Appendix E

"Dr. Ronald J. Ryel"
<range@cc.usu.edu>

05/22/2001 12:49 AM
Please respond to
range

To: brian.tillemans@water.ladwp.com
cc: john_gray@urscorp.com
Subject: Delta HEC modeling

Attached is an Excel file with the results of HEC modeling of flows into the delta. Three sets of simulations were conducted for flows 7.2 to 150 cfs:
1) using the north transect and Manning's n = 0.1
2) using the north transect and Manning's n = 0.2
3) using the south transect and Manning's n = 0.1

The first three figures show maximum water depth, width of the wetted channel(s), and average channel velocity, respectively. The final figure shows the time it takes water to travel one mile at the average velocity. This is an indicator of retention time once water is reduced in flow.

Best wishes,
Ron Ryel

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   ---- File information -----------
     File:  delta-sum.xls
     Date:  22 May 2001, 1:46
     Size:  33792 bytes.
     Type:  Excel-sheet
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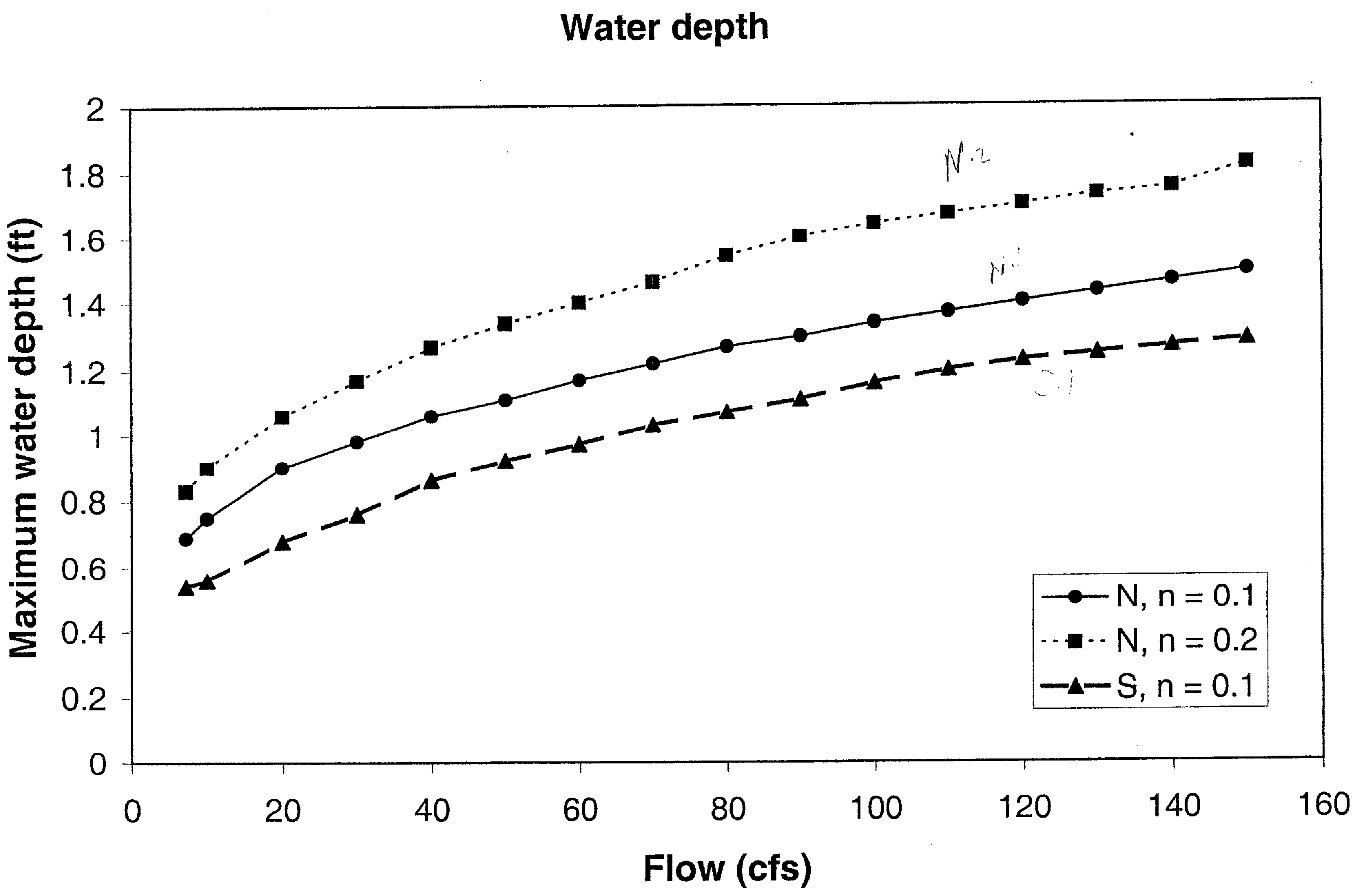
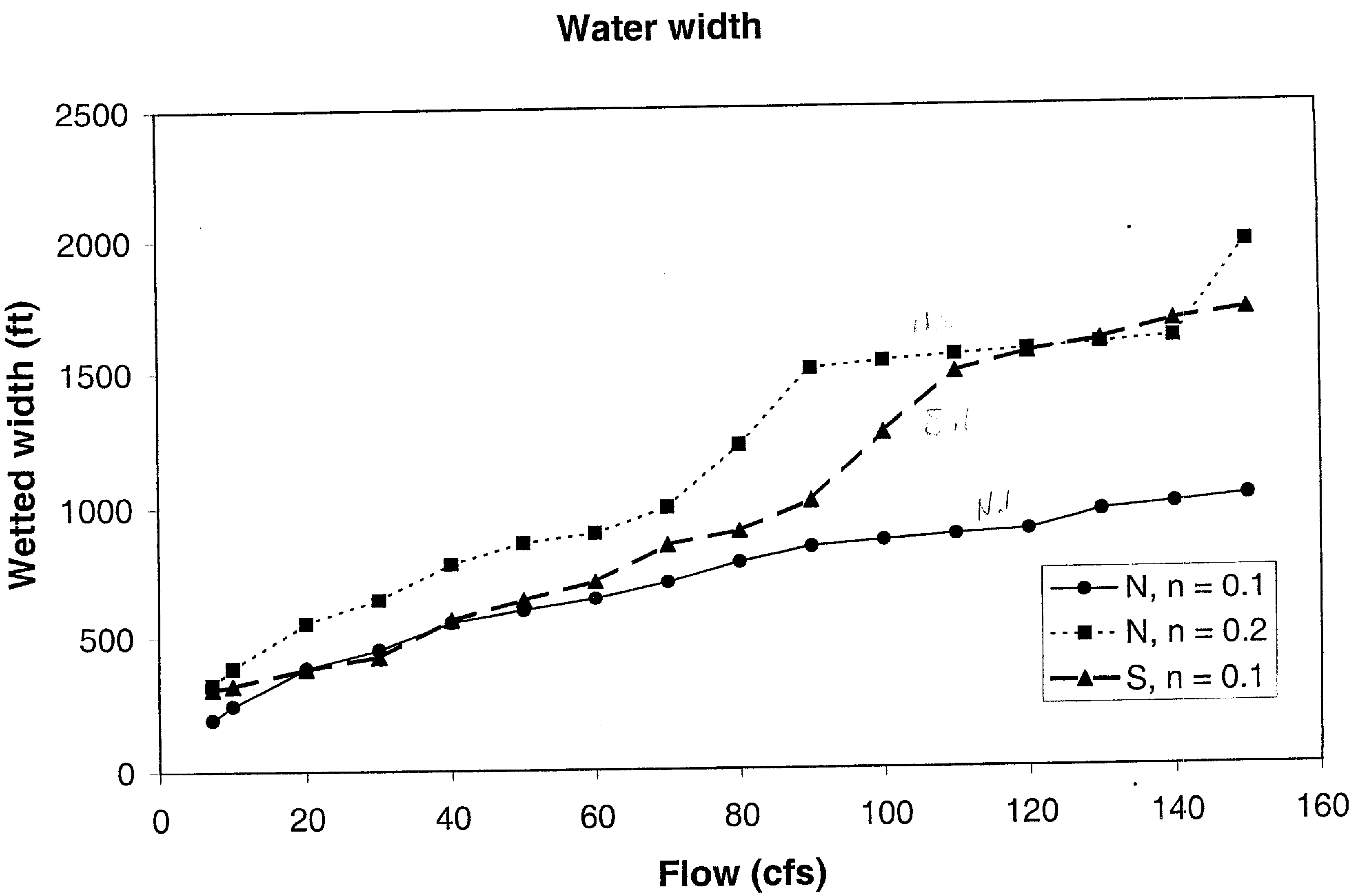
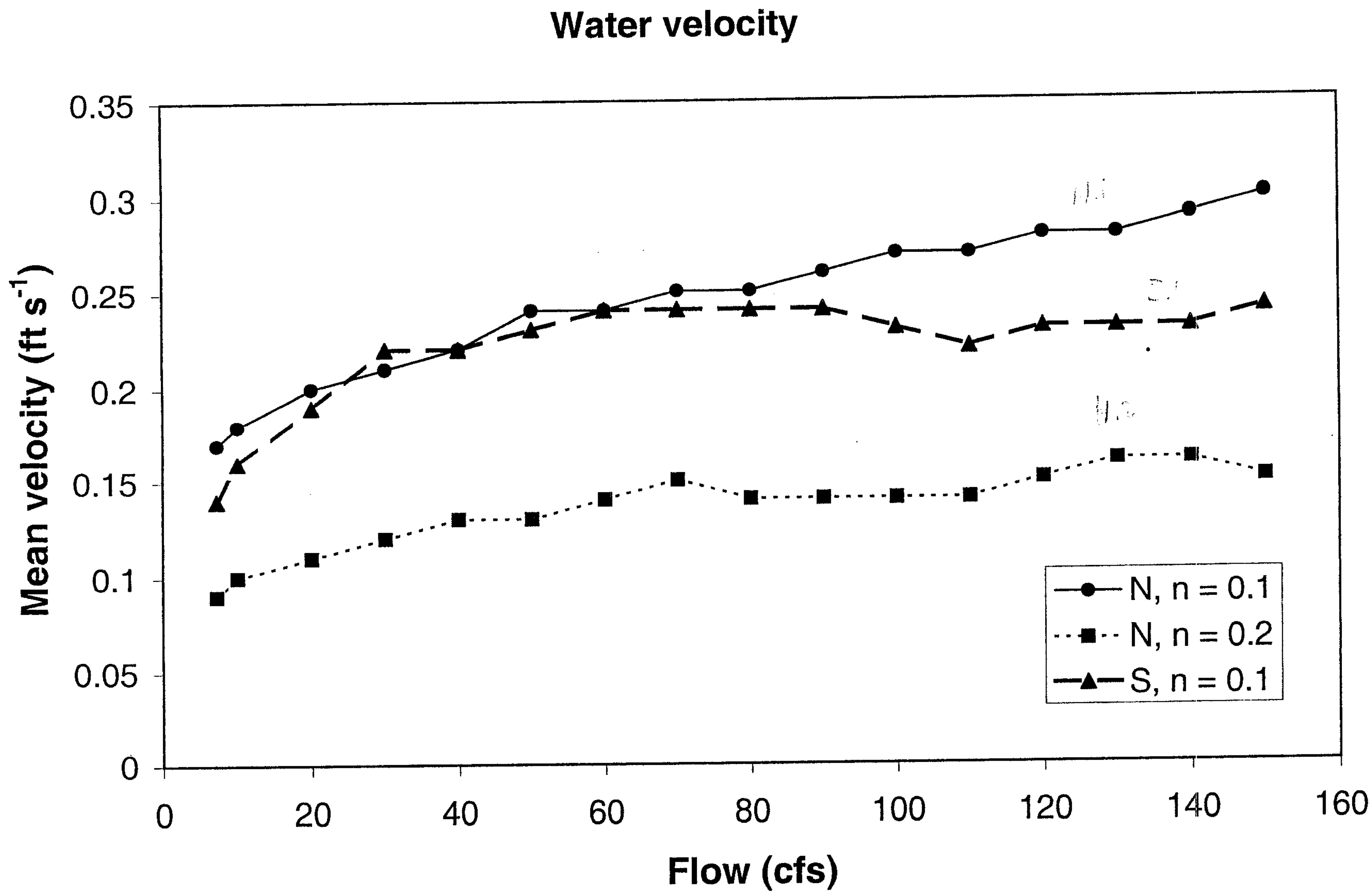
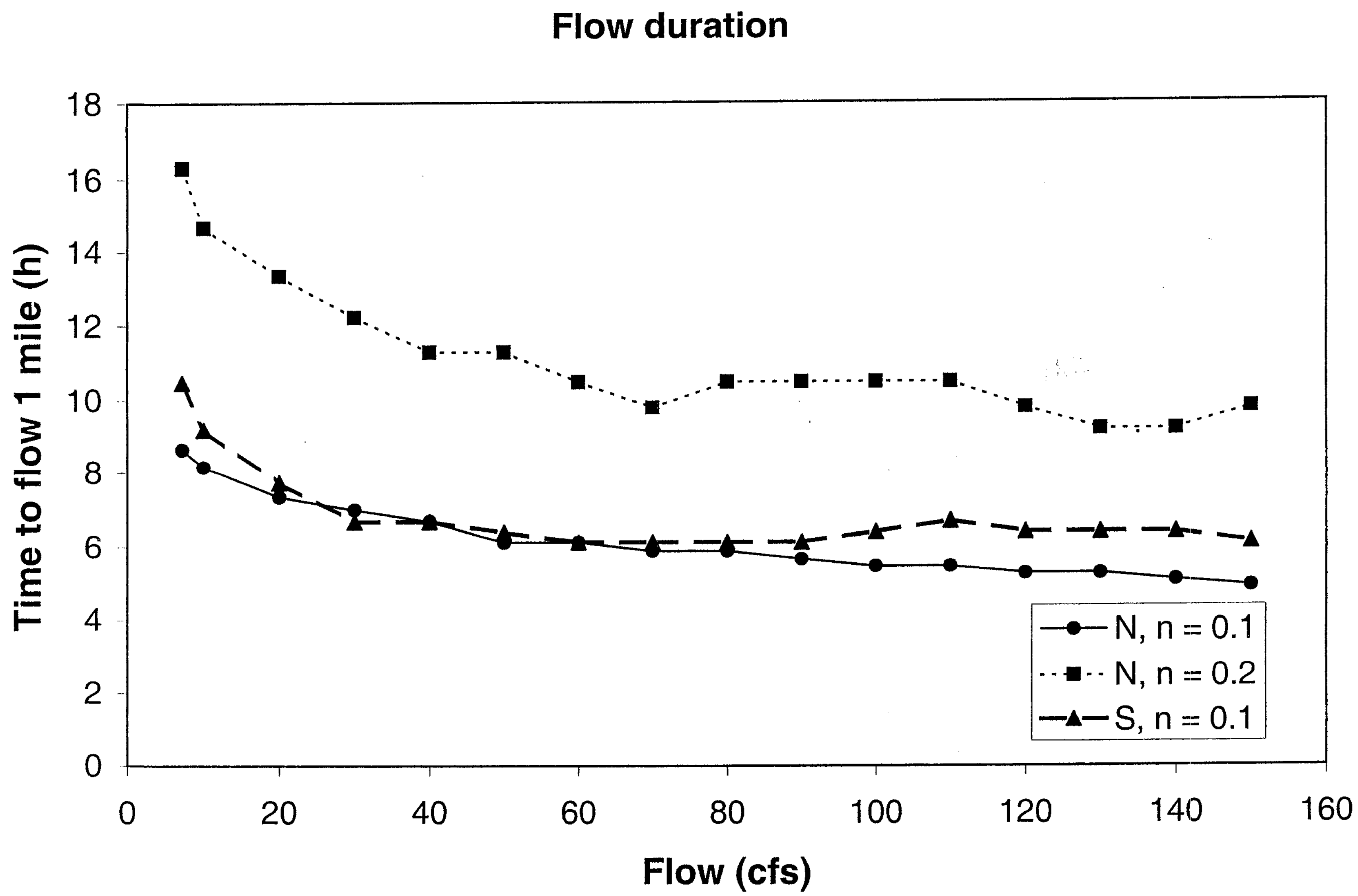
delta-sum.xls


