known utility conflicts.

Figure 9
Consolidated Terminal Program - Proposed Improvements
Alternative 2



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (basemap); WSP USA, March 2023.



SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

BASE MAP: L11,L12

THE PROFESSIONAL WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON, ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE, AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS, OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED PROFESSIONAL RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

m3 ENGINEERING GROUP INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eg.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

REV.	DATE	DESCRIPTION	BY

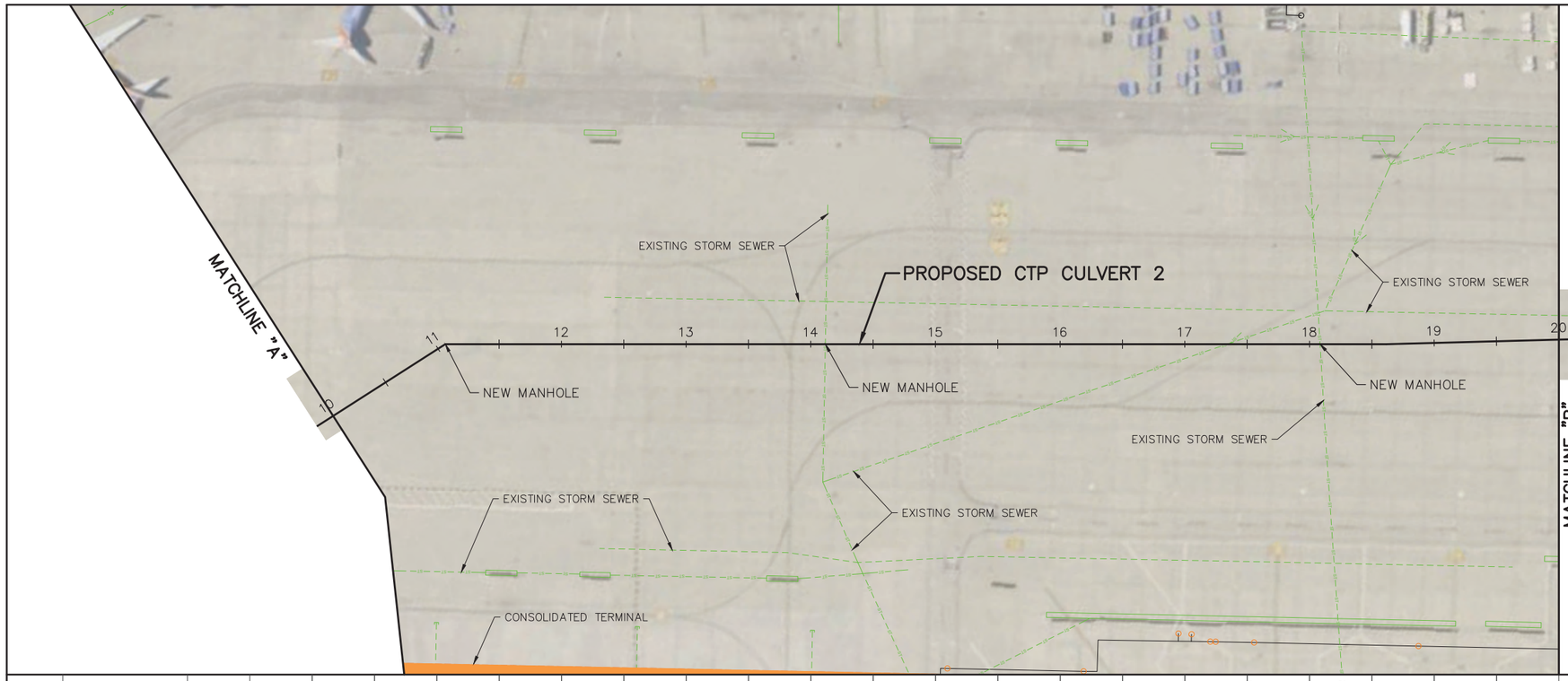
ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

