ATTACHMENT 7

Economic Analysis –

Flood Damage Reduction Costs and Benefits

7-1 Narrative description of the project and its relationship to other projects in the Proposal

Please see Attachment 3, Work Plan, for the narrative description of the project. The narrative description of the project shown with Attachment 3 was not repeated in Attachment 7 to save paper. The Haster Retarding Basin and Pump Station Preliminary Design Report (PDR), prepared by AKM Consulting Engineers, dated July 2008, contains engineering and technical details about the project. The PDR is attached for reference. The Haster Retarding Basin and Pump Station project is the only project in the Proposal.

7-2 Narrative description of the project's economic costs

The total estimated cost of the project is $31,354,200. Table 6, located in Attachment 4 presents a breakdown of the total project cost by line item.

- Line (a) Direct Project Administration Cost is the estimated cost of Orange County Public Works (OCPW) staff time that will be spent on project administration and management. The Haster Retarding Basin and Pump Station project is currently the largest and most critical capital improvement project under design at the County of Orange and will require a significant amount of staff time to manage.
- Line (c) Design Engineering is the cost of the OC Public Works Amendment #2 to the Agreement with AKM Consulting Engineers for preparation of plans and specifications for the project.
- Line (d) Construction/Implementation is the total estimated cost of construction of the proposed retarding basin and pump station.
- Line (e) Environmental Compliance/Mitigation/Enhancement is the cost of the OC Public Works Agreement with AECOM to prepare the Environmental Impact Report for the proejct.
- Line (f) Construction Administration and Management is the estimated cost to provide construction management for this project. This line item includes both OC Public Works in-house OC Inspection staff hours as well as contracted construction inspection hours.
- Line (g) Other Costs is not used.
- Line (h) Contingency is the overall contingency that covers all line items in the project budget.

7-3 Cost details for the project using Table 10 and the information in Table 6 (Budget)

The total estimated cost of the project is $31,354,200. The net present value is calculated assuming an expected project life of 50 years and an interest rate of 6 percent. Table 10 lists the projected annual project costs from 2009 through 2014 and calculates a net present value of $25,419,387 for the project.

In 2010 through April 2011, costs have been expended for OC Public Works staff time, preparation of plans and specifications, and preparation of the Environmental Impact Report. These costs are included as part of the Non-State Share (Funding Match) in Table 6, Lines (a), (c) and (e). The total amount spent in 2010 is approximately $485,000.

Final design plans and specifications and bidding of the project are scheduled to be completed in 2011. The total amount expected to be spent in 2011 is $740.000.

Construction of the retarding basin and pump station is expected to begin in early 2012 and be completed in 2014.

7-4 Narrative description of all of the project's expected flood damage reduction benefits, which shall address the following items:

A. Estimates of historical flood damage data

B. Estimates of existing without-project conditions

C. Estimates of existing with-project conditions

D. Description of methods used to estimate without- and with-project conditions

E. Description of the distribution of local, regional, and statewide benefits, as applicable

F. Identification of beneficiaries

G. When the benefits will be received

H. Uncertainty of the benefits

I. Description of any adverse effects

A. Estimates of historical flood damage data

The following historical flood damage information has been taken from a draft report entitled Westminster Watershed Feasibility Study, Without-Project Economics, dated January 2007, prepared by the U.S. Army Corps of Engineers and the Westminster Watershed Feasibility Study, Economic Appendix, dated April 2010, prepared by the U.S. Army Corps of Engineers.

Historical Flooding

FEMA claims records associated with overflows from the East Garden Grove Wintersburg Channel (Facility C05) and the Ocean View Channel (Facility C06) show that between the years 1992 and 1998, for four (4) storm events, claims totaled approximately $533,000 and $495,000, respectively. Previous storm events in the local area and region demonstrate the area's significant susceptibility to flood damages from large storm events. While there are no records directly attributing significant flood damages to CO5, and CO6, overflows from these channels have almost certainly contributed to damages have been attributed to other nearby flood conveyance systems such as the nearby Santa Ana River; but no accounting of this has been completed for these events. With recent improvements to the Santa Ana River and other flood damage reduction features in the region, most of the remaining flooding threat to Orange County is attributable to C04, C05, and C06. The table below describes some of the more notable flood events in Orange County since the early 19 century.