Water depth
Maximum water depth (ft)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
120
140
160
Flow (cfs)
N, n = 0.1
N, n = 0.2
S, n = 0.1
N.2


Water width
Wetted width (ft)
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
140
160
Flow (cfs)
N, n = 0.1
N, n = 0.2
S, n = 0.1


Water velocity
Mean velocity (ft s-1)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160
Flow (cfs)
N, n = 0.1
N, n = 0.2
S, n = 0.1


Flow duration
Time to flow 1 mile (h)
18
16
14
12
10
8
6
4
2
0
0
20
40
60
80
100
120
140
160
Flow (cfs)
N, n = 0.1
N, n = 0.2
S, n = 0.1

North transect -- Manning's n = 0.20

Flow	Depth (ft)	Width (ft)	Vel (ft/s)	Time to move water one mile (h)
7.2	0.83	326	0.09	16.2963
10	0.9	386	0.1	14.66667
20	1.06	553	0.11	13.33333
30	1.17	641	0.12	12.22222
40	1.27	781	0.13	11.28205
50	1.34	860	0.13	11.28205
60	1.4	897	0.14	10.47619
70	1.46	992	0.15	9.777778
80	1.54	1222	0.14	10.47619
90	1.6	1502	0.14	10.47619
100	1.64	1529	0.14	10.47619
110	1.67	1551	0.14	10.47619
120	1.7	1568	0.15	9.777778
130	1.73	1589	0.16	9.166667
140	1.75	1609	0.16	9.166667
150	1.82	1969	0.15	9.777778

North transect -- Manning's n = 0.10

Flow	Depth (ft)	Width (ft)	Vel (ft/s)	Time to move water one mile (h)
7.2	0.69	196	0.17	8.627451
10	0.75	248	0.18	8.1481481
20	0.9	384	0.2	7.3333333
30	0.98	451	0.21	6.984127
40	1.06	553	0.22	6.6666667
50	1.11	598	0.24	6.1111111
60	1.17	641	0.24	6.1111111
70	1.22	704	0.25	5.8666667
80	1.27	781	0.25	5.8666667
90	1.3	837	0.26	5.6410256
100	1.34	860	0.27	5.4320988
110	1.37	880	0.27	5.4320988
120	1.4	897	0.28	5.2380952
130	1.43	968	0.28	5.2380952
140	1.46	992	0.29	5.0574713
150	1.49	1019	0.3	4.8888889

South transect -- Manning's n = 0.10

Flow	Depth (ft)	Width (ft)	Vel (ft/s)	Time to move water one mile (h)
7.2	0.54	310	0.14	10.47619
10	0.56	322	0.16	9.166667
20	0.68	383	0.19	7.719298
30	0.76	426	0.22	6.666667
40	0.86	562	0.22	6.666667
50	0.92	638	0.23	6.376812
60	0.97	709	0.24	6.111111
70	1.03	849	0.24	6.111111
80	1.07	901	0.24	6.111111
90	1.11	1012	0.24	6.111111
100	1.16	1262	0.23	6.376812
110	1.2	1485	0.22	6.666667
120	1.23	1559	0.23	6.376812
130	1.25	1602	0.23	6.376812
140	1.27	1673	0.23	6.376812
150	1.29	1712	0.24	6.111111

John Gray
05/18/2001 07:58 AM

To: m.hill@micron.net, brian.tillemans@water.LADWP.com, gahlborn@vom.com, leahkirk@qnet.com
cc:
Subject: Delta Modeling

Mark-

I assume you will be e-mailing or faxing results to all parties on Monday PM or early Tues AM so that we can view them during the conference call. Simple output would be great, such as an 81/2 x 11 map of the Delta showing the cross sections (measured and interpolated, if appropriate), a table of water surface elevations for the 50 and 150 cfs runs, avg or typical flow velocities, and map(s) of the Delta with your projection of out-of-bank flow.

When you have completed the modeling, I will have our hydrologist review the modeling inputs and HEC-RAS output tables. Will you be modeling anything less than 50 cfs? It seems that modeling a 5-10 cfs flow would be useful as a type of model validation - the results should show that the flows are contained in the two main channels for most of the length of the Delta. This is what is observed today on the ground.

Finally, I recommend that the modeling work be presented as a technical analyses in support of the EIR/EIS, not as a stand alone or supplemental LORP Tech Memo. To the extent that we (URS) can review and validate the reasonablness of the model for purposes of the EIR/EIS, the less likely that it will be challenged by opponents that have taken exception to past Delta-related Tech Memos. As such, I do not recommend that the modeling be packaged as a formal report at this time.

Thanks!

John Gray

05/24/2001 10:26 AM

To: m.hill@micron.net
cc: leahkirk@qnet.com, clarence.martin@water.LADWP.com
Subject: Delta modeling

Thanks to Ron and Sherm for their work on this odd, but important modeling effort. Here is a couple of follow up items:

1. Can you fax me the locations of the new transects to be taken at the upper and lower end of the Delta? (fax 805-964-0259)

2. For the final product, would you display the graphs of water depth, widtn and velocity for three "n" values for both transects (total 6 lines), putting each transect on a different graph. Add a third "n" value of 0.07 to provide a lower range that may reflect better conveyance conditions in the Delta after the LORP has been operative for a long time.