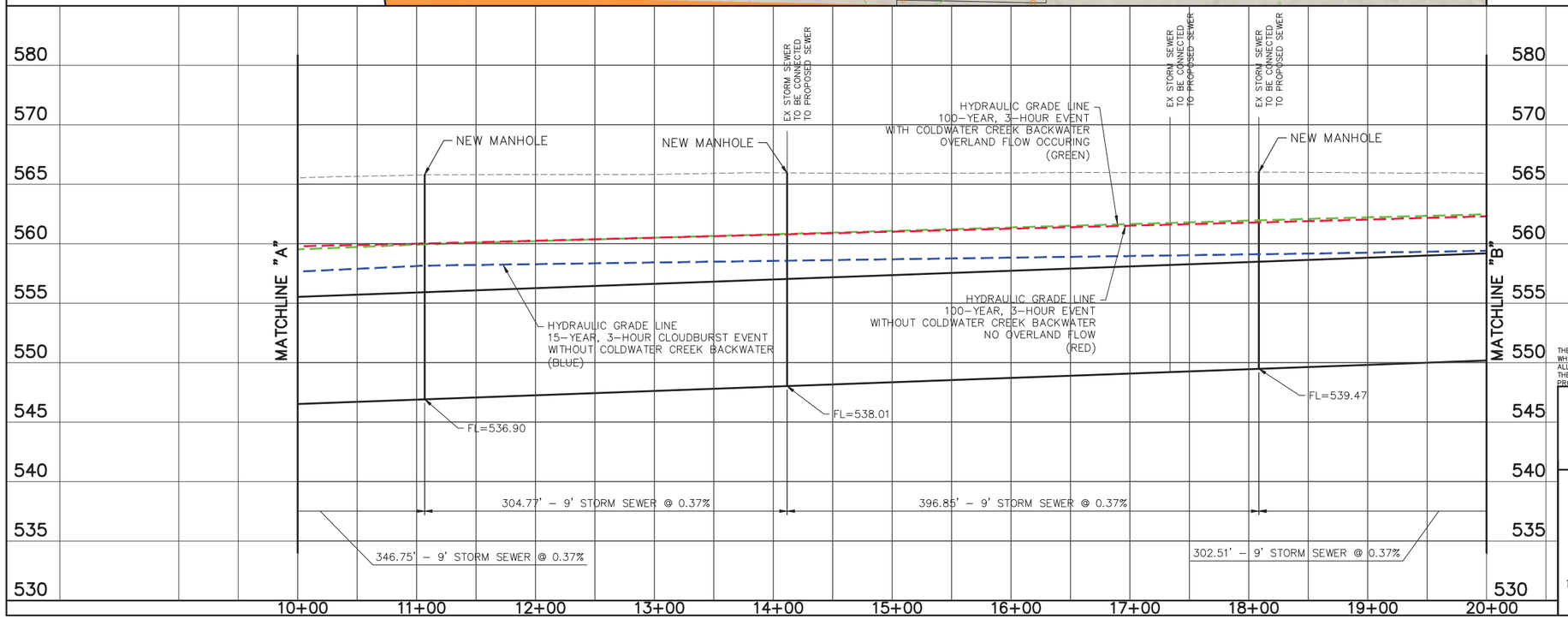
AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 2
FIGURE 10
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 5 of 7





SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

THE PROFESSIONAL WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON, ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE, AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS, OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED PROFESSIONAL RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

m3 ENGINEERING & TECHNOLOGY, INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eng.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

