2012 – 2015 Delta Salinity Conditions under a Without Project Scenario

PREPARED FOR: Terry Erlewine/SWC

PREPARED BY: Tyler Hatch/CH2M HILL

Chandra Chilmakuri/CH2M HILL

DATE: June 5, 2015

Study Objective

The purpose of this study is to analyze salinity conditions in the south Delta channels under a Without Project scenario using the January 1, 2012 to August 31, 2015 Central Valley rim inflows. 2012 - 2015 historic and projected Sacramento River and San Joaquin River inflows to the Delta were modified to remove the impairments related to the upstream CVP – SWP reservoirs under the Without Project Scenario in addition to zeroing out the Delta exports at the Banks and Jones Pumping Plants and closing the Delta Cross Channel. The 2012 – 2015 study is an extension of a previous study of Without Project conditions for the year 2014. The multi-year timeframe allows understanding Delta salinity conditions under a sequence of differing hydrologic conditions.

Approach

A DSM2 model capable of simulating 2012-2015 historical Delta hydrodynamics and salinity conditions obtained from the DWR was used for representing the With Project scenario in this task. DWR used 2012 – 2015 Delta inflows, exports and salinity as the boundary conditions for the DSM2 model.

For the 2012-2015 Without Project DSM2 model, adjusted daily Delta inflow data at Vernalis and Freeport provided by the SWC were used as boundary conditions. As shown in Figures 1 and 2, Sacramento and San Joaquin Without Project inflows to the Delta are significantly lower (in some cases negative) in the summer and fall months compared to the historical conditions primarily due to the lack of contributions from project reservoir storage. The Without Project Scenario also assumed zero Delta exports from Banks and Jones Pumping Plants. The Without Project DSM2 model also uses historical electrical conductivity estimates for salinity boundary conditions at Freeport consistent with the historical DSM2 model. However, for the San Joaquin River at Vernalis modified electrical conductivity estimates were used to account for the unimpaired conditions under the Without Project scenario. The modified Vernalis EC estimates for the Without Project scenario were computed based on a methodology provided by the SWC, which is outlined in the Appendix A of this memo. For the Without Project conditions, the Delta Cross Channel gates were assumed to be closed for the entire length of the simulation.

Clifton Court Forebay (CCF) gate operations under the historical and Without Project DSM2 simulations were modified to represent Priority 3 gate operations. Under the Without Project simulation, instead of relocating BBID's existing DICU diversion from inside the CCF and closing the CCF gates, the With Project CCF gate operations were assumed to allow for the BBID diversion to continue. Even though the CCF gates are operational under the Without Project scenario, resulting Clifton Court inflow (Figure 3) confirms that inflow to CCF occurs only during the months with BBID diversion.

Sacramento River at Freeport timeseries input into the Without Project DSM2 model used only the positive flows provided. All negative flows were set to zero. Figure 1 below shows a comparison of the historical record, the Without Project timeseries with negative values from SWC, and the timeseries input into DSM2. In the summer months, the demands upstream of the Delta exceed the supply when there is no storage available to supplement the river flows into the Delta.

For the San Joaquin River at Vernalis, the Without Project DSM2 simulation used a 20 cfs base flow, when the Without Project flows from SWC are negative in order to achieve model stability in the channels near the San Joaquin River boundary in the DSM2 model. This base flow was used to keep water in the few channels downstream of Vernalis and was diverted upstream of the Old River (model node 4). Figure 2 shows a comparison between the historical Vernalis flows, the Without Project flows from SWC, and the Without Project flows used in the DSM2 simulation. In addition, the

SWC Ex. 0005

diversion component of the Delta Island Consumptive Use (DICU) in the channels near the San Joaquin River boundary (at node 1 and 3) were set to zero when the base flow was the only flow assumed in the model at Vernalis. Without curtailing the DICU diversions at model nodes 1 and 3, the base flow would have to be large enough to meet the DICU demand and keep water in the channel.

Based on the modified electrical conductivity at Vernalis under the Without Project conditions, zero or negative flows have zero electrical conductivity. This assumption of zero EC was continued even though 20 cfs base flow was assumed under the Without Project scenario. However, the artificial base flow of 20 cfs with zero EC could therefore dilute salinity in the San Joaquin River near the Vernalis boundary that would otherwise exist in higher concentrations. A sensitivity analysis using the same model and assuming 2014 historical salinity for the 20 cfs base flows shows that the resulting salinity in the San Joaquin River near the Vernalis boundary is somewhat sensitive, but the differences are minimal beyond model node 4. In addition, while the DICU diversion values are set to zero at nodes 1 and 3, the DICU drain flow is continued in the model, which continues to add salt to the Delta channels.

For conditions projected from May 2, 2015 to August 31, 2015, stage and electrical conductivity at the downstream boundary was assumed at 2014 values for both the With Project and Without Project scenarios. For the With Project conditions, 2014 conditions were assumed for May 2, 2015 to August 31, 2015 for all inflows and outflows with the exception of inflows at Freeport and Vernalis and outflows for SWP and DMC. Projected 2015 with project flows at Vernalis were calculated as the sum of New Melones monthly outflows and San Joaquin River above the Stanislaus River flows after removing any contractor deliveries from the forecasted operations provided by the U.S. Bureau of Reclamation to the SWRCB in support of the 2015 TUC petition (http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/inputsheet_april90_upstream_ops.pdf). Projected 2015 With Project flows at Freeport were estimated as the balance of Delta monthly inflows and outflows, and assuming SWP and CVP Delta exports to be zero for May through August 2015. The Without Project simulation used the same boundary inflows and diversions as the With Project simulation for May 2, 2015 to August 31, 2015 period with the exception of Sacramento River at Freeport and San Joaquin River at Vernalis inflows, which were assumed to be zero. Figures 1 and 2 show the assumed inflow boundary conditions for 2015 projected conditions.

Results

Due to a lack of inflow at both Freeport and Vernalis during the summer and fall months under the Without Project scenario, salinity is much higher in the Delta compared to the historical conditions. During these months there is no fresh water to dilute the higher salinity intrusion, and as a result, the tide brings saltier water further into the Delta. In figures 5 to 52, the saltwater-freshwater interface has moved much further inland by the end of June in the Without Project Scenario than the With Project conditions. The Sacramento River inflows tend to be much higher than the San Joaquin River inflows and cause the salt to be in higher concentrations in the south Delta. However, low flows in the Sacramento River allow the salt concentrations to be relatively high in the north Delta as well. By September the flows in the Sacramento River are high enough to push the saltwater interface further to the south. The area around Frank Tract tends to hold higher salinity water late into the year even after the Sacramento and San Joaquin Delta inflows have flushed much of the saltwater back out of the Delta. The contribution of New Melones Reservoir to flows at Vernalis appears to be a major component of the historical flows during the summer and fall months. Contour plots of weekly EC conditions for 2012 - 2015 are provided as electronic attachments to this memorandum.

Martinez EC Sensitivity Simulations

To consider the potential effect of modified NDOI on the Martinez EC boundary condition, a sensitivity analysis was performed of the modeled salinity under the With Project and Without Project cases by using the Martinez salinity boundary condition estimated using the DWR's G-Model, instead of the historical Martinez EC values. Figure 4 compares the daily-average Martinez EC values for the historical conditions, G-model estimates using With Project NDOI, and G-model estimates using Without Project NDOI. The G-Model salinity values are higher on average than the historical salinity used. DSM2 model for both With Project and Without Project cases were simulated with G-model based EC values specified at Martinez. DSM2 results showed that the higher salinity conditions extended further into the Delta under both the With Project and Without Project cases. Since the Martinez tide and the hydrology used remained unchanged under the sensitivity runs, the resulting hydrodynamics remained consistent with the original simulations. Therefore, using the G-model based EC values resulted in similar durations of salinity as compared to the simulations using historical Martinez EC.

Summary

The results in this memorandum show that without the CVP-SWP project reservoir storage, salinity would be much higher in the Delta during dry years than under the historical (With Project) conditions. There appears to be some pockets of higher salinity that persist late into the fall months in the central/south Delta channels over the multiple dry years simulated. However, due to the higher storm flows into the delta in the Without Project scenario, the driest years still have most of the salinity flushed east of Antioch in the spring months. The high salinity in the summer and fall months would further limit the beneficial use of water from the Delta during years like 2012 through 2015 under the Without Project scenario.

Limitations

Simulation of Delta salinity under With Project conditions and Without Project conditions using DSM2 are subject to limitations of the model and the approach used. DSM2 limitations and uncertainties are well documented in the DWR Annual Reports (http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm).

Salinity in San Joaquin River upstream of Head of Old River is likely not accurate due to artificial base flows assumed for model stability, and curtailing of the DICU diversions upstream of Head of Old River (at model nodes 1 and 3), under the Without Project scenario. Projections of Delta inflows and exports for May – Aug 2015 are also subject to change.

The salinity contour plots presented in this memorandum were created from point data in the model using kriging. As a result, the zones where the contours are calculated may be influenced by a neighboring channel without direct access to comingled salinity. An example of this is the Sacramento Deep Water Ship Channel and the Sacramento River on September 6, 2014.

FIGURE 1: SACRAMENTO RIVER AT FREEPORT DSM2 MODEL INFLOW FOR 2012 TO 2015

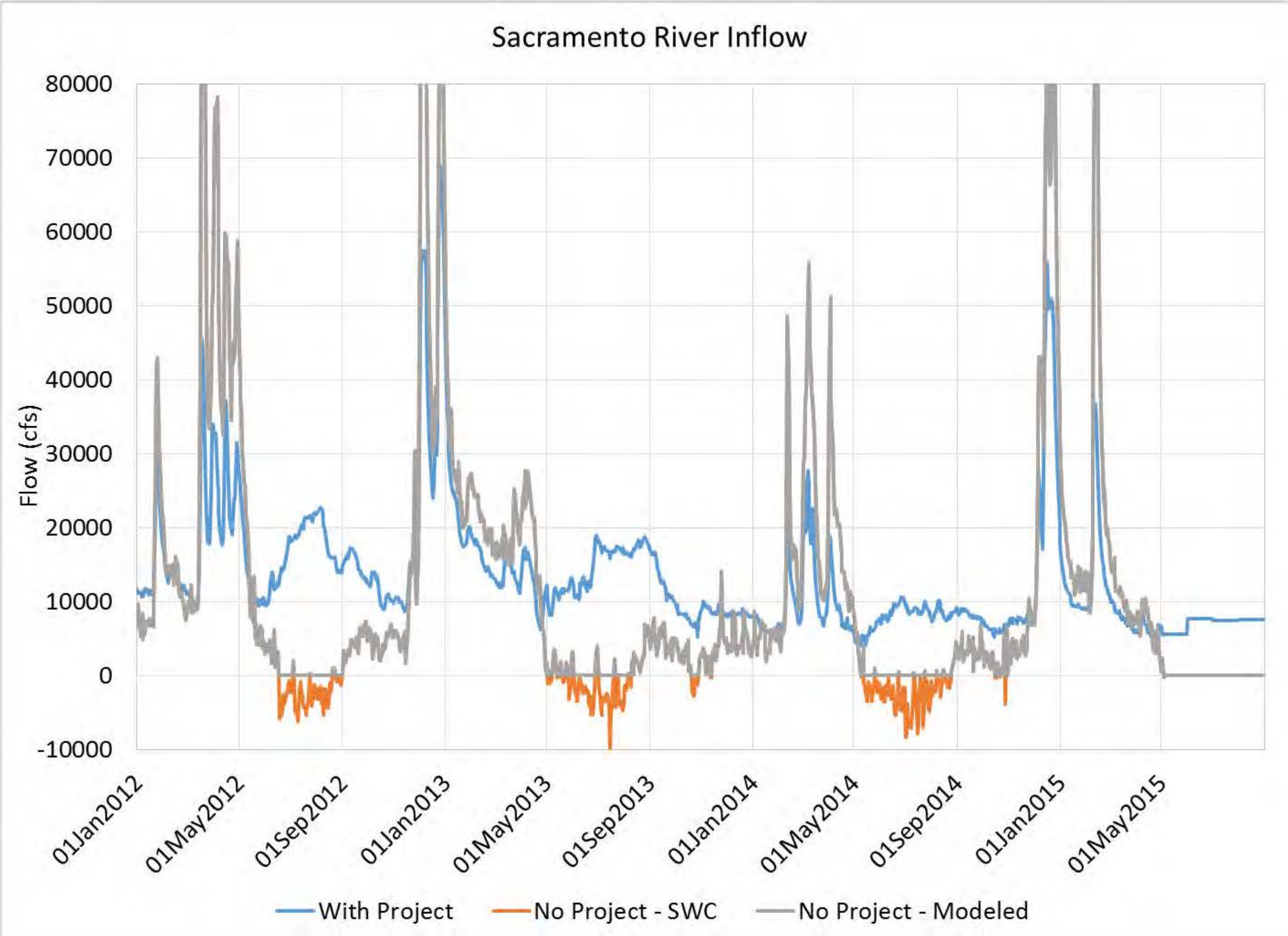


FIGURE 2: SAN JOAQUIN RIVER AT VERNALIS DSM2 MODEL INFLOW FOR 2012 TO 2015

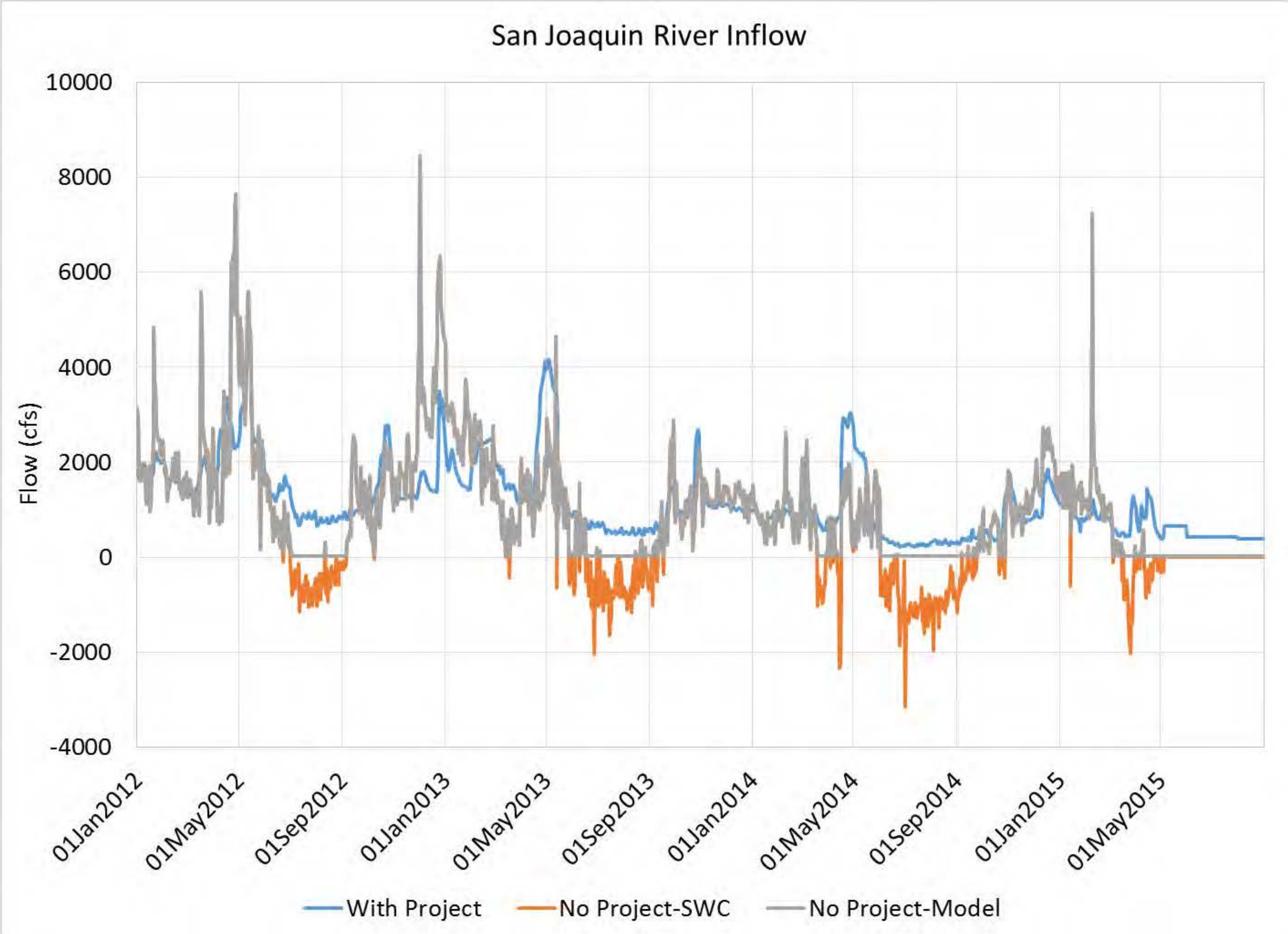


FIGURE 3: ASSUMED BBID DICU DIVERSION, AND DSM2 RESULT OF CLIFTON COURT FOREBAY INFLOW

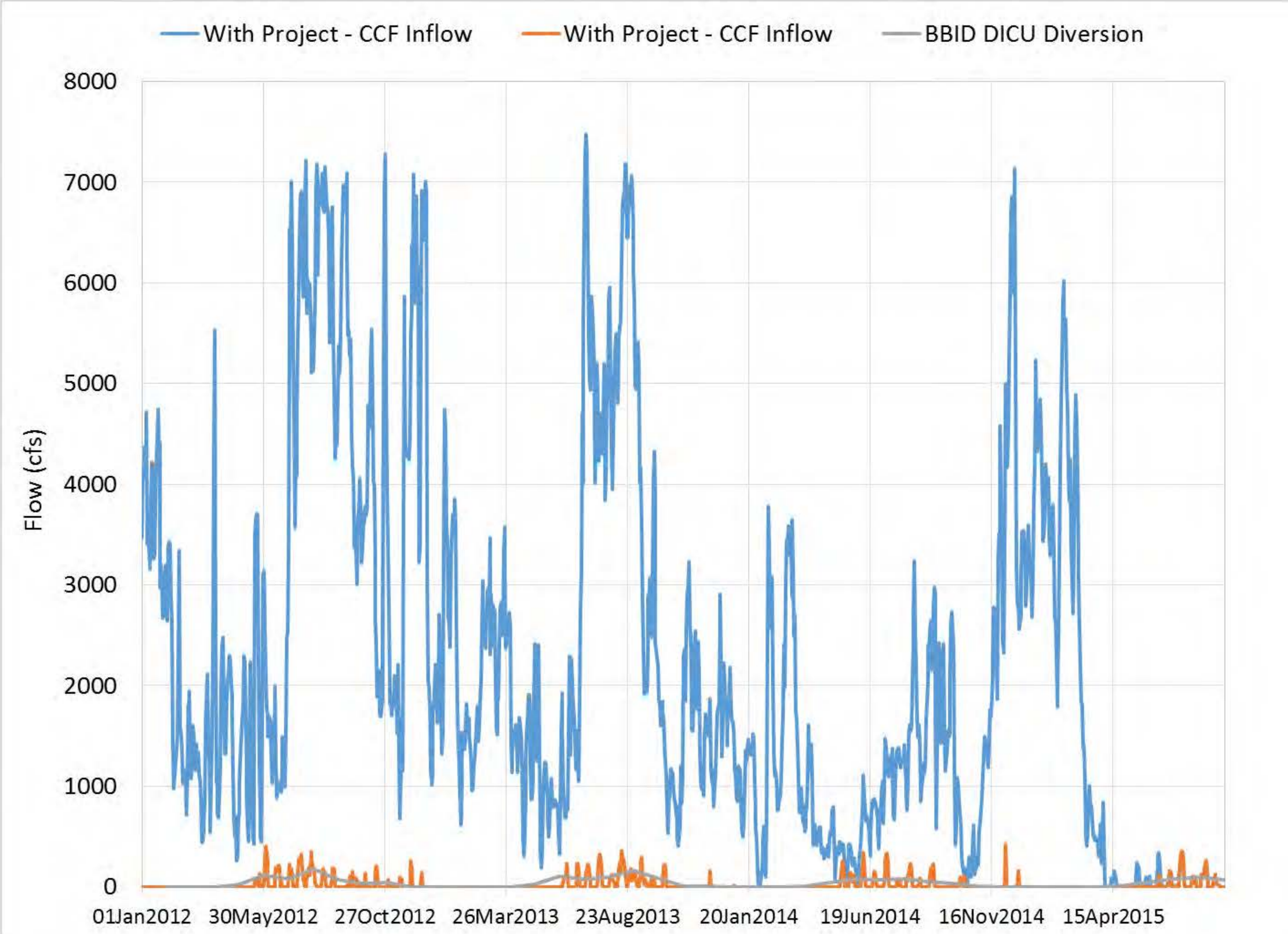
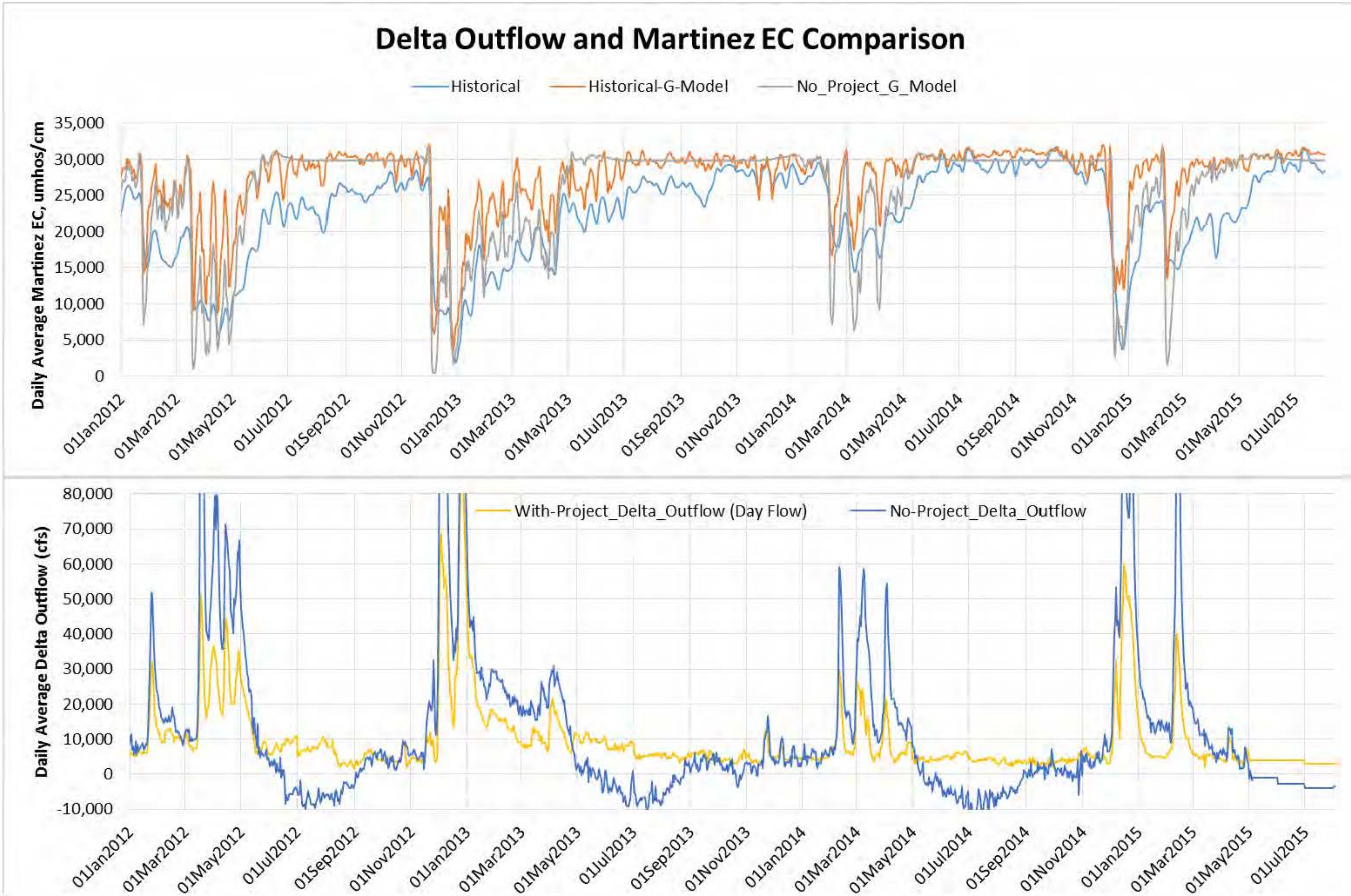
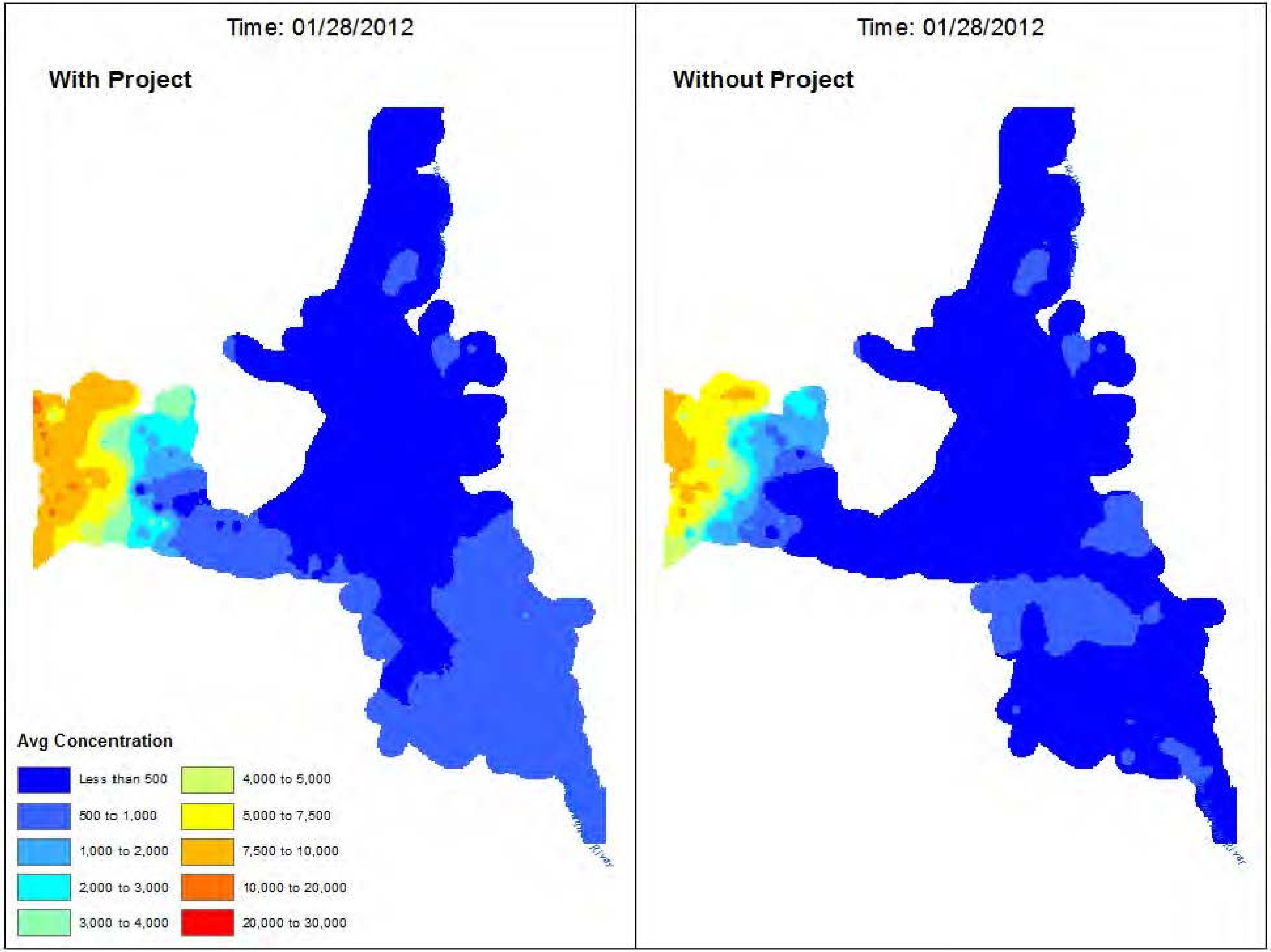