Significant Flood Events in Orange County

Year	Event
1825	Flood on the Santa Ana River said to have created Balboa Island in Newport Beach.
1862	Considered the area's worst-recorded flood; most of County covered by at least three feet of water.
1914	Santa Ana River overflow submerges nearly all of Newport Beach.
1916	Four die in massive flooding that washes out most roads and rail lines, leaving Orange, Fullerton and Tustin marooned.
1938	Fifty-eight people killed, portions of downtown Garden Grove, Santa Ana and Anaheim under water, all bridges washed out.
1969	Five people die in Silverado Canyon when they are buried by mudslide; $12 million in damage countywide.
1983	Intense rain overwhelms channels, damaging nearly 1,000 homes and causing $48.5 million in damage.
1995	Channels again overflow, flooding dozens of homes from Seal Beach to Garden Grove.
Source: Los Angeles Times, October 3, 1999 'Disaster Prompted $1.3 Billion Effort to Tame Santa Ana River, Protect Basin'	

B. Estimates of existing without-project conditions

Please see attached draft report titled Westminster Watershed Feasibility Study, Orange County, California, Economics Appendix, dated April 2010, by the U.S. Army Corps of Engineers.

The economic analysis by the Corps separates the floodplains of the Westminster Channel (C04), East Garden Grove-Wintersburg Channel (C05) and the Ocean View Channel (C06). Haster Basin is located on East Garden Grove-Wintersburg Channel (C05).

The floodplains evaluated in this analysis span a very large, densely populated area of Orange County, CA - an area that is over twenty square miles large and populated by over 100,000 residents. The size and population density of these floodplains adds to the challenge and complexity of estimating damages from flood events. In order to help the analysis manage this complexity - and the corresponding uncertainty - principles of Risk & Uncertainty (R&U) Analysis were applied. The analysis incorporated these principles in the estimate of the damage categories evaluated.

Table 10- Annual Cost of Flood Damage Reduction Project

(All costs should be in 2009 Dollars)

Project: Haster Retarding Basin and Haster Pump Station

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 6 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs (g) x (h)
2008							$0	1.010	$0
2009							$0	1.000	$0
2010	$485,700						$485,700	0.943	$458,015
2011	$740,000						$740,000	0.890	$658,600
2012	$12,000,000						$12,000,000	0.840	$10,080,000
2013	$15,128,500						$15,128,500	0.792	$11,981,772
2014	$3,000,000						$3,000,000	0.747	$2,241,000
2015							$0	0.705	$0
Project Life	50 years							…	
Total Present Value of Discounted Costs (Sum of Column (i)) Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									$25,419,387

Given that there is little or no vacant or developable land in the floodplains, the analysis assumed that the future without-project economic condition is equivalent to the current without-project condition - the flood damage estimate did not include any structures that are not currently found in the floodplains. The analysis focused on estimating damages to private and public property, as well as on emergency response and recovery costs, which includes emergency assistance to food victims.

An initial inventory of the parcels in the 500-year floodplain was compiled in ArcGIS (ARCMap) software by linking a shapefile of the floodplain with a shapefile containing the parcel information. The parcels identified as within the 500-year floodplain were then matched to data downloaded from the First American Real Estate Solutions database. Given the massive floodplain, sampling was done to collect information on a representative sample of the residential structures in the floodplain, while for the other structure categories (commercial, industrial, etc.), of which there are much fewer, a more complete inventory was collected. The valuation of the structures in the floodplain synthesized information that had been collected on structure type, construction quality, current conditions, and number of stories. Once collected, this information was utilized to calculate the structure depreciated replacement values. Base per square foot construction cost estimates for each structure type were determined by utilizing the Marshall and Swift Real Estate Valuation Service.

In order to begin to estimate damages, structure and content data were first processed through an @RISK Excel spreadsheet to generate the appropriate stage-damage references with uncertainty for entry into the HEC-FDA model. Each structure in the floodplain was associated with flood depths for the 50-, 100-, and 500-year flood events based on digital overlow maps created as an output of the FLO2D flood model. The results of the @RISK calculations were entered directly into the HEC-FDA Model as cumulative damage functions for each damage category for each impact area.

The without-project flood damages from each of the floodplains considered flooding damages associated with eleven different categories.

The event-based (50-, 100-, 500-year, etc.) analysis shows very large damages occurring across the floodplains, and in particular within the C05/C06 floodplain. The results of the analysis show that the 500-year event is expected to cause in excess of $1.7 billion in property damages across the C05/C06 floodplain, and in excess of $277 million across the C04 floodplain. The EAD, which is the probability weighted value of damages expected per year when considering a very long time horizon, of the without-project analysis is shown in the table below. The total EAD for each channel and for each damage category are displayed. As shown, the annual damages associated with C04, C05, and C06 are $3.4 million, $46.6 million, and $5.9 million, respectively.

