CITY OF COOS BAY CITY COUNCIL
Agenda Staff Report

MEETING DATE	AGENDA ITEM NUMBER
December 4, 2012	

TO: Mayor Shoji and City Council

FROM: Jennifer Wirsing, Engineering Service Coordinator
Through: Rodger Craddock, City Manager and RCC
Jim Hossley, Public Works and Development Director

ISSUE: Presentation of Engineering Report, prepared by The Dyer Partnership, related to the Historic Drainage Issue at the Egyptian Theatre

BACKGROUND:
During storm events, specifically storm events occurring at high tide, the area in front of the Egyptian Theatre, including portions of southbound Highway 101, experiences ponding of water. This area, along with the majority of the downtown area is located within the defined Federal Emergency Management Agency (FEMA) 100–year floodplain. This historic ponding has been occurring for several decades. This ponding has been discussed in several meeting and staff was provided direction to analyze this historic condition and determine if a solution to the ponding could be engineered. The City contracted with The Dyer Partnership Engineers & Planners, Inc. (herein referred to as "Dyer") to prepare a drainage alternative analysis. Dyer is listed as one of the three on-call engineers in the City's Miscellaneous Engineering Services Contract and was the author of the 2004 Storm Water Master Plan. The Technical Memorandum prepared by Dyer has been included with this report for your reference.

This Technical Memorandum was not an exhaustive analysis, but rather a feasibility study to flush out the appropriate course of action if the City makes the decision to remedy this ponding situation. The Memorandum analyzed multiple options that range from re-grading the 101 to installing a regional pump station that will not only minimize the ponding at the Theatre but also the flooding situation that this entire basin experiences. An engineer from Dyer will present all of the alternatives in detail immediately following this staff report. The Technical Memorandum also includes cost estimates for the viable alternatives that were analyzed. As stated above, this Technical Memorandum is not an exhaustive analysis however the memo did analyze this situation in more detail than the 2004 Dyer report that is discussed below.

In 2004 Dyer prepared a Stomwater Master Plan for the downtown Coos Bay area which comprises 2,300 acres. In addition to other areas, the plan evaluated all the drainage basins and tidegates along the Highway 101 corridor. The plan identified numerous projects and drainage issues. One of which was the local ponding in front of the Egyptian Theatre. In reference to this ponding, the plan stated that "without pumping this area is subject to flooding during high tide high rain events". However resolving this ponding issue was not identified as a priority in the Master Plan nor was it identified in the twelve Priority 1 projects that totaled over 8.3 million dollars (Note: This amount is based on 2004 dollars and does not include inflation). It is important to note that these Priority 1 projects are only for the downtown area. The City also has a Master Plan that analyzes the remaining portion of the City. Within that Master Plan there is 4.9 million dollars worth of additional storm water projects.

ADVANTAGES:
If the Council chooses to pursue a solution for the ponding at the theatre, it shall minimize the historic flooding situation at the theatre. Additionally, the ponding will also be reduced along Highway 101.

DISADVANTAGES:
Due to the size of the drainage basin, the intense storms, and high tides it is not feasible to completely resolve the flooding issues associated with the Theatre and the drainage basin. Additionally, analyses would have to be performed to ensure that adjacent structures, drainage basins, and Highway 101 are not impacted by the preferred solution. Also, as stated previously, the Memorandum is not a comprehensive analysis, additional analysis will have to be performed and plans and specifications will have to be prepared. Based the report's cost estimate for a regional pump station and assuming 10% design cost, design could be approximately $200,000. Any solution that the City would proceed forwards with will only minimize the flooding. The cost estimates associated with the solutions presented in the Dyer Technical Memorandum are significant and have not been included in the City's overall 20-Year Plan. If the City decides to proceed forward with one of the recommendations with the Dyer Memorandum, staff will have to consult with a financial consultant to determine an appropriate rate increase to implement this additional project. There are numerous other projects that are identified in both of the City's Storm Water Master Plans that have been determined to be a higher priority than the Egyptian Theater flooding. The majority of these higher priority storm water projects have not been included in the City's 20-year plan due to higher priority sanitary sewer projects and cost limitations.

BUDGET IMPLICATIONS:
Should Council decide to move forward and further explore solutions for the ponding at the Theatre, Staff will work with a waste water financial consultant to determine the new rate increase that is necessary to fund this project (both design and construction). If Council moves forward with the preferred recommendation within the Technical Memorandum, the total cost for the project could exceed 2 million dollars.

ACTION REQUESTED:
Provide direction to Staff regarding the drainage issue associated with the Egyptian Theatre. If Council decides to move forward and further evaluate a solution, it is suggested that a work session be scheduled. There are many items to be considered that need to be determined prior to entering into a contract with a design engineer. These items can include but are not limited to:

- Understanding all alternatives
- Determining the preferred alternative
- Formalize a scope of work for the design engineer
- Funding of the Project (both design and construction)

ATTACHMENTS:
1. November 26, 2012 Technical memorandum for the Egyptian Theatre Storm Drain Alternatives, prepared by The Dyer Partnership Engineers & Planners, Inc.

TECHNICAL M E M O R A N D U M

Project: City of Coos Bay

Subject: Egyptian Theatre Storm Drain Alternatives

Date: November 8, 2012

Prepared By: Aaron Speakman, P.E.

PURPOSE AND SCOPE

The purpose of this technical memorandum is to evaluate and present four (4) viable alternatives to reduce the impacts of flooding in front of the Egyptian Theatre.

BACKGROUND & EXISTING STORM DRAINAGE

The Egyptian Theatre is located at 229 S. Broadway Street (Highway 101 southbound) and has historically had drainage issues in front of the building. There is a storm drain catch basin located on Highway 101 directly in front of the building. Storm water runoff from the catch basin is then piped in a northerly direction through an 8-inch storm drain pipe for approximately 433 feet. The 8-inch pipe intersects with two other storm drain systems at the intersection of S. Broadway Street and Central Avenue, and then conveys flow in an easterly direction along Central Avenue for approximately 313 feet, and ultimately flows into the Bay.

During storm events, specifically storm events occurring at high tide, ponding occurs and has caused flooding through the front doors of the theatre and along Highway 101 southbound, immediately adjacent to the theatre.

The Egyptian Theatre is located in Storm Drainage Basin No. 11 as described in the Storm Water Master Plan dated September 2004, prepared by The Dyer Partnership Engineers and Planners. As described in the Storm Water Master Plan, Basin No. 11 is approximately 7.7 acres in size, and has a 50-year storm runoff of 8.3 cubic feet per second (cfs).

EXISTING STORM DRAIN MAP

The figures included in the Appendix that accompany this memorandum include existing storm drainage infrastructure serving the Egyptian Theatre and the surrounding area. Figure No. 3 illustrates the existing storm drain system.

EVALUATION OF EXISTING STORM DRAIN INFRASTRUCTURE

Evaluation of the existing storm drain infrastructure was limited to visual inspection of storm drain components directly linked to the Egyptian Theatre drainage issues described as follows:

Storm water outfall: The outfall is named Tidegate No. 14 by the City of Coos Bay Storm Water Master Plan. The outlet pipe is an 18-inch corrugated metal pipe (CMP) with a hinged metal tidegate at the end of the pipe. The tidegate mechanism appears to function as designed, however the existing 18-inch CMP pipe is failing and has holes in the outfall piping allowing water to flow back into the system around the tidegate. See the Appendix for photos of the outfall pipe and tidegate.

Catch Basin in front of Egyptian Theatre: This catch basin does not have a concrete bottom. The bottom of the catch basin is mud and bare earth.

Sidewalk in front of Egyptian Theatre: The sidewalk directly in front of the Egyptian Theatre creates ponding between the entry doors and the curb of Highway 101. The grades are such that any water that overtops or lands on the sidewalk runs back towards the doorway of the theatre. Photos of the sidewalk in front of the Egyptian are located in the Appendix. Figure No. 2 in the Appendix shows the approximate elevations of the sidewalk and entry to the theatre.

DYE TESTING

Dye testing of the storm drain catch basin located in front of the Egyptian Theatre was conducted on July 18th, 2012 with the assistance of the CH2M Hill Collection Crew. The purpose of the dye testing was to confirm that the catch basin located in front of the Egyptian Theatre was connected to the storm water outfall denoted as Tidegate No. 14 in the City of

Coos Bay Storm Water Master Plan. Dye testing confirmed that the catch basin located in front of the Egyptian Theatre was connected to Tidegate No. 14.

An unknown outfall pipe was noted adjacent (north) to Tidegate No. 14. No dye was observed in the outfall pipe, although fluid was witnessed flowing out of the pipe. Since the outfall is not known to connect to the existing storm drain system, this outfall was not further evaluated.

EVALUATION OF CAUSE OF FLOODING/PONDING IN FRONT OF THEATRE

To obtain gravity flow of storm water to the bay, the storm water system must obtain enough head pressure to open the tidegate, overcome friction losses within the pipe, and ultimately discharge to the bay. When high tides and high river levels combine, the head pressure required by the storm drainage system increases. The flooding seen in front of the Egyptian Theatre is the storm water backing up in order to develop the required head pressure to allow the storm water flows to discharge to the bay. The catch basin and area located in front of the Egyptian Theatre appears to be the lowest point within the limits of Basin No.11, and explains why the flooding occurs in this area.

Figure No. 2 is a schematic profile from the Egyptian Theatre to the outfall, and graphically shows the profile elevations in a section view. Figure No. 4 in the Appendix is a large scale excerpt of the Flood Hazard Map (2004 Storm Water Master Plan Figure A-4) for the area surrounding the Egyptian Theatre. This shows that the area is well within the FEMA 100-year flood boundary.

The historical recorded high tide (including increased river levels) in the bay was approximately 11.00 feet as noted in the 2004 Storm Water Master Plan. The mean higher high water (MHHW) is the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. In Coos Bay the MHHW is approximately 7.5 feet. The MHHW levels do not adjust or account for higher river levels as a result of significant rainfall events. Historically Coos Bay experiences some of the year's highest high tide events during December and January, which also occur during some of the yearly

peak rainfall events. A schematic of the elevations mentioned above is shown graphically in Figure No. 2 in the Appendix of this memo.

The majority of the area located within Storm Drain Basin No. 11, including the catch basin in front of the Egyptian Theatre, is located below historical high tide levels. The ponding and flooding in front of the Egyptian Theatre is a result of the catch basin's rim elevation being at an elevation of 9.53 feet. This rim elevation is not high enough to allow the storm drain system to generate the required hydraulic head to handle the basins storm water flows. The catch basin is also missing a bottom, potentially allowing groundwater to infiltrate into the storm drain system.