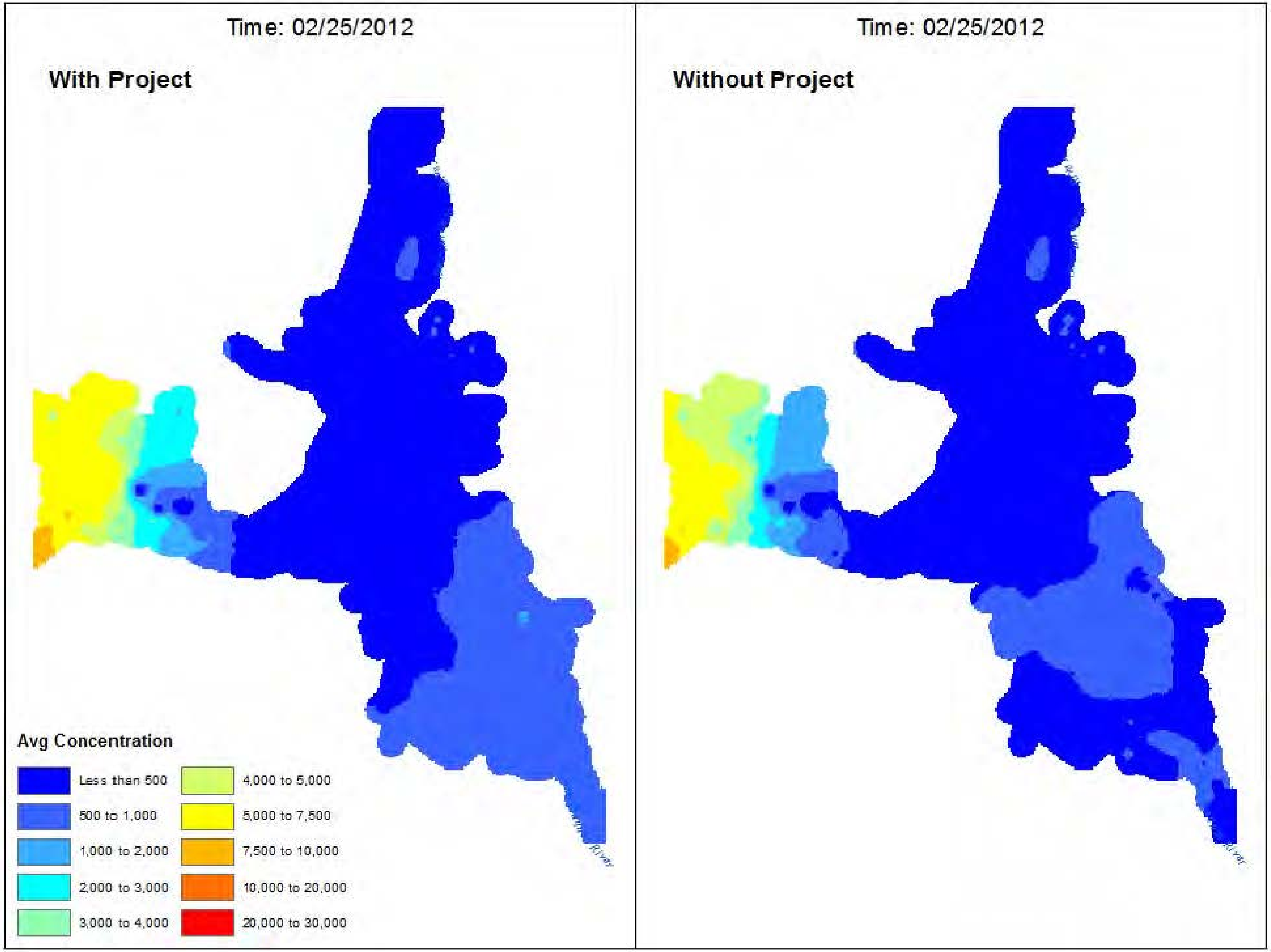
FIGURE 4: DAILY AVERAGED EC AT MARTINEZ FOR 2012 TO 2015

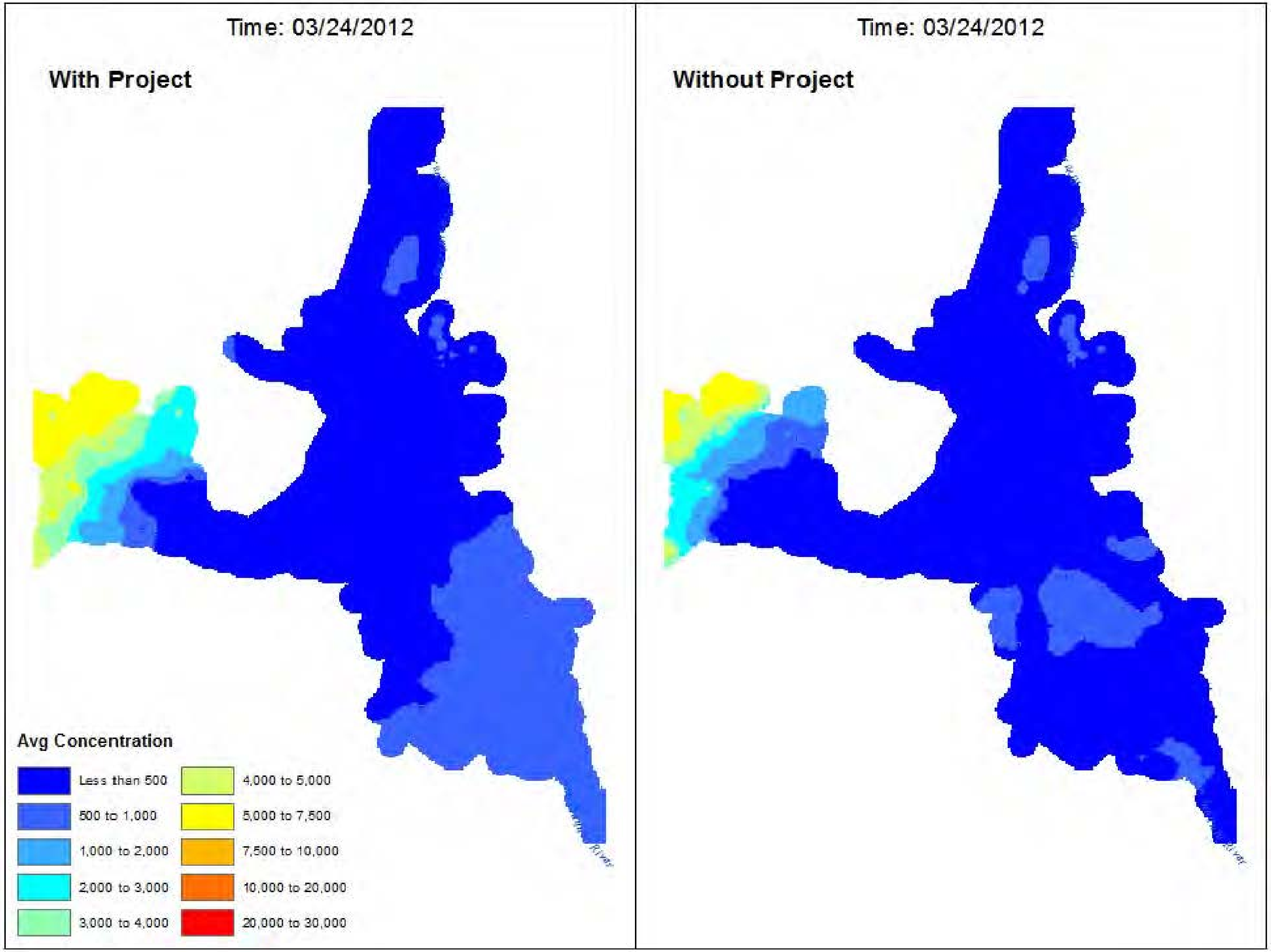


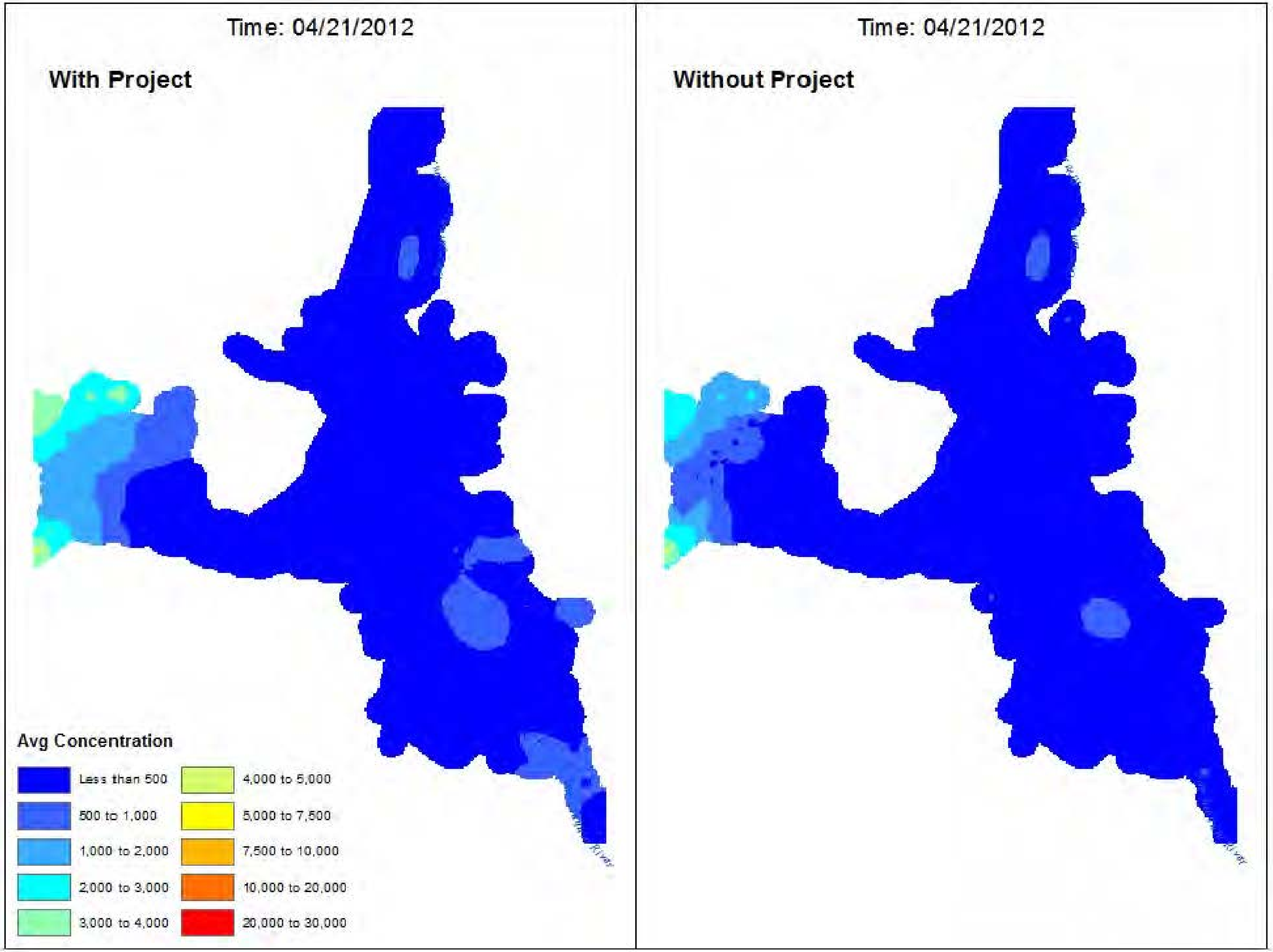
FIGURES 5 TO 52

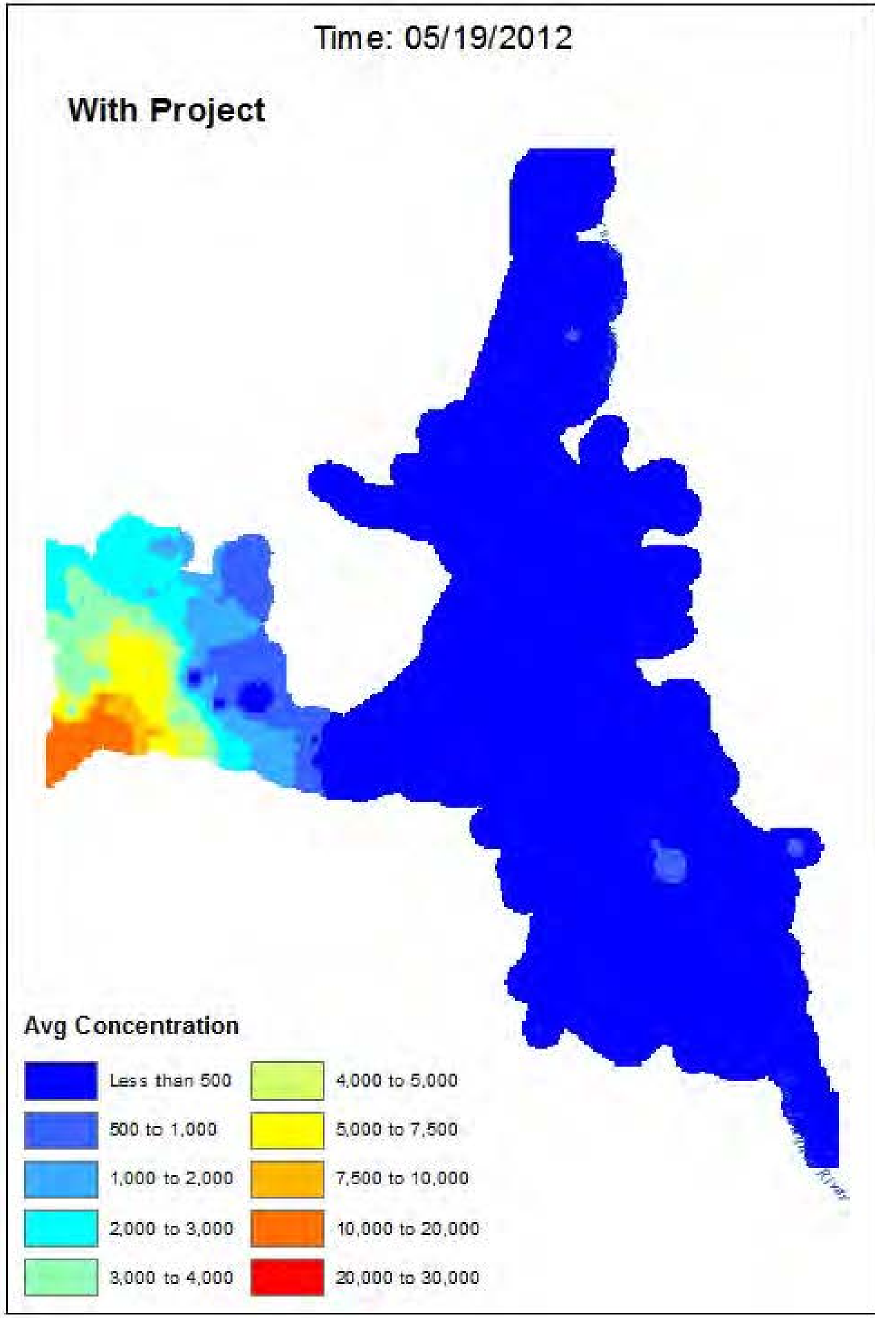
Contour plots of DSM2 electrical conductivity in the Delta on a 4 week timestep for 2011-2015 for With Project conditions (left) and Without Project conditions (right)

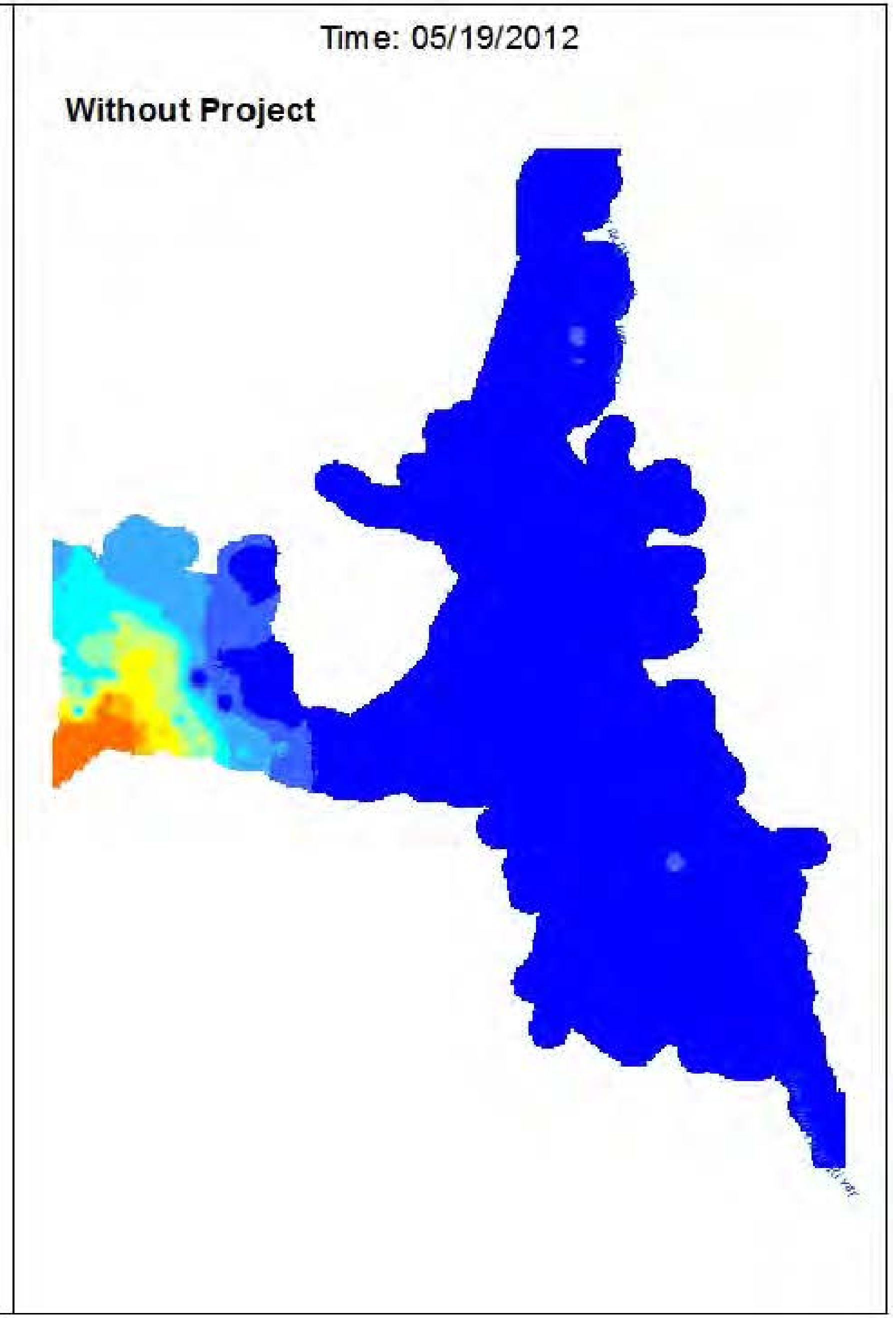

Time: 01/28/2012
With Project
Time: 01/28/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

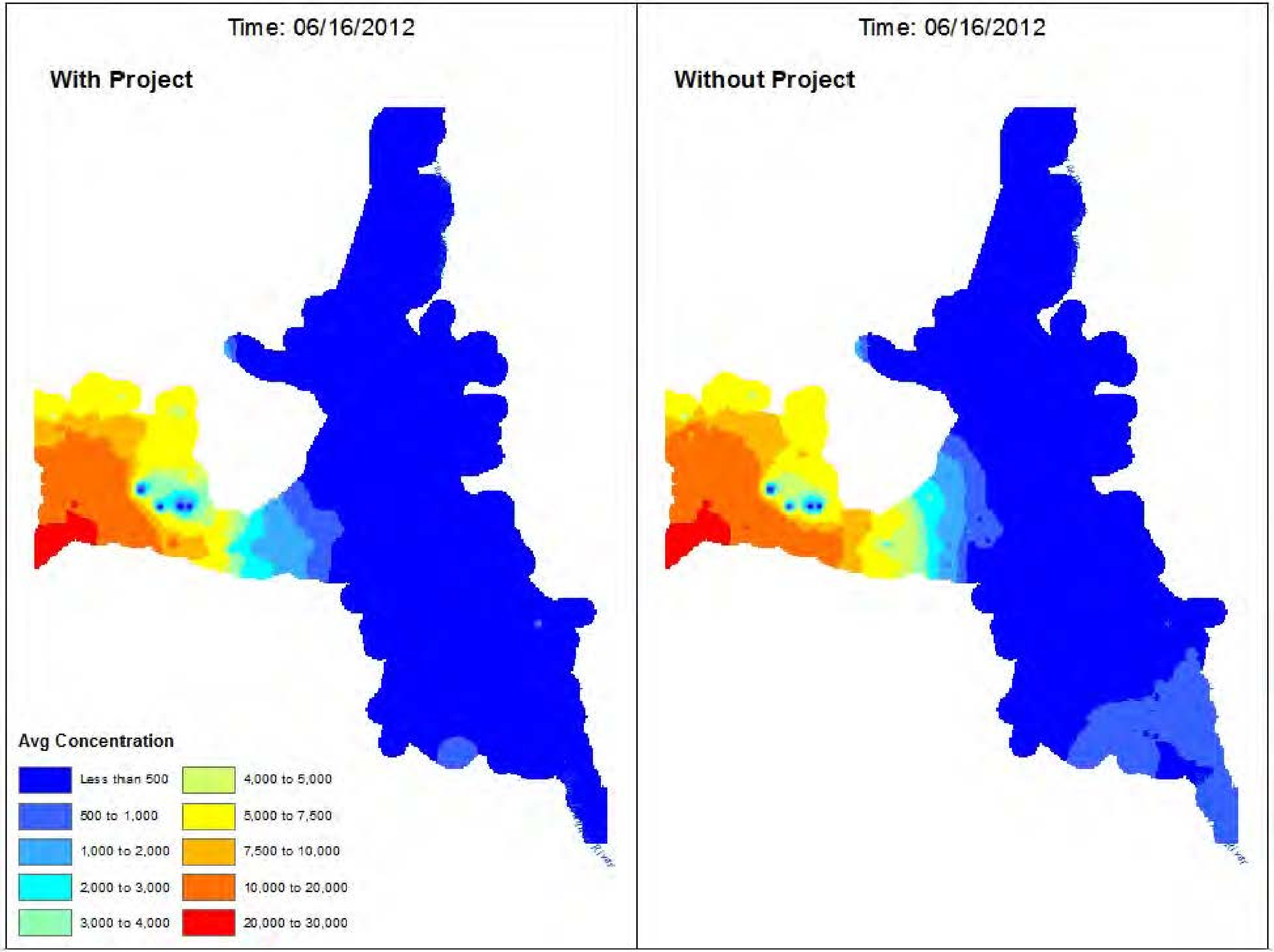

Time: 02/25/2012
With Project
Time: 02/25/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

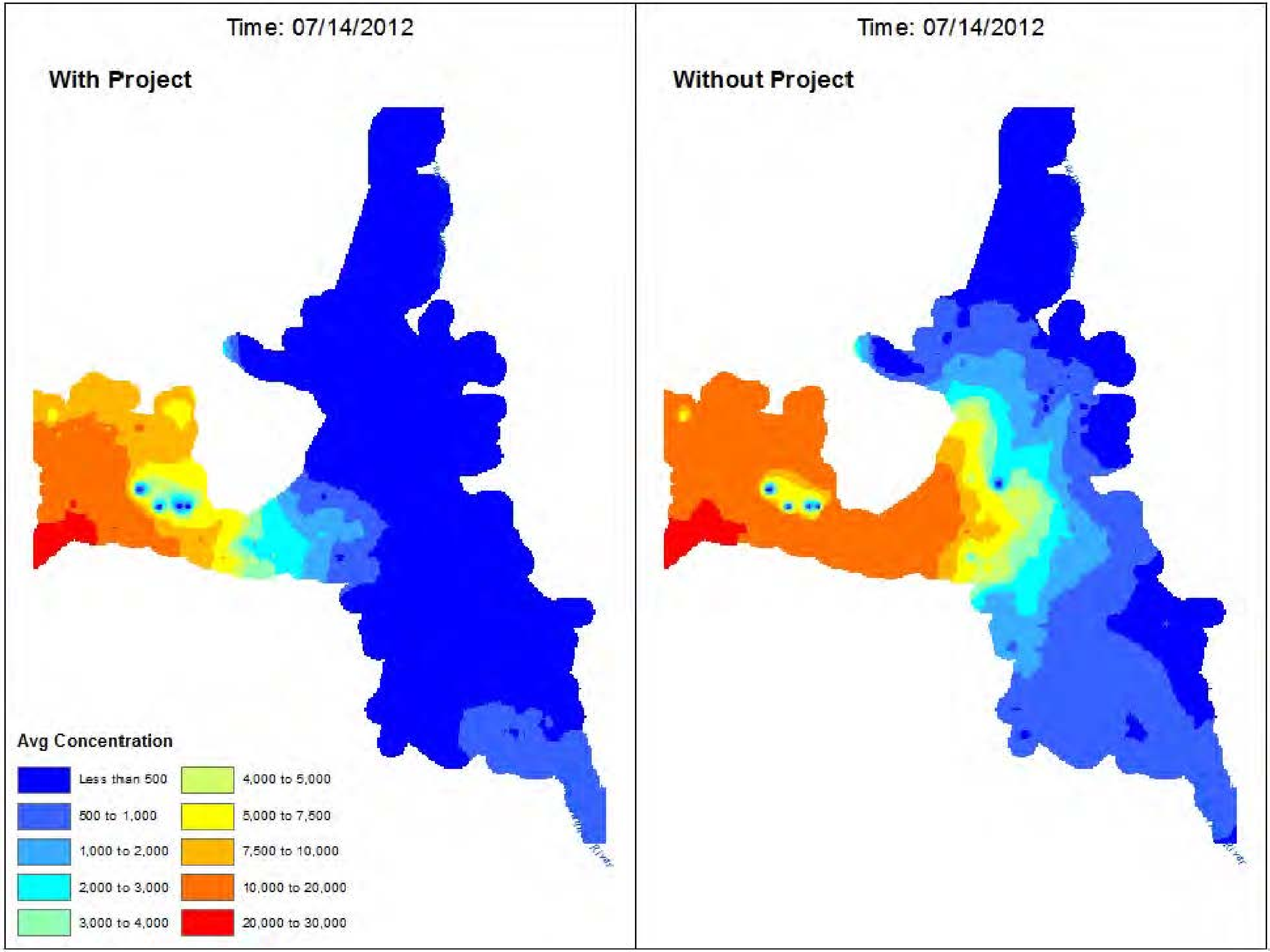

Time: 03/24/2012
With Project
Time: 03/24/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