REV.	DATE	DESCRIPTION	BY

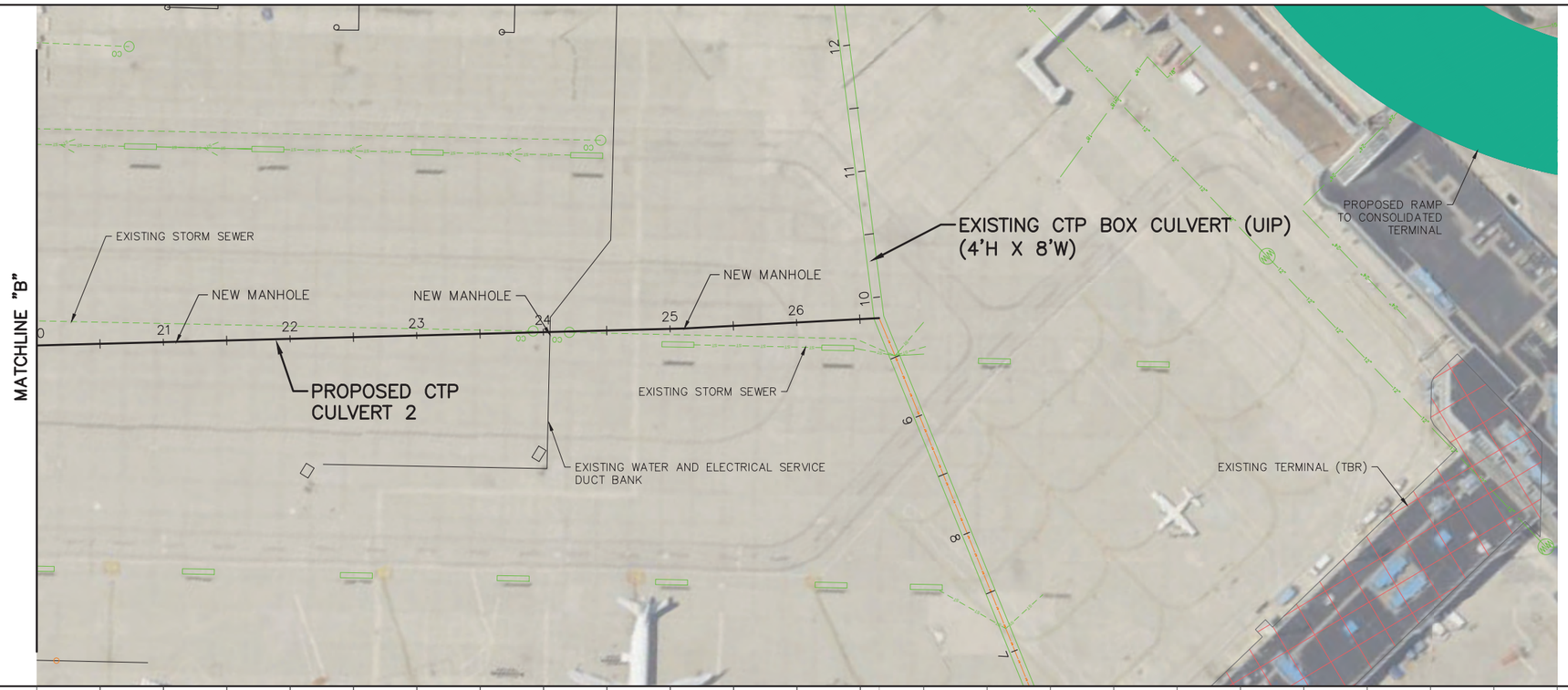
ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