3. Could you provide a spreadsheet that shows water and ground elevations at each transect interval for varying flows so that we can see where the low point is located, determine if spreading is occuring more to the east or west parts of the transect, and calculate an average depth across the transect for various flows. I am assuming that the "depth of water" graph refers to the maximum depth along a transect for a given flow, right?

Thanks

"Dr. Ronald J. Ryel"
<range@cc.usu.edu>
06/08/2001 11:36 AM
Please respond to
range

To: brian.tillemans@water.ladwp.com
cc: john_gray@urscorp.com, shermjensen@sisna.com
Subject: HEC2 modeling

Attached is a .PDF file containing resuts for the HEC2 simulations for the Upper reach (where west channel breaks off) and the lower reach (above the brine pool) for the Owen's delta. The results are pretty general due to the difficulty of effectively modeling the situation.
Best wishes,
Ron

The following section of this message contains a file attachment prepared for transmission using the Internet MIME message format. If you are using Pegasus Mail, or any another MIME-compliant system, you should be able to save it or view it from within your mailer. If you cannot, please ask your system administrator for assistance.

---- File information -----------
File: Summary-UL.PDF
Date: 8 Jun 2001, 12:27
Size: 8660 bytes.
Type: Acrobat

Summary-UL.PDF

Summary of simulations for upper reach and lower reach of Owen's River delta.

Several approaches to the data were attempted, but two problems limited the effectiveness of the efforts:

1) Cross sections were only made to the water's edge, not across the river channel.
2) The cross sections were not close enough together (upper section) to provide adequate linkages between cross sections. This resulted in water conveyance problems—that is, the channel configuration between cross sections were too dissimilar to effectively transfer the correct volume of water.
3) River gradient (slope parallel to river channel) could not effectively be estimated from the cross sections as water's edge was the same elevation for most of the transects.
4) No effective way to measure Manning's n roughness coefficient due to beaver dams and vegetation structure.

To get around these problem, I made the following assumptions:

1) The present water level was effectively a stored pool due to beaver dams and constraining vegetation. I assumed that the present water level was the bottom for simulations. This assumption was not too bad unless flows destroyed the holding structure of this bottom (e.g., beaver dams were blown out).
2) The cross section (2) at the west channel for the upper reach was located where the channel was most constricted (and would effectively regulate the water level). Based on the measured transects, this cross section had the least cross-sectional area, and should be the most confining. I then determined through simulations the equilibrium water depth for this cross section based on flow, gradient and roughness coefficient. A similar approach was used for the lower transects 7 and 8.
3) I used two different gradients in simulations: 0.1 and 0.01 %. The 0.1% was based on the average gradient for the whole delta, and the other was assumed to be even flatter. Reducing the gradient increases water depth and reduces average water velocity.
4) I used a low (0.05) and medium (0.10) Manning's n roughness coefficient for the simulations.

Results

Upper Reach

1) At 150 cfs, water depths were nearly twice that for 50 cfs. For 150 cfs, the river would likely overflow into the west channel. That is the predicted water levels was higher than the 1.1 ft bank height. This occurred for 3 of the 4 simulations. Only the simulation with the low Manning's n with 0.1% gradient did not overflow the bank, but was within 0.2 ft of the top. At 50 cfs, the flow was much less likely to overflow into the west channel as only one simulation (gradient = 0.01% and Manning's n = 0.10) resulted in

water depths sufficient to overflow into the west channel. For one other simulation at 50 cfs (gradient =0.01%, Manning's n = 0.05), however, the water depth was close to overflowing the bank.

2) Average water velocity increased nearly 50% between 50 and 150 cfs. This strongly suggests that water velocities at 150 cfs would be more likely to erode bottom structures (e.g., beaver dams) and banks.

Lower Reach

1) Predicted water depths increased 20-42% when flow was increased from 50 to 150 cfs. However, in both simulations, water depth filled or exceeded the existing cut channel. Water with 150 cfs flow simply spread out in the flat topography above the cut channel resulting in a moderate increase in depth.
2) Average water velocities were generally higher for 150 cfs. But since both flows filled the channel for both cross sections, both flows could similarly erode the banks of the channel, and perhaps result in the migration of the cut channel further upstream.
3) Several simulations with the low gradient (0.01%) resulted in water depths that exceeded the bank height.

Simulations for upper reach

				Simulation results		Increase from 50 to 150	
Transect	flow	Manning's n	Gradient (%)	Maximum depth (ft)	Mean Velocity (ft/sec)	Maximum depth (%)	Mean Velocity (%)
2	150	0.05	0.01	1.8	0.4	89.47368	48.14815
2	150	0.1	0.01	2.65	0.25	89.28571	38.88889
2	150	0.05	0.1	0.92	0.85	91.66667	51.78571
2	150	0.1	0.1	1.39	0.54	93.05556	50
2	50	0.05	0.01	0.95	0.27		
2	50	0.1	0.01	1.4	0.18		
2	50	0.05	0.1	0.48	0.56		
2	50	0.1	0.1	0.72	0.36		