Estimated Annual Damages (EAD) without project condition

Category	EAD ($000s)		
	C04	**C05**	**C06**
Industrial	551.10	1,621.38	0.00
Commercial	290.01	6,870.48	864.18
Single-Family	1,664.91	23,598.63	3,021.56
Multi-Family	140.28	2,423.67	457.59
Manufactured Housing	9.71	274.79	0.00
Public	10.60	1,430.40	0.00
ONA	33.89	497.13	76.89
TRA	56.08	821.97	127.08
PA	241.95	3,563.99	542.58
Vehicle	133.08	2,767.07	430.58
Cleanup	266.04	2,775.09	410.99
Total	3,397.65	**46,644.60**	5,931.45

With respect to population, Orange County is the fifth largest county in the nation, and the third largest in California. Orange County is one of the nation's most densely populated counties, and it ranks second in California behind San Francisco. Orange County has a population density that is approximately fifty percent higher than Los Angeles County.

The C05 East Garden Grove Wintersburg Channel within the Westminster Watershed has 27,057 structures in the 500 year flood plain, 16,529 structures in the 100-year flood plain, and 12,778 structures in the 50-year flood plain.

Table 11A contains a breakdown of Expected Annual Damages (EAD) by Damage Category and Damage Reach for the Without-Project condition based on data contained in the Westminster Watershed Feasibility Study, Without-Project Economics.

Table11A

Expected Annual Damage by Damage Categories and Damage Reaches for the Without (Without project condition) (Damages in $1,000s)

Stream Name	Damage Reach Name	Damage Categories																	TOTAL
		CLEANUP	COMC	COMS	INDC	INDS	MFRC	MFRS	MHC	MHS	ONA	PA	PUBC	PUBS	SFRC	SFRS	TRA	VEHICLE	
C05	Area A	360.50	2020.75	1409.97	200.54	143.22	153.03	530.95	0.32	9.36	61.66	442.82	81.30	152.08	821.50	1256.63	102.16	273.09	8019.88
	Area 1	352.30	539.59	428.00	7.06	12.92	41.82	149.67	7.73	23.93	44.19	317.24	47.74	111.75	692.23	1165.45	73.05	202.60	4217.27
	Area 2	246.10	254.87	170.77	164.96	119.59	31.50	104.56	3.26	14.44	25.06	179.70	83.14	200.81	774.75	1261.06	41.44	129.54	3805.55
	Area 3	667.16	568.17	445.48	460.18	238.63	150.36	522.78	4.10	15.58	120.95	864.87	160.67	393.65	2029.47	3493.13	199.91	655.46	10990.55
	Area 4	104.38	300.69	173.35	0.00	0.00	3.69	13.44	0.00	0.00	14.10	101.13	15.36	11.31	279.12	486.80	23.31	72.68	1599.36
	Area 5	178.30	16.99	13.46	177.68	96.60	29.96	109.35	0.00	0.00	34.12	244.89	13.88	29.95	523.87	924.89	56.41	183.86	2634.21
	Area 6	59.30	0.00	0.00	0.00	0.00	0.14	0.61	0.00	0.00	11.11	79.60	17.81	15.59	236.50	421.01	18.35	65.06	925.08
	Area 7	807.06	294.15	234.24	0.00	0.00	122.93	458.89	46.71	149.36	185.94	1333.74	32.13	63.23	3345.97	5886.24	307.34	1184.76	14452.69
Total for stream: C05		**2775.10**	**3995.21**	**2875.27**	**1010.42**	**610.96**	**533.43**	**1890.25**	**62.12**	**212.67**	**497.13**	**3563.99**	**452.03**	**978.37**	**8703.41**	**14895.21**	**821.97**	**2767.05**	**46644.59**

C. Estimates of existing with-project conditions

The Estimated Annual Damage (EAD) for the without project is $46.6 million, the EAD Reduction Benefit is $24.0 million and the EAD with-project is $22.6 million as shown in the Table 11B.