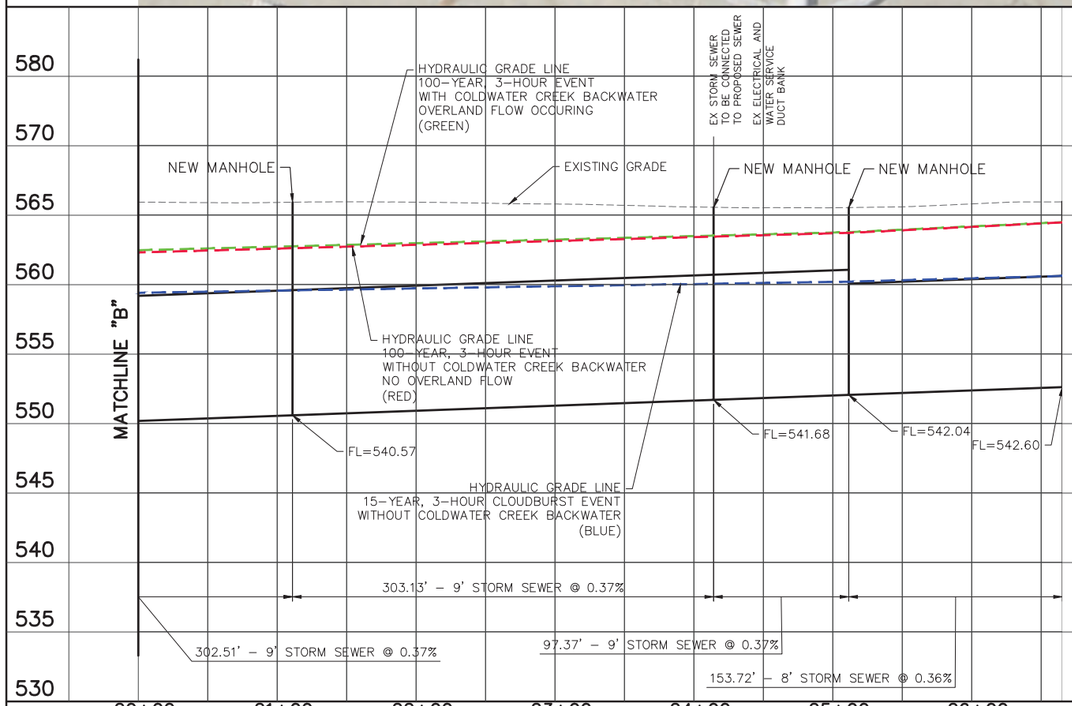
AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 2
FIGURE 11
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 6 of 7

BASE MAP: L11,L12





SCALE: 1"=50'
0 25 50

SCALE: 1"=50' HORZ.
1"= 5' VERT.

m3 ENGINEERING GROUP INC.
911 Washington Ave, Suite 620
St. Louis, Missouri 63101
www.m3eng.com
PH: 314.588.0699
FX: 314.588.9442
#2009027953

REV.	DATE	DESCRIPTION	BY

ST. LOUIS LAMBERT INTERNATIONAL AIRPORT

AIRPORT LAYOUT PLAN
CTP ALTERNATIVE 2
FIGURE 12
CITY OF ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

MICHAEL S. FITZHENRY, P.E.
PROFESSIONAL ENGINEER
P.E. No. E-2001018730
11/01/2023

Designed M.S.F.
Drawn M.R.B.
Checked M.S.M.

Date NOVEMBER 2023
Sheet No 7 of 7

BASE MAP: L11,L12

4.2.2 CONSTRUCTION COSTS

The construction costs for Alternative 2 include the cost to construct a new section of 5-foot diameter CTP Culvert 1, a new section of 9-foot diameter CTP Culvert 2, an extension of the Coldwater Creek 12-foot x 12-foot double box culvert, and a 39 acre-ft. water quality storage basin at a location to be determined. The total cost is estimated at $13.5 million, including a 30% contingency and accounts for uncertainties in potential utility conflicts that may be encountered during design and construction. **Table 3** below provides a summary of costs for Alternative 2. A breakdown of the costs is provided in more detail in **Appendix B**.

Table 3: CTP Alternative 2 Construction Cost Summary

	COST ESTIMATE (CURRENT DOLLARS)	
Construction Costs	$	8,200,000
Contingency	$	2,460,000
General Contractor Markups	$	760,000
Owner's Soft Costs	$	2,000,000
Total Including Soft Costs	**$**	**13,400,000**
Environmental Assessment	$	540,000
ROM TOTAL COST ESTIMATE	**$**	**14,000,000**

Note: A cost for constructing a WQv basin is included in the construction costs for Alternative 2.