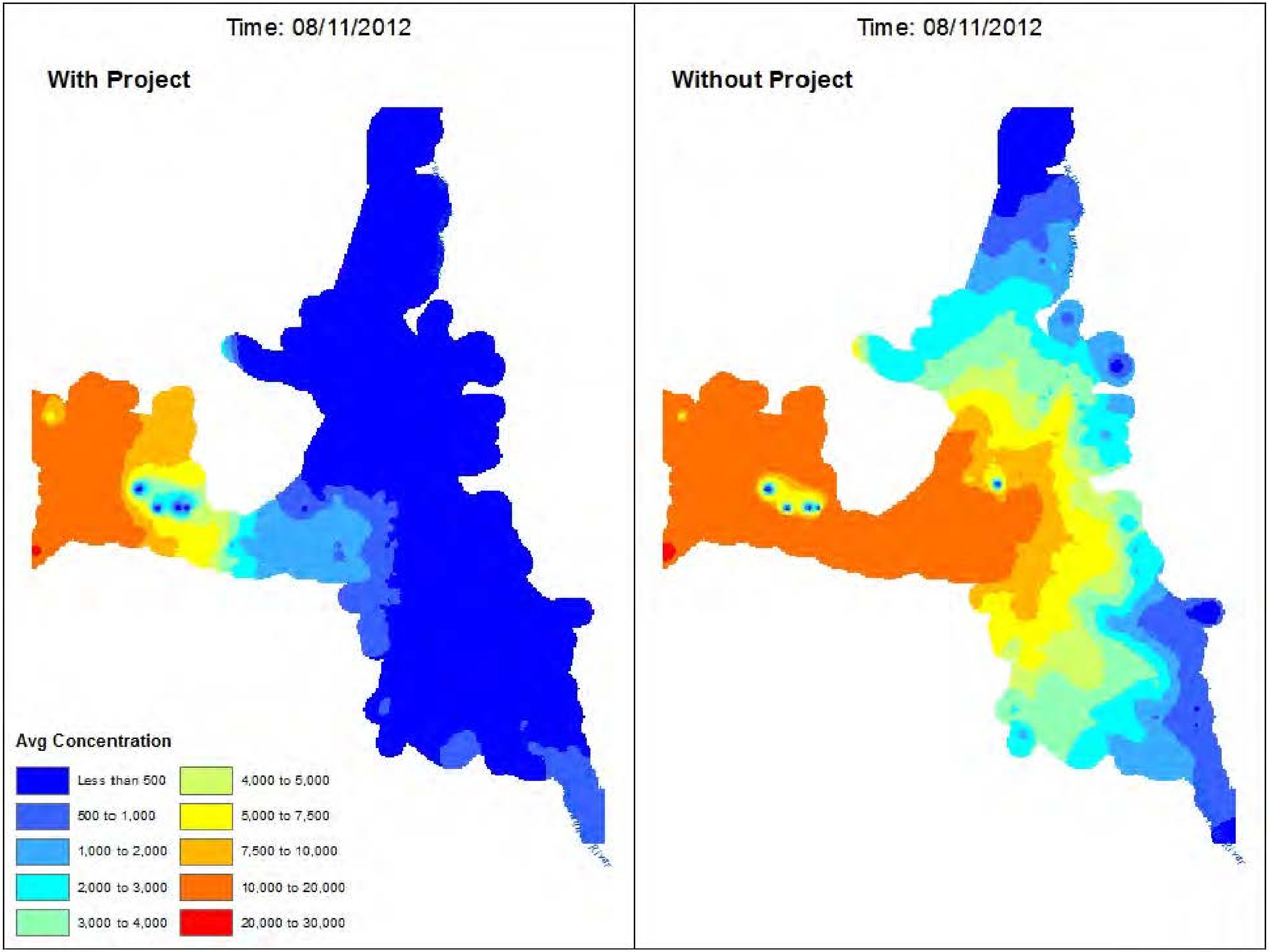

Time: 04/21/2012
With Project
Time: 04/21/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

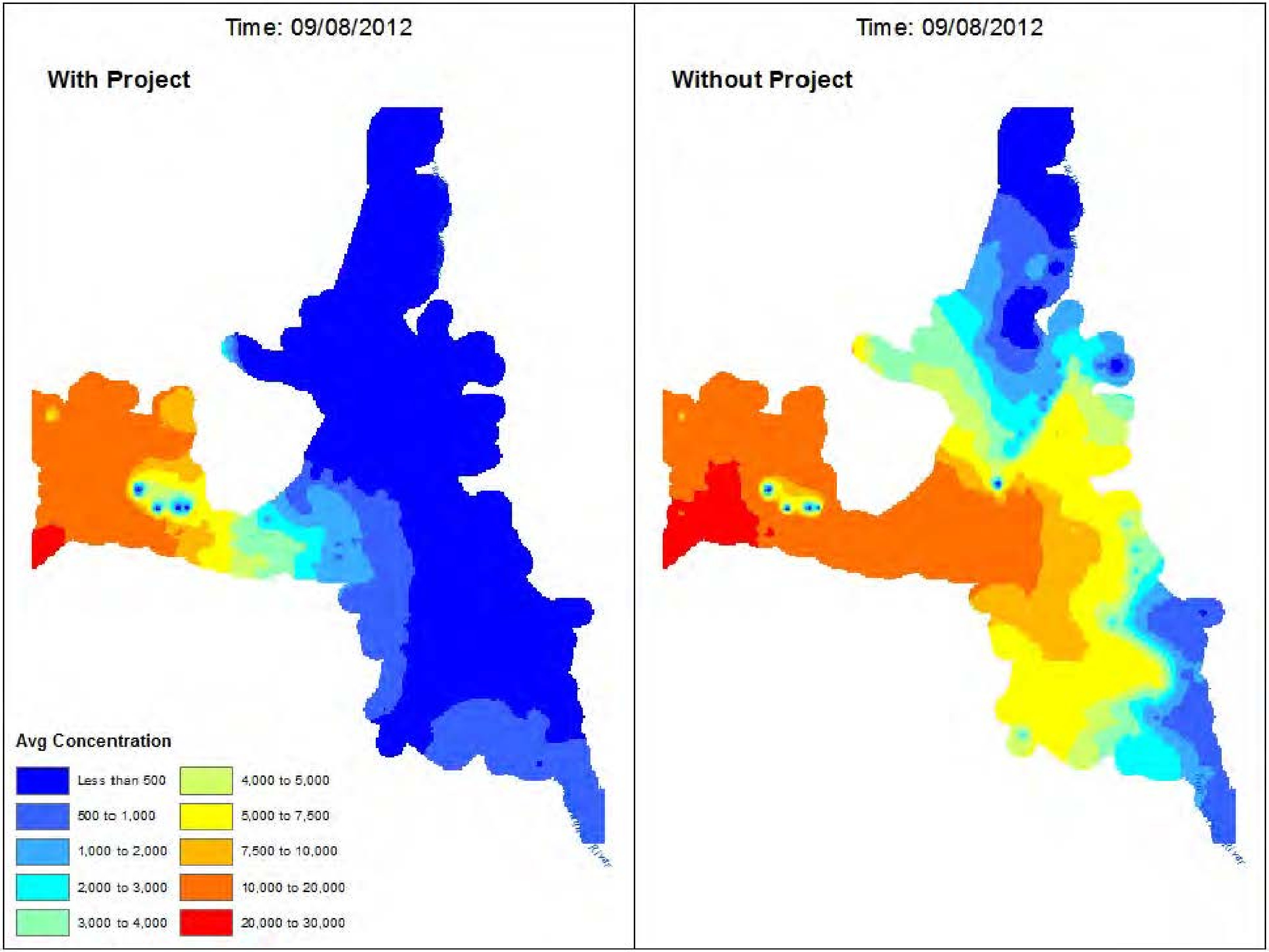

Time: 05/19/2012
With Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

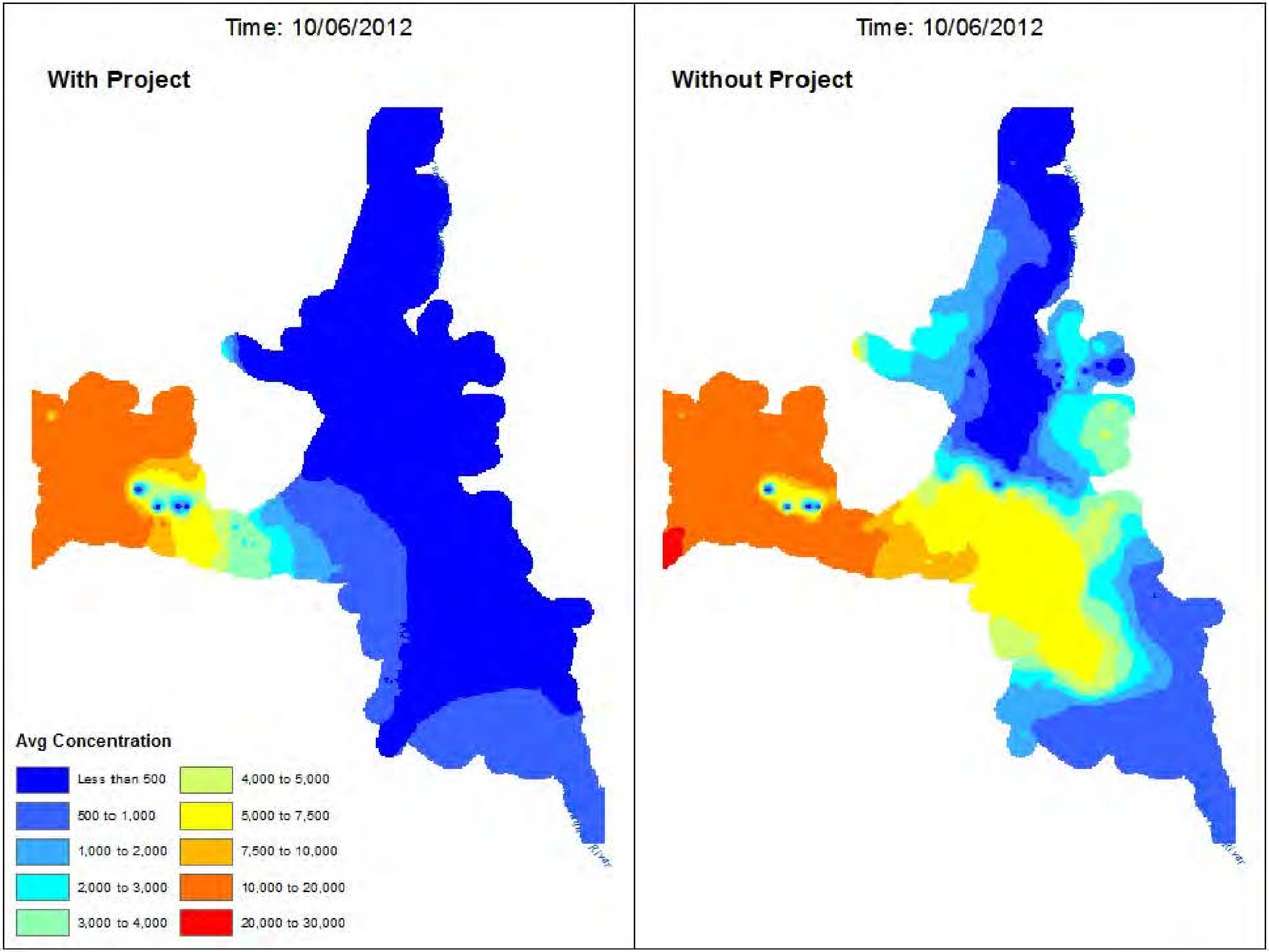

Time: 05/19/2012
Without Project

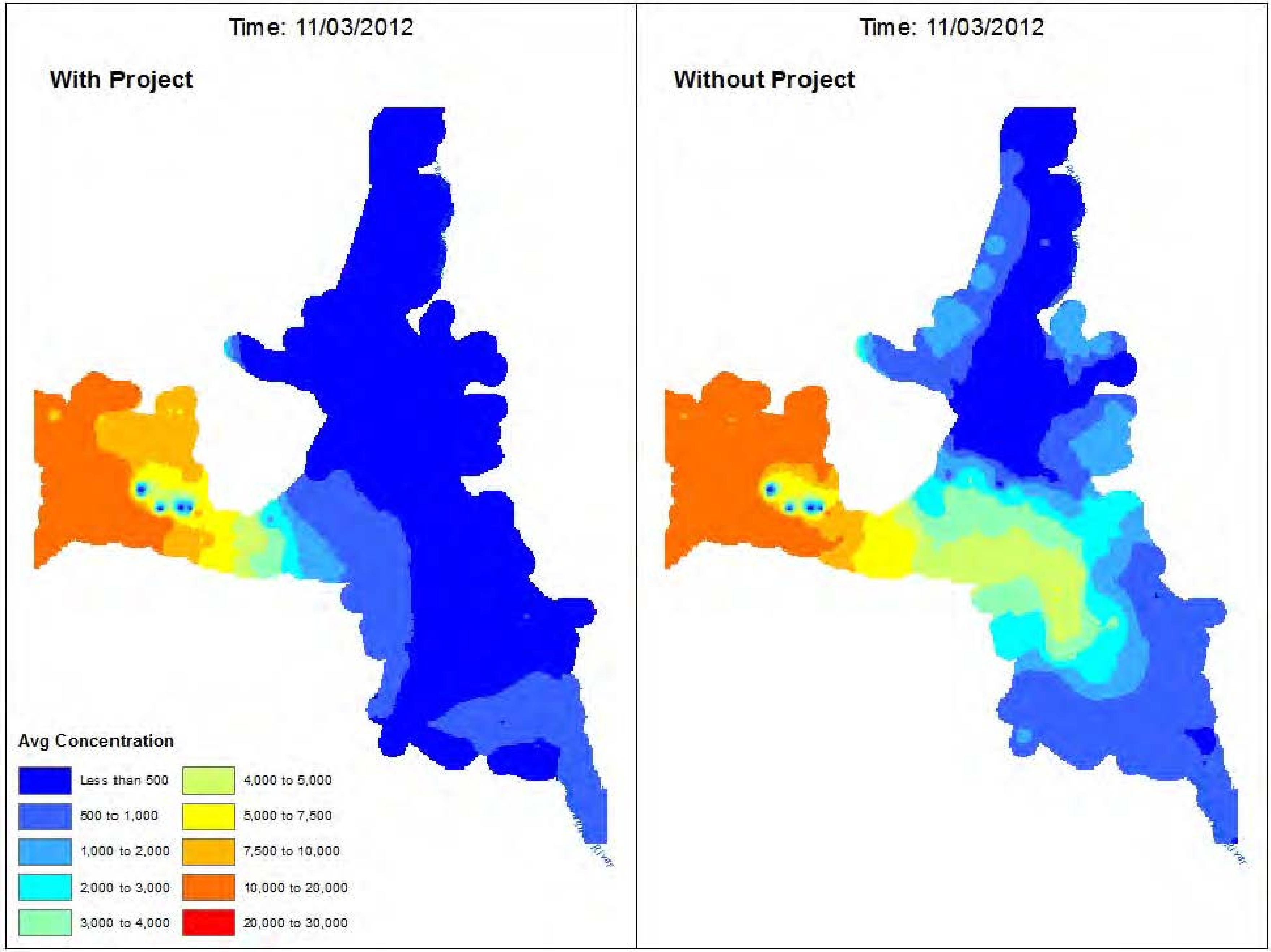

Time: 06/16/2012
With Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000
Time: 06/16/2012
Without Project

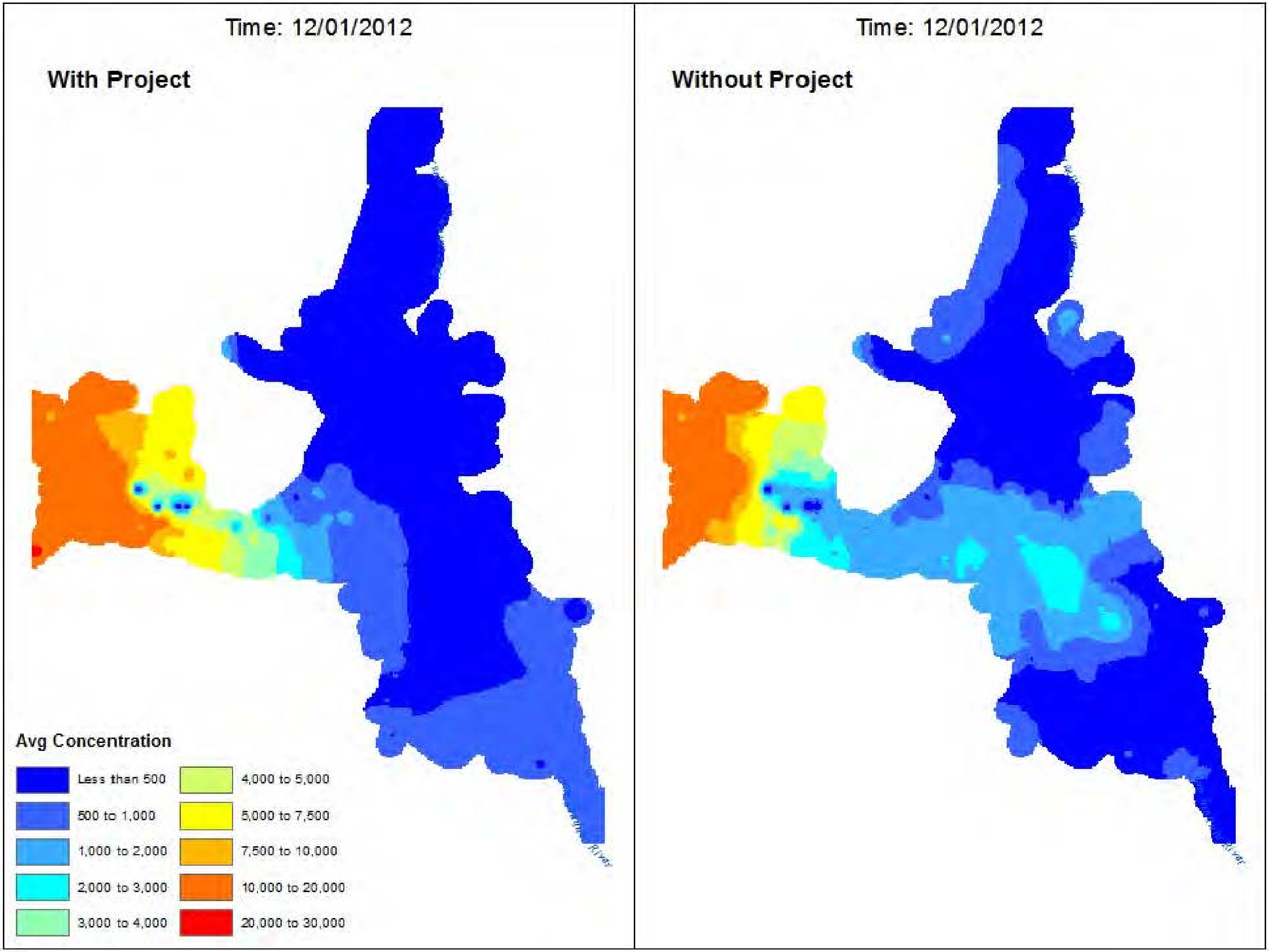

Time: 07/14/2012
With Project
Time: 07/14/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

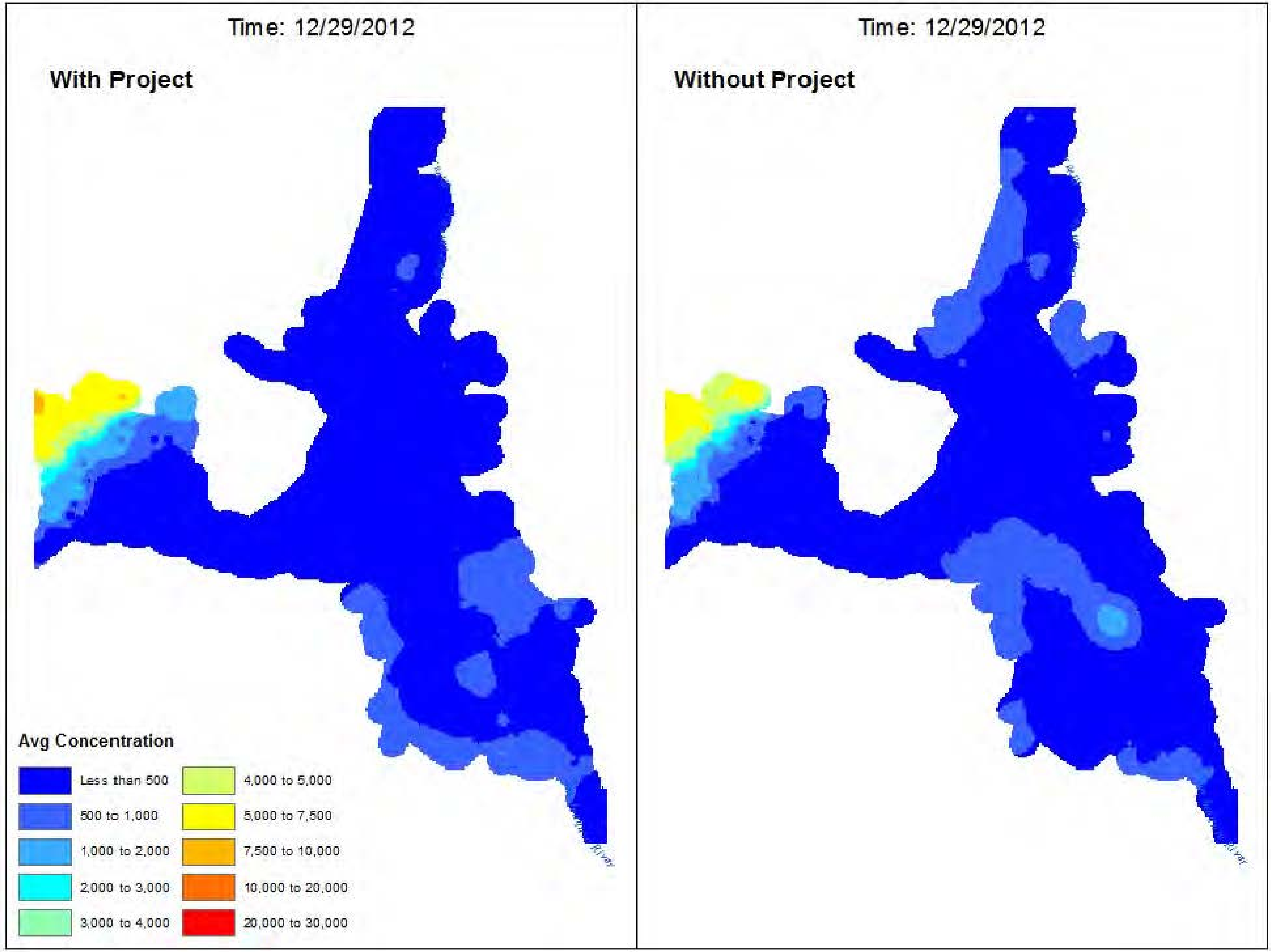

Time: 08/11/2012
With Project
Time: 08/11/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

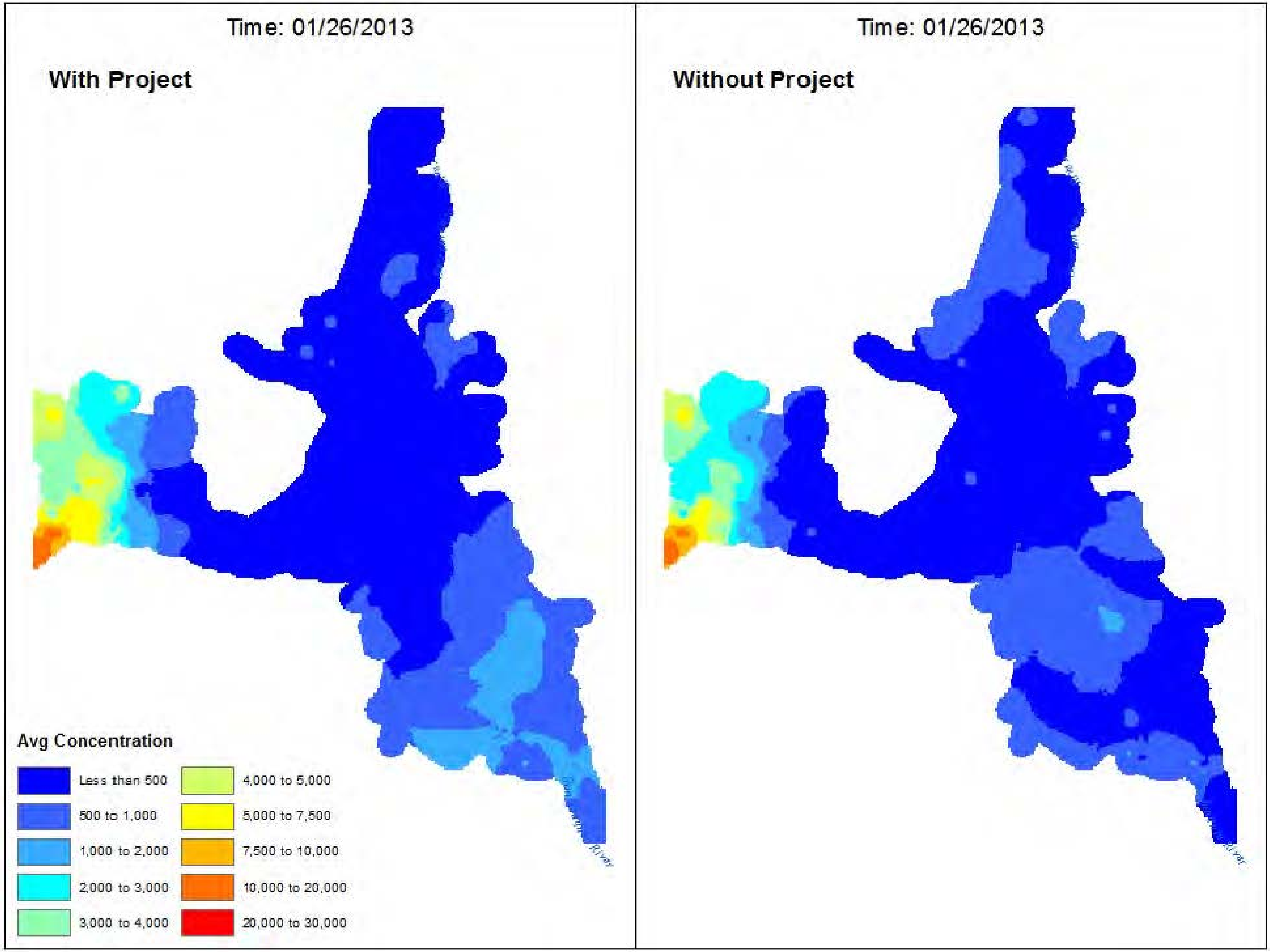

Time: 09/08/2012
With Project
Time: 09/08/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