Hydraulic modeling and elevation mapping conducted in the City's Storm Drain Master Plan determined that a pump station would be required to reduce flooding in this area during high tide/high rainfall events.

STORMWATER RUNOFF VOLUMES

As described in the City of Coos Bay Storm Drain Master Plan, Basin No. 11 collects storm water for the area surrounding the Egyptian Theatre. The study calculated the peak storm water runoff for a 50-year storm (6.0 inches of rainfall over a 24-hour period) to be 8.3 cfs or approximately 3,725 gallons per minute (gpm). Runoff calculations from the Storm Water Master Plan for Basin No. 11 are located in the Appendix.

A site survey was conducted to determine elevations and limits of the runoff area draining to the catch basin in front of the Egyptian Theatre. The roof structure of the Egyptian Theatre drains approximately 80 percent of the roof structure to the roadway catch basin, while the back portion of the roof drains to the alley behind the building. It is assumed that the buildings located directly to the north of the Egyptian Theatre also have a large portion of their roofs draining to the front of the buildings. This assumption was made since gutter drains enter the roadway curb in front of the buildings. It should be noted that the portion of the roof that drains to the alley behind the theatre is located within the same drainage basin

(Basin No. 11). Ultimately these flows are conveyed to the same outfall as the flows associated with the portion of roof that drains to the font of the theatre.

The approximate runoff area used in evaluating a local pump station for the area impacting or directly draining to the catch basin in front of the Egyptian Theatre is 45,600 square feet. Utilizing the Rational Equation for storm water runoff calculations, a 50-year storm water event results in a peak runoff for the area contributing to the flooding area of approximately 3.39 cfs or 1,520 gpm. The local pump station runoff calculations are located in the Appendix.

ALTERNATIVES CONSIDERED BUT NOT EVALUATED

Six alternatives were evaluated to alleviate the flooding in front of the Egyptian Theatre. A Summary of Alternatives Analyzed is included within the Appendix. Of the six alternatives analyzed, only four were found to be feasible alternatives that would alleviate the flooding problem in front of the Egyptian Theatre. The two infeasible alternatives evaluated are described below.

Infeasible Alternative 1: Routing Storm Water Runoff to Southern Drainage Basin

Storm Drain Basin No. 12B (Storm Drain Master Plan 2004) is located directly to the south of Basin No. 11. Basin No. 12B is referred to as the Blossom Gulch Drainage Basin and during high tide and rainfall events, the basin experiences flooding similar to that of the Egyptian Theatre and Basin No. 11. The Storm Drain Master Plan indicates that there is no additional capacity within the Basin No. 12B storm drain system due to undersized storm drain infrastructure within the basin. Contributing additional flows from Basin No. 11 to Basin 12B would increase flooding impacts to Basin 12B. Due to the significant costs required to increase the storm drain infrastructure in Basin No. 12B, this alternative was considered infeasible. No project costs were estimated for this alternative.

Infeasible Alternative 2: Re-grading Highway 101 within the Vicinity of the Theatre

Raising the finished grades of the Highway would require replacement or modification to surrounding roadways, intersections, crosswalks, sidewalks, curbs, storm drain manholes,

roof drains, sewer manholes, and many other unforeseen utilities. Most business entryways, storefronts, and foundations would be impacted by the re-grading of Highway 101. Raising of the roadways would increase the ponding of storm water in surrounding areas due to the low elevations within the storm drain basin. Depending on finished grading of a raised roadway, surrounding storm drain basins such as Basin No. 12B could be impacted.

Raising of the sidewalks, while keeping Highway 101 at its current grade, would not eliminate standing water on the Highway, and water would be splashed and conveyed from the roadway to the sidewalks and surrounding businesses. Water that currently ponds on the sidewalk would be added to the ponding water in the roadway if the sidewalk is repaired and the storm drain system not upgraded. This alternative was considered infeasible due to the overall project complexity, project costs, and impacts to surrounding businesses.

FEASIBLE ALTERNATIVES

Four feasible alternatives to reduce flooding impacts in front of the Egyptian Theatre are described below. A plan view schematic of each alternative is included in the Appendix of this memorandum. Each alternative is provided for planning purposes, and is not considered a final design. The number of catch basins, final infrastructure sizing, routing, construction methods, and locations would be determined during final design.

Cost estimates for each feasible alternative are provided within the Appendix of this memo. The cost estimates shown include construction costs, engineering costs, contingencies, legal, permitting, and administrative costs. No land acquisition or easement costs are included within the estimates and it is assumed the pump stations would be placed within City-owned property and/or right-of-way. Each feasible alternative has a cost estimate provided with a range of minus 10% to plus 20% to cover unforeseen costs and/or design changes.

All four of the feasible alternatives analyzed include replacement or rehabilitation of at least one outfall pipe to Coos Bay. Each outfall would involve work within the Port of Coos Bay Railroad right-of-way, Oregon Department of Transportation (ODOT) right-of-way, Division of State Lands (DSL), United States Army Corps of Engineers (USACE), and have potential

impacts to the City Boardwalk and dike system. Significant planning and coordination will be required for these projects, due to the strict construction standards and permits required by the various jurisdictions and agencies.

Railroad crossings typically require special permitting, insurances, and bonding along with locating all pipes under the rails within a steel casing pipe. We anticipate that the rail system is being supported by wood piles as were encountered during the installation of the Koos Bay Boulevard Storm Drain Outfall project in 2007. Installation of a casing pipe under a railroad supported by wood piles significantly increases construction costs.

Alternative 1: Local Pump Station at Egyptian Theatre-New Outfall

This alternative includes a new pump station, catch basins, piping, and infrastructure to reduce flooding in front of the Egyptian Theatre. The existing storm drain catch basin in front of the Egyptian Theatre and the 173 feet of storm drain piping that connects this storm drain catch basin to Basin No. 11 would be abandoned. Five new catch basins located within the vicinity of the Egyptian Theatre would convey storm water across S. Broadway (Highway 101 South) to a new pump station located in the parking lot across the street from the theatre. The pump station would include a new wet well with submersible pump. The submersible-style pump was selected rather than vertical turbine style pumps so that no parking spaces would be eliminated in the existing parking lot. A control panel for the pump station would be placed inside the existing fenced recycling/dumpster area of the parking lot. A new outfall line would exit the proposed pump station and be installed in an easterly direction across Highway 101, the railroad, the dike, and discharge into Coos Bay.

The outfall would serve both as the pump station force main and the gravity storm drain line. During normal rainfall events when pumping is not required, the system would be a gravity storm drain system. If high water events were experienced, floats or level sensors within the wet well would trigger operation of the pump station to lower storm water levels within the area. A check valve in a vault outside of the wet well would prevent the pumped storm water from re-circulating back into the storm drain system and prevent short circuiting of the system.

The pump station would have a capacity of approximately 3.39 cfs or 1,520 gpm. The pump horsepower would be 10 to 12 horsepower. The outfall pipe to the bay would be an 18-inch diameter PVC pipe with a tidegate.

This alternative only addresses the flooding issues directly in front of the Egyptian Theatre and does not address storm water issues in Basin No. 11. In high water events, some catch basins in Basin No. 11 could still overflow and surcharge back into the low point that floods in front of the Egyptian Theatre, exceeding the capacity of the pump station.

Estimated project cost for Alternative 1: $1,060,000 to $1,142,000

Alternative 2: Local Pump Station at Egyptian Theatre-New Outfall and Replacement of Basin No. 11 Outfall

This alternative is the same as Alternative 1 with the addition of replacement of the existing storm drain outfall line serving Basin No. 11 (Tidegate No. 14). Without the replacement of the Basin No. 11 outfall line, storm water backs up into Basin No. 11's storm water system, and during extreme high tides and rainfall events, flooding as a result of surcharging within the basin, could eventually flood into the area in front of the Egyptian Theatre.

The outfall replacement for Basin No. 11 is anticipated to be a 24-inch diameter outfall with new tidegate. The existing outfall is an 18-inch diameter pipe. The increase to a 24-inch diameter pipe is recommended for the basin to accommodate the peak flows within the basin.

The benefit of this alternative is that it addresses the localized flooding issues in front of the Egyptian Theatre and also eliminates outfall issues affecting Basin No. 11. This alternative does not address all storm water issues for Basin No. 11. In high water events, some catch basins in Basin No. 11 could still overflow and surcharge back into the low point that floods in front of the Egyptian Theatre.

Estimated project cost for Alternative 2: $1,114,000 to $1,486,000

Alternative 3: Regional Pump Station for Storm Drain Basin No. 11 (Recommended Alternative)

This alternative includes installation of a new regional pump station with associated piping and manholes from the catch basin in front of the Egyptian Theatre to the pump station, and replacement of the existing Basin No. 11 outfall pipe. The regional pump station would convey Basin No. 11's peak 50-year storm water flows to the bay. The pump station would have a capacity of 8.3 cfs (3,725 gpm), and would significantly reduce flooding within Basin No. 11 and the area in front of the Egyptian Theatre.

The pump station would only pump when high water was detected within the system. During periods of high rainfall and low tides, the system would operate as a gravity flow system. A new manhole or vault would be installed to accommodate the gravity storm drain line and the new pump station force main. A check valve would be installed on the gravity system to prevent short circuiting of the storm drain system when the pump station was in operation. Replacement of the existing outfall would also be conducted and would include a new tidegate on the outfall to prevent debris from entering the system and clogging the outfall manhole.

The existing storm drain lines and infrastructure not directly connected to the catch basin in front of the Egyptian Theatre were not evaluated for capacity or condition. Flooding could still occur if it is determined that a surrounding storm water basin surcharges into Basin No. 11, or if the existing storm water piping in Basin No. 11 is currently undersized or in poor condition.

Significant planning would be required for construction of a regional pump station in Basin No. 11. Portions of the existing storm drain conveyance system and outfall piping are located under concrete sidewalks and artwork adjacent to the new City of Coos Bay Visitors Center. These lines may require replacement or relocation.

Estimated project cost for Alternative 3: $1,613,000 to $2,150,000

Alternative 4: Local Pump Station at Egyptian Theatre -Shared Outfall

This alternative includes a new local pump station for the area in front of the Egyptian Theatre described in Alternatives 1 and 2. Alternative 4 would construct a new outfall that would be shared between the local pump station at the Egyptian Theatre and Basin No. 11. The pump station force main would discharge into a manhole or vault located in Basin No. 11's outfall line. The manhole or vault would be located in the dike and have enough head capacity to allow storm water flows to gravity flow from the manhole to the bay. A check valve would be located on the main Basin No. 11 outfall piping to prevent short circuiting of the storm water from the pump station discharge and back into Basin No. 11. All of the storm water flows from the catch basins in front of the Egyptian Theatre would require full time pumping; there would be no gravity flow from the station to the bay.