Source: M3 Engineering Group, 2023.

4.2.3 CONSTRUCTION SEQUENCING

Table 4 below displays the necessary order and expected duration of events for the construction of the CTP stormwater improvements for Alternative 2.

Table 4: Sequencing and Approximate Duration of Construction Events

CONSTRUCTION EVENT	APPROXIMATE DURATION
1. Demolition of Existing Structures	–
2. CTP Culvert 1 Construction	6 months
3. Enclosure of Coldwater Creek	6 months
4. Start of Construction on Western Leg of CTP Concourse and New Pavement	–
5. CTP Culvert 2 Construction (can occur simultaneously with construction of CTP Culvert 1)	9 months

Source: M3 Engineering Group, 2023.

4.3 ALTERNATIVE 3 - REROUTE CTP CULVERT 1 AND CTP CULVERT 2

MSD indicated they would review Alternative 2 closely to ensure no negative impacts to flooding and overland flow. Given MSD's input on Alternative 2, Alternative 3 was developed to evaluate the feasibility and effectiveness of rerouting CTP Culvert 2 around the east end of the proposed footprint of the Consolidated Terminal and tying back into the existing CTP Culvert 2 north of the proposed terminal. The CTP Culvert 2 alignment, shown in **Figure 13,** consists of 4,231 feet of 96-inch to 120-inch diameter pipe culvert.

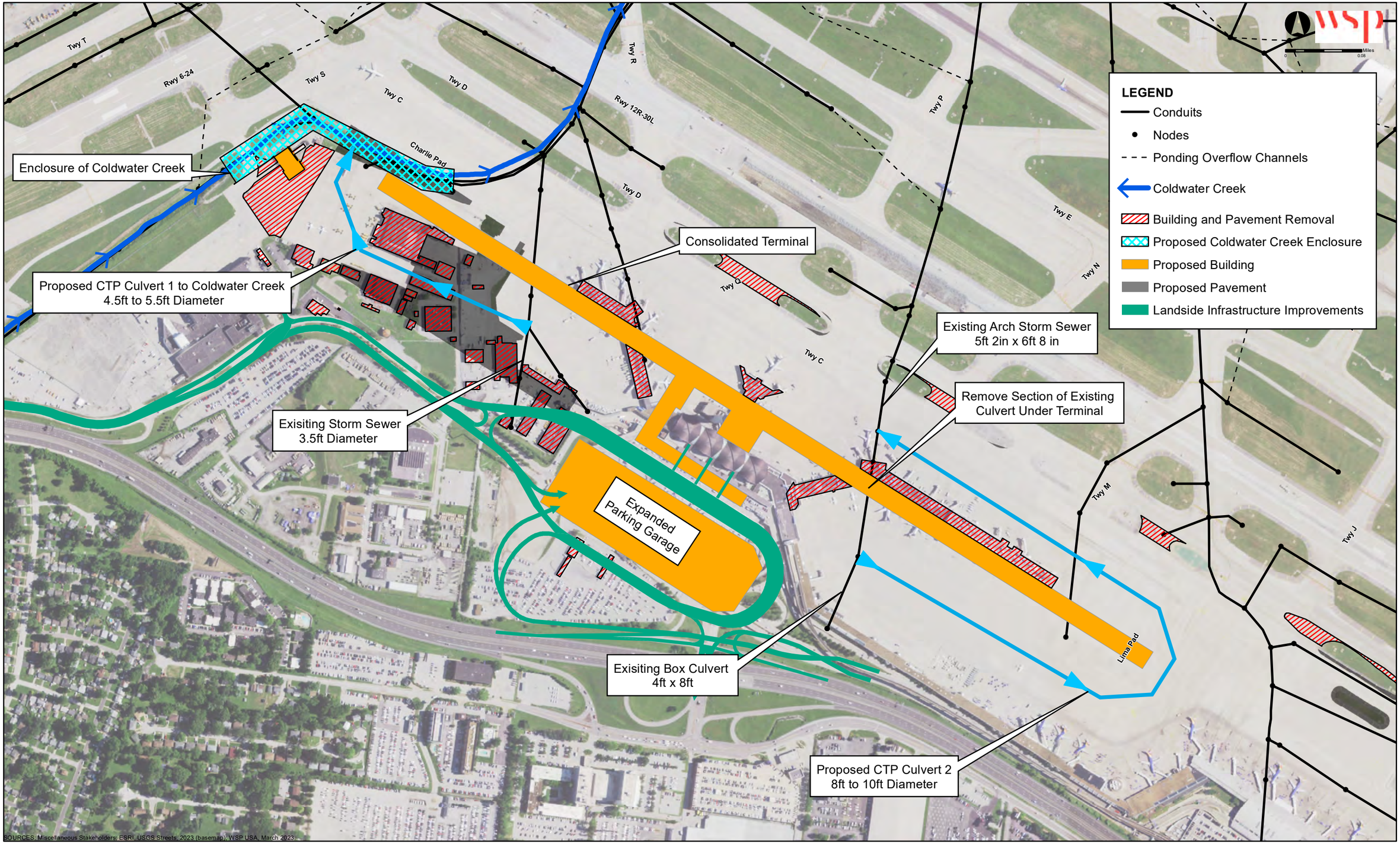
The slope of the proposed culvert had to be reduced due the longer length of this alignment. The reduced slope of 0.1% for the proposed section of CTP Culvert compares to an existing sewer slope of 0.6%. This reduction in slope decreased the capacity of the proposed section of pipe to the point Alternative 3 was not adequate to convey the design flows and was eliminated from further evaluation.