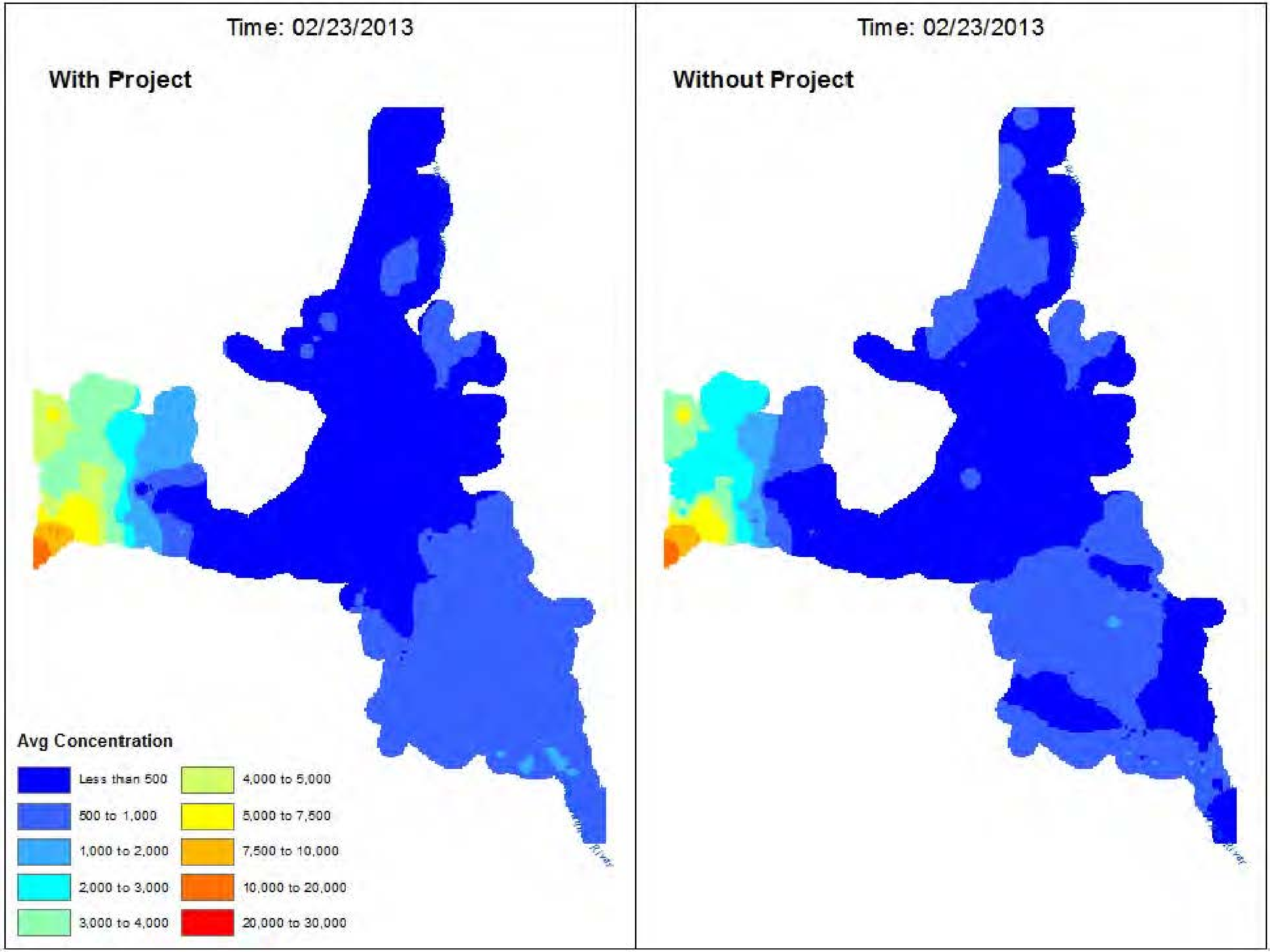

Time: 10/06/2012
With Project
Time: 10/06/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

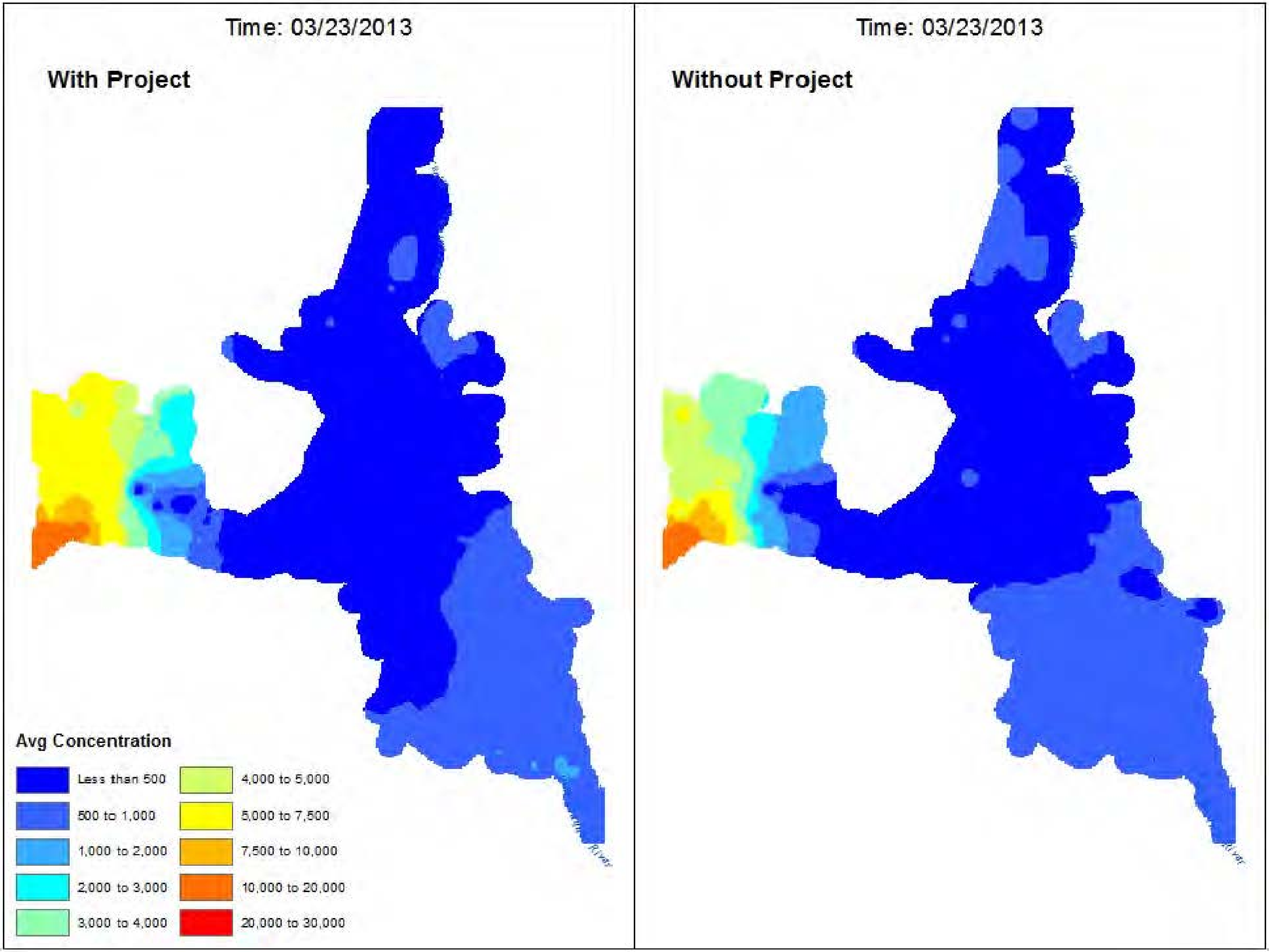

Time: 11/03/2012
With Project
Time: 11/03/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

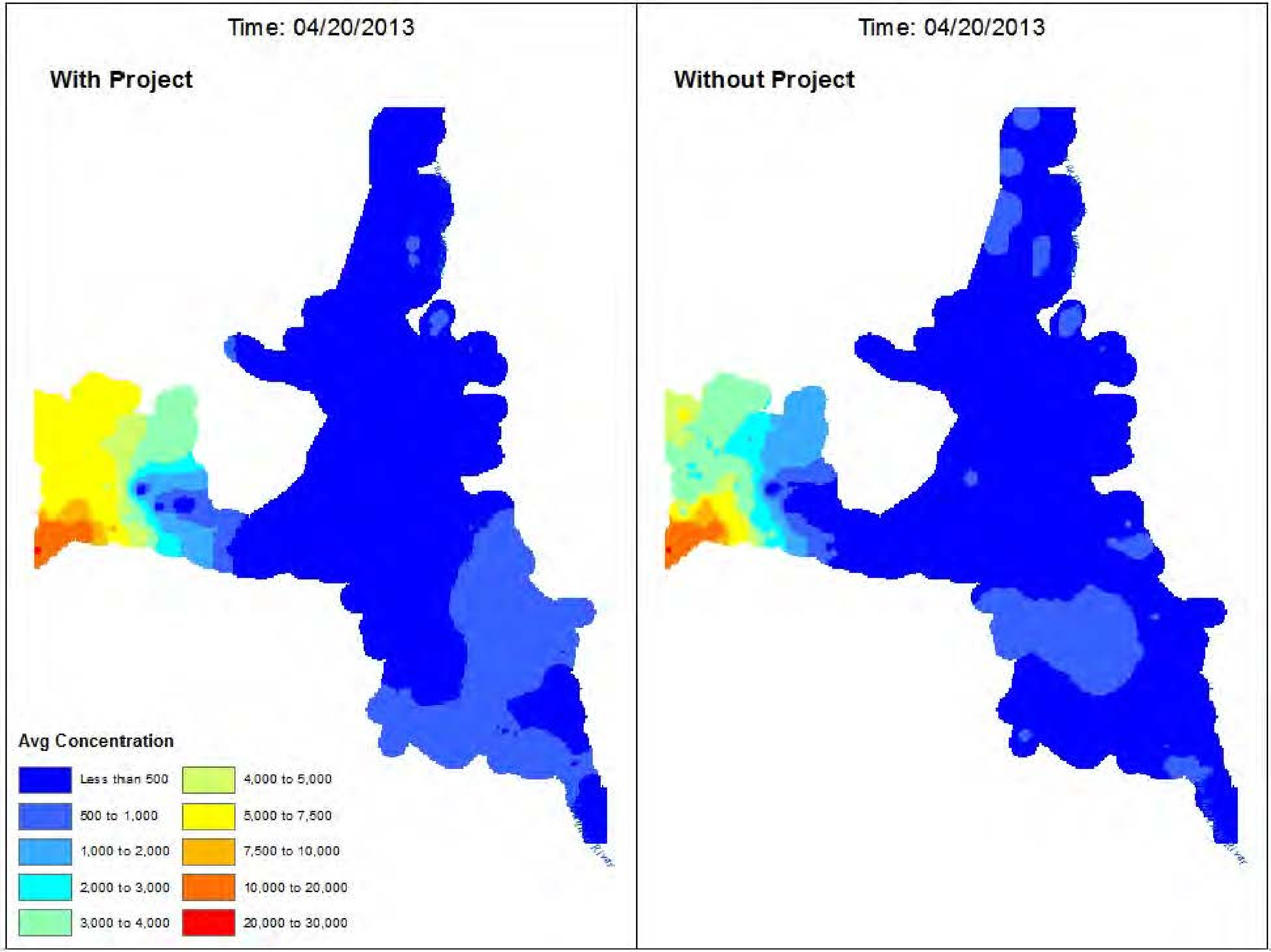

Time: 12/01/2012
With Project
Time: 12/01/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 12/29/2012
With Project
Time: 12/29/2012
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

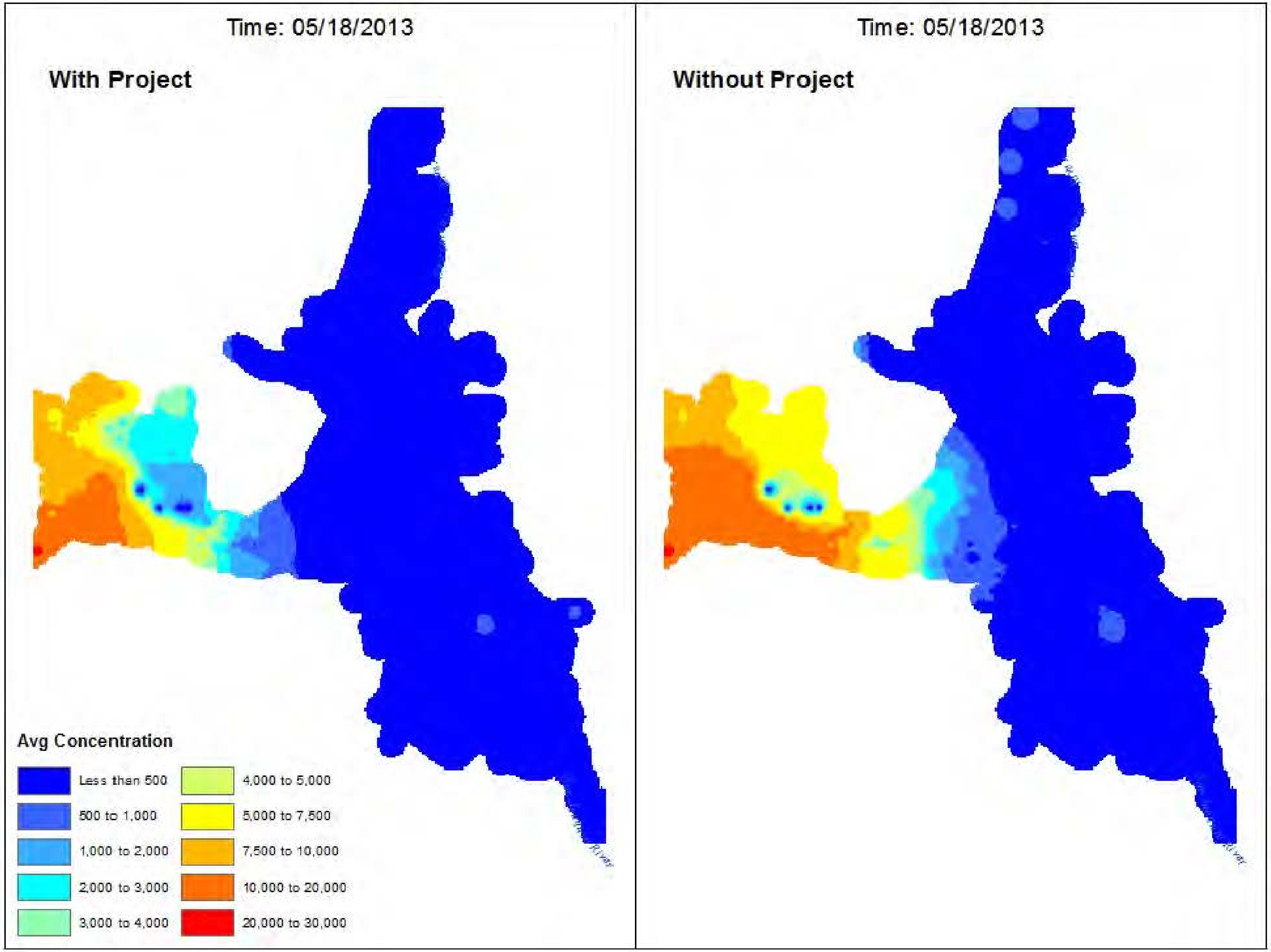

Time: 01/26/2013
With Project
Time: 01/26/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

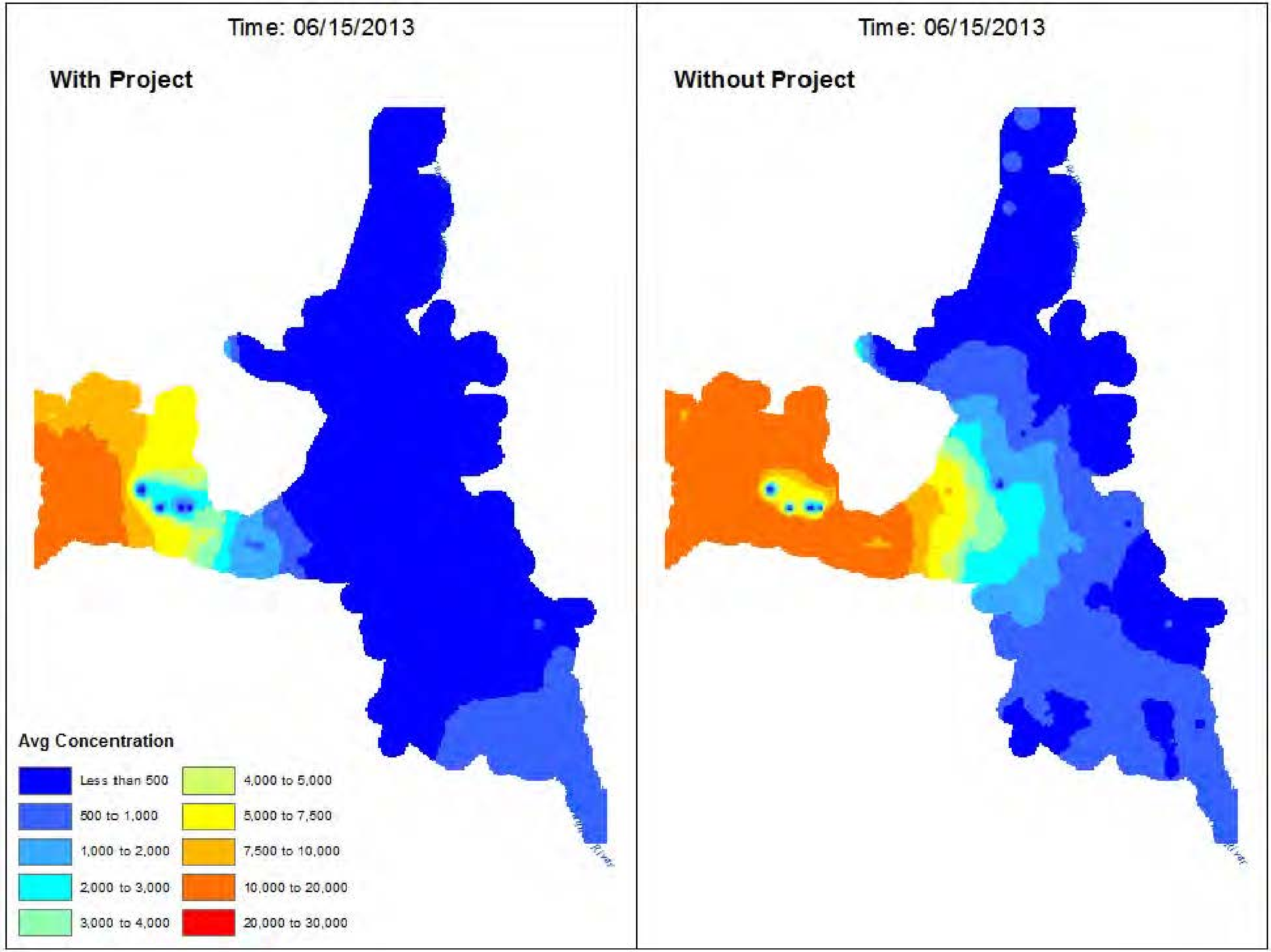

Time: 02/23/2013
With Project
Time: 02/23/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

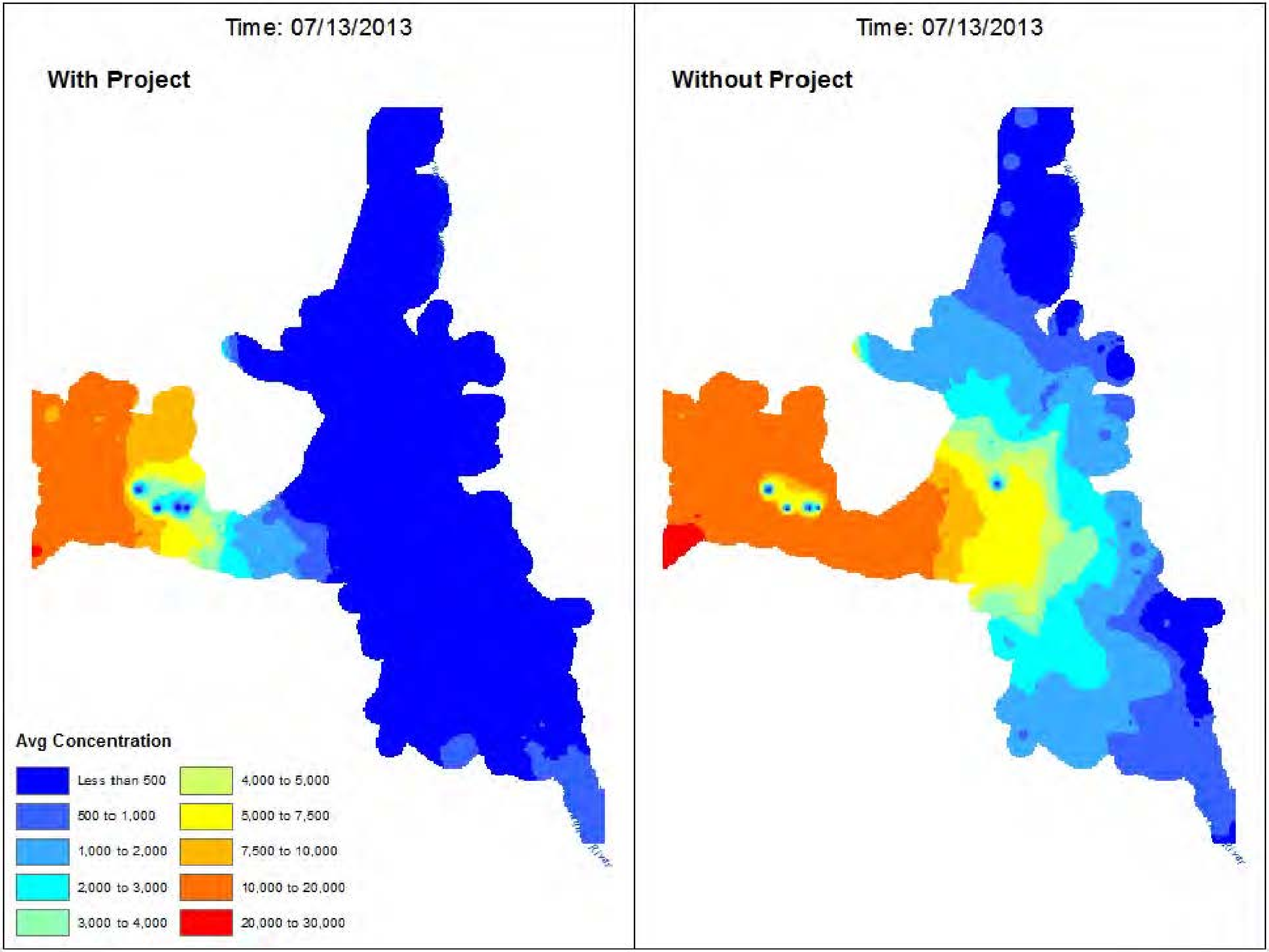

Time: 03/23/2013
With Project
Time: 03/23/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