In high water events, some catch basins in Basin No. 11 could still overflow and surcharge back into the area that floods in front of the Egyptian Theatre, exceeding the capacity of the pump station. The existing storm drain lines and infrastructure not directly connected to the catch basin in front of the Egyptian Theatre were not evaluated for capacity or condition. Flooding could still occur in front of the Egyptian Theatre if it is determined that a surrounding basin surcharges into Basin No. 11, or if the existing storm water piping in Basin No. 11 is currently undersized or in poor condition.

Estimated project cost for Alternative 4: $1,022,000 to $1,362,000

EVALUATION OF ALTERNATIVES

To obtain gravity flow of storm water to the bay, the storm water in front of the Egyptian Theatre, along with all of the storm water within Basin No. 11, must obtain enough head pressure to open the tidegate, overcome friction losses within the pipe, and ultimately discharge to the bay. The flooding seen in front of the Egyptian Theatre is the storm water within Basin No. 11 backing up in order to develop the required head pressure to allow the storm water flows to discharge to the bay. The catch basin located in front of the Egyptian Theatre is the lowest point within the limits of Basin No. 11.

Construction of a local pump station as described in Alternatives 1, 2, and 4 will reduce some flooding events in front of the Egyptian, but doesn't address the root cause of the flooding, which is that the Egyptian Theatre and surrounding areas of Basin No. 11 are at a lower elevation than high tide. A gravity storm drain system that can't create enough head pressure to drain will surcharge and cause flooding, as is the case with the current storm drain system. Alternatives 1, 2, and 4 will all reduce the flooding impacts, but impacts may still be seen when surrounding areas flood due to the tide being at a higher elevation.

Due to such a large area of Basin No. 11 being within the FEMA 100-year boundary and below the historic high tide elevation, reduction in flooding impacts to the area in front of the Egyptian Theatre is best addressed by installation of a regional pump station as described in Alternative 3. The regional pump station would reduce flooding in a larger area than any of the other alternatives analyzed. The regional pump station should not be assumed to have the capacity to eliminate of all flooding issues with Basin No. 11, because adjacent storm drain basins may flood and contribute additional storm drain flows to Basin No. 11. However a regional pump station would certainly reduce the magnitude of flooding impacts.

The Egyptian Theatre and surrounding businesses could construct on-site property-specific flood prevention infrastructure. For example, the theatre could raise their entry doors and foyer leading into the building; however these types of systems do not eliminate flood impacts and do have high costs to the individual properties. Reconstruction of the sidewalk in front of the theatre to eliminate the negative slopes on the sidewalk would reduce ponding in front of the theatre doors, but again would not prevent all flood impacts.

A Summary of Alternatives Analyzed is located on the next page.

SUMMARY OF ALTERNATIVES ANALYZED

ALTERNATIVE	ADVANTAGES	DISADVANTAGES	ADDITIONAL CONSIDERATIONS	PROJECTED PROBABLE COST
1 Local Pump Station at Theatre and New Outfall	- Reduce flooding at theatre - Underground Pump Station will have no impact on parking - Improves inlet in front of theatre	- Does not eliminate flooding - Requires an additional outfall to be constructed - Does not repair existing outfall - Only addresses flooding issues at the theatre	- Environmental Permitting will be required - Federal permitting will required to install storm drain under railroad tracks - Federal permitting (FEMA, Army Corps of Engineers) will have to be performed to install storm drain under dike - Due to additional permitting, the schedule for completion may be extended. - Additional calculations would have to be performed to determine actual capacity of storm drain system - ODOT coordination will have to be performed - In order to further reduce and/or eliminate flooding the entire downstream storm drain system must be upsized. This will significantly increase costs and most likely make project infeasible	$1,060,000 To $1,142,000
2 Local Pump Station at Theater, New Outfall, and Replacement of Existing Outfall	- Reduce flooding at theatre - Underground Pump Station will have no impact on parking - Improves inlet in front of theatre - Improves existing outfall	- Requires an additional outfall to be constructed - Does not eliminate flooding - Only addresses localized flooding issues at the theatre		$1,114,000 To $1,486,000
3 Regional Pump Station *RECOMMENDED PLAN*	**- Reduce flooding at theatre - Reduce flooding throughout entire basin - Improves inlet in front of theatre - Improves existing outfall - May not require an additional outfall**	**- Does not eliminate flooding - Pump station may impact parking - Highest project cost that was analyzed**		**$1,613,000 To $2,150,000**
4 Local Pump Station at Theatre and a shared Outfall	- Reduce flooding - Underground Pump Station will have no impact on parking - Improves inlet in front of theatre - Improves existing outfall - Does not require an additional outfall	- Does not eliminate flooding - Requires full time pumping because proposed storm drain cannot be gravity flow - Only addresses flooding issues at the theatre		$1,022,000 To $1,362,000
Additional Alternatives That Were Discarded Due To Infeasibility				
Routing Runoff to the Southern Drainage Basin	Not Evaluated			
Re-Grading Highway 101 Within the Vicinity of the Theatre	Not Evaluated			

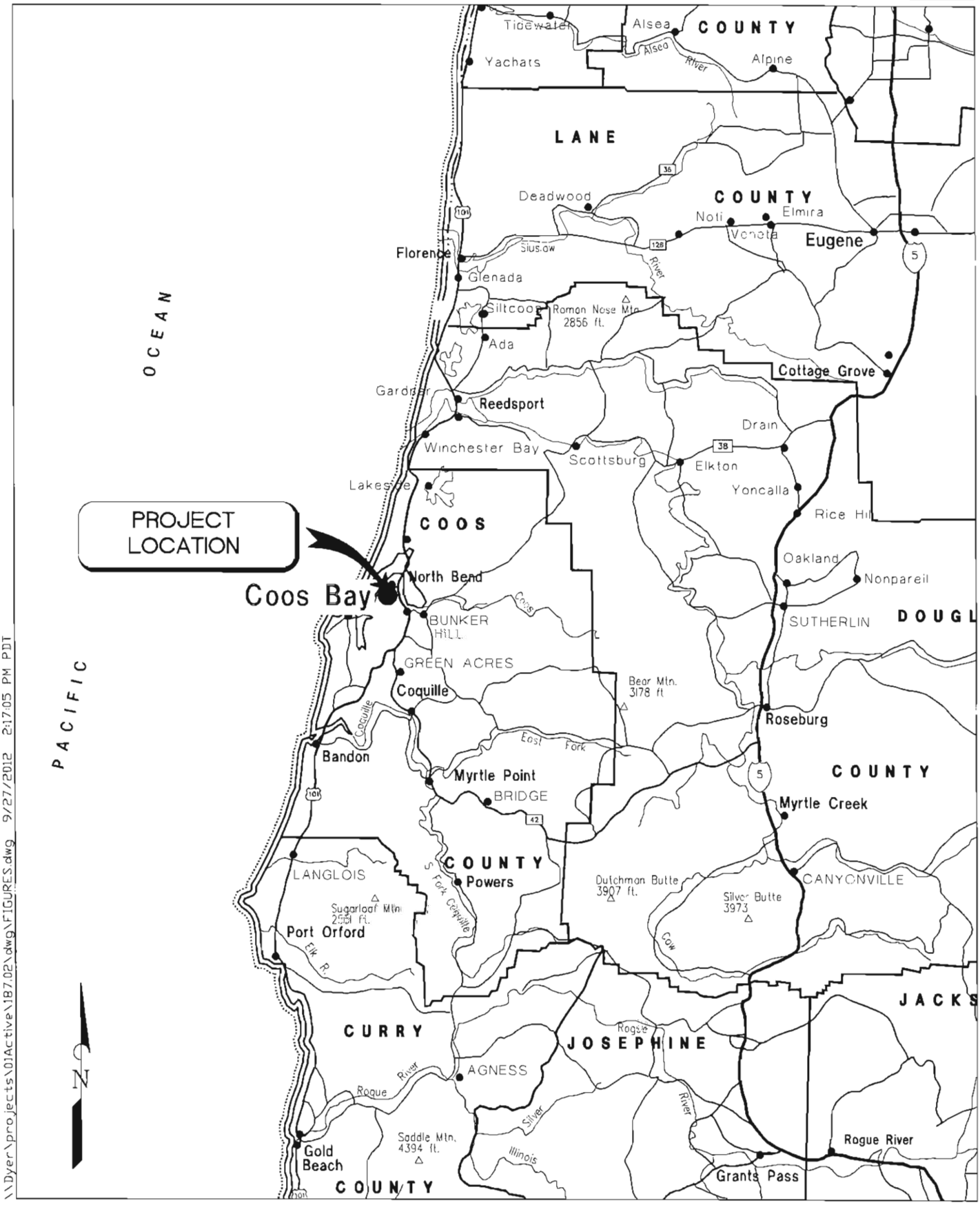
RECOMMENDED ALTERNATIVE

The sidewalk issues in front of the Egyptian Theatre should be corrected to prevent ponding on the sidewalk. The sidewalk and entry should be reconstructed so that slope is obtained from the entry doors to the curb without creating a location for ponding water. However, correction of the sidewalk without correcting the storm drain system will increase the volume of ponding water in front of the Egyptian Theatre. This additional ponding may adversely impact Highway 101 and adjacent buildings.

As such, if the City wishes to proceed forward with a solution to minimize the flooding at the Egyptian Theatre, it is recommended that the City further investigate Alternative No. 3 – Regional Pump Station for Storm Drain Basin No. 11. Additionally, the catch basin in front of the Egyptian Theatre would be replaced as part of Alternative No. 3. This will minimize the potential for groundwater and sediment to filter into the storm drain system and further impact the flooding. This alternative has the highest potential to reduce flooding in front of the Egyptian Theatre and also provides a regional solution for Basin No. 11.