4.4 ALTERNATIVE 4 - REROUTE CTP CULVERT 1 AND CTP CULVERT 2

Alternative 4 reroutes all existing culverts around the footprint of the new Consolidated Terminal as shown in **Figure 14**. Alternative 4 was developed to provide a similar reroute of CTP Culvert 2 in Alternative 3, but with a greater pipe slope and capacity. Alternative 4 consists of installing the same 60-inch storm sewer (CTP Culvert 1) around the west end of the proposed terminal as proposed in Alternative 1 and 2. The existing 4' x 8' arch sewer (CTP Culvert 2) would be rerouted around the east end and north side of the new terminal with 6,802 feet of 120-inch diameter storm sewer before tying into the existing Coldwater Creek double box culvert**.**

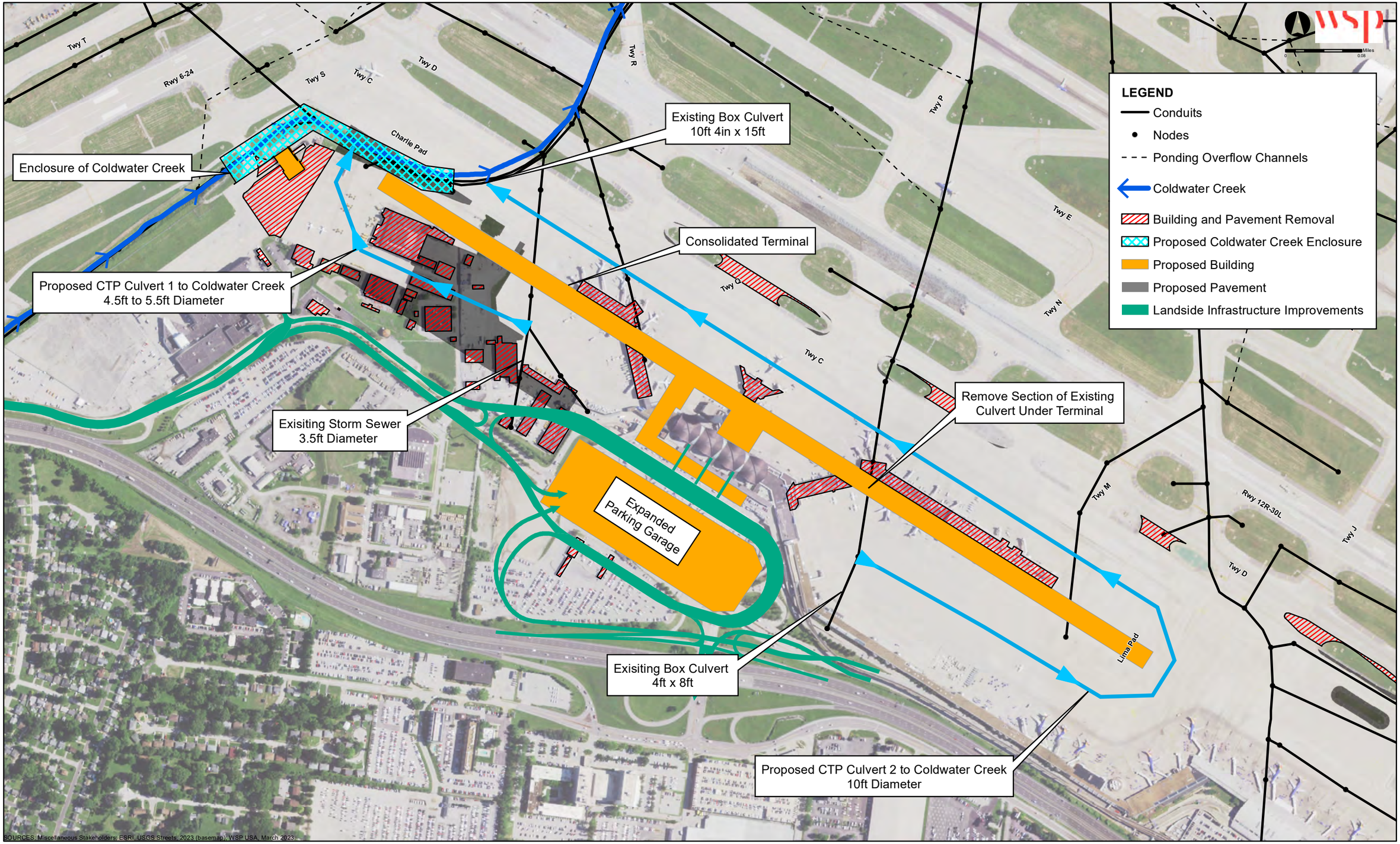
While Alternative 4 adequately conveys the 15-year design storm, construction of this alternative would cause significant disruption to use of the north side of the concourse for an estimated 12 to 15 months. Given the $23.4 million ROM cost of Alternative 4 far exceeds the ROM cost of Alternative 2 and the amount of disruption to Airport operations required by Alternative 4, a plan and profile evaluation of Alternative 4 was not warranted.

Figure 13
Consolidated Terminal Program - Proposed Improvements
Alternative 3



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (basemap); WSP USA, March 2023.

Figure 14
Consolidated Terminal Program - Proposed Improvements
Alternative 4



SOURCES: Miscellaneous Stakeholders; ESRI, USGS Streets, 2023 (basemap); WSP USA, March 2023.

4.4.1 CONSTRUCTION COSTS

The total Alternative 4 ROM cost is estimated at $23.4 million, including a 30% contingency and accounts for uncertainties in potential utility conflicts that may be encountered during design and construction. **Table 5** below provides a summary of costs for Alternative 4. A breakdown of the costs is provided in more detail in **Appendix B**.