Simulations for lower reach

				Simulation results		Increase from 50 to 150	
Transect	flow	Manning's n	Gradient (%)	Maximum depth (ft)	Mean Velocity (ft/sec)	Maximum depth (%)	Mean Velocity (%)
7	150	0.05	0.1	4.82	0.89	42.18289	-16.0377
7	150	0.1	0.1	5.29	0.58	23.31002	9.433962
7	50	0.05	0.1	3.39	1.06		
7	50	0.1	0.1	4.29	0.53		
7	150	0.05	0.01	5.72	0.44 *	17.93814	51.72414
7	150	0.1	0.01	6.62	0.29 *	24.20263	52.63158
7	50	0.05	0.01	4.85	0.29 *		
7	50	0.1	0.01	5.33	0.19 *		
8	150	0.05	0.1	3.04	0.74	25.10288	8.823529
8	150	0.1	0.1	3.41	0.46	19.64912	39.39394
8	50	0.05	0.1	2.43	0.68		
8	50	0.1	0.1	2.85	0.33		
8	150	0.05	0.01	3.71	0.35	21.24183	45.83333
8	150	0.1	0.01	4.36	0.23 *	26.74419	53.33333
8	50	0.05	0.01	3.06	0.24		
8	50	0.1	0.01	3.44	0.15		

* Note: Water depth which exceeded transect upper bank measurement

John Gray

06/15/2001 08:44 AM

To: range@cc.usu.edu
cc:
cc: brian.tillemans@water.ladwp.com, john_gray@urscorp.com, shermjensen@sisna.com
Subject: Re: HEC2 modeling

Ron-

Thanks for sending the results. I have several questions:

--Do you have the locations and cross section data for each transect? Should I request this information from DWP? I don't know how many and how wide the transects were. It appears that they were insufficient for your modeling. Were you expecting more transects than were provided?

--Your results indicated that the transects did not include the full channel dimensions, including the channel invert (because water was present?) - is this true? Without the invert elevation, we can't really estimate actual channel capacity, nor gradient. As a result, your modeling effort was severely comprised.

--Your data suggest that even a 50 cfs flow could break out at the upper reach. Correct?

--Furthermore, it appears that the transects did not extend beyond the edge of the water. True? I thought the transects would extend to at least the top of bank, and onto the adjacent floodplain for a nominal distance.

--Finally, were the transects at the upper end located at what appeared to be the low point along the reach - that is, the area most susceptible to overbank flooding?

I believe that you made reasonable assumptions (as listed in your memo) to address the limitations noted above. I like the use of two gradient values and I like the n values that you used. However, your assumption about using the current water level as the channel invert seems overly conservative for the upper transect and is not applicable to the lower transect (no beavers there). I believe that the dense vegetation and beaver dams at the upper end will be removed over time as flows of up to 35 cfs move through the delta. In additon, there will be management efforts to remove beavers from the river where they cause hydraulic constraints. Hence, I would request that the simulations be conducted with a large channel cross section at both locations. I don't know how we estimate the depth of the channel - I thought that was going to be accomplished from a boat last month. Perhaps DWP personnel could give you an estimate of water depth at the time of the survey. At the lower end, it would probably be about 3-4 feet at a maximum. I cannot guess the depth at the upper end.

In summary, I would like to see the following completed for the EIR:

1. Estimate channel depth and the cross sections and run the simulations again, and provide a summary table or graphic showing these dimensions and ground surface elevations. This scenario is more accurate for the lower reach, and can be called a "no beaver" scenario for the upper reach.

2. Run the simulations with 20 cfs and 7 cfs flows.

3 Provide map and cross sections of transects with ground elevations

4. Add the following to your results table: elevations of water surface, channel invert, and top of bank.

5. For your original modeling analysis, please run the simulation with a thrid manning's "n," say 0.05 per my e-mail of 5/24/01 (which also discusses format of figures).

6. Finally, when you have completed the analyses, I would like to get spreadsheets of the results.

Thanks. Call me if you have any questions. Thanks for being so creative in addressing this problem. You are getting a lot out of little data!

John Gray
805-964-6010

METHODS

Flows in the Center of the Delta

Two cross-sections through the middle region of the delta were provided. These cross-sections were not sufficient to model flows directly moving water between the transects as at least three transects would be necessary to roughly model water surface elevation (WSE) and average velocity for one transect. Also, with some flows, there would be significant conveyance problems between these two transects due to the somewhat dissimilar shape of the cross-sections resulting from the complex nature of the delta stream “channel”. Conveyance refers to the ability of the model to convey water between transects, keeping the water level and cross-sectional area of the flow somewhat consistent.

Because of these problems, and the nature of the results needed for this exercise, a different approach was used for this modeling effort for all simulations within the delta, and for the above and below simulations. The simulations were conducted using 21 identical cross-sections equally spaced, but differing in elevation as determined by the stream gradient. This allowed for the determination of the equilibrium WSE and average velocity for the given flow, roughness coefficient (n) and stream gradient for the measured cross-section.

For the two transects in the center of the delta, the 21 transects were separated by 250 feet, although the results would be the same regardless of this distance. The gradient selected was estimated from elevational data parallel to the “stream” course. The measured gradient averaged about 0.10 %, and this value was used for the simulations.

During the simulations, the water level of the lowest transect was changed until the equilibrium water level could be determined. When in equilibrium, all 21 identical transects would have the same water depth.