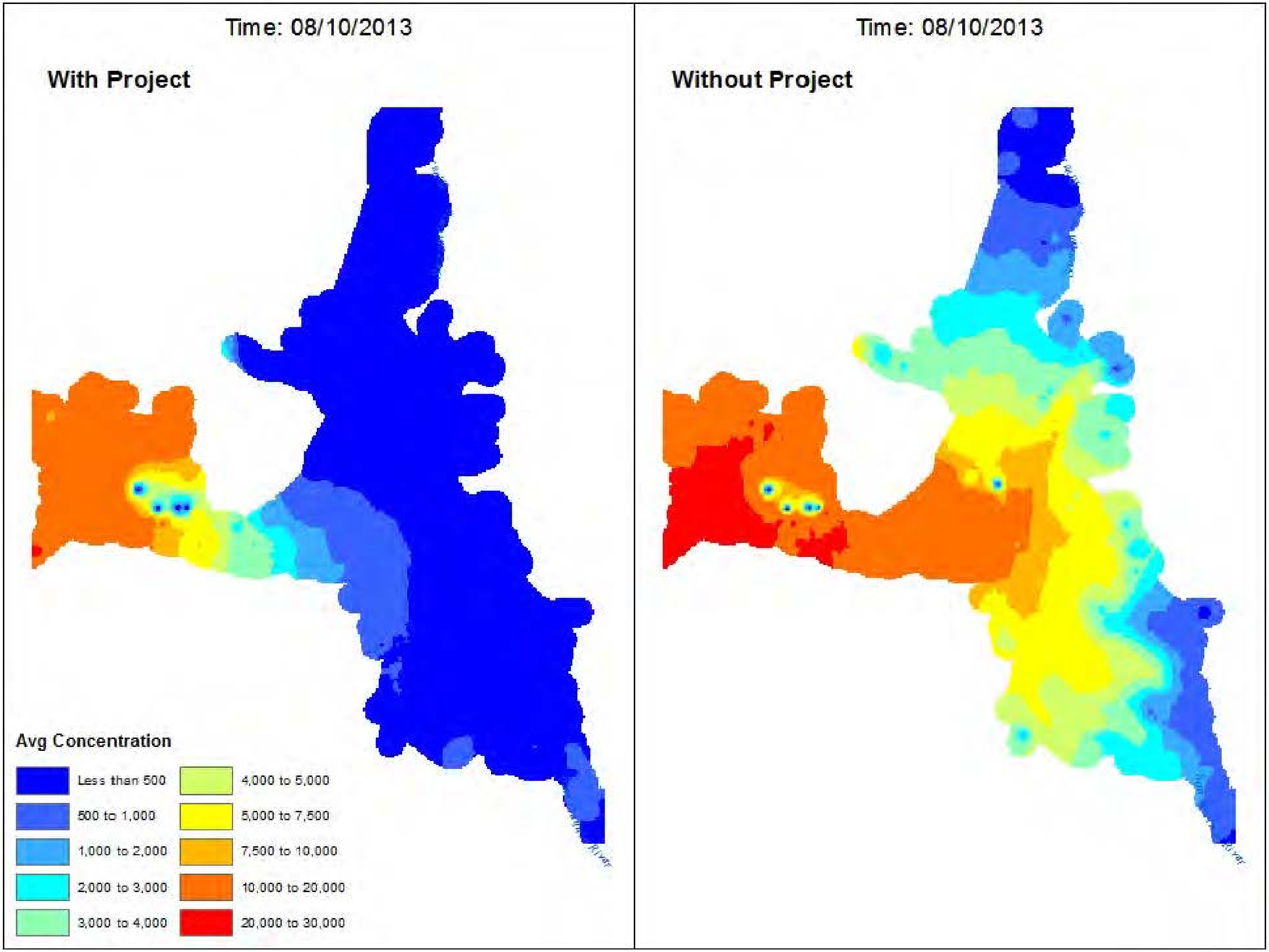


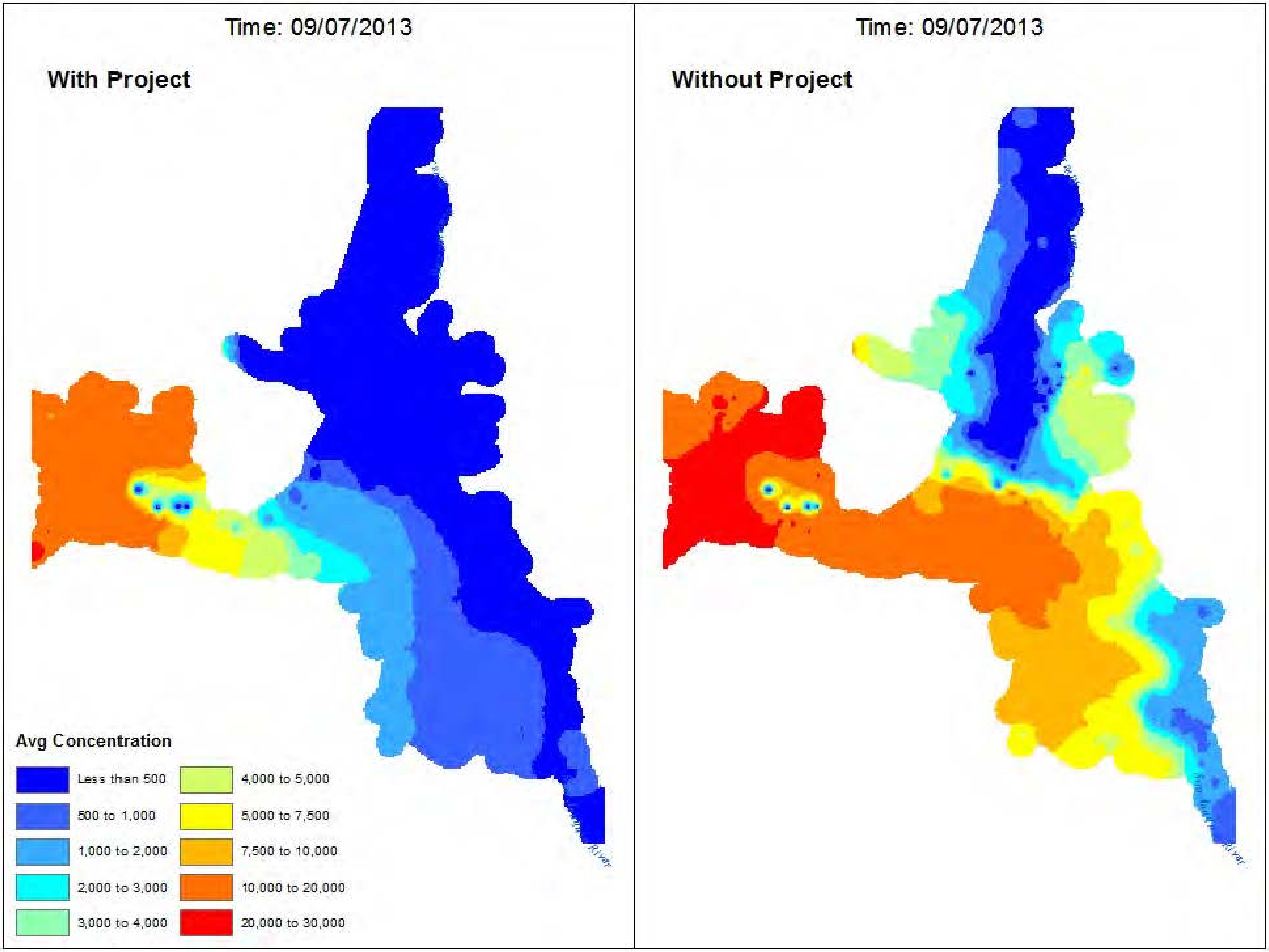
Time: 04/20/2013
With Project
Time: 04/20/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

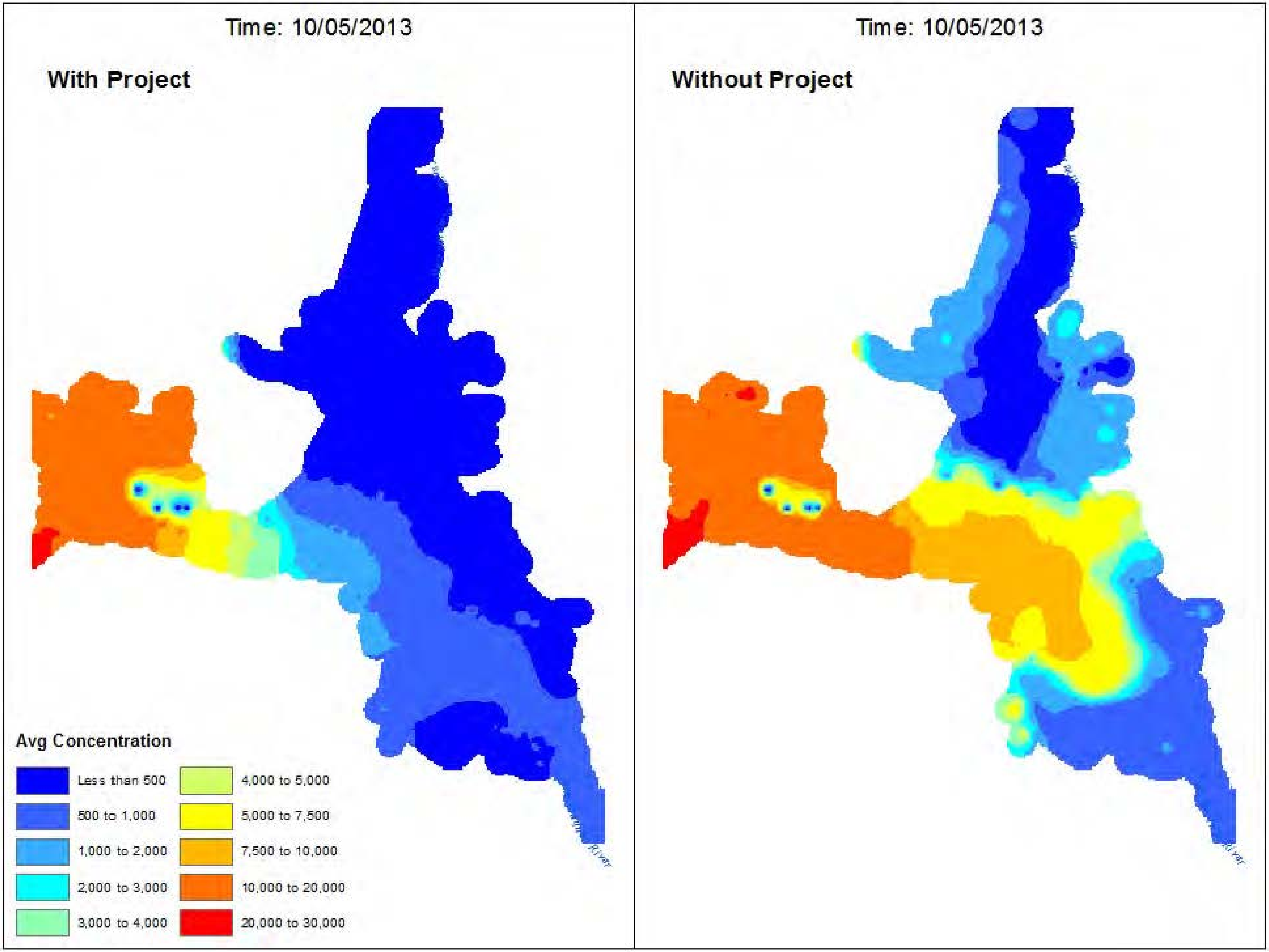

Time: 05/18/2013
With Project
Time: 05/18/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

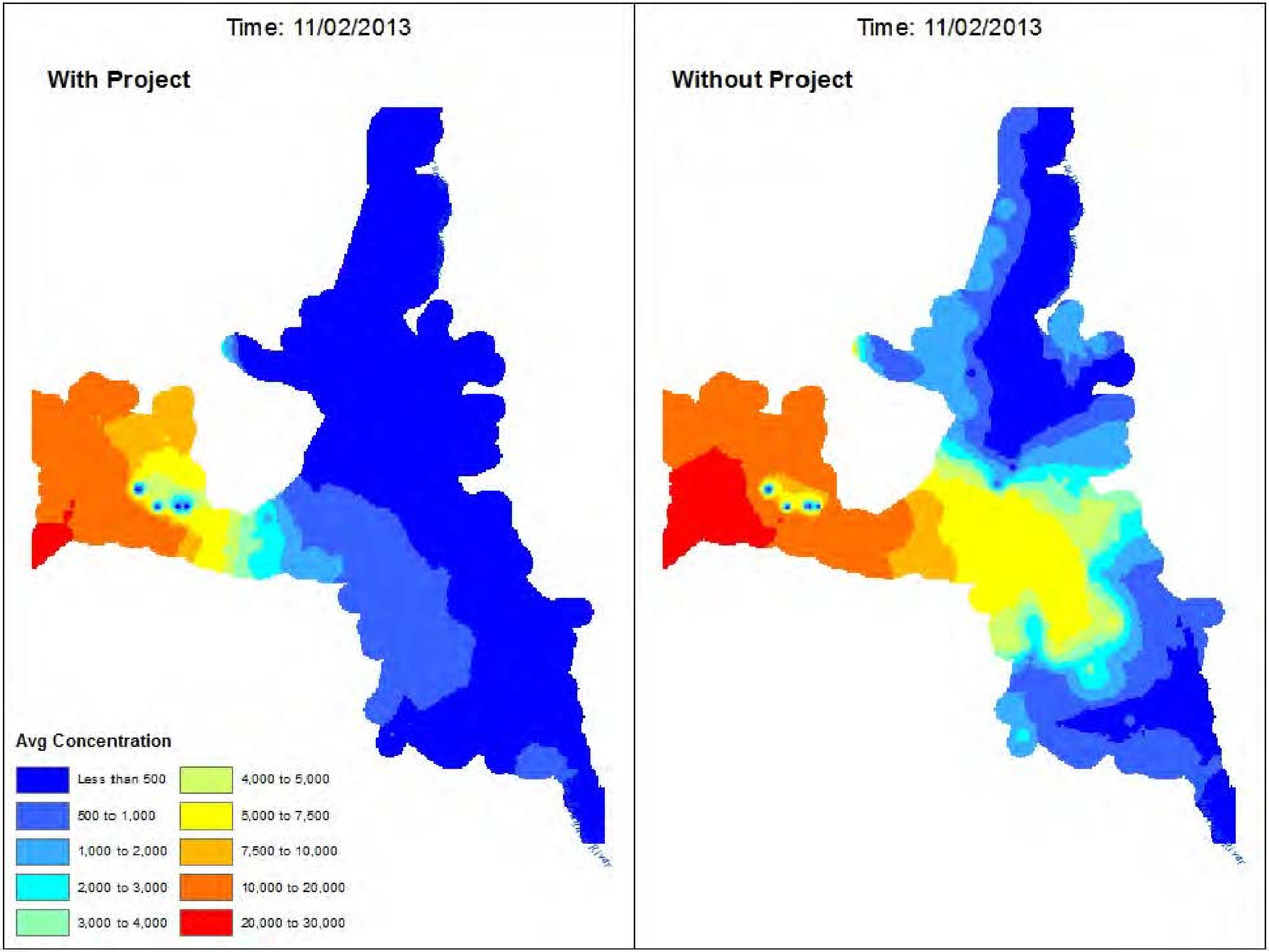

Time: 06/15/2013
With Project
Time: 06/15/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

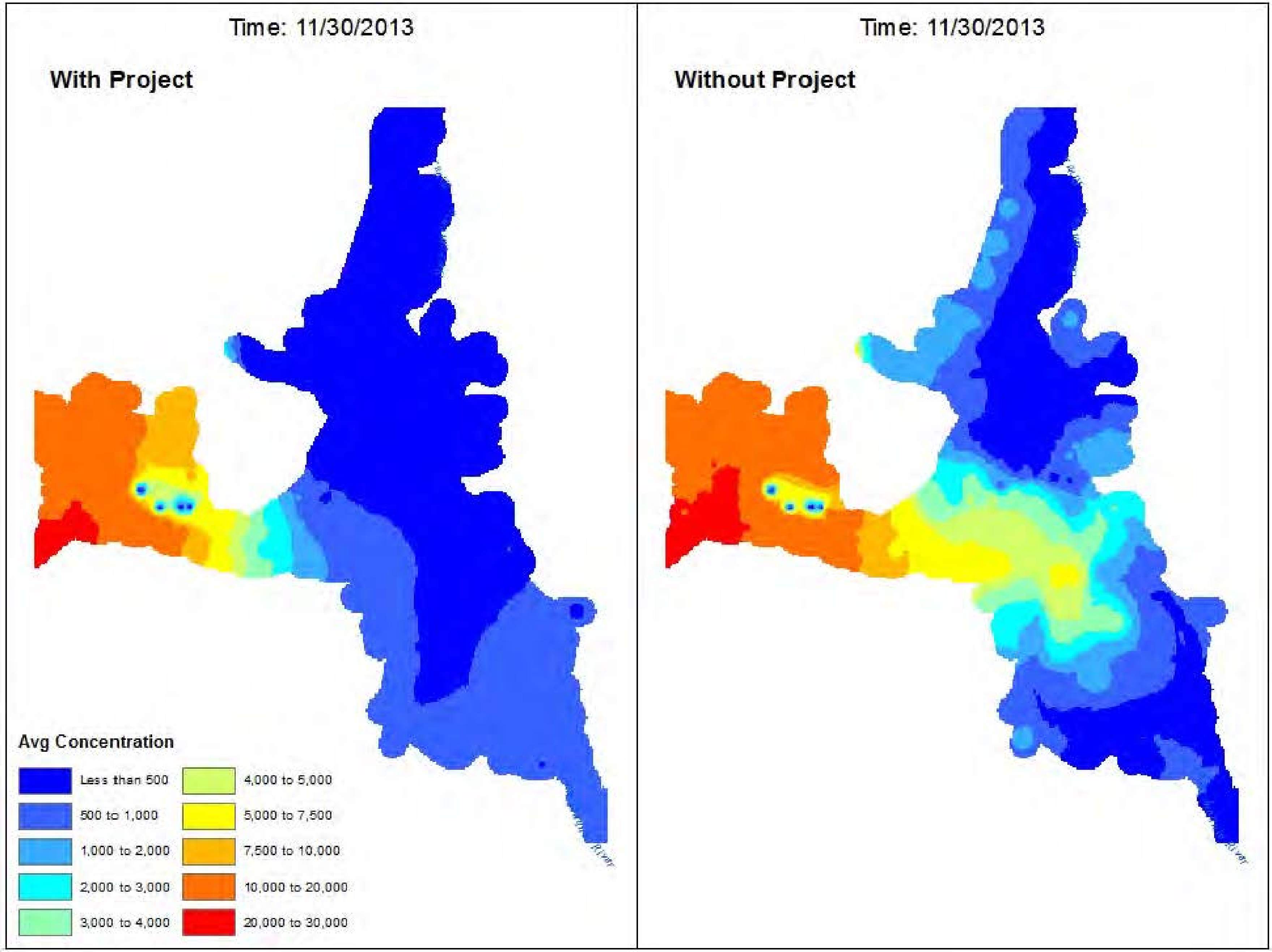

Time: 07/13/2013
With Project
Time: 07/13/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

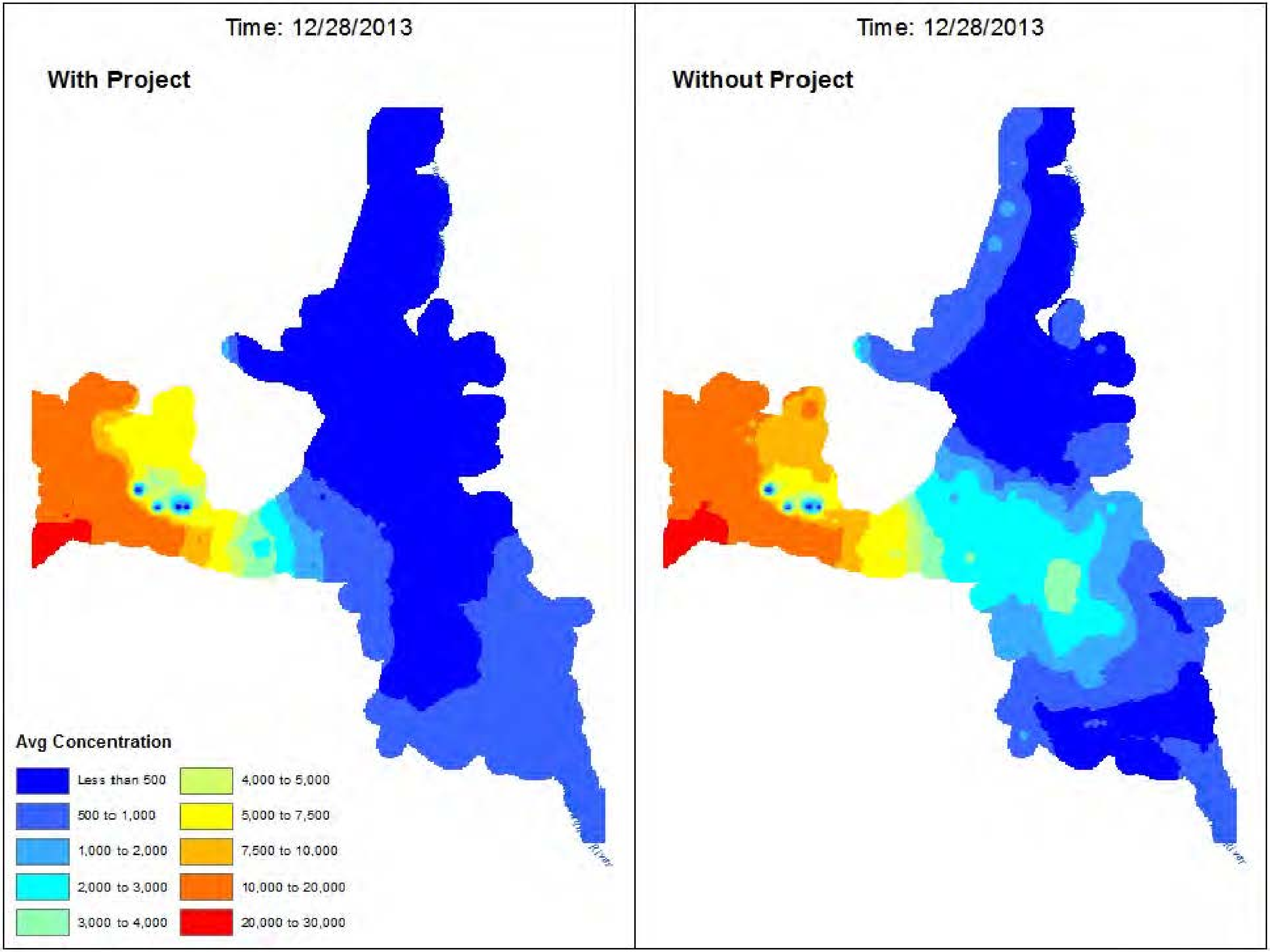

Time: 08/10/2013
With Project
Time: 08/10/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

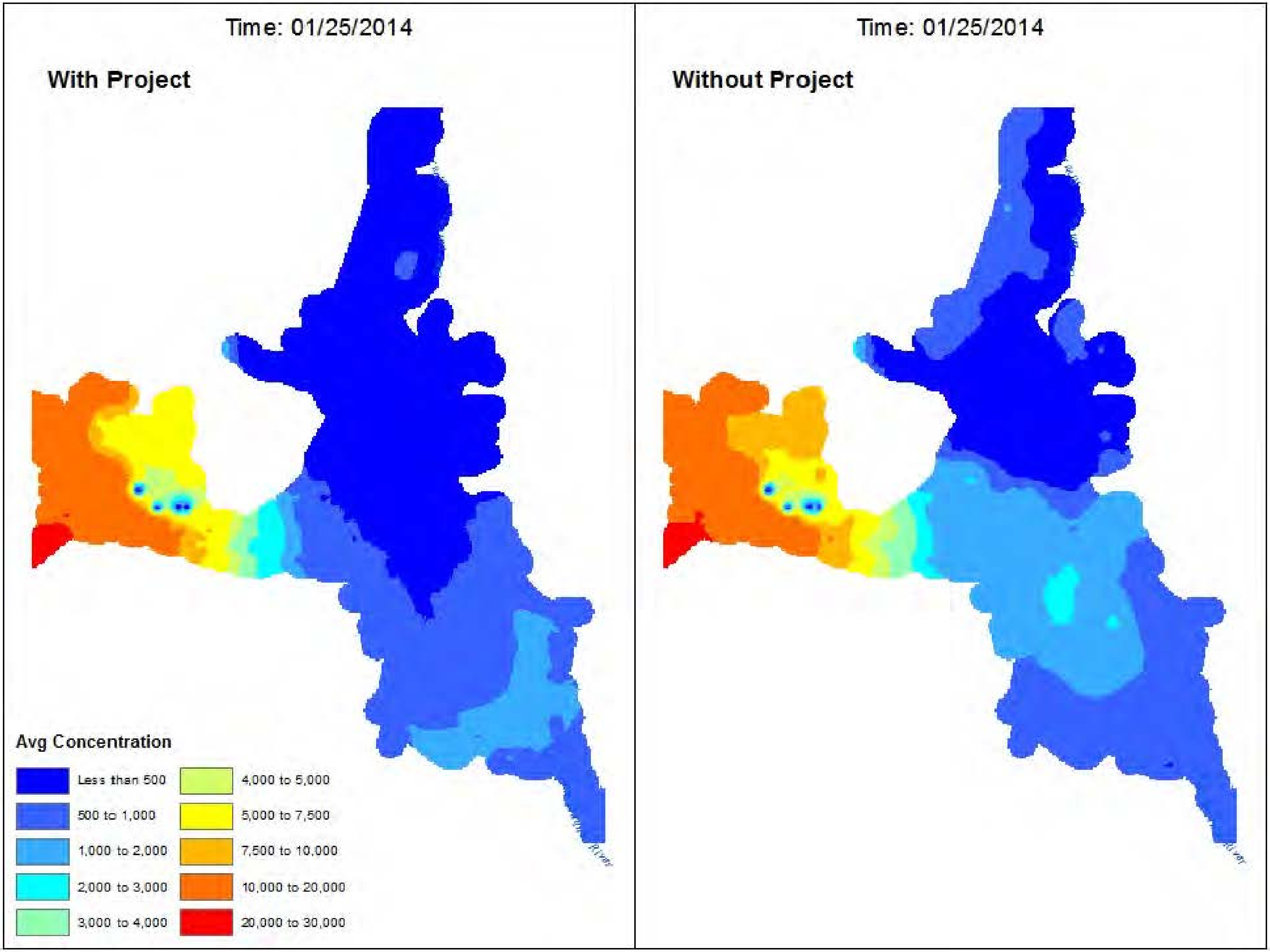

Time: 09/07/2013
With Project
Time: 09/07/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

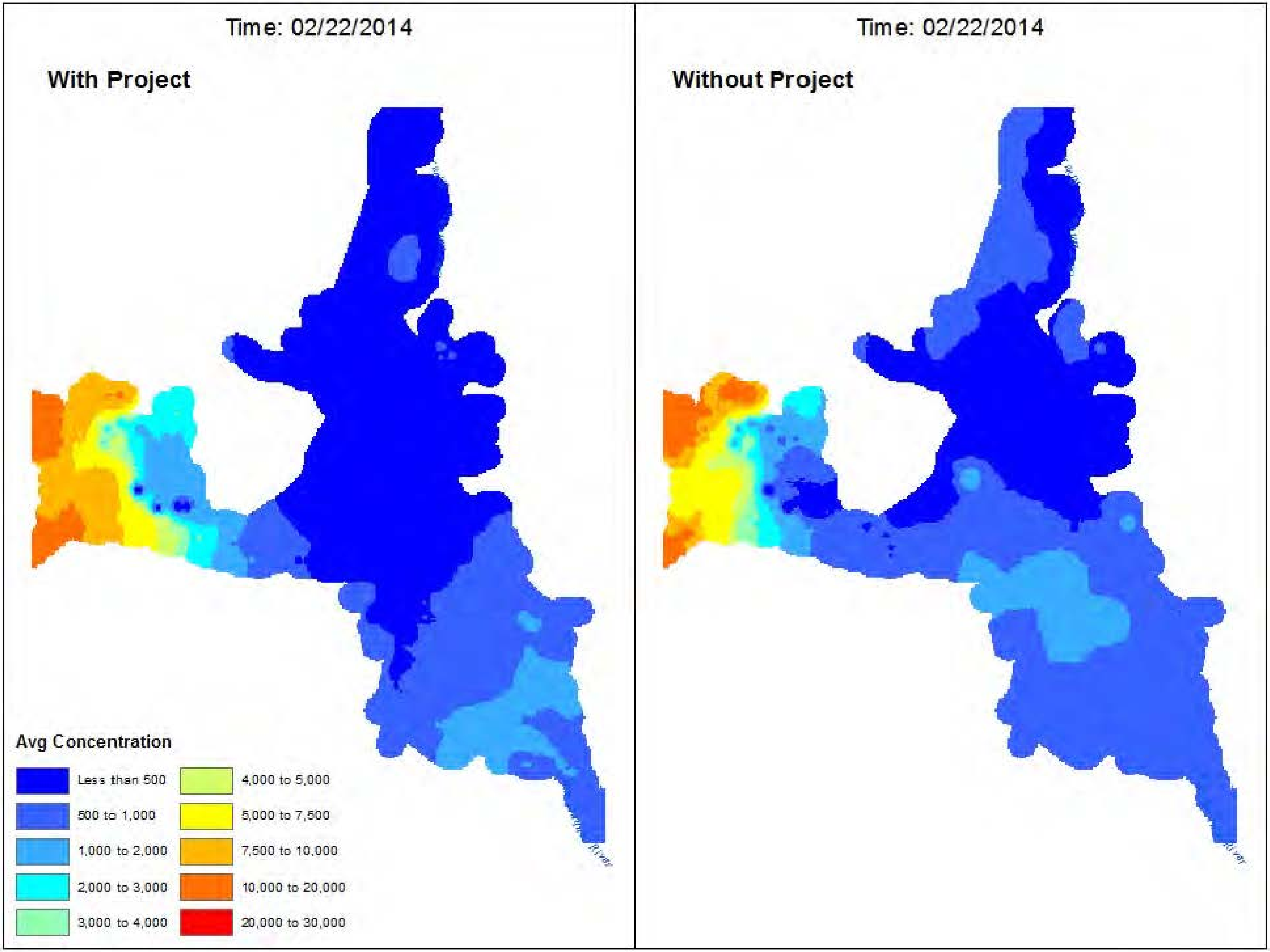

Time: 10/05/2013
With Project
Time: 10/05/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