Table 5: CTP Alternative 4 Construction Cost Summary

	COST ESTIMATE (CURRENT DOLLARS)
Construction Costs	$ 13,700,000
Contingency	$ 4,110,000
General Contractor Markups	$ 1,280,000
Owner's Soft Costs	$ 3,320,000
Total Including Soft Costs	**$ 22,410,000**
Environmental Assessment	$ 900,000
ROM TOTAL COST ESTIMATE	**$ 23,400,000**

Note: A cost for constructing a WQv basin is included in the construction costs for Alternative 4.

Source: M3 Engineering Group, 2023.

4.4.2 CONSTRUCTION SEQUENCING

Table 6 below displays the necessary order and expected duration of events for the construction of the CTP stormwater improvements for Alternative 4.

Table 6: Sequencing and Approximate Duration of Construction Events

CONSTRUCTION EVENT	APPROXIMATE DURATION
1. Demolition of Existing Structures	–
2. CTP Culvert 1 Construction	6 months
3. Enclosure of Coldwater Creek	6 months
4. Start of Construction on Western Leg of CTP Concourse and New Pavement	–
5. CTP Culvert 2 Construction (Construction may require phasing depending on operation of the existing terminal during construction)	12-15 months

Source: M3 Engineering Group, 2023.

4.5 RECOMMENDATIONS

Evaluation of stormwater alternatives is summarized in **Table 7** with the proposed CTP Culvert 1 being identical in all 4 alternatives.

Table 7: Evaluation of Alternatives

	ADVANTAGES	DISADVANTAGES
ALTERNATIVE 1	1. Proposed CTP Culvert 1 adequately conveys the 15-year Design Storm. 2. Low Cost Alternative due to use of existing CTP Culvert 2 in place	1. Providing a tunnel over the existing CTP Culvert 2 within the Consolidated Terminal will have some impacts on construction and usage of the lower level of new terminal for Airport maintenance and operations. 2. Existing CTP Culvert 2 Capacity is insufficient to convey the 15-year design storm resulting in surcharge above grade on the south side of the concourse.
ALTERNATIVE 2	1. Proposed CTP Culvert 1 adequately conveys the 15-year Design Storm. 2. Proposed CTP Culvert 2 adequately conveys the 15-year Design Storm without surcharge above grade. 3. CTP Culvert 2 sufficiently conveys storm flows for the 100-year event without flooding of the proposed Consolidated Terminal. 4. CTP Culvert 2 sufficiently conveys storm flows to meet FAA requirements for runways and taxiways during the 5-year and 10-year storms.	5. The alternative involves diverting flow from one culvert system to a different culvert which MSD indicated may draw greater scrutiny regarding evaluation of overland flow paths during the 100-year storm with and without Coldwater Creek backwater, but have been evaluated and meet MSD criteria.
ALTERNATIVE 3	1. Proposed CTP Culvert 1 adequately conveys the 15-year Design Storm.	2. Proposed CTP Culvert 2 for this alternative results in surcharge above grade as it does not have adequate capacity to convey the 15-year Design Storm.
ALTERNATIVE 4	1. Proposed CTP Culvert 1 adequately conveys the 15-year Design Storm. 2. Proposed CTP Culvert 2 adequately conveys the 15-year Design Storm.	3. Highest Cost Alternative due to long length of proposed 120-inch diameter CTP Culvert 2. 4. Alternative with the most disruptive construction to Airport operation.

Through evaluation of Alternatives 1, 2, 3, and 4, the recommended alternative is Alternative 2. Alternative 2 and Alternative 4 both are adequate hydraulically, but Alternative 2 avoids impacts to the north side of the main terminal, provides the lowest risks for construction, lower construction cost, and ease of future maintenance of the proposed sewers. CTP Culvert 1 and CTP Culvert 2 in Alternative 2 both adequately convey the 15-year design storm and provide adequate overland flow paths to convey the 100-year storm with 100-year Coldwater Creek backwater conditions.