Flows at the North End

The objective of these simulations were to determine whether the WSE in the main channel would overflow into a channel to the west. Cross sections were measured at six locations above and below the bank dividing the main channel and west channel. An additional cross section was also measured where a pipeline crosses the channel upstream from the other 6 transects. The six transects were only measured to the water’s edge, due to the complex of vegetation and beaver dams within the channel that elevated the water level essentially creating an impounded system.

Simulations were initially conducted using the six measured cross-sections spaced as measured. However, the large differences in the shape of these cross-sections resulted in significant conveyance problems. It was decided that only the transect (Transect 2) closest to the bank dividing the main and west channels would be used, and the approach used for the main delta would be employed.

A second problem arose because of the lack of measurements made for the bottom of the stream channel. In addition, the stream channel due to vegetation and beaver dams was essentially an impounded system, and additional flows would have to flow over the existing structures—that is over the existing wetted area. The assumption was made that the existing structure as indicated by the existing WSE for 7.2 cfs would act like a stream bottom with low resistance for additional flows. The existing WSE as measured to the edge of the stream would then be the bottom of the stream for simulations. This assumption is likely not too bad as long as the structures impounding the flows remains. However, if these structures are removed or damaged by higher flows, the flows would then be different due to a different bottom configuration. The extreme of this situation was simulated by lowering the bottom by 4 feet (following the gradients at the water's edge of the transects). Four feet was selected as half of the depth measured in the pipeline crossing (8 ft) where the stream bottom was measured across the wetted area.

As discussed above, 21 transects of cross section identical to Transect 2 were used in the simulations separated by 250 feet. Two different gradients were used: 0.1 and 0.01 %. The former was close to the gradient measured among all 6 transects (0.07 %) while the latter was close to the gradient measured between transects 1 and 4 (0.008 %). Two roughness coefficients were used: 0.1 and 0.05. The value of 0.1 would suggest some roughness induced by emergent vegetation, while the 0.05 would suggest that this roughness was minimal, or that the vegetation would be flattened or removed. As before, equilibrium WSE and average velocity were calculated for the transect.

To determine whether the flows would exceed the bank separating the main and west channels would require a transect at the low point of the bank. Such a transect was not measured. Since Transect 2 was the closest to this point, it was assumed that the channel configuration was the same as Transect 2 at the lowest point. The WSE for 7.2 cfs was measured to be 1.1 ft below the bank at its lowest point. However, for transect 2, this bank was measure to be about 3.9 ft above the WSE for 7.2 cfs. Simulations were conducted using the original configuration for Transect 2, but water was assumed to spill into the west channel when the WSE was 1.1 ft above the “bottom” of Transect 2 (“bottom” = measured WSE at 7.2 cfs). While the quantity of water flowing into the west channel was not quantified, the opportunity for such water movement was determined by the water level for Transect 2.

Flows at the south end

Two transects (7 and 8) were used for predicting flows in the narrow channel below the delta. The simulations were designed to determine whether these narrow sections would be overflowed and perhaps degraded due to high velocity and water depth. A third transect (9) was measured below the narrow section of the stream and was not used in this analysis.

As before, 21 identical transects (like 7 or 8) separated by 250 ft were used in the simulations to determined equilibrium water depths. Gradients of 0.1 and 0.01 % were used, and the same roughness coefficients were also used (0.1 and 0.05).

MEMORANDUM

TO: Mark Hill – Ecosystem Sciences
Ron Ryel – Ecosystem Sciences
Gary Ahlborn – Ecosystem Sciences

INFO: Clarence Martin – LADWP
Leah Kirk – Inyo County

FROM:John Gray – URS Corporation

RE: Delta Modeling – Additional Information

Ecosystem Sciences conducted two hydraulic analyses (using HEC-2) for the LORP EIR/EIS related to the Delta. The first analysis was conducted in May 2001 to estimate the water depth, width, and flow velocities for two cross sections in the center of the Delta. Results of the first analysis were provided in an e-mail dated May 22, 2001. They included Excel spreadsheets for both transects using two different Manning's "n" values, discharges from 7 to 150 cfs, and an unknown stream gradient.

The second analysis was conducted for cross sections at the northern end of the Delta, above the "Y", and at the southern end of the Delta, before the "water to brine" reach. Results were provided in an e-mail dated June 8, 2001 and included tables for the northern and southern transects for 50 and 150 cfs, two stream gradients, and two Manning's "n" values.

As requested in several e-mails sent to Ecosystem Sciences in May and June, we require additional information on the modeling to provide sufficient technical support for the analyses in the EIR/EIS. We will include the modeling results and supporting documentation in an appendix to the EIR/EIS. The specific information needs are described below. This information should be provided to LADWP, Inyo County, and EPA by August 24th.

First Analysis – Flows in the Center of the Delta

1. Please provide results for both transects using 0.05 "n" values to reflect relatively cleared channel conditions which may occur over time due to higher flows.

2. Please provide results for the southern transect using 0.2 "n" value, as this analysis was not included in the original effort.

3. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, boundary conditions, and stream gradient used.

Second Analysis – Flows at the North End

1. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, and boundary conditions. The initial results indicated that only Cross Section 2 was used, which has the lowest bank elevation on the west side. We need to justify this approach and note any bias introduced by the methodology. There were 6 cross sections collected at the north end – we need to explain why only one was used.

2. Please conduct the modeling for all flows and stream gradients with 0.05 "n" value to reflect a potential future condition when beaver dams are removed.