Table 11B

Expected Annual Damage Reduction and Expected Annual Damage with project condition by Damage Reaches Area (Damages in $1000s)

Stream Name	Damage Reach Name	EAD without project	Percent Reduction	EAD Reduction	EAD with project
C05	Area A	8019.88	100%	8019.88	0.00
	Area 1	4217.27	100%	4217.27	0.00
	Area 2	3805.55	50%	1902.78	1902.78
	Area 3	10990.55	50%	5495.28	5495.28
	Area 4	1599.36	50%	799.68	799.68
	Area 5	2634.21	20%	526.84	2107.37
	Area 6	925.08	20%	185.02	740.06
	Area 7	14452.69	20%	2890.54	11562.15
Total for stream: C05		46644.59	--	24037.28	22607.31

D. Description of methods used to estimate without- and with-project conditions

For the typical flood damage analysis, the HEC-FDA program is used to combine H&H and economic data (structure inventory, etc.) in order to derive a stage-damage function for each reach or impact area. Among other inputs to this procedure are water surface profiles for the various channel or river reaches, which are an output of the HEC-RAS model utilized by engineers. For this study though, a different flood modeling program was used (FL02D) that doesn’t create water surface profiles, but instead provides as an output surface flood depths across the floodplain. For this reason, it was necessary to calculate the stage-damage function outside of the HEC-FDA program, which would then be an input into the HEC-FDA program, further incorporating risk and uncertainty into the analysis and resulting in an estimate of the Expected Annual Damages from flooding.

Using numerous shapefiles within the ArcMap computer program, each structure in the floodplain was associated flood depths for the 50,100, and 500-year flood events. The flood depth shapefiles are an output of the FL02D program model, and were provided by USACE Engineers. A shapefile delineating parcels in the floodplain was provided by Orange County officials for use in this analysis.

Using the shapefiles produced as FL02D outputs, the parcel centroids were spatially joined to their respective flood depths for the three different flood frequency events (50, 100, and 500). The ArcMap program was then prompted to produce an output table giving the depth of flooding at each structure for each of the three flood events.

The estimation of damages was conducted in part by using the @RISK program, which is essentially an add-on tool used within the Microsoft EXCEL program. The U.S. Army Corps of Engineers developed a template to estimate damages from various single storm events, which provides as an output a mean damage estimate and a corresponding standard deviation. Damages were estimated for three flood events: the 50-, 100-, and 500-year events. These results serve as inputs to the HEC-FDA program. The @RISK program template allows for the direct entry of water depths at each parcel, combining this information with data on the foundation height and structure characteristics at each parcel in the particular floodplain. Like the HEC-FDA program, the @RISK program uses Monte Carlo (or Latin Hypercube) simulation in the calculations. Unlike HEC-FDA though, the @RISK template calculates the damages by referencing the depth of water at each individual structure, as opposed to referencing the structure to a water surface profile that corresponds to a channel or river cross section. The @RISK outputs are a frequency-damage function that is then matched transitively with the appropriate frequency-stage functions to arrive at a stage-damage function for entry into HEC-FDA.

The @RISK program was used to calculate and aggregate damages associated with most of the damage categories included in the analysis. These include damages associated with all structures and contents, vehicles, private cleanup cost, and displacement costs (temporary relocation).

The HEC-FDA v. 1.2..4 program was utilized to calculate expected annual damages. Among the data requirements for the program to calculate EAD are three functions:

1. Exceedance Probability/Discharge function-A relationship that defines for many points within each channel, and across a large range of values, the probability in a given year that a specific discharge will be exceeded.
2. Stage/Discharge Function-A relationship between the depth or elevation of water and the amount of discharge (cfs) in the channel.
3. Stage/Damage Function-A relationship between the depth or elevation of water in the interior of the floodplain and the amount of economic damage expected as a result.

Each of these functions must be defined for each reach/impact area based upon a representative cross section or index location within the impact area. The first two functions were derived by Engineering Division staff based upon output from the HEC-RAS model. The third function is typically derived within the HEC-FDA program. Structure inventory data, including values, elevations, depth/damage functions, and locations, are entered into the Economics Module of the program. The program calculates aggregated stage/damage functions by cross referencing water surface profile data imported from HEC-RAS with the structure data based upon the cross section, or river mile location, assigned to each structure.