City of Coos Bay
Egyptian Theatre Storm Drain Alternatives
Appendix

Table of Contents



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THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. *1*
DATE: SEP, 2012	*PROJECT LOCATION MAP*	
PROJECT NO.: 187.02		

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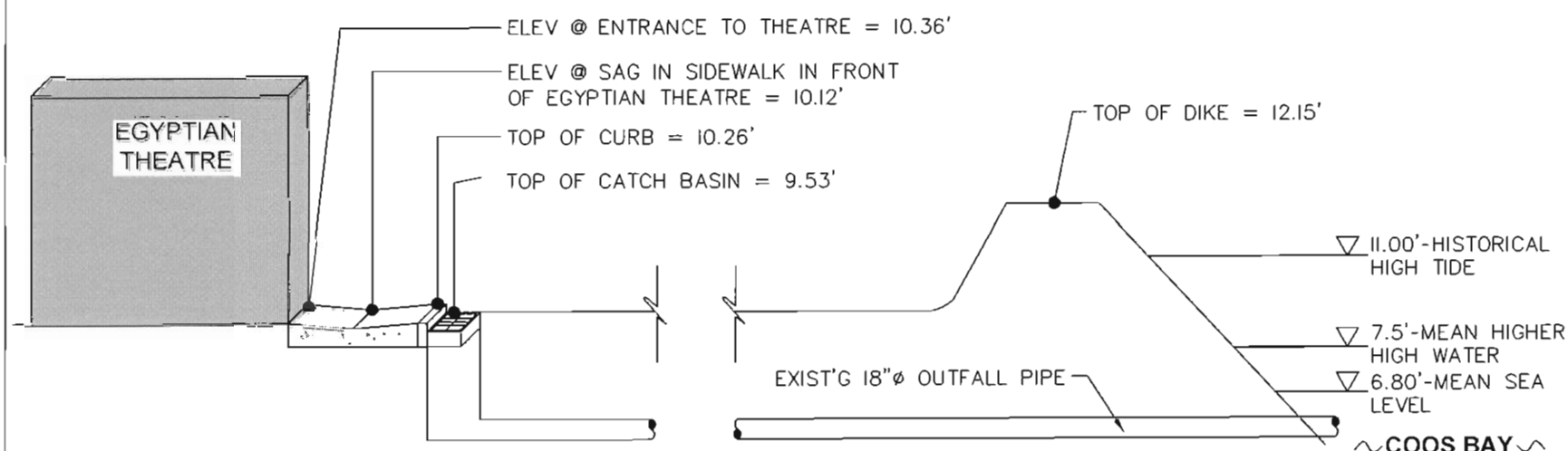

SCHEMATIC PROFILE
NOT TO SCALE

NOTES:
1. ALL ELEVATIONS ARE SHOWN IN NAVD 88 DATUM
2. HISTORICAL HIGH TIDE INFORMATION TAKEN FROM THE STORM WATER MASTER PLAN. DYER, 2004.
3. MEAN HIGHER HIGH WATER AND MEAN SEA LEVEL INFORMATION OBTAINED FROM NOAA CALIFORNIA STREET BOAT RAMP DATA FOR TIDAL DATUMS.
4. ELEVATION OF EXISTING OUTFALL NOT CONFIRMED.

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS, INC.

DATE: SEP, 2012
PROJECT NO.: 187.02

CITY OF COOS BAY
EGYPTIAN THEATRE STORM DRAIN STUDY
SCHEMATIC PROFILE

FIGURE NO.
2

Agenda Item #5

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THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. *3*
DATE: SEP, 2012	*EXISTING STORM DRAIN SYSTEM*	
PROJECT NO.: 187.02		

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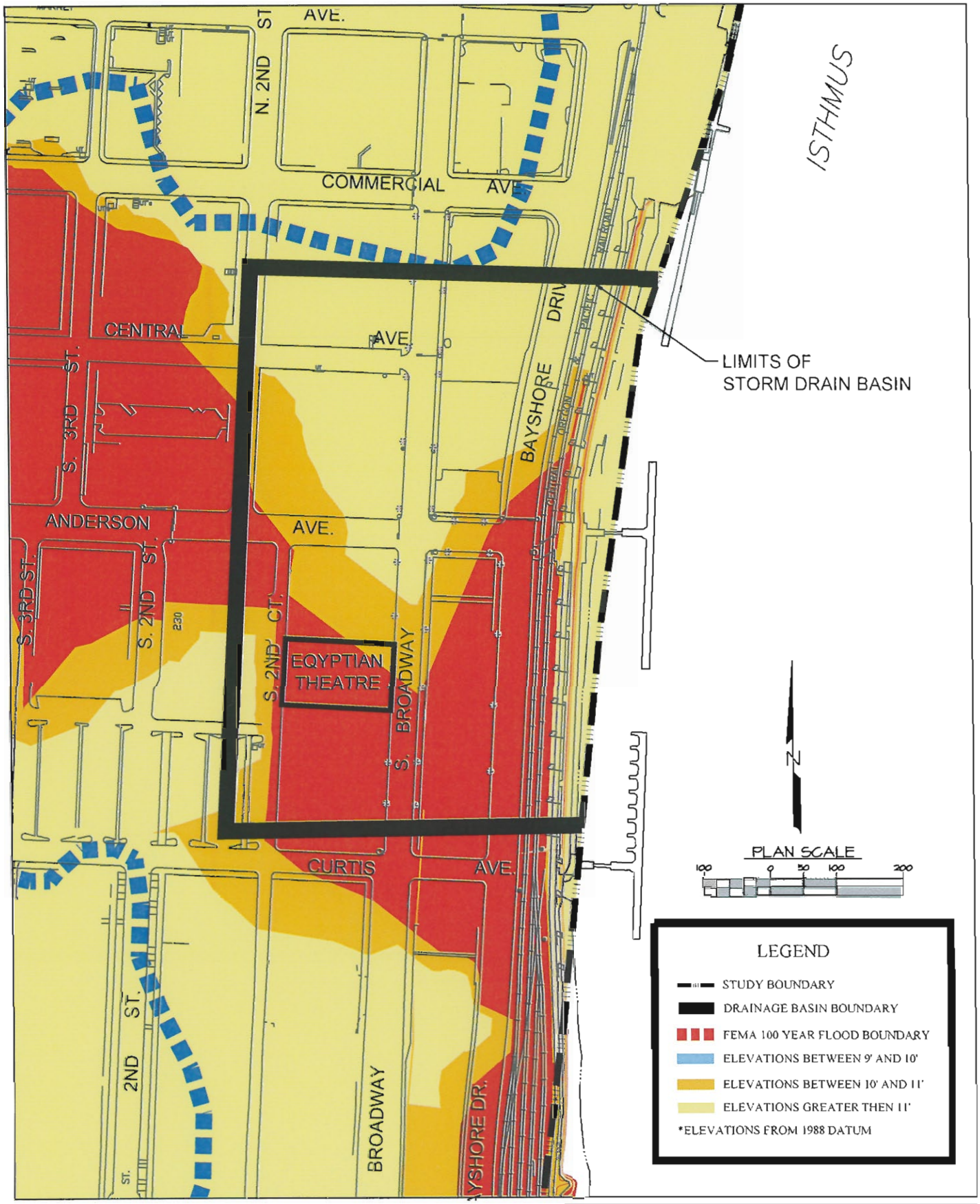
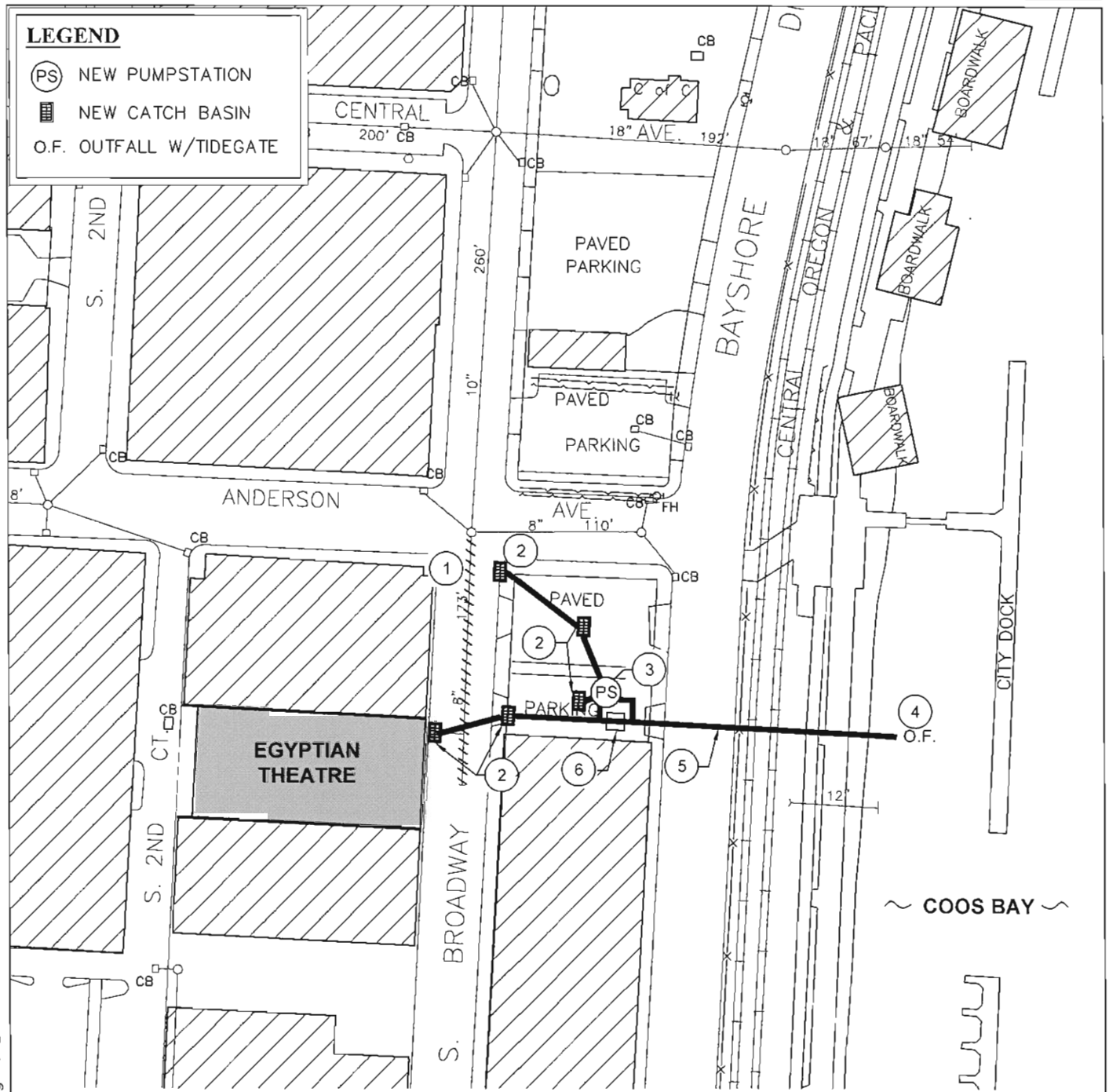


THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	**FIGURE NO.** 4
DATE: NOVEMBER, 2012 PROJECT NO.: 187.02	*FLOOD HAZARD MAP*	



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. 5
DATE: SEP, 2012	*ALTERNATIVE 1*	
PROJECT NO.: 187.02		