3. The cross sections at the northern end did not include channel invert elevations due to the presence of water and dense in-channel vegetation. However, we have measured channel depths at the upstream pipeline crossing which show a water depth of 8 feet (see attached Excel charts). Please conduct the modeling for the northern end with a channel depth of 4 feet below the measured water surface to approximate the actual channel depth. Four feet should be used instead of 8 feet to retain a conservative approach to the modeling.

4. Please conduct the modeling for the northern end using 7.2 cfs and 25 cfs to determine water depths and velocities for current flows and proposed pulse flows.

5. Please provide water surface elevation data in addition to water depth data for each cross section to allow us to determine if flows will exceed bank heights.

6. The May 2001 results stated that the western bank was 1.1 feet higher than the water surface. However, the survey data for Cross Section 2 show the following -- water surface was at 3586 feet, while the bank between the river and the western channel was at 3588.7 feet, and the outer bank of the western channel was at 3592 feet. This apparent discrepancy needs to be resolved. The modeling results should show actual predicted elevations so that we can see if the flow will exceed the riverbanks and enter the western channel, and if the flows will also exceed the western channel.

Second Analysis – Flows at the Southern End

1. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, and boundary conditions.

2. Please provide water surface elevation data in addition to water depth data for each cross section to allow us to determine if flows will exceed bank heights.

3. Please provide width of flows to determine how much spreading occurs

7. Please conduct the modeling for the northern end using 7.2 cfs and 25 cfs to determine water depths and velocities for current flows and proposed pulse flows.

4. Note that the survey data for the two southern transects included actual channel inverts.

Response to the MEMORANDUM

I have indicated my response to your comments below each one.

First Analysis – Flows in the Center of the Delta

1. Please provide results for both transects using 0.05 “n” values to reflect relatively cleared channel conditions which may occur over time due to higher flows.

This is included in file: delta-sum-2.xls

2. Please provide results for the southern transect using 0.2 “n” value, as this analysis was not included in the original effort.

This is included in file: delta-sum-2.xls

3. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, boundary conditions, and stream gradient used.

This is included in file: Methods-1.doc

Second Analysis – Flows at the North End

1. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, and boundary conditions. The initial results indicated that only Cross Section 2 was used, which has the lowest bank elevation on the west side. We need to justify this approach and note any bias introduced by the methodology. There were 6 cross sections collected at the north end – we need to explain why only one was used.

This is included in file: Methods-1.doc

2. Please conduct the modeling for all flows and stream gradients with 0.05 “n“ value to reflect a potential future condition when beaver dams are removed.

This is included in file: up-low-sum-2.xls

3. The cross sections at the northern end did not include channel invert elevations due to the presence of water and dense in-channel vegetation. However, we have measured channel depths at the upstream pipeline crossing which show a water depth of 8 feet (see attached Excel charts). Please conduct the modeling for the northern end with a channel depth of 4 feet below the measured water surface to approximate the actual channel depth. Four feet should be used instead of 8 feet to retain a conservative approach to the modeling.

This is included in file: up-low-sum-2.xls. I have also included a file showing the modified transect. I also show the transect modified for 1 and 2 ft depths, but did not run these per our conversation.

4. Please conduct the modeling for the northern end using 7.2 cfs and 25 cfs to determine water depths and velocities for current flows and proposed pulse flows.

This is included in file: up-low-sum-2.xls. Please note that the simulations for 7.2 cfs are actually on top of the existing WSE measured for 7.2 cfs. The measured data is the best estimate of the WSE. I wanted to see how much 7.2 cfs would change the WSE. The rather small change (ranged from 0.15 to 0.45 ft) suggests that most of the water elevation in the channel is due to impounding by beaver dams and vegetation, not due to the volume of water at 7.2 cfs. And thus, the assumption of a “bottom” made by existing structure may not be too bad.

5. Please provide water surface elevation data in addition to water depth data for each cross section to allow us to determine if flows will exceed bank heights.

This is included in file: up-low-sum-2.xls. Please note that these WSE are relative to the low point in the bank, not to the original Transect 2. However, the original shape of Transect 2 was used so the water would go above 1.1 ft depth if necessary. Modeling flow into the west channel would be quite difficult.

6. The May 2001 results stated that the western bank was 1.1 feet higher than the water surface. However, the survey data for Cross Section 2 show the following -- water surface was at 3586 feet, while the bank between the river and the western channel was at 3588.7 feet, and the outer bank of the western channel was at 3592 feet. This apparent discrepancy needs to be resolved. The modeling results should show actual predicted elevations so that we can see if the flow will exceed the riverbanks and enter the western channel, and if the flows will also exceed the western channel.

I have discussed this in file: Methods-1.doc and in the response to 5 above. Let me know if this is still unclear.

<u>Second Analysis – Flows at the Southern End</u>

1. Please provide a description of the methodology, including the number of real and synthetic transects, length of modeled reach, and boundary conditions.

This is included in file: Methods-1.doc.

2. Please provide water surface elevation data in addition to water depth data for each cross section to allow us to determine if flows will exceed bank heights.

This is included in file: up-low-sum-2.xls.

3. Please provide width of flows to determine how much spreading occurs

This is included in file: up-low-sum-2.xls.

7. Please conduct the modeling for the northern end using 7.2 cfs and 25 cfs to determine water depths and velocities for current flows and proposed pulse flows.

This is included in file: up-low-sum-2.xls.

4. Note that the survey data for the two southern transects included actual channel inverts.

Yes, this was noted.