As noted, for this study because of the nature of flooding in the study area, a determination was made that the FL02D model provided better estimates of overbank flooding than would be capable with the HEC-RAS model. Because of this, frequency/damage functions were derived outside the HEC-FDA program within the @Risk framework as discussed previously. The output of the @RISK model is frequency/damage functions for each impact area. Since the HEC-FDA model requires a stage/damage function for each impact area, the frequency/damage functions were transitively associated with stages instead of frequencies based upon the Exceedance Probability/Discharge and corresponding Stage/Discharge functions derived from HEC-RAS modeling. For example, if the @Risk model results yielded SFR structure damages of $10 million for the 50 year event for Impact Area X, first the discharge for the 50-year event for Impact Area X is determined from the Exceedance Probability/Discharge function, and then for this discharges, the corresponding stage is determined from the Stage/Discharges function. This stage is then associated with damages to derive stage/damage functions for each impact area.

In some areas, because of the nature of flooding, it was necessary to make adjustments to the Stage/Discharge and Stage/Damage functions. The topography in many locations is such that elevations are the same or even lower as one moves further from the channel. The result is a large floodplain with generally shallow flooding. The HEC-RAS model output shows water surface elevations for discharges exceeding channel capacity that essentially do not change for less frequent events. Although the water surface elevation at the location of the channel may not increase, the actual flood depths in the overbank area do increase with less frequent flood events. Accordingly, stage for discharges exceeding channel capacity were adjusted to reflect the average increase in overbank flood depth based upon the FL02D results. This has the benefit of both reflecting the nature of flooding in the floodplain and enabling the HEC-FDA program to function properly, as the program requires increases in each of the major parameters for less frequent flood events (discharges, stages, and damages) to yield logical results.

The following outlines and summarizes the major steps taken to estimate the damages to property in the various floodplains.

- Structure value and first floor elevation are estimated for each parcel in the floodplain (see the Structure Inventory and Valuation section) – structure inventory database created within MS Excel;
- Structures are separated into various impact areas, as shown in the maps contained previously;
- Within the ArcMap program, parcel shapefile with centroids is overlain with flood shapefiles of the 50, 100, and 500-year events. The results are exported to a database file;
- For each parcel, the structure inventory database is updated to include flood depth for each of the three flood frequencies analyzed;
- Utilizing the @RISK program, Latin Hypercube simulations are performed to estimate the mean and standard deviation of damages associated with each of the flood frequencies. These simulations include the use of distributions to help account for the risk and uncertainty associated with several of the relevant variables;
- H&H data (frequency-discharge and stage-discharge data) are entered into the HEC-FDA program in order to further account for Risk and Uncertainty;
- Outputs of the @RISK simulations are entered into HEC-FDA as stage-damage functions for each damage category for each impact area-frequency-stage data;
- The HEC-FDA model is run, producing an estimate of the Expected Annual Damages for each category for each impact area for each floodplain.

To estimate Expected Annual Damage Reduction, GIS floodplain maps prepared by the Corps of Engineers for the 25-year, 50 year, 100-year and 200-year with and without the Project were reviewed and compared. Based upon review and comparison of floodplain maps, a percentage reduction of flooded area was estimated for each tributary area. The Expected Annual Damage Reduction was calculated by multiplying the Expected Annual Damage without-project by the estimated percentage reduction. The Expected Annual Damage with-project was calculated by subtracting the Expected Annual Damage Reduction values from the Expected Annual Damage without-project values.

E. Description of the distribution of local, regional, and statewide benefits, as applicable

Local and regional residents and businesses will benefit from reduced flooding damage. Local and regional residents and businesses that can be removed from the flood plain after the project is constructed will benefit from elimination of flood insurance requirements. City of Garden Grove residents will benefit from the new sports and recreation area. Local and regional resident will benefit from restoration of the ecosystem.

F. Identification of beneficiaries

Beneficiaries of project implementation include the following:

- The City of Anaheim
- The City of Garden Grove
- The City of Orange
- The City of Westminster
- The City of Santa Ana
- The City of Fountain Valley
- The City of Huntington Beach
- Orange County

G. When the benefits will be received

Benefits will be received upon completion of construction of the retarding basin capacity increase and new pump station. This is a regional flood control facility and the cities of Anaheim, Garden Grove and Anaheim will be responsible for upgrading their storm drain infrastructure to ensure that the stormwater can access the retarding basin and pump station.

H. Uncertainty of the benefits

Many of the factors that influence the estimate of flood damages can and should be represented by a range of values instead of a single number. The estimate of the value of and damage to economic assets in the floodplain is based on numerous inputs, none of which are understood or known with 100% certainty. Errors in measurement, variation in classification and judgment, and a general lack of information all contribute to the inability to accurately describe these values with a single, discrete number. For the economic analysis for this Corps watershed study, in accordance with Engineering Manual 1110-2-1619, an attempt was made to account for the uncertainty associated with several variables. The Corps economic analysis for this project displays a table of standard deviation per variable in an attempt to quantify the uncertainly.