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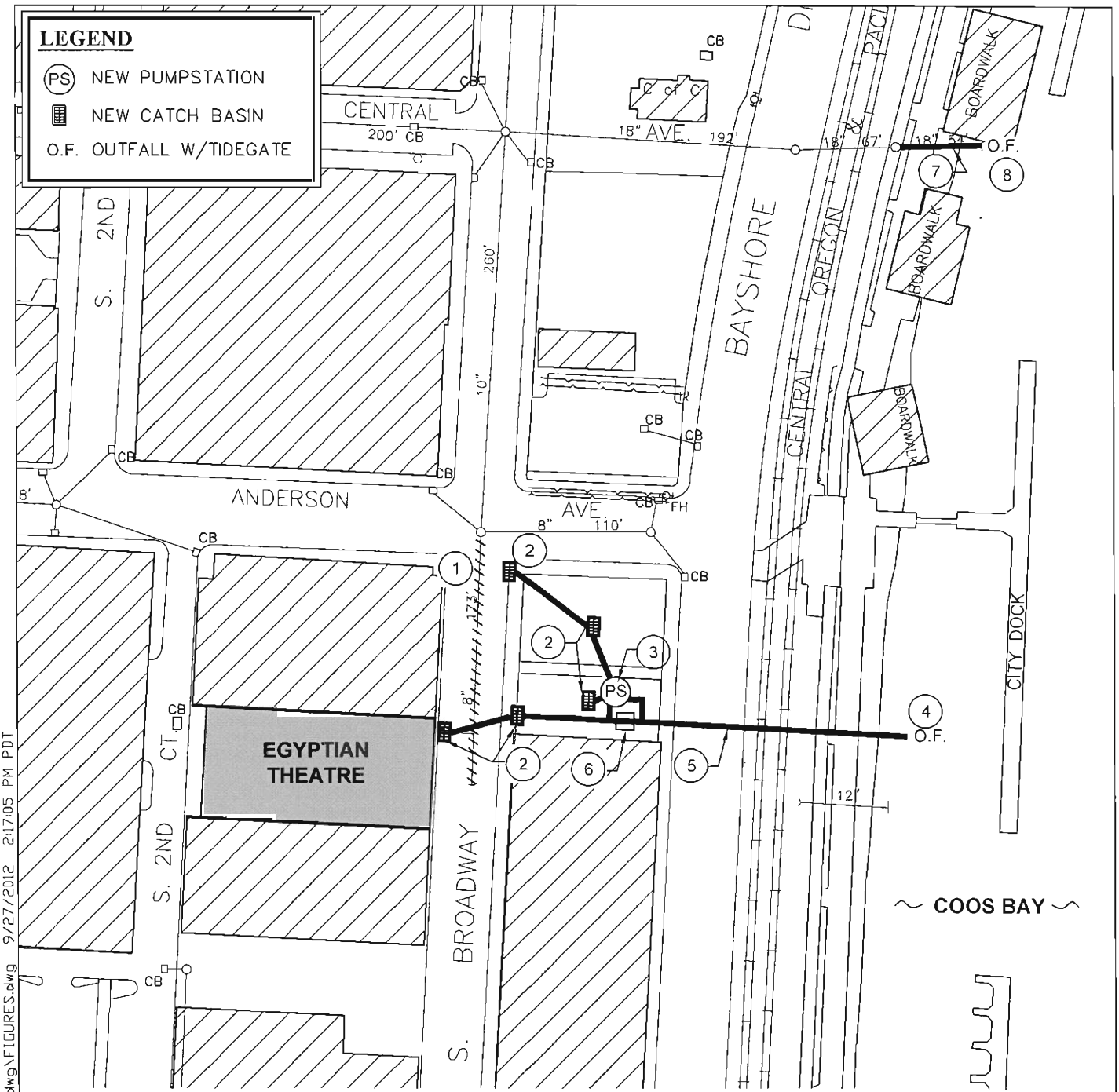

1. PLUG & ABANDON EXIST'G STORM DRAIN LINE.
2. NEW CATCH BASINS
3. NEW PUMP STATION - 1,233 GPM
4. NEW OUTFALL W/TIDEGATE
5. NEW PUMP STATION FORCEMAIN/GRAVITY STORM DRAIN LINES - 18"ø PIPE
6. NEW VAULT W/CHECK VALVE
7. NEW GRAVITY STORM DRAIN PIPE - 24"ø
8. NEW TIDEGATE

N

SCALE: 1" = 100'

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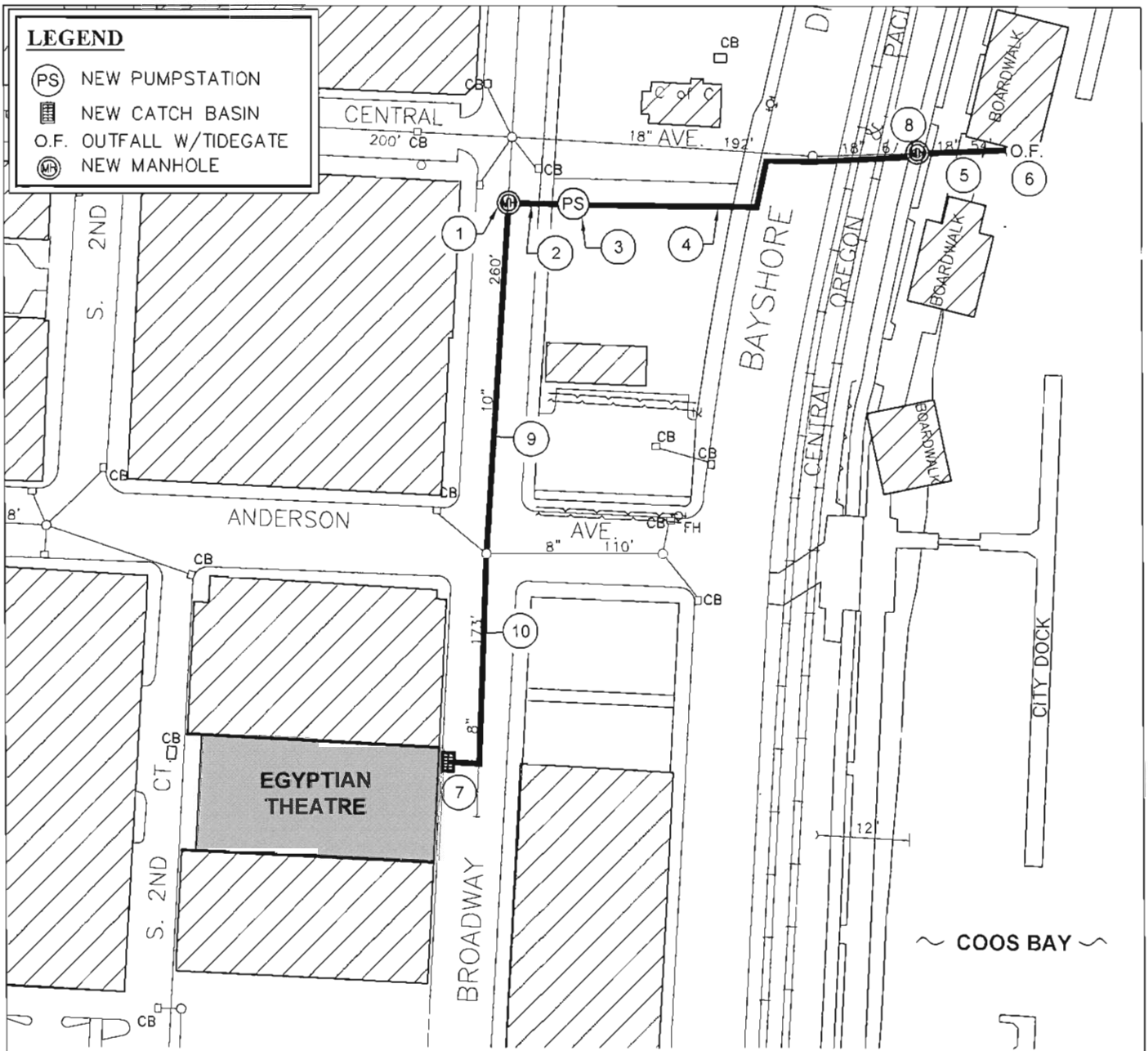
THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. 6
DATE: SEP, 2012 PROJECT NO.: 187.02	*ALTERNATIVE 2*	



1. NEW STORM DRAIN MANHOLE
2. NEW GRAVITY STORM DRAIN LINE TO 24"ø PUMP STATION
3. NEW REGIONAL STORM DRAIN PUMP STATION - 3,725 GPM
4. PUMP STATION FORCEMAIN - 14"ø
5. NEW OUTFALL PIPE - 24"ø
6. NEW OUTFALL W/TIDEGATE
7. NEW CATCH BASIN
8. NEW STORM DRAIN MANHOLE W/CHECK VALVE ON GRAVITY STORM DRAIN LINE
9. NEW 15"ø
10. NEW 18"ø

NOTE: FINAL LOCATION AND SIZE/FOOTPRINT OF PUMP STATION TO BE DETERMINED IN DESIGN. CAPACITIES AND CONDITION OF EXIST'G BASIN NO. II STORM DRAIN LINES SHOULD BE FURTHER EVALUATED. THEY WERE NOT EVALUATED IN THIS REPORT.