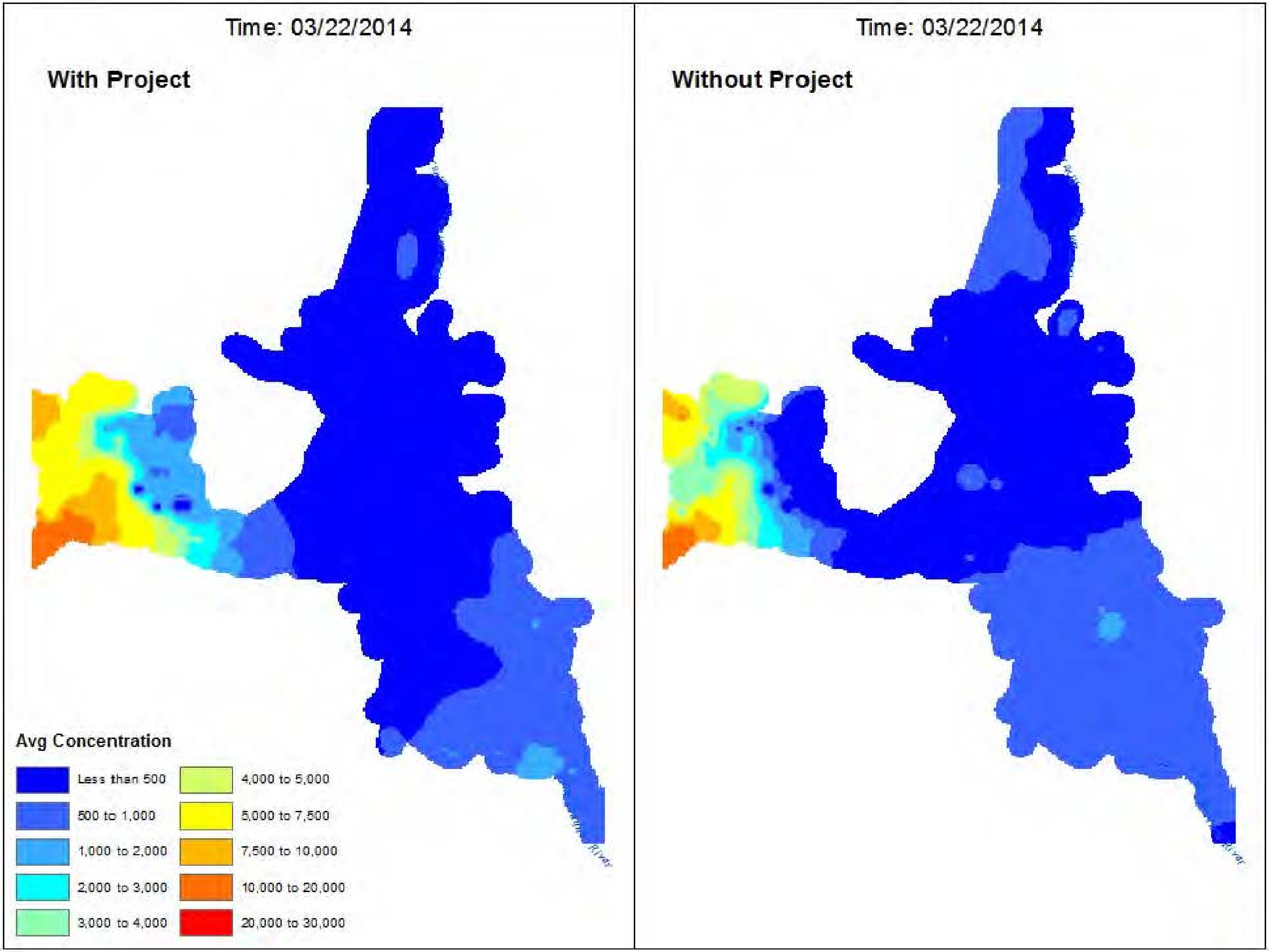

Time: 11/02/2013
With Project
Time: 11/02/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

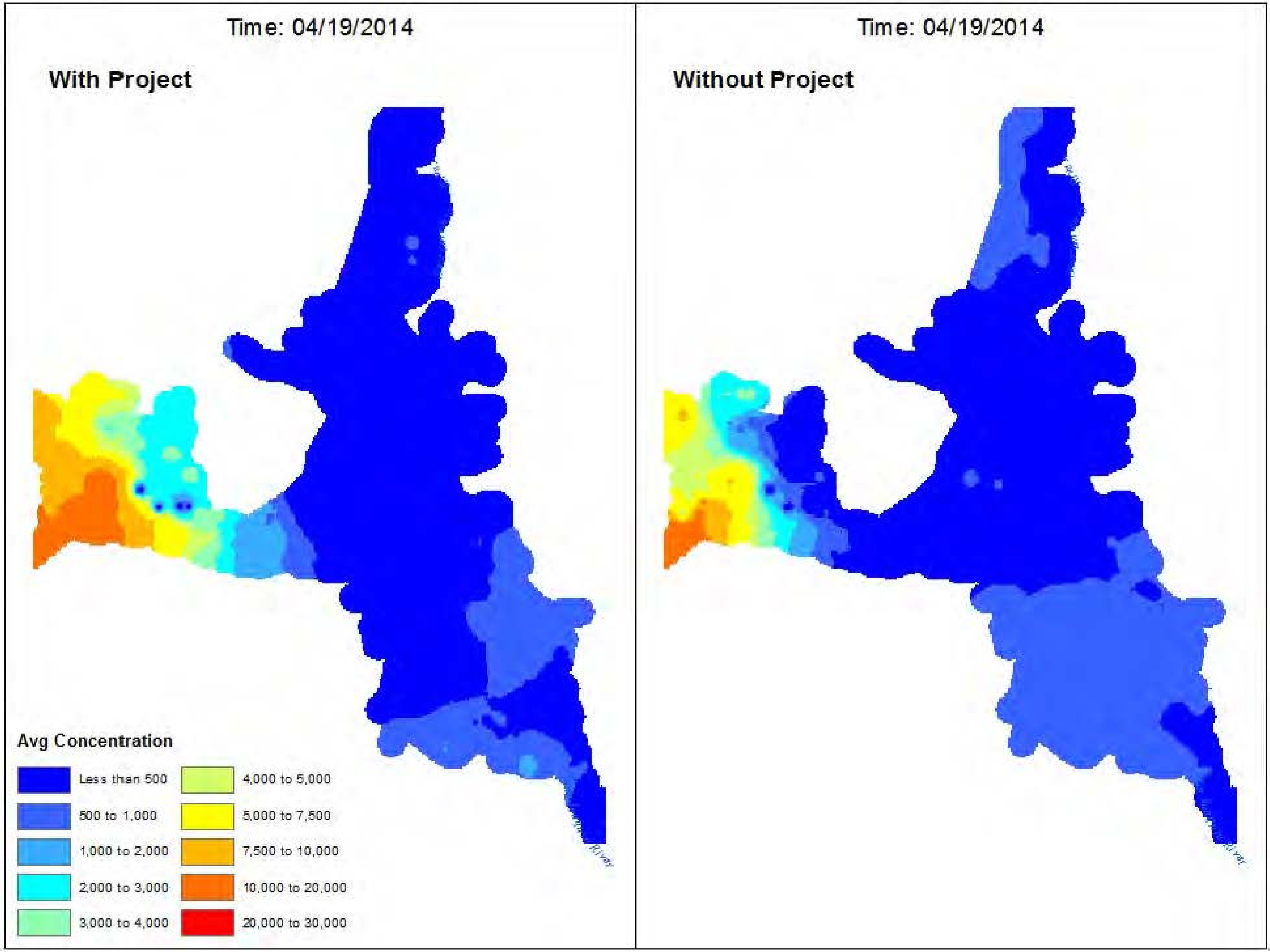

Time: 11/30/2013
With Project
Time: 11/30/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

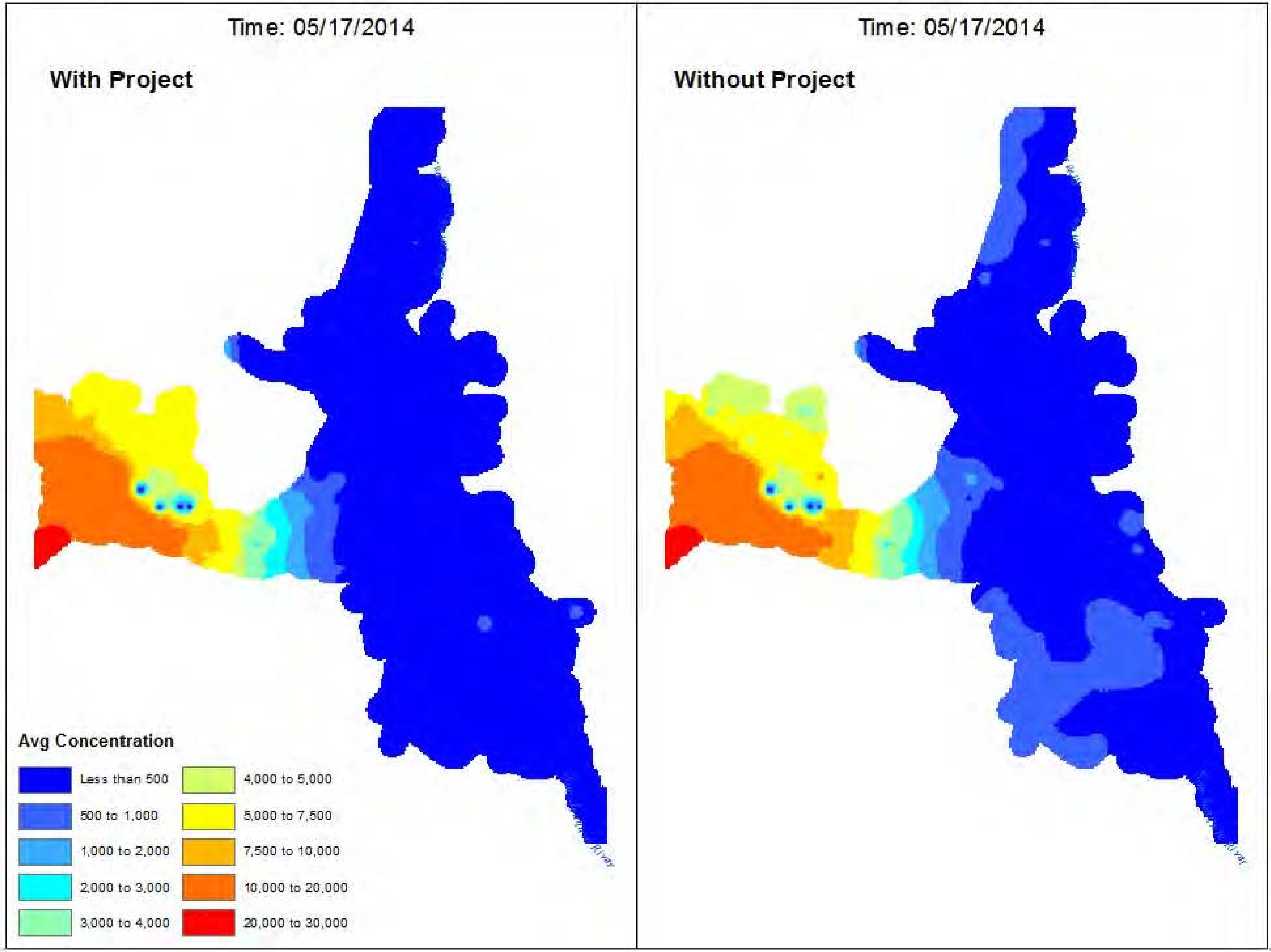

Time: 12/28/2013
With Project
Time: 12/28/2013
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

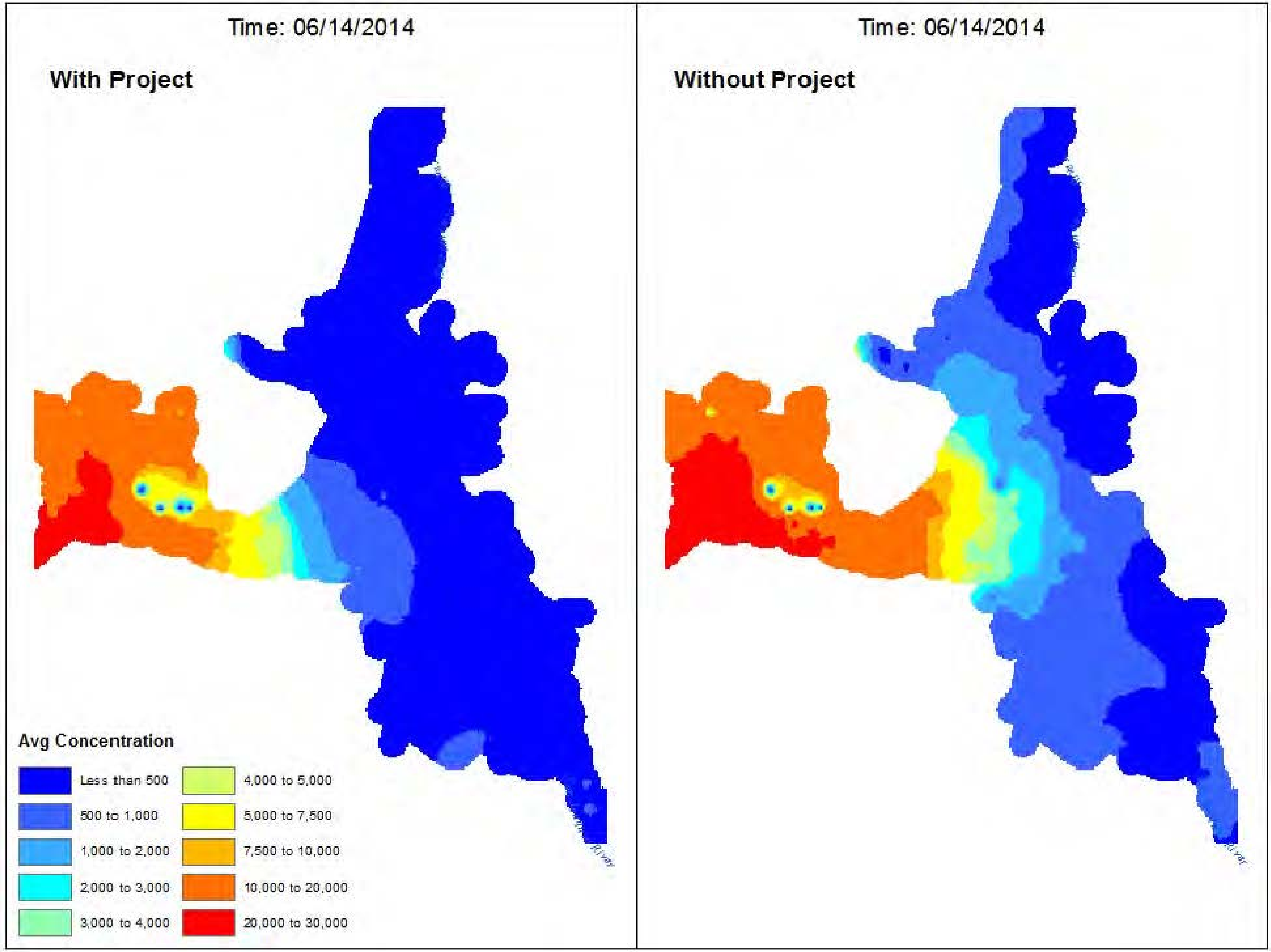

Time: 01/25/2014
With Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000
Time: 01/25/2014
Without Project

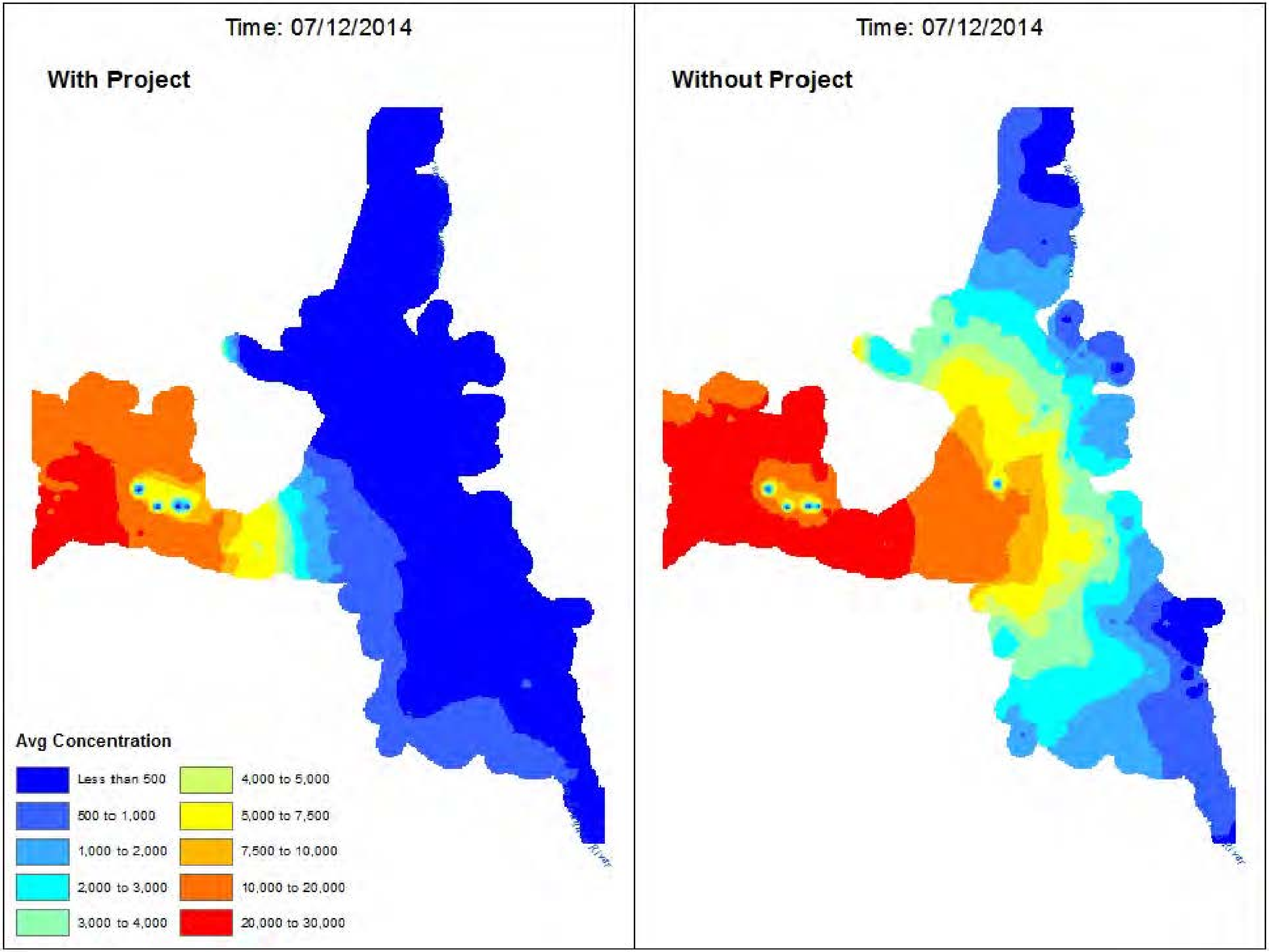

Time: 02/22/2014
With Project
Time: 02/22/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 03/22/2014
With Project
Time: 03/22/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

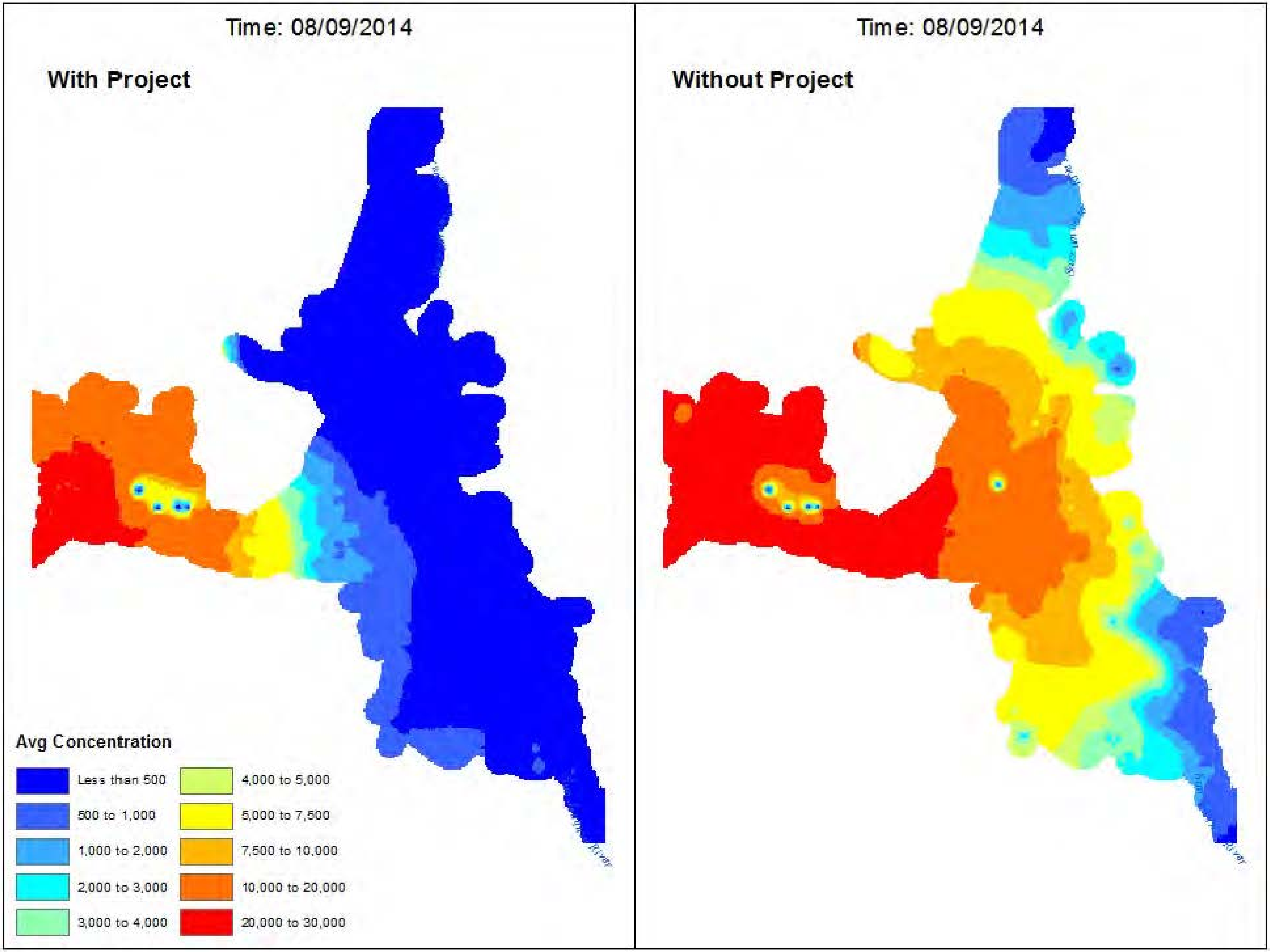

Time: 04/19/2014
With Project
Time: 04/19/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

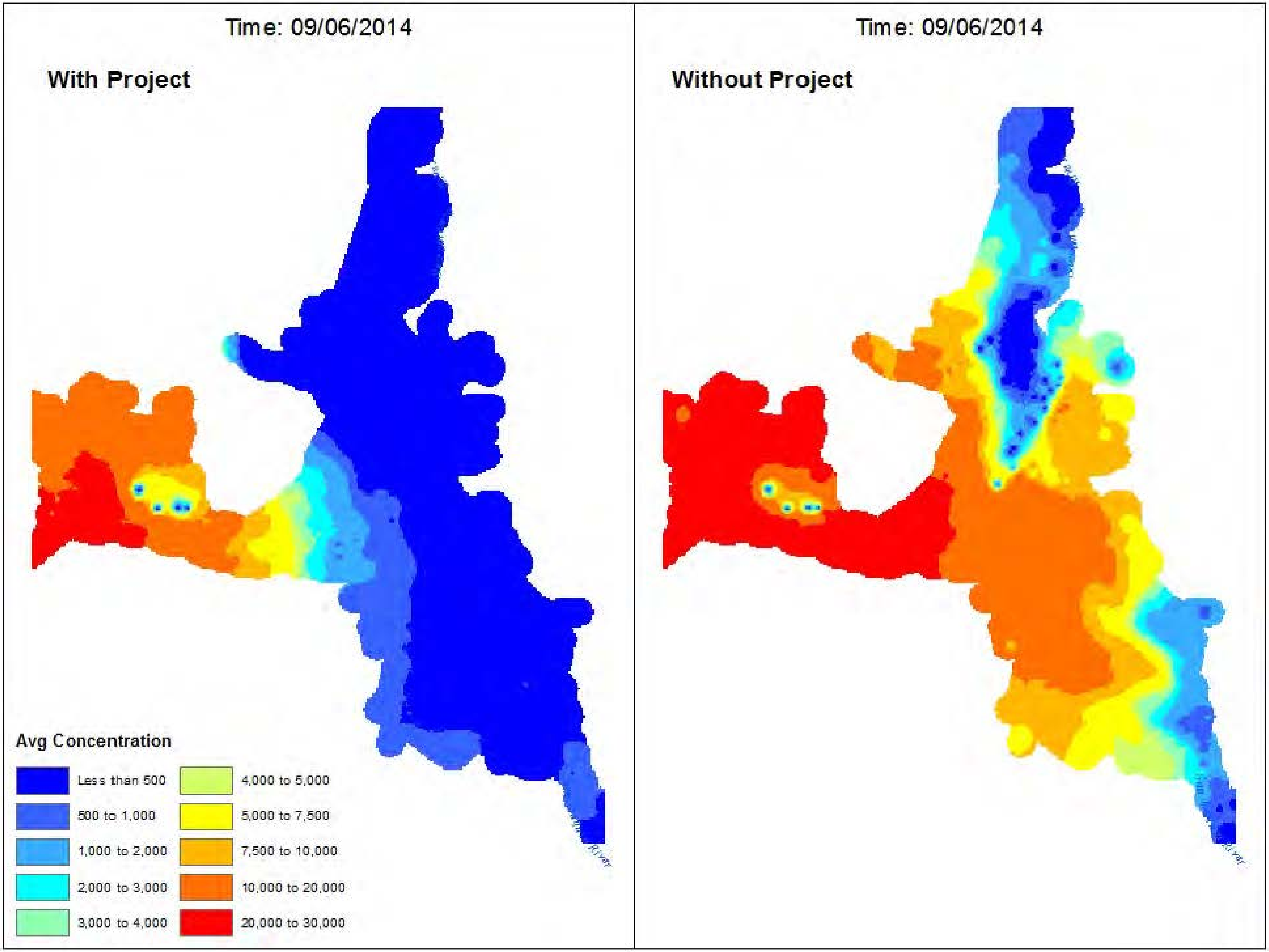

Time: 05/17/2014
With Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000
Time: 05/17/2014
Without Project