I. Description of any adverse effects

No adverse impacts are anticipated from project implementation.

7-5 Narrative discussion that describes, qualifies, and supports the values entered in the tables

Narrative discussion that describes, qualifies, and supports the values entered in the tables:

- Table 6 - Project Budget and Table 7 - Summary Budget are introduced in Attachment 4. Tables 6 and 7 are initially discussed in Attachment 4. Section 7-2 of Attachment 7 contains additional narrative discussion that describes, qualifies, and supports the values entered in Tables 6 and 7.
- Section 7-3 of Attachment 7 contains narrative discussion that describes, qualifies, and supports the values entered into Table 10 – Annual Cost of Flood Damage Reduction Project. As shown in Table 10 the present value of the discounted project costs is $25.4 million. This present value of costs is carried over and used as the cost value in Table 20 – Project Costs and Benefits Summary.
- Section 7-4b contains narrative discussion that describes, qualifies, and supports the values entered into Table 11 – Expected Annual Damage by Damage Categories without project condition. The estimated value for the Expected Annual Damage without project condition is $46.6 million.
- Section 7-4c contains a table that is used to calculate values for Expected Annual Damage Reduction and Expected Annual Damage for the with-project condition. The estimated values for the Expected Annual Damage Reduction and Expected Annual Damage for the with-project condition are $24.0 million and $22.6 million, respectively.
- Sections 7-4d contains a narrative discussion that describes the methodology used to calculate values entered into Table 11 – Expected Annual Damage by Damage Categories without project condition. The estimated value for the Expected Annual Damage without project condition is $46.6 million.

7-6 If possible, quantify estimates of economic flood damage reduction benefits using Table 12 as applicable

Table 12 is used to calculate the Present Value of Expected Annual Damage Benefits.

- Line (a) is the Expected Annual Damage without-project that is discussed in Section 7-4b Estimates of existing without-project conditions and calculated in Table 11.
- Lines (b) and (c) are the Expected Annual Damage and the Expected Annual Damage Reduction with-project that is calculated in the embedded table in Section 7-4c.
- Line (d) is the present value coefficient based on a 50 year project life at a 6 percent interest rate.
- Line (e) is the present value of future benefits that is calculate by multiplying the value in Line (c) Expected Annual Damage Reduction by the Line (d) present value coefficient. This present value of benefits is carried over and used as the benefit value in Table 20 – Project Costs and Benefits Summary.

Table 12 - Present Value of Expected Annual Damage Benefits Project: Haster Retarding Basin and Haster Pump Station			
(a)	Expected Annual Damage Without Project (1)		**$46,644,590**
(b)	Expected Annual Damage With Project (1)		**$22,607,310**
(c)	Expected Annual Damage Benefit	(a) – (b)	**$24,037,280**
(d)	Present Value Coefficient (2)		**15.76**
(e)	**Present Value of Future Benefits** **Transfer to column (e) Table 20: Proposal Costs**	**(c) x (d)**	**$378,827,533**

(1) This program assumes no population growth thus EAD will be constant over analysis period.
(2) 6% discount rate; 50-year analysis period (could vary depending upon life cycle of project).

7-7 Documentation to support information presented in the project(s), including studies, reports, and technical data, which will be used to assess the project's ability to produce the benefits claimed

The following studies, reports, and technical data have been used to provide information contained in Attachment 7 - Economic Analysis:

1. Haster Retarding Basin and Haster Pump Station Preliminary Design Report, (PDR) prepared by AKM Consulting Engineers, dated July 2008

2. Westminster Watershed Feasibility Study, Draft Without-Project Economics, prepared January 2007 by the U.S. Army Corps of Engineers

3. Westminster Watershed Feasibility Study, Draft Economics Appendix, prepared April 2010 by the U.S. Army Corps of Engineers

4. Westminster Watershed Feasibility Study, Exhibits D-1 through D-5 Floodplain Maps baseline Conditions without Haster Basin Improvements for the 25-year, 50-year, 100-year, 200-year and 500-year storm.

5. Westminster Watershed Feasibility Study, Exhibits E-1 through E-5 Floodplain Maps baseline Conditions with Haster Basin Improvements for the 25-year, 50-year, 100-year, 200-year and 500-year storm.