N

SCALE: 1" = 100'

THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. 7
DATE: SEP, 2012	*ALTERNATIVE 3*	
PROJECT NO.: 187.02		

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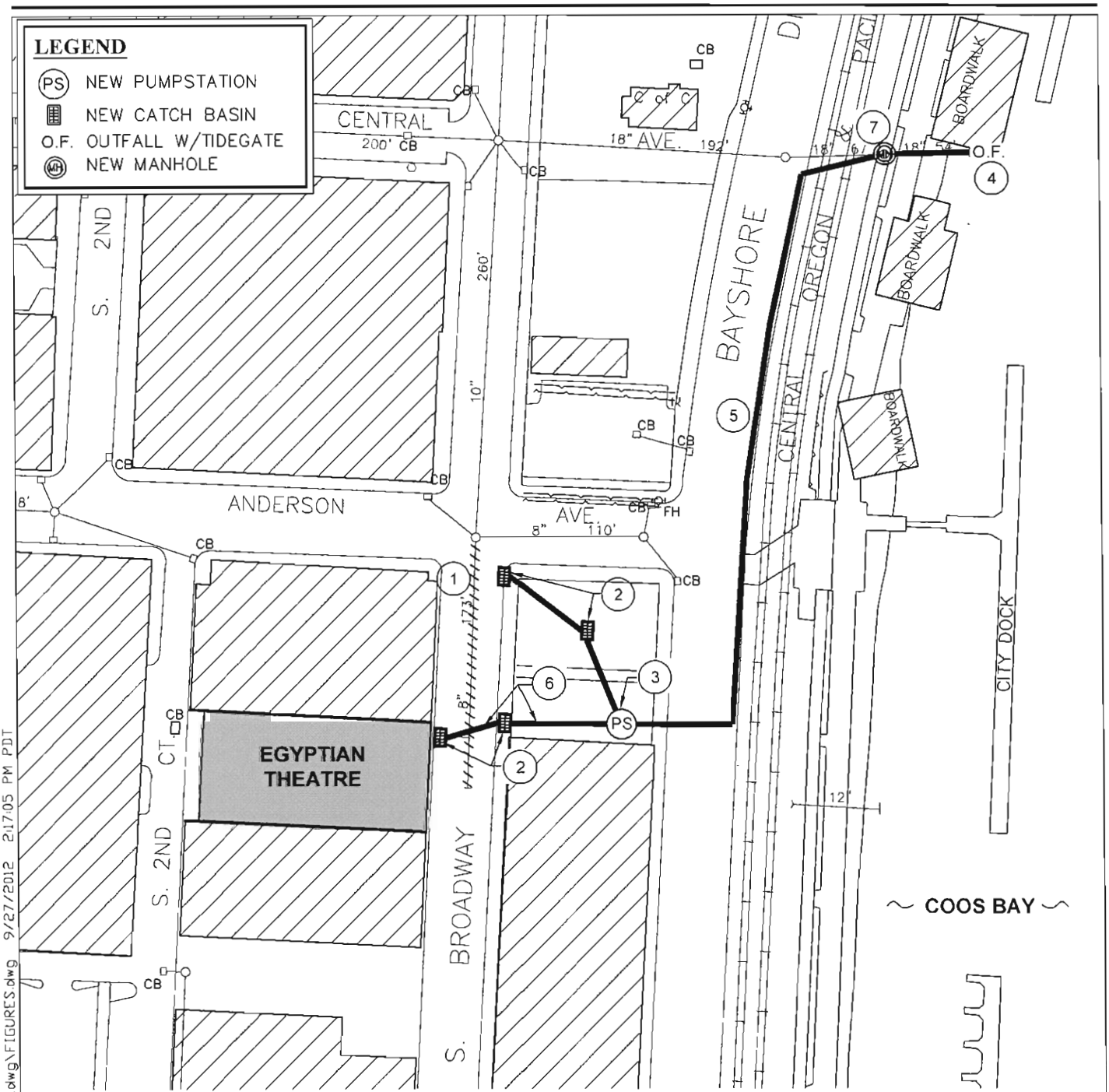

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THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO. *8*
DATE: SEP, 2012	*ALTERNATIVE 4*	
PROJECT NO.: 187.02		

City of Coos Bay **11/08/12**
Egyptian Theatre Storm Drain Study
Alternative 1: Local Pump Station at Egyptian Theatre

Item	Description	Unit	Quantity	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	ALL	$78,800.00	$78,800
2	Demolition and Site Preparation	LS	ALL	$63,000.00	$63,000
3	Misc. Appurtenances	LS	ALL	$38,600.00	$38,600
4	Shoring and Piling	LS	ALL	$40,000.00	$40,000
5	Pump Station	EA	1	$225,000.00	$225,000
6	Vault w/ Check Valve	EA	1	$8,000.00	$8,000
7	8" PVC Storm Drain - Class C Backfill	LF	20	$100.00	$2,000
8	12" Storm Drain - Class C Backfill	LF	160	$70.00	$11,200
9	18" Storm Drain - Class C Backfill	LF	80	$75.00	$6,000
10	18" PVC Storm Drain - Bore	LF	100	$300.00	$30,000
11	18" Rail Road Crossing	LF	80	$3,000.00	$240,000
12	18" Outfall w/ Tidegate	EA	1	$15,000.00	$15,000
13	Catch Basin	EA	5	$1,500.00	$7,500
14	Curb and Gutter R&R	LF	20	$30.00	$600
15	Sidewalk R&R	SF	120	$10.00	$1,200
16	AC Pavement R&R	TON	43	$120.00	$5,160

Construction Total	**$772,060**
Engineering	**$154,410**
Geotechnical Enginnering	**$15,000**
Environmental Study/Permitting	**$20,000**
Contingency	**$192,290**
Legal & Administration	**$23,160**
Total Project Cost	**$1,176,920**

Estimated Budget Cost **$1,060,000, to $1,142,000**

This cost estimate is for planning purposes only. Final Design will determine pipe routes, construction methods, and quantity of materials needed.

City of Coos Bay 11/8/12

Egyptian Theatre Storm Drain Study

Alternative 2: Local Pump Station at Egyptian Theatre - New Outfall and Replace Basin No. 11 Outfall

Item	Description	Unit	Quantity	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	ALL	$83,000.00	$83,000
2	Demolition and Site Preparation	LS	ALL	$66,400.00	$66,400
3	Misc. Appurtenances	LS	ALL	$40,500.00	$40,500
4	Shoring and Piling	LS	ALL	$45,000.00	$45,000
5	Pump Station	EA	1	$225,000.00	$225,000
6	Vault w/ Check Valve	EA	1	$8,000.00	$8,000
7	8" PVC Storm Drain - Class C Backfill	LF	20	$100.00	$2,000
8	12" Storm Drain - Class C Backfill	LF	160	$70.00	$11,200
9	18" Storm Drain - Class C Backfill	LF	80	$75.00	$6,000
10	18" PVC Storm Drain - Bore	LF	100	$300.00	$30,000
11	18" Rail Road Crossing	LF	80	$3,000.00	$240,000
12	18" Outfall w/ Tidegate	EA	1	$15,000.00	$15,000
13	24" Storm Drain - Class C Backfill	LF	60	$120.00	$7,200
14	24" Outfall w/ Tidegate	EA	1	$20,000.00	$20,000
15	Catch Basin	EA	5	$1,500.00	$7,500
16	Curb and Gutter R&R	LF	20	$30.00	$600
17	Sidewalk R&R	SF	120	$10.00	$1,200
18	AC Pavement R&R	TON	43	$120.00	$5,160

Construction Total	**$813,760**
Engineering	**$162,750**
Geotechnical Enginnering	**$15,000**
Environmental Study/Permitting	**$20,000**
Contingency	**$202,300**
Legal & Administration	**$24,410**
Total Project Cost	**$1,238,220**

Estimated Budget Cost **$1,114,000 to $1,486,000**

This cost estimate is for planning purposes only. Final Design will determine pipe routes, construction methods, and quantity of materials needed.

City of Coos Bay **11/8/12**
Egyptian Theatre Storm Drain Study
Alternative 3: Regional Pump Station for Basin No. 11

Item	Description	Unit	Quantity	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	ALL	$121,500.00	$121,500
2	Demolition and Site Preparation	LS	ALL	$97,200.00	$97,200
3	Misc. Appurtenances	LS	ALL	$60,300.00	$60,300
4	Shoring and Piling	LS	ALL	$50,000.00	$50,000
5	Pump Station	EA	1	$325,000.00	$325,000
6	Check Valve	EA	1	$3,000.00	$3,000
7	15" Storm Drain - Clacc C Backfill	LF	173	$110.00	$19,030
8	18" Storm Drain - Class C Backfill	LF	260	$115.00	$29,900
9	24" Storm Drain - Class C Backfill	LF	200	$120.00	$24,000
10	24" PVC Storm Drain - Bore	LF	150	$500.00	$75,000
11	24" Outfall w/ Tidegate	EA	1	$25,000.00	$25,000
12	24" Rail Road Crossing	LF	80	$3,500.00	$280,000
13	Standard Storm Drain Manhole	EA	2	$5,500.00	$5,500
14	72" Storm Drain Manhole	EA	2	$7,500.00	$15,000
15	72" Storm Drain Manhole w/ Tidegate	EA	1	$20,000.00	$20,000
16	Catch Basin	EA	1	$1,500.00	$1,500
17	AC Pavement R&R	TON	320	$120.00	$38,400

Construction Total	**$1,190,330**
Engineering	**$238,070**
Geotechnical Enginnering	**$15,000**
Environmental Study/Permitting	**$20,000**
Contingency	**$292,680**
Legal & Administration	**$35,710**
Total Project Cost	**$1,791,790**

Estimated Budget Cost **$1,613,000 to $2,150,000**

This cost estimate is for planning purposes only. Final Design will determine pipe routes, construction methods, and quantity of materials needed.

City of Coos Bay **11/8/12**
Egyptian Theatre Storm Drain Study
Alternative 4: Local Pump Station at Egyptian Theatre - Shared Outfall

Item	Description	Unit	Quantity	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	ALL	$128,600.00	$128,600
2	Demolition and Site Preparation	LS	ALL	$55,900.00	$55,900
3	Misc. Appurtenances	LS	ALL	$33,600.00	$33,600
4	Shoring and Piling	LS	ALL	$45,000.00	$45,000
5	Pump Station	EA	1	$225,000.00	$225,000
6	Check Valve	EA	1	$3,000.00	$3,000
7	8" PVC Storm Drain - Class C Backfill	LF	300	$100.00	$30,000
8	8" PVC Storm Drain - Bore	LF	60	$400.00	$24,000
9	12" Storm Drain - Class C Backfill	LF	240	$70.00	$16,800
10	8" Rail Road Crossing	LF	80	$1,500.00	$120,000
11	24" Outfall w/ Tidegate	EA	1	$20,000.00	$20,000
12	72" Storm Drain Manhole w/ Tidegate	EA	1	$15,000.00	$15,000
13	Catch Basin	EA	5	$1,500.00	$7,500
14	Curb and Gutter R&R	LF	20	$30.00	$600
15	Sidewalk R&R	SF	100	$10.00	$1,000
16	AC Pavement R&R	TON	147	$120.00	$17,640
		Construction Total			**$743,640**
		Engineering			**$148,730**
		Geotechnical Enginnering			**$15,000**
		Environmental Study/Permitting			**$20,000**
		Contingency			**$185,470**
		Legal & Administration			**$22,310**
		Total Project Cost			**$1,135,150**

Estimated Budget Cost **$1,022,000 to $1,362,000**

This cost estimate is for planning purposes only. Final Design will determine pipe routes, construction methods, and quantity of materials needed.

City of Coos Bay
Egyptian Theatre Storm Drain Memo
Photos of Tidegate 14

Notes:

1. Pipe on left of photo is Tidegate No. 14. The pipe is an 18-inch diameter corrugated metal pipe. Tidegate appears to be functional however there are holes in the sides of the pipe. The 2004 Storm Water Master Plan identified an abandoned outfall under the existing outfall. The abandoned manhole cound not be seen and was not evaluated.