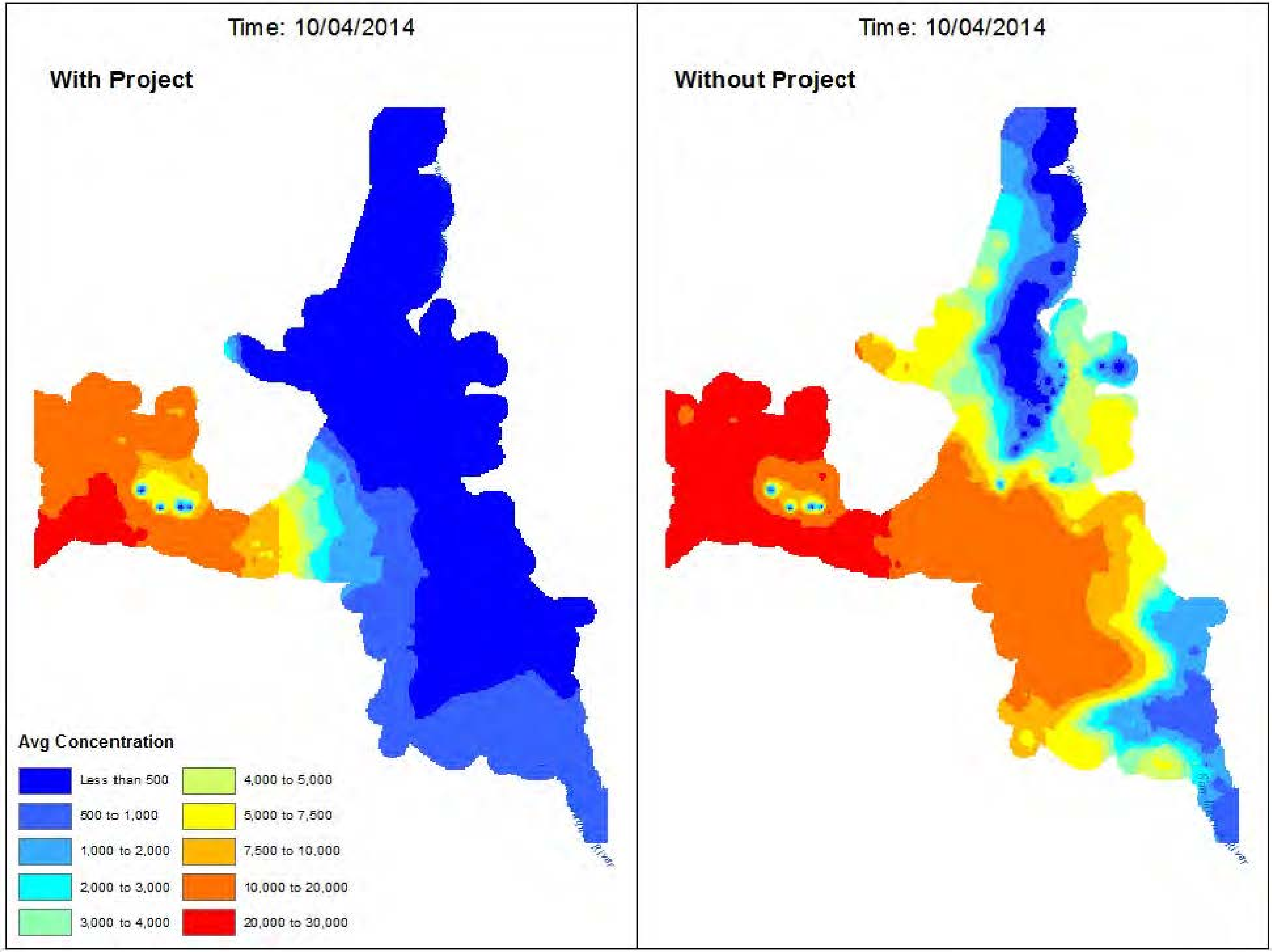

Time: 06/14/2014
With Project
Time: 06/14/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

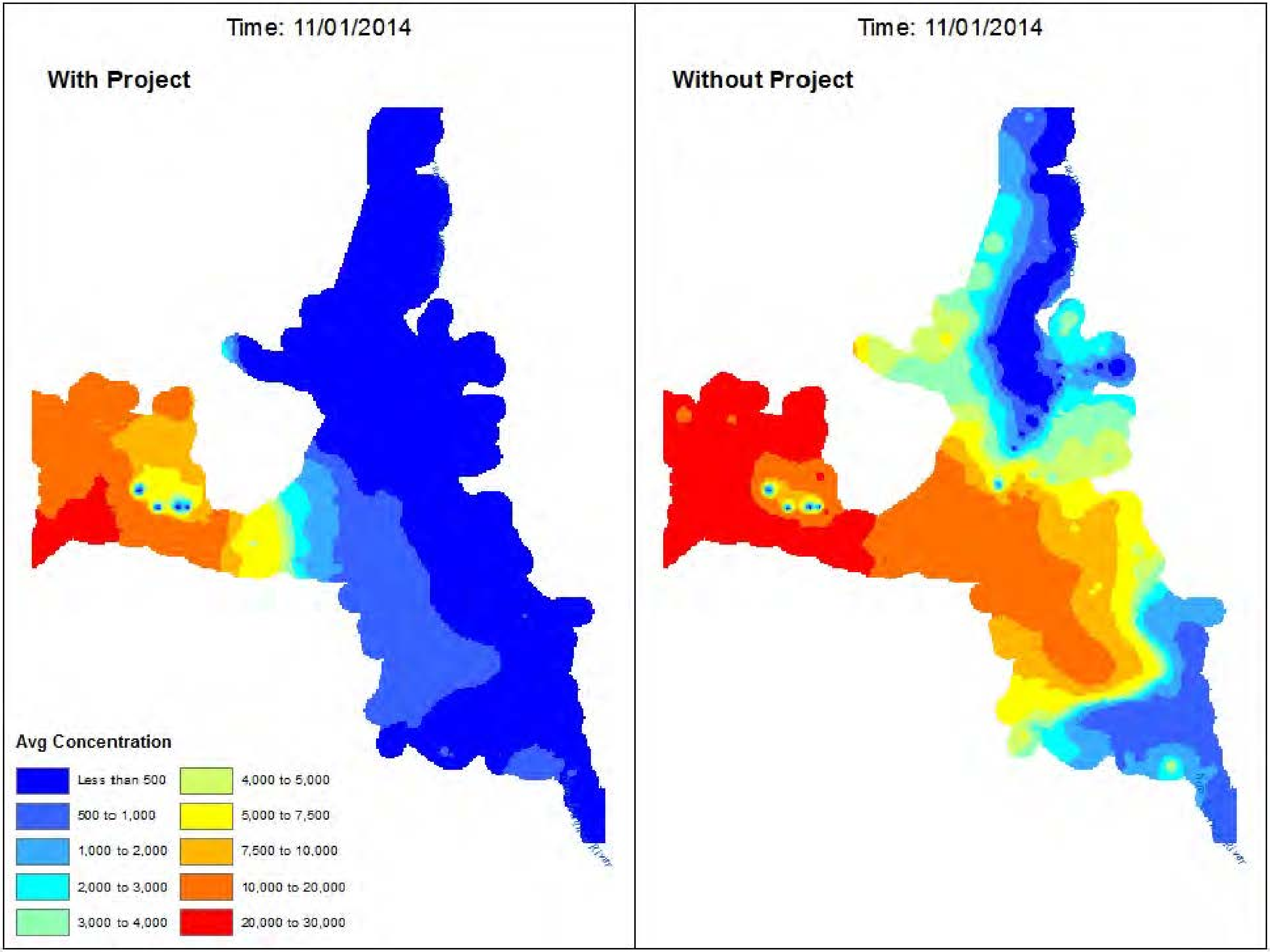


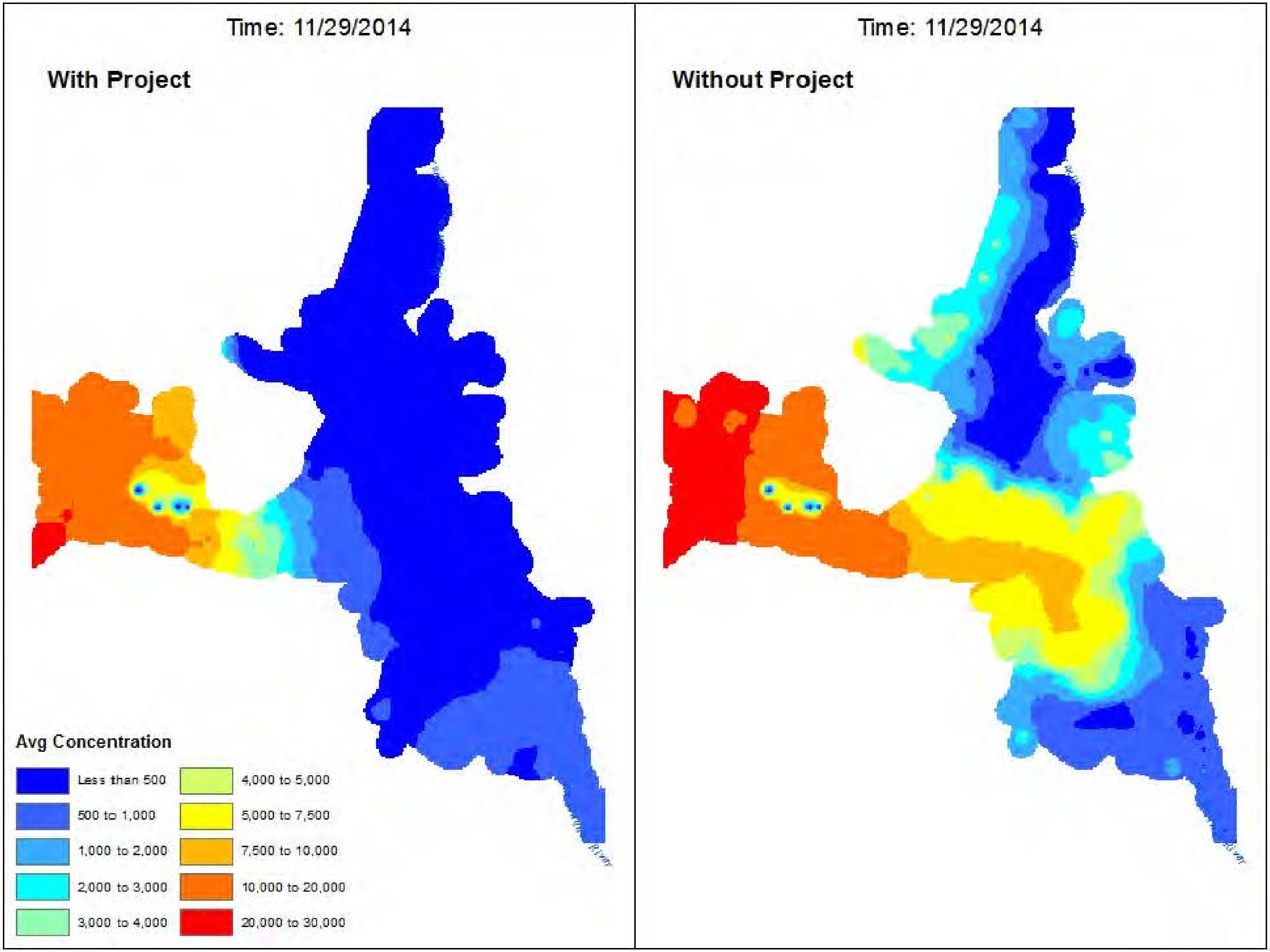
Time: 07/12/2014
With Project
Time: 07/12/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

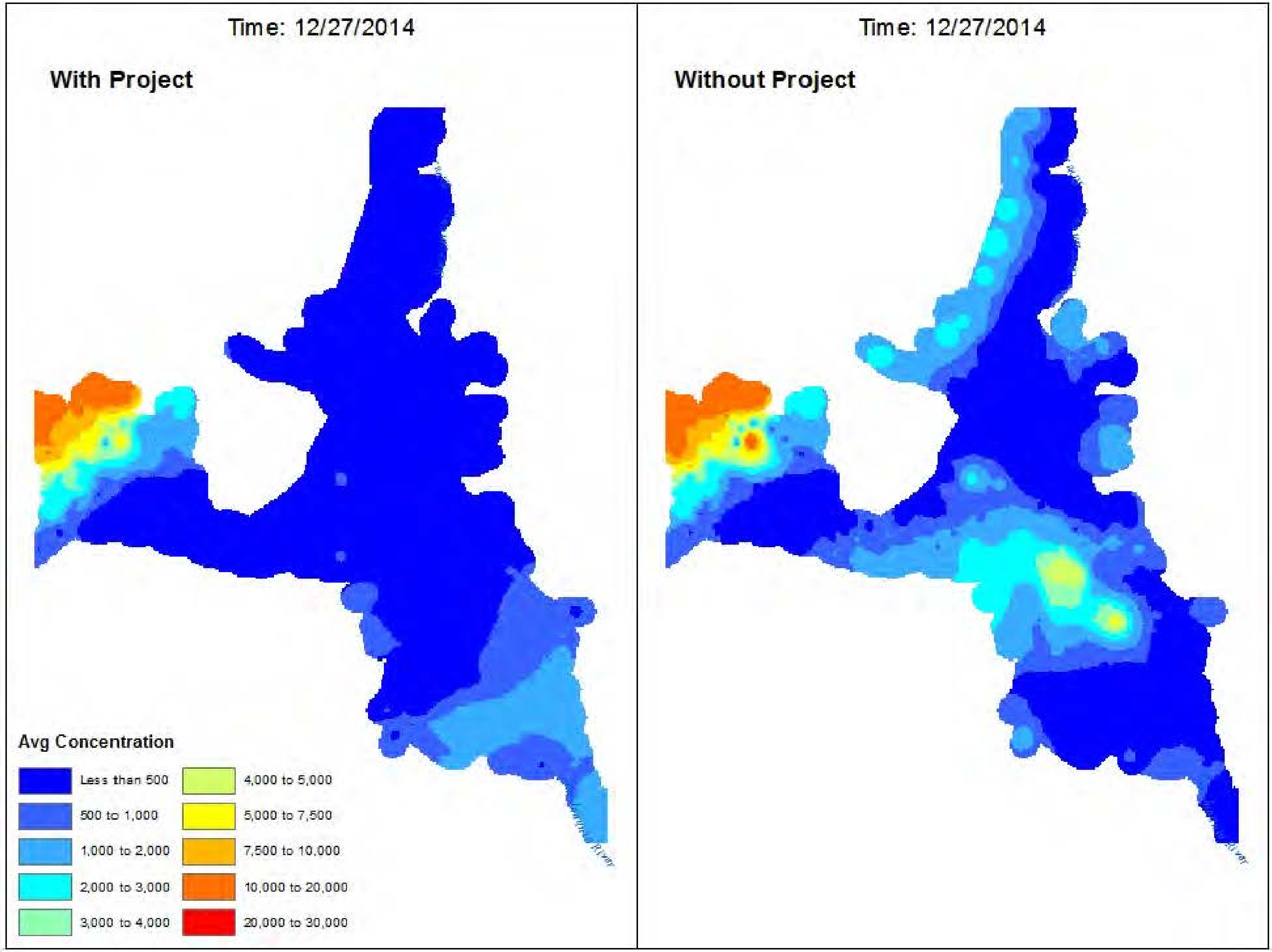

Time: 08/09/2014
With Project
Time: 08/09/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

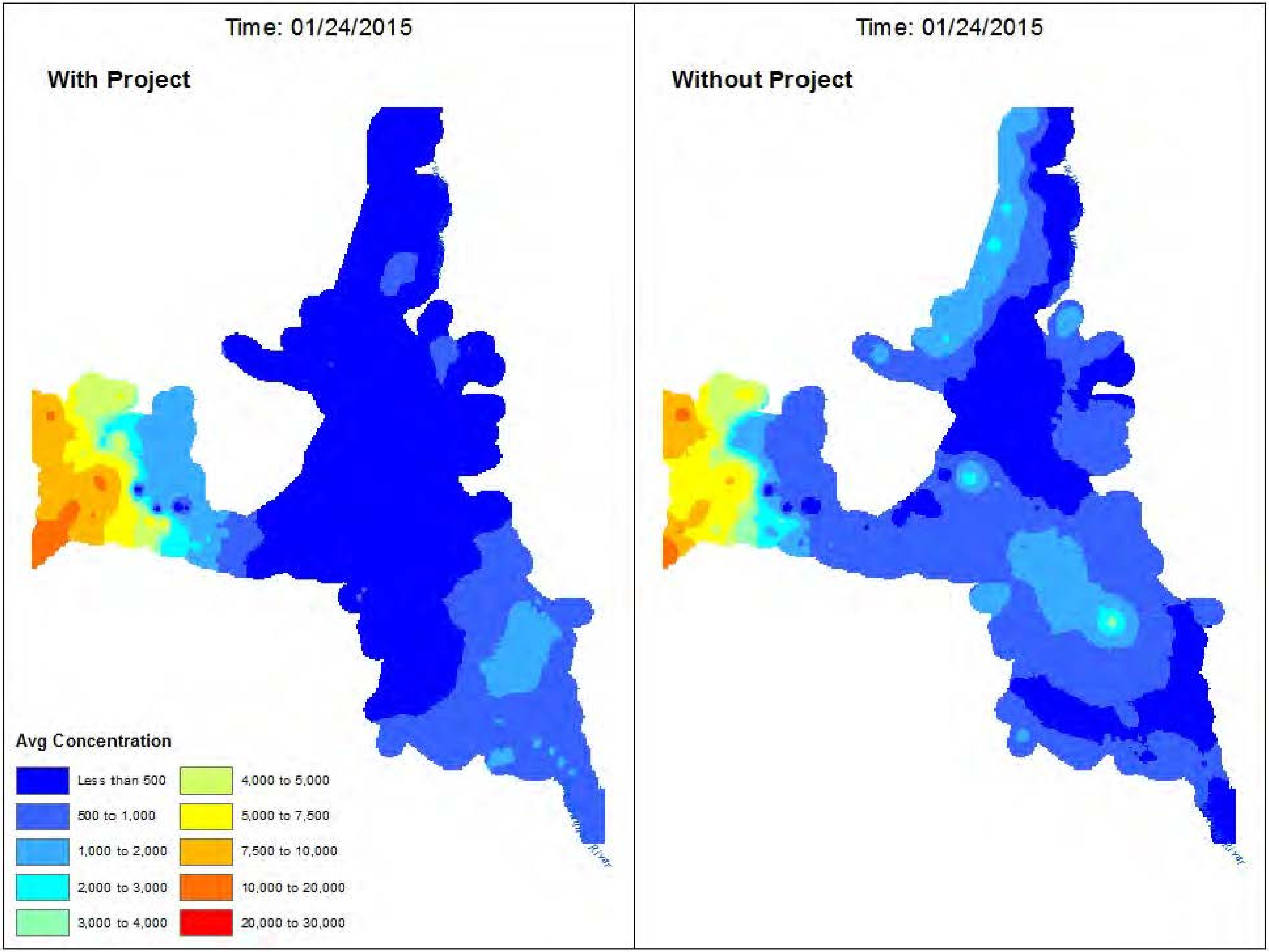

Time: 09/06/2014
With Project
Time: 09/06/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

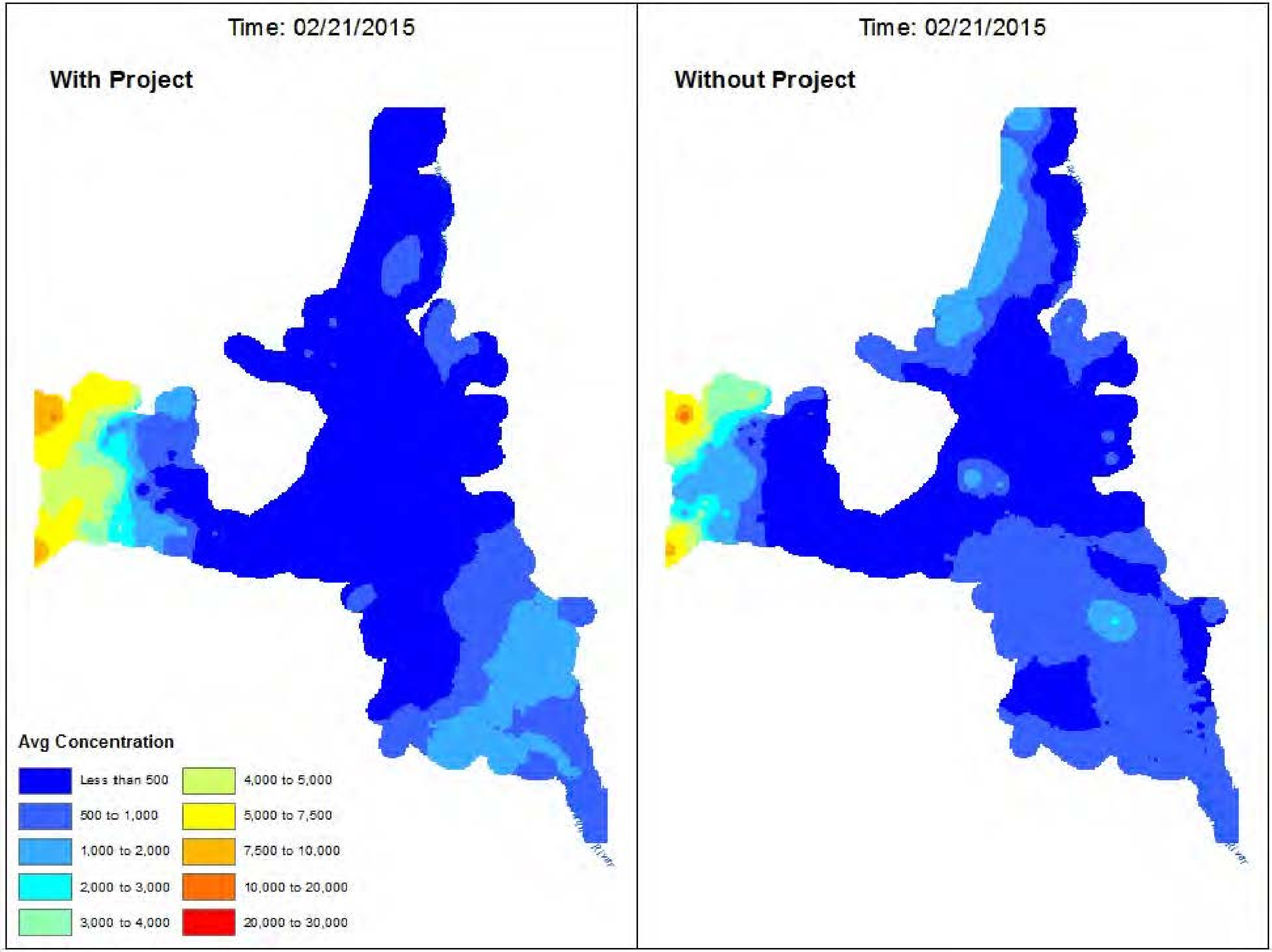

Time: 10/04/2014
With Project
Time: 10/04/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 11/01/2014
With Project
Time: 11/01/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

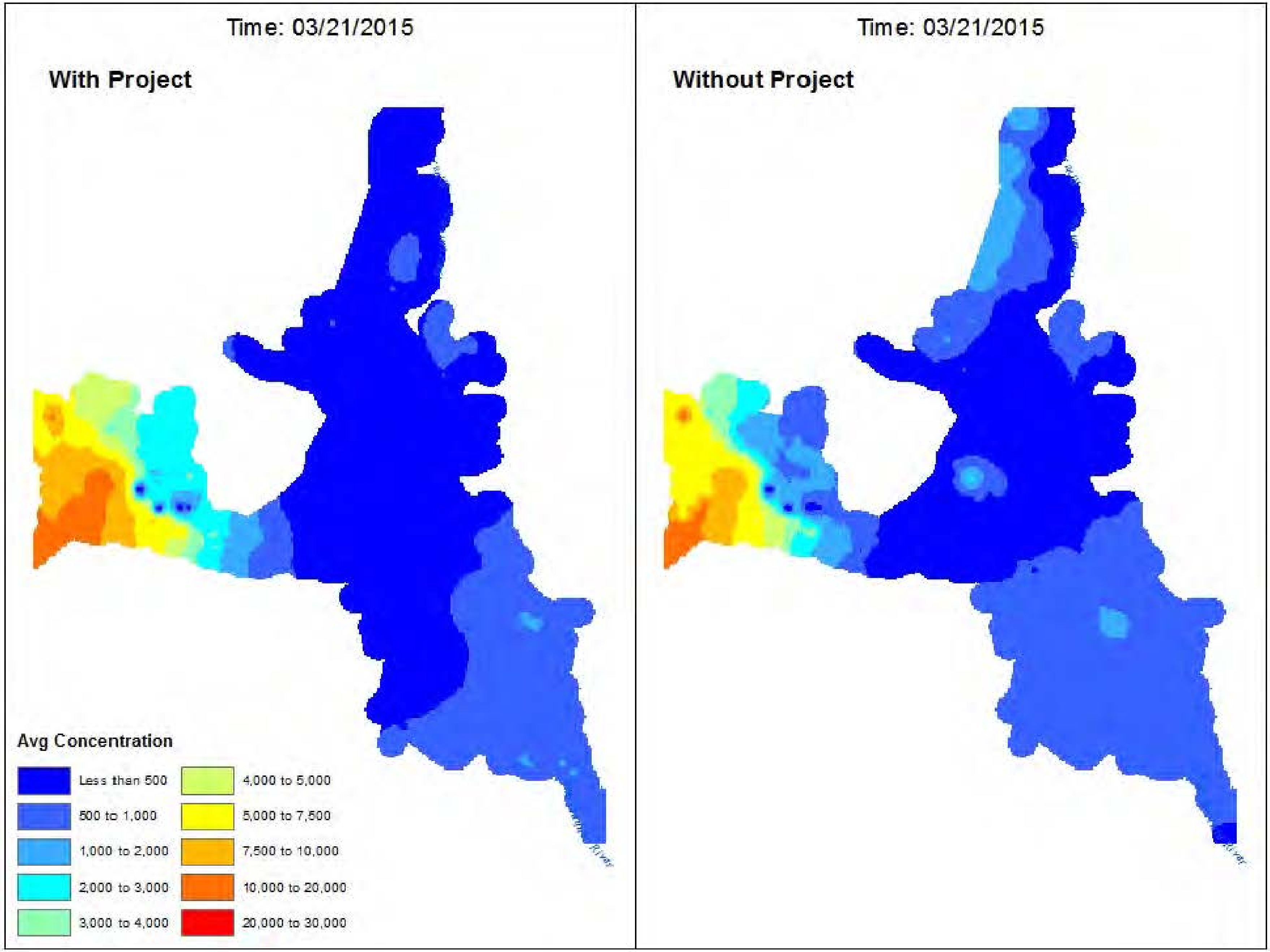

Time: 11/29/2014
With Project
Time: 11/29/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