2. The pipe shown on the right is an unknown pipe. No dye was observed exiting this pipe.

City of Coos Bay
Egyptian Theatre Storm Drain Memo
Photos of Tidegate 14

Notes: Tidegate No. 14: Hole observed in side of 18-inch corrugated metal pipe, upstream of tidegate.

City of Coos Bay
Egyptian Theatre Storm Drain Memo
Photo No. 1 of Egyptian Theatre Sidewalk

Notes:

1. Photo is taken facing south. The tiled sidewalk slopes from left to right in front of the Egyptian Theatre doors.

City of Coos Bay
Egyptian Theatre Storm Drain Memo
Photo No. 2 of Egyptian Theatre Sidewalk

Notes:

1. Photo is taken facing south. This photo shows the flooding that occurs in front of the theatre. Photo was taken on 12/23/2003 at approximately 1:20 p.m, within an hour of high tide for that day.

Storm Drainage Calculations
Basin No. 11
From 2004 Storm Water Master Plan

Basin No. 11

Basin 11 is approximately 7.7 acres bound to the north by Basin 10A, the east by the Bay, and the south by Curtis.

Soil Type
Udorthents, (Artificial Fill)

Slope
0-1%

Current Land-use
6.19 Acres Commercial
1.51 Acres Industrial

Peak Runoff
25-Year Storm: 7.4 CFS
50-Year Storm: 8.3 CFS
Future 25-Year Storm: 7.4 CFS
Future 50-Year Storm: 8.3 CFS

Existing System
One 18-inch CMP outfall line, on Central Avenue, drains Broadway from Commercial to Bennett Avenues and Central from 4th Street to the Bay. There are two other outfalls within 10-feet of this outfall (Tidegate 14) that do not show on City maps. A 24-inch concrete outfall located a few feet to the north was noted as having considerably higher flows than the 18-inch line on the plans.

Present Day Problems
No problems were reported, although some of the area within the basin is located in the flood plain and Broadway floods in front of the Egyptian Theater during unusually high tides. Modeling of the basin indicates that the existing CMP pipe on Central Avenue has inadequate capacity and needs to be 18" diameter concrete pipe or equivalent to meet a 50-year rainfall event. Without pumping, this area is subject to flooding during high tide high rain events.

Future System
No development is predicted for this basin throughout the planning period.

SUBCATCHMENT 10 Basin 10

PEAK= 27.88 CFS @ 8.15 HRS, VOLUME= 10.52 AF

ACRES	CN	
9.60	92	Comm
.70	88	Ind
23.40	75	Small REs
33.70	80	

SCS TR-20 METHOD
TYPE IA 24-HOUR
RAINFALL= 6.0 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD L=725' s=.31 '/'	Upper	4.4
CURVE NUMBER (LAG) METHOD L=761' s=.024 '/'	Middle	16.5
CURVE NUMBER (LAG) METHOD L=300' s=.027 '/'	Lower	7.4
	Total Length= 1786 ft Total Tc=	28.3

SUBCATCHMENT 11 Basin 11 (Report Basin-DELETED)

PEAK= 4.71 CFS @ 8.01 HRS, VOLUME= 1.58 AF

ACRES	CN	
3.00	92	Commercial
.85	88	Ind
3.85	91	

SCS TR-20 METHOD
TYPE IA 24-HOUR
RAINFALL= 6.0 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD L=480' s=.004 '/'	Length	18.8

SUBCATCHMENT 13 Basin 13 (Report Basin 11)

PEAK= 8.25 CFS @ 8.22 HRS, VOLUME= 3.15 AF

ACRES	CN	
1.51	88	Industrial
6.19	92	Commercial
7.70	91	

SCS TR-20 METHOD
TYPE IA 24-HOUR
RAINFALL= 6.0 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD L=440' s=.001 '/'	Length	35.1

Storm Drainage Calculations
Egyptian Theatre – Local Pump Station

Rational Method

The Rational Method is based upon the concept of mass balance and relates rainfall intensity to runoff intensity. The Rational Method incorporates the use of the rational formula, which is generally expressed as:

$$Q_p = CIA$$

Where:
Q_p = peak discharge (cfs)
C = runoff coefficient (dimensionless)
I = rainfall intensity (in/hr)
A = watershed area (ac)

Once values for runoff coefficient, rainfall intensity, and watershed area have been determined, peak discharge (Q_p) values for drainage basins in the area are calculated. Each of the parameters in the formula is described below.

Runoff Coefficients
Values for C, the runoff coefficient, are readily available in most hydrology or engineering handbooks. Some common C values are listed in the table below:

COMMON RUNOFF COEFFICIENTS

AREA DESCRIPTION	RUNOFF COEFFICIENT
Downtown Business	0.70 to 0.95
Neighborhood	0.50 to 0.70
Single Family (Residential)	0.30 to 0.50
Detached Multi-units (Residential)	0.40 to 0.60
Attached Multi-units (Residential)	0.60 to 0.75
Light Industrial	0.50 to 0.80
Parks, Cemeteries	0.10 to 0.25
Unimproved	0.10 to 0.30

For Egyptian Theatre Local Pump Station, a Runoff Coefficient of 0.95 was selected.

Rainfall Intensity
Rainfall intensity (I) is the intensity (inches per hour) of rainfall for a given design storm at a given time in the storm. Intensity is typically determined from Rainfall Intensity, Duration, Frequency (IDF) curves. IDF curves are used to determine rainfall intensity associated a specific storm frequency. The IDF curves for Coos Bay are shown at the end of these calculations.

For Egyptian Theatre Local Pump Station, using a t_c of 5 minutes, the Rainfall Intensity (I) is 3.4 in/hr)

Time of Concentration
Rainfall duration in a drainage basin is computed by determining the time of concentration for that drainage basin. Time of concentration (t_c) is defined as the longest travel time it takes a particle of water to reach a discharge point in a watershed. While traveling towards a discharge point, a water particle may experience sheet flow, shallow concentrated flow, open channel flow, or a combination of these.

For Egyptian Theatre Local Pump Station, the t_c of 5 minutes was used to calculate the rainfall intensity. This is a small basin, which results in a short time of concentration. The flows during this type of rainfall event will be sheet flows.

Area
The final variable in the rational formula is the watershed area (A). Watershed area is determined from topographic maps of the area.

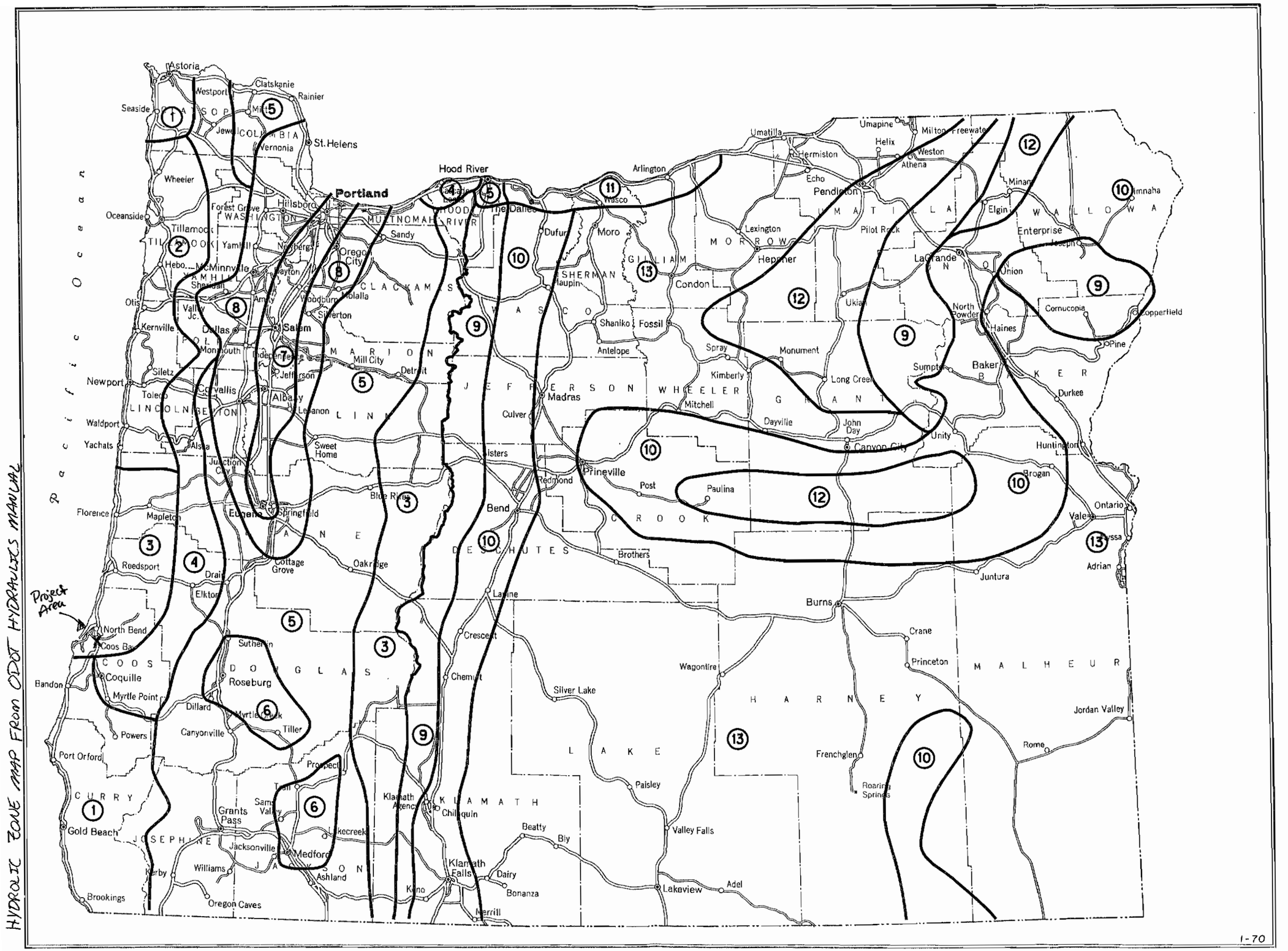
From Figure 9: Storm Water Calculation Area Map, the area for the Egypian Theatre Local Pump Station was 45,600 square feet which is 1.05 acres