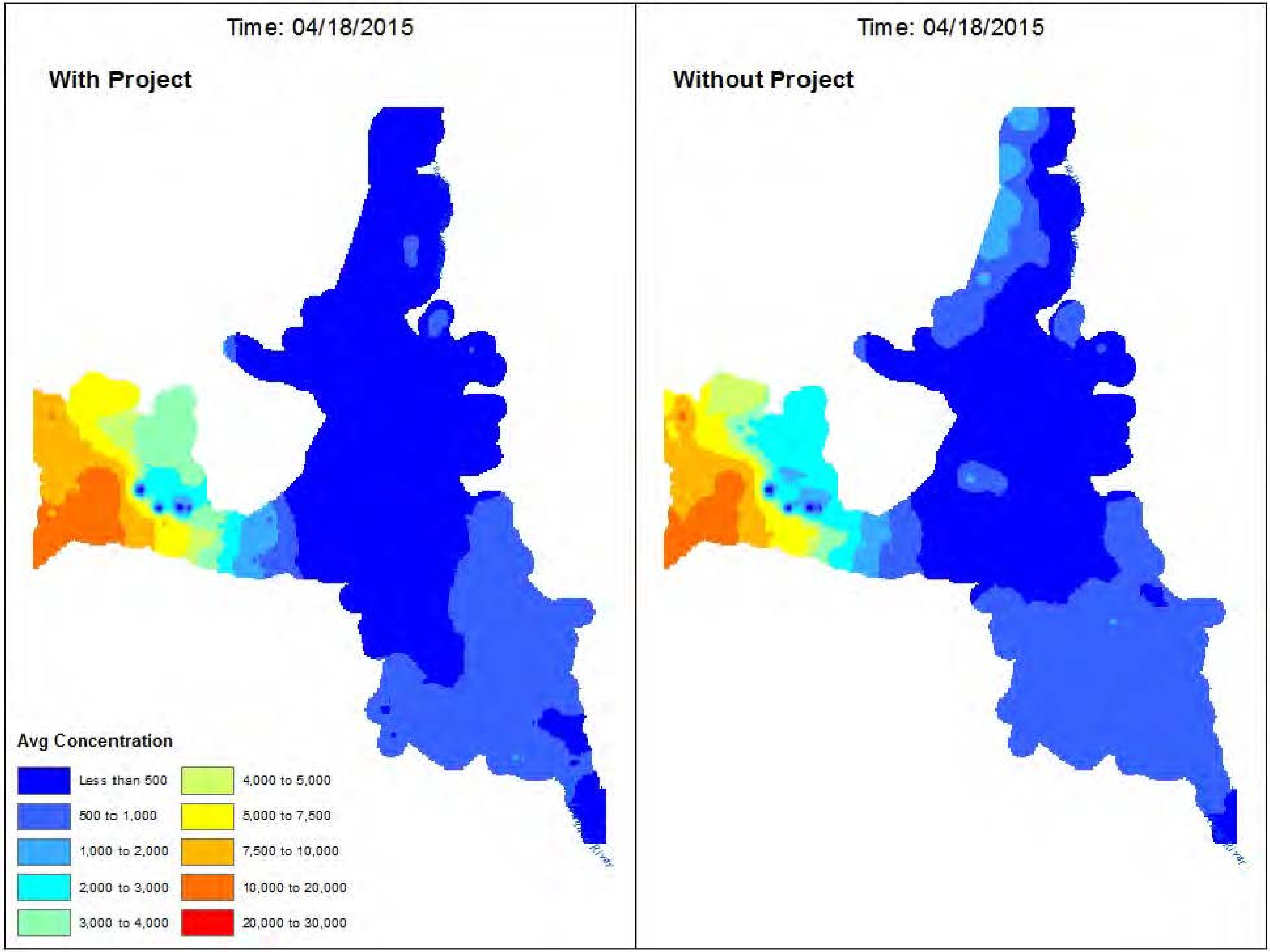

Time: 12/27/2014
With Project
Time: 12/27/2014
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

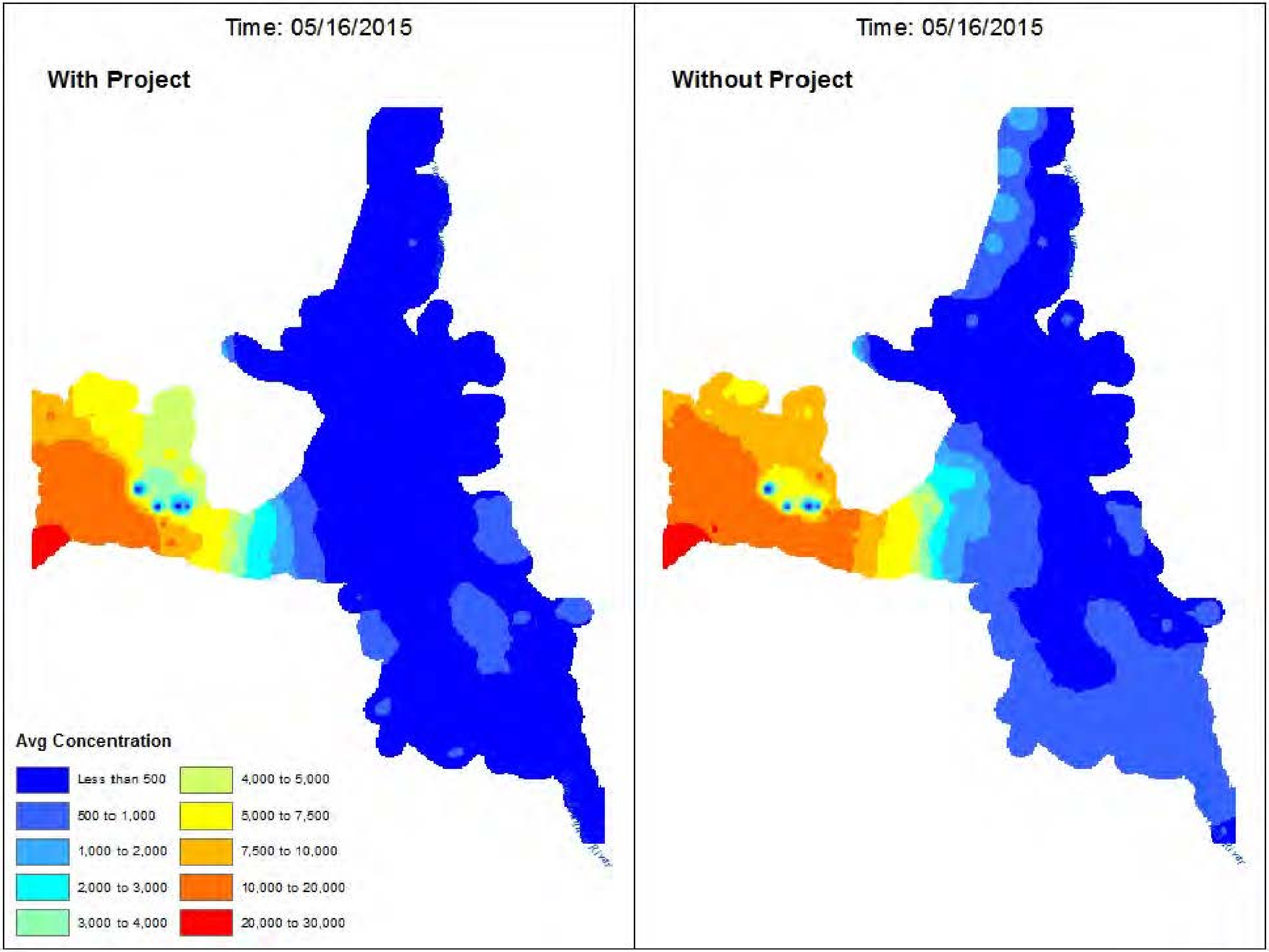

Time: 01/24/2015
With Project
Time: 01/24/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

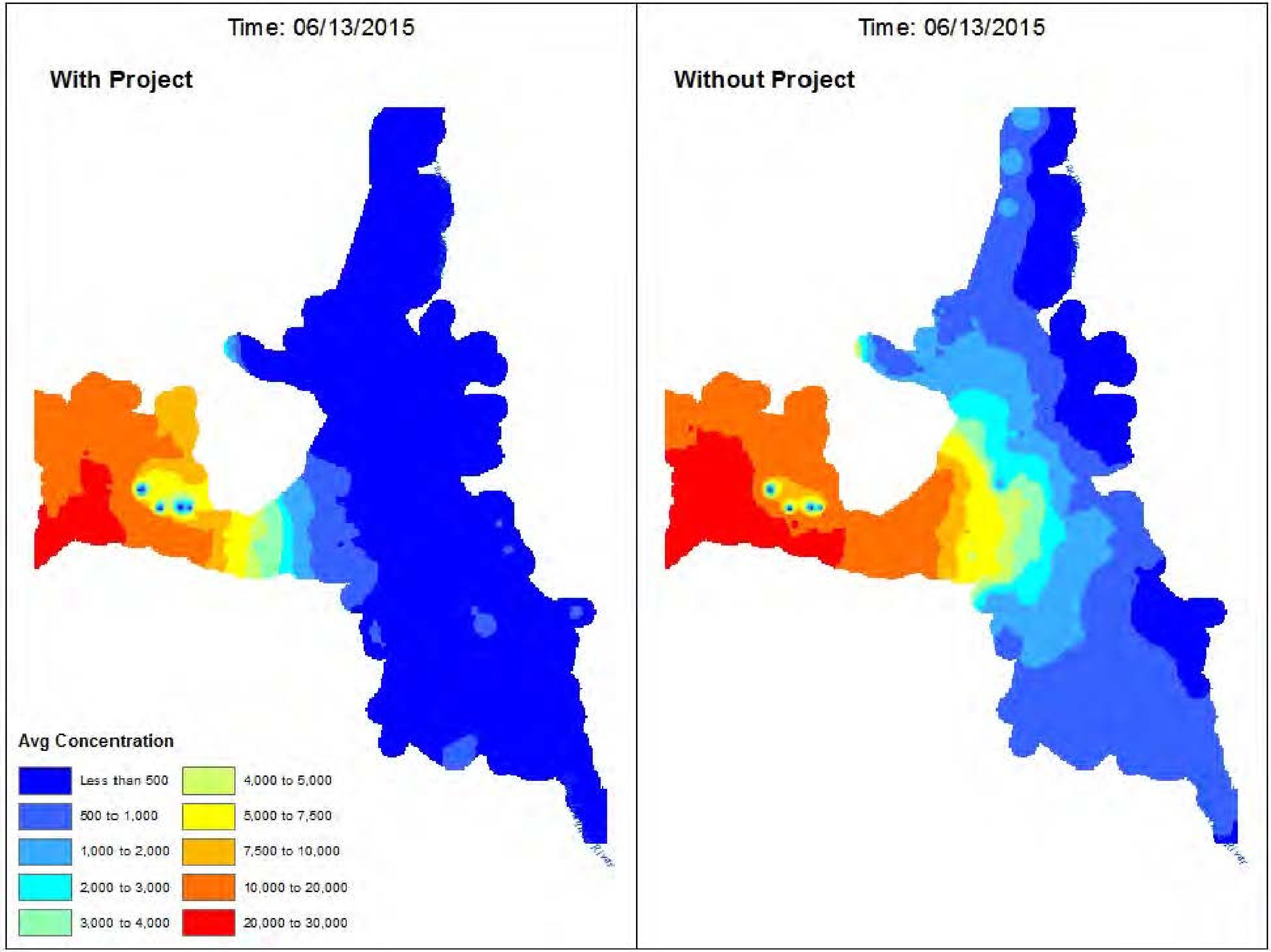


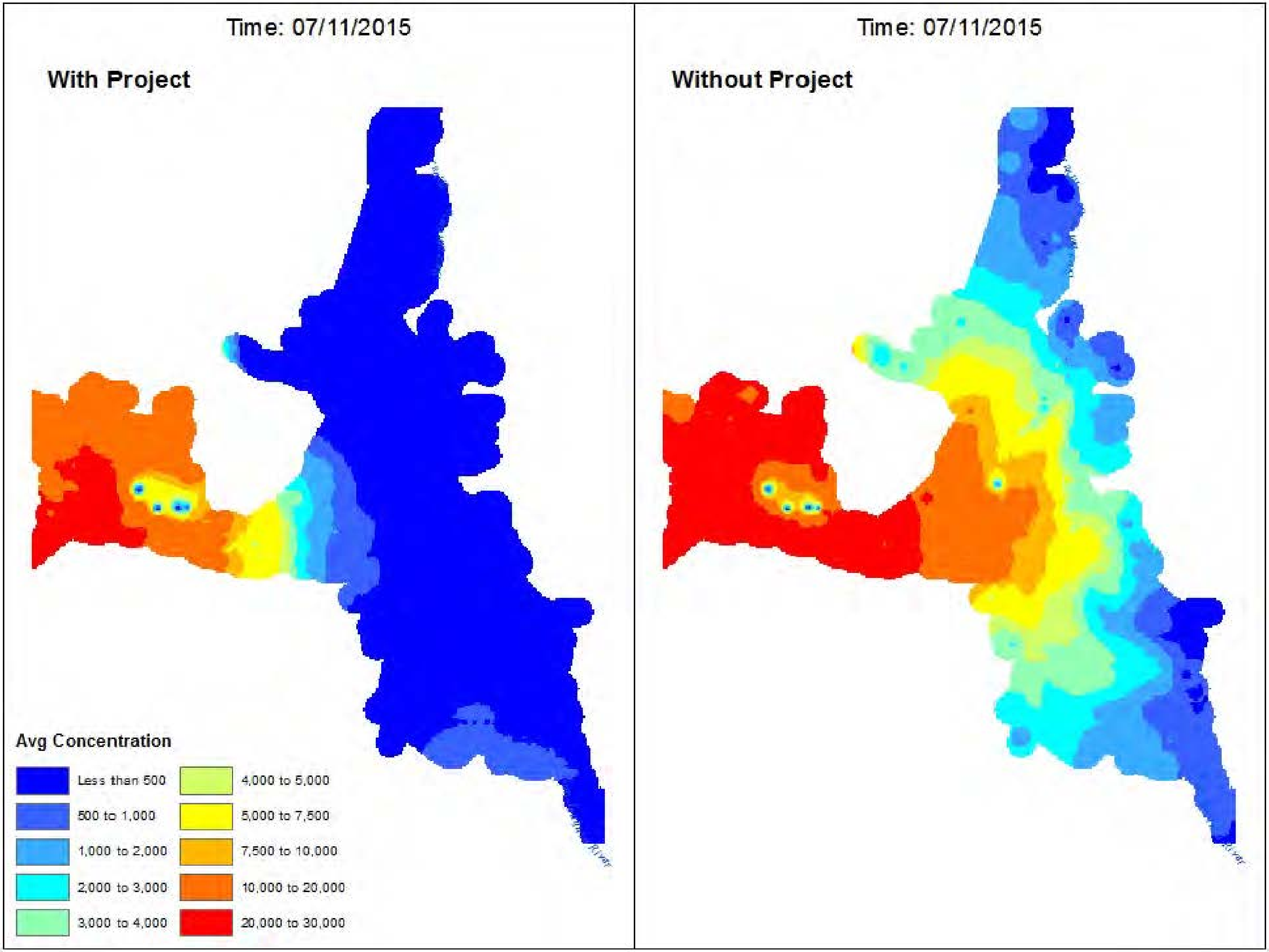
Time: 02/21/2015
With Project
Time: 02/21/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000
River
River

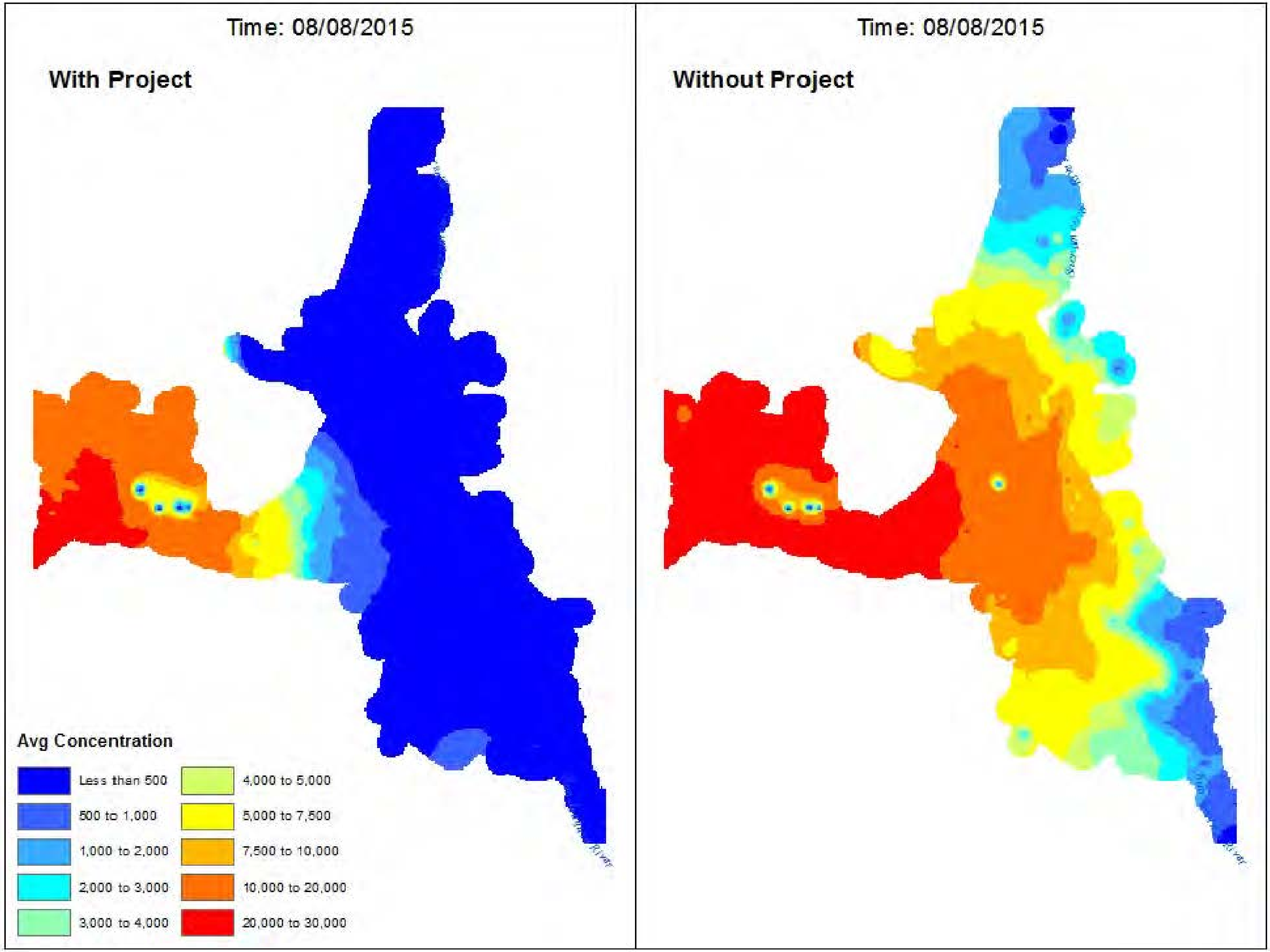

Time: 03/21/2015
With Project
Time: 03/21/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

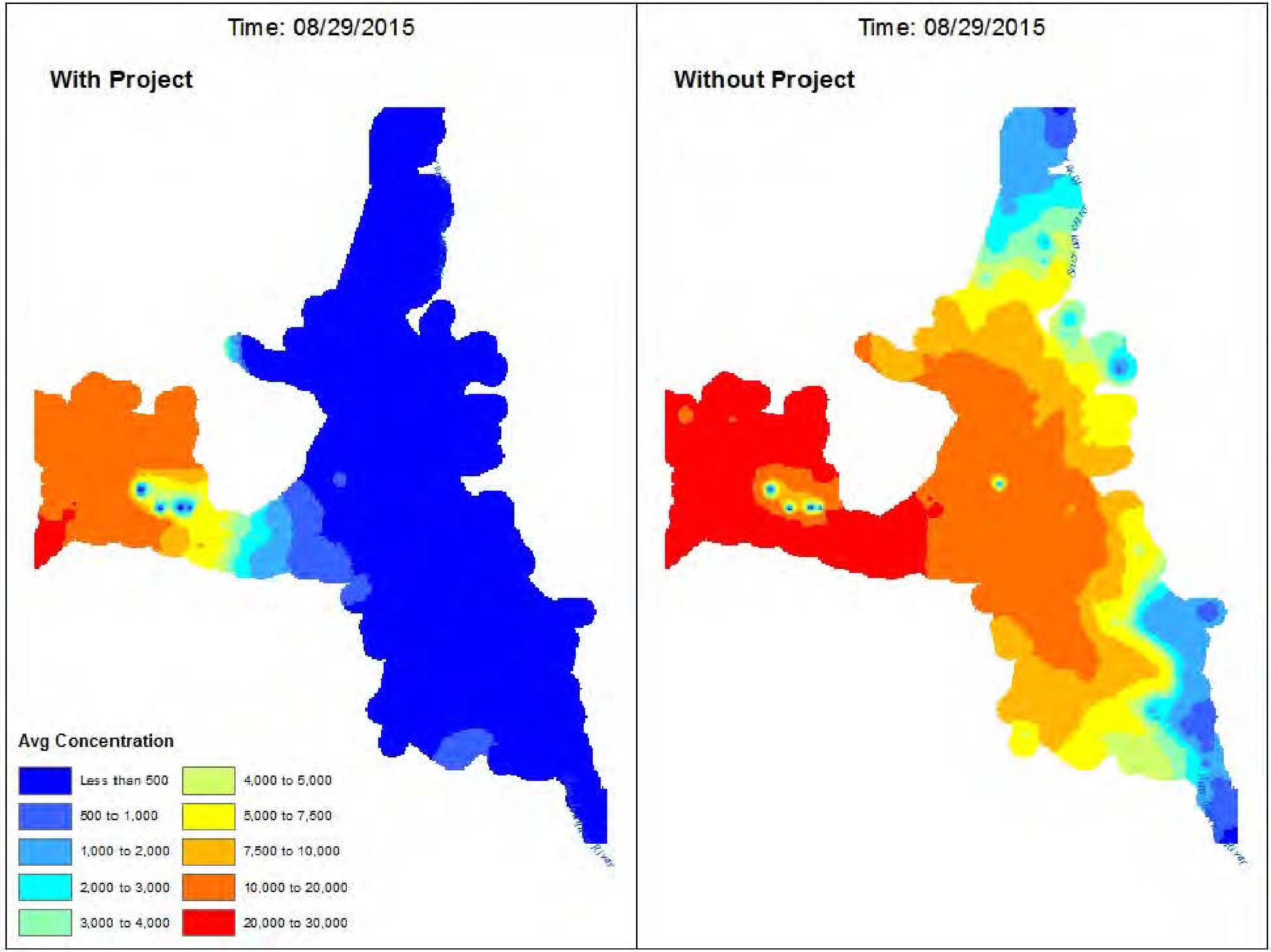

Time: 04/18/2015
With Project
Time: 04/18/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 05/16/2015
With Project
Time: 05/16/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 06/13/2015
With Project
Time: 06/13/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 07/11/2015
With Project
Time: 07/11/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 08/08/2015
With Project
Time: 08/08/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000


Time: 08/29/2015
With Project
Time: 08/29/2015
Without Project
Avg Concentration
Less than 500
500 to 1,000
1,000 to 2,000
2,000 to 3,000
3,000 to 4,000
4,000 to 5,000
5,000 to 7,500
7,500 to 10,000
10,000 to 20,000
20,000 to 30,000

Appendix A: Methodology to Estimate Vernalis Salinity Under Without Project Conditions (from USBR & SDWA 1980) – provided by SWC

Calculate Salt Load Based on Flow (Table VI-7, page 89)

TABLE VI - 7
CHLORIDE LOAD VS. FLOW COEFFICIENTS AT VERNALIS

1930 - 1950

MONTH	C1	C2	# OF PAIRS*	R
OCTOBER	.3416451758E+03	.7238303788	7	.993
NOVEMBER	.3393044927E+03	.6880766404	6	.987
DECEMBER	.3639052910E+03	.6787756342	7	.972
JANUARY	.3928349175E+03	.6231583178	10	.965
FEBRUARY	.5368474514E+03	.5675747831	9	.914
MARCH	.4968879101E+03	.6035477710	10	.951
APRIL	.3866605718E+03	.5624873484	9	.942
MAY	.3805863844E+03	.5399998219	9	.920
JUNE	.6355065225E+03	.5175446121	9	.849
JULY	.6038658134E+03	.6219848451	8	.900
AUGUST	.3874538954E+03	.7410226741	8	.991
SEPTEMBER	.3500905302E+03	.7524035817	8	.989

* # OF PAIRS DOES NOT INCLUDE RESTRICTION POINT (.5,200)

$y = C1*(X)^{C2}$

Convert Salt Load to Chloride Concentration (page 110)

$$p/m = \frac{\text{Load}}{\text{Flow} \times 1.36}$$

where,

p/m = parts per million Cl^-
Load = chloride load in tons
Flow = 1,000's of acre-feet

Calculate Specific Conductance EC from Chloride Concentration (page 86)

$$Cl^{-} = 0.15\ EC - 5.0 \qquad (2a)$$
$$0 < EC < 500$$

$$Cl^{-} = 0.202\ EC - 31.0 \qquad (2b)$$
$$500 < EC < 2000$$

Rearranging the equations to solve for EC yields:

EC = (Cl- + 5.0) / 0.15 0 < EC < 500

EC = (Cl- + 31.0) / 0.202 500 < EC < 2000