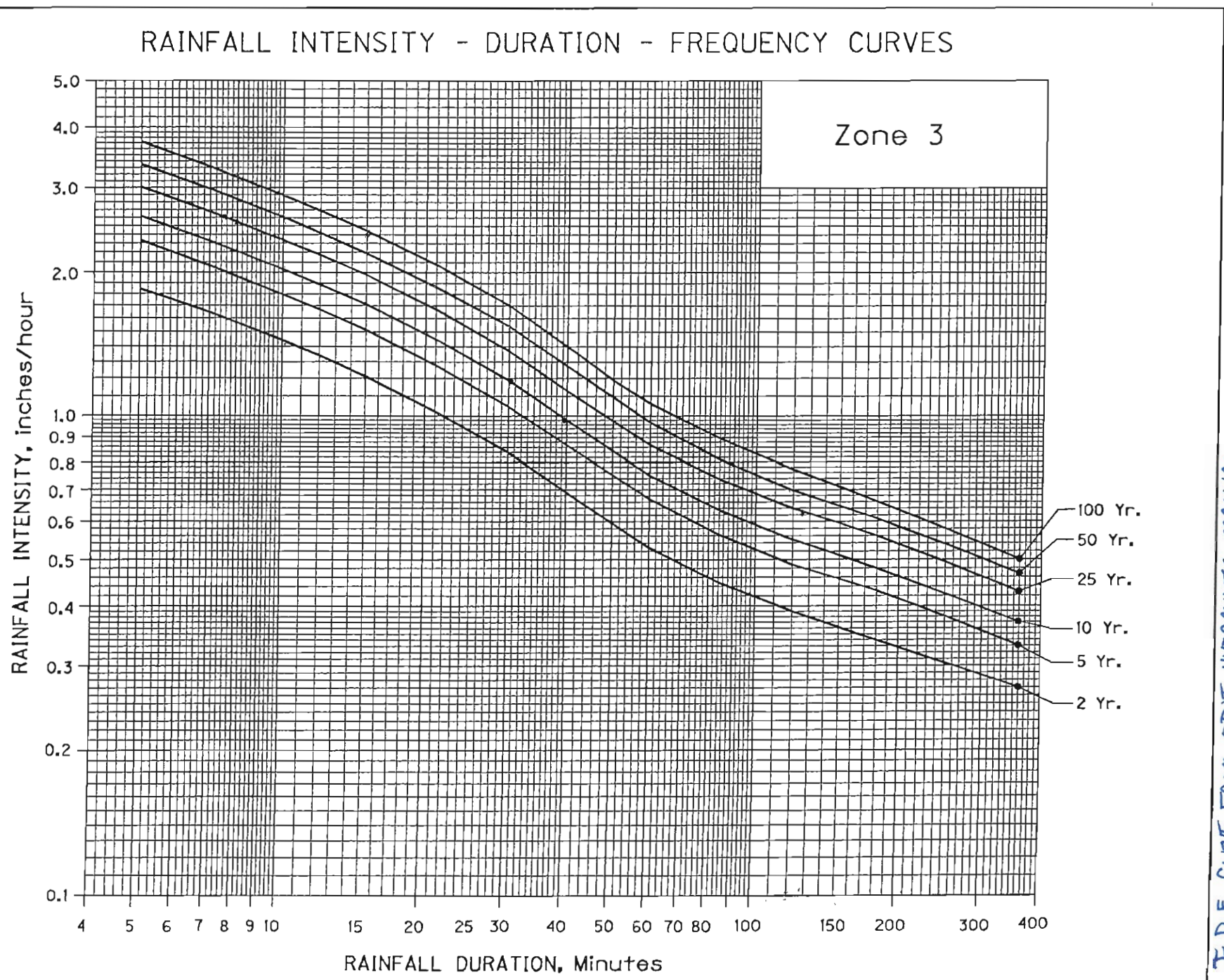
$Q_p = CIA$

Where:
Q_p = peak discharge (cfs)
C = 0.95
I = 3.4 (in/hr)
A = 1.05(ac)

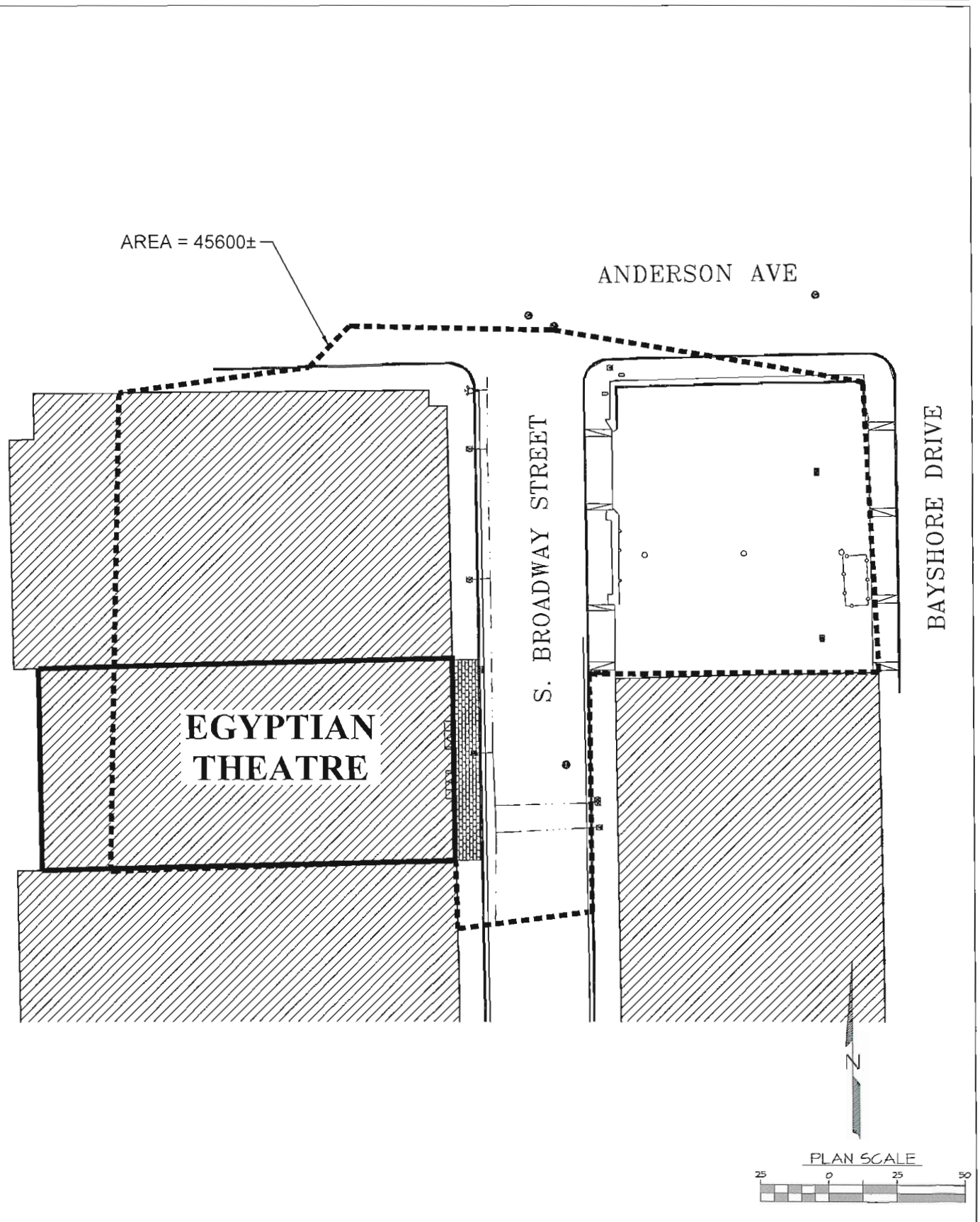
$Q_p = (0.95)*(3.4 \text{ in/hr})*(1.05 \text{ ac})$

$Q_p = 3.39$ cfs


HYDROLIC ZONE MAP FROM ODOT HYDRAULICS MANUAL
Pacific Ocean
Project Area
Astoria
Seaside
Clatskanie
Westport
Rainier
St.Helens
Vernonia
Wheeler
Portland
Hood River
The Dalles
Oceanside
Tillamook
Forest Grove
Hillsboro
Yamhill
Newberg
Sandy
Oregon City
Hebo
McMinnville
Dayton
Sheridan
Amity
Woodburn
Molalla
Silverton
Otis
Valley Jc.
Kernville
Dallas
Salem
Monmouth
Independence
Mill City
Detroit
Jefferson
Siletz
Newport
Toledo
Corvallis
Albany
Lebanon
Waldport
Yachats
Alsea
Sweet Home
Florence
Mapleton
Eugene
Springfield
Blue River
Reedsport
Cottage Grove
Oakridge
Drain
Elkton
North Bend
Coos Bay
Sutherlin
Roseburg
Coquille
Bandon
Myrtle Point
Dillard
Myrtle Creek
Tiller
Canyonville
Powers
Port Orford
Prospect
Trail
Grants Pass
Sams Valley
Gold Beach
Jacksonville
Medford
Ashland
Williams
Kerby
Brookings
Oregon Caves
Lakecreek
Klamath Agency
Chiloquin
Klamath Falls
Keno
Dairy
Bonanza
Merrill
Redmond
Sisters
Bend
Prineville
Post
Paulina
Brothers
Lapine
Crescent
Chemult
Silver Lake
Paisley
Valley Falls
Beatty
Bly
Lakeview
Adel
Umatilla
Hermiston
Arlington
Echo
Umapine
Helix
Milton Freewater
Weston
Athena
Pendleton
Pilot Rock
Lexington
Heppner
Dufur
Moro
Wasco
Condon
Shaniko
Fossil
Antelope
Spray
Monument
Kimberly
Long Creek
Mitchell
Dayville
John Day
Canyon City
Unity
Ukiah
La Grande
Union
North Powder
Haines
Baker
Sumpter
Durkee
Elgin
Enterprise
Joseph
Minam
Imnaha
Cornucopia
Copperfield
Pine
Huntington
Brogan
Ontario
Vale
Nyssa
Adrian
Juntura
Burns
Crane
Princeton
Wagontire
Frenchglen
Roaring Springs
Rome
Jordan Valley
Shermans
Gilliam
Morrow
Umatilla
Wasco
Sherman
Wheeler
Grant
Baker
Union
Wallowa
Malheur
Harney
Lake
Klamath
Deschutes
Crook
Jefferson
Linn
Marion
Clackamas
Multnomah
Hood River
Columbia
Washington
Tillamook
Yamhill
Polk
Lincoln
Benton
Lane
Douglas
Coos
Curry
Josephine
Jackson
1-70



I.D.F. CURVE FROM ODOT HYDRAULICS MANUAL



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF COOS BAY* *EGYPTIAN THEATRE STORM DRAIN STUDY*	FIGURE NO.
DATE: NOVEMBER, 2012 PROJECT NO.: 187.02	*STORM WATER CALCULATION AREA MAP*	Agenda Item #5