

BLACK & VEATCH CORPORATION
NISP EIS SUPPORT

To: Carl Brouwer, Northern Colorado Water Conservancy District

From: Mark Maxwell, Black & Veatch Corporation

Reviewed by: Klint Reedy, Black & Veatch Corporation

Subject: Wastewater Treatment Plant Issues

1.0 Introduction

This evaluation focuses on the impact of the Northern Integrated Supply Project (NISP) on the two City of Fort Collins water reclamation facilities (WRFs), the Mulberry and Drake facilities, which have a maximum month rated capacity of 6.0 and 23.0 million gallons per day (mgd), respectively. Note that the terms water reclamation facility and wastewater treatment plant (WWTP) will be used interchangeably throughout this memorandum because the entities mentioned herein use these designations for facilities that provide essentially the same functions.

The Mulberry WRF, with a maximum month flow of 6.0 mgd, uses a coupled trickling filter/activated sludge biological treatment process, with UV disinfection of the clarified effluent. A very high degree of treatment, including ammonia removal, is provided at this facility. The Drake WRF, with a maximum month capacity rating of 23.0 mgd, is a conventional activated sludge plant with two liquid stream treatment trains, designated the North and South Complexes. As with the Mulberry plant, the Drake facility also provides a high quality final effluent.

The discharge permits for these facilities expired in 2005 and have been administratively extended since then by the Colorado Department of Public Health and Environment (CDPHE). Draft permit renewals, dated September 30, 2008, plus the supporting water quality assessment (WQA) prepared by CDPHE (dated July 11, 2008) were reviewed in the process of developing this memorandum.

Figure WWTP-1, adapted from the WQA, shows that the Boxelder Sanitation District WWTP was considered in the State's determination of effluent ammonia limits for the Drake WRF. CDPHE also indicated that none of the following facilities have an impact on the standards-setting process for the two Fort Collins WWTPs:

- Town of Wellington WWTP
- Town of Windsor WWTP
- Eastman Kodak Company WWTP
- City of Greeley WWTP

The Mulberry WRF, which is shown on Figure WWTP-2, discharges to the mainstem of the Cache la Poudre River (Poudre River) within Stream Segment COSPCP11, which extends from Shields Street to immediately above the confluence with Boxelder Creek. As depicted on Figure WWTP-3, the Drake WRF can discharge to the following three locations:

- Cache La Poudre Stream Segment COSPCP 11
- Fossil Creek Reservoir (Stream Segment COSPCP13a) by means of Fossil Creek Reservoir Inlet Ditch. The inlet ditch itself is not considered waters of the state by CDPHE.
- The cooling water pond at Platte River Power Authority's (PRPA) Rawhide Power Plant. This pond is not considered waters of the state and the effluent pumped to it need only meet CDPHE's minimum secondary treatment standards, which it easily does.

When discharging to the Poudre River, CDPHE believes the Drake facility and the Boxelder Sanitation District WWTP (see Figure WWTP-4) could jointly influence compliance with in-stream ammonia standards in the upper portions of Stream Segment COSPCP12, which extends from just above Boxelder Creek to the confluence with the South Platte River. All three of the above-noted stream segments (COSPCP 11, 12, and 13a) share the designations and classifications shown in Table WWTP-1.

Table WWTP-1	
Stream Segment Designations & Classifications	
Designation/Classification	Definition
Use Protected	Designation provides the lowest level of protection afforded by State water quality rules. Higher designations include "Undesignated" (i.e. subject to anti-degradation review) and "Outstanding Waters."
Aquatic Life Warm 2	Classification means the stream segments are protected for the propagation of warm water aquatic life. According to CDPHE, Class 2 waters are not capable of sustaining a wide variety of biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.
Recreation 1a	Classification means that in-stream E.coli standards are set at the level deemed necessary to protect people who use the water for primary contact (full body immersion) recreation.
Agriculture	Classification means the surface water is suitable for agricultural use, including irrigation and livestock watering.
Notes:	
1) Fort Collins WWTPs discharge to Poudre River stream segments COSPCP 11, 12, and 13a.	
2) According to CDPHE, all of these stream segments share the designations and classifications shown in this table.	

It is important to note that, because these stream segments are designated as use protected, the Fort Collins WWTPs can utilize all of the available assimilative capacity in the stream. This means that if there is water in the stream other than the wastewater flow from the WWTP, Fort Collins can get the potential benefit the mixing of the two waters to achieve its regulatory requirements. Although this sounds like a major benefit, it is important to note that being able to use all of the available assimilative capacity is of limited value when upstream dilution flows are very low, which is the case for the Poudre River in the vicinity of the Fort Collins WWTPs. Section 3 of this memorandum focuses on how NISP will not impact the availability of dilution flows to the point where additional facilities are required or operations costs are impacted.

2.0 Regulatory Framework

The WQA provides a good summary of the current regulatory framework upon which the standards will be established for the pending renewal of discharge permits for the Mulberry and Drake WRFs. With respect to capital and annual operation and maintenance (O&M) costs, the most determinative parameter in the WQA is ammonia. All other parameters can be met through basic secondary treatment, disinfection, and an effective industrial pretreatment program, which Fort Collins currently has in place.

In 2010, CDPHE will issue a nutrient quality rule that will affect all WWTPs in the State. To meet new in-stream nutrient quality requirements, it is anticipated that as a minimum, WWTPs will have to treat for stringent total phosphorous (Total-P) removal requirements. Total nitrogen (Total-N) removal may also be a requirement, which would require complete ammonia oxidation (nitrification), plus at least partial reduction of nitrates to nitrogen gas (denitrification). Effluent filtration will also be required to polish effluent Total-P residuals, and to remove particulate organic nitrogen if a stringent Total-N standard is established by CDPHE. Accordingly, it is anticipated that Total-N and/or Total-P limits will be written into discharge permit renewals during the 2010 to 2020 timeframe.

Beyond 2020, WWTPs may be required to treat for the removal of trace organic compounds, such as endocrine disrupting compounds (EDCs), although product bans or substitutions and industrial pretreatment programs may be more cost-effective ways to deal with at least some of these compounds in the future.

3.0 Regulatory Low Flows

Regulatory low flows for wastewater treatment plants are developed to identify how much (if any) a wastewater treatment plant can rely on dilution of the wastewater flow from the WWTP with in-stream flows already present in the receiving stream. Table WWTP-2 summarizes the acute and chronic dilution flows (i.e. regulatory low flows) that were derived in the WQA for the Mulberry and Drake facilities. The acute regulatory evaluation condition is based on the low one day flow expected once every three years (1E3). The chronic regulatory evaluation condition is based on the low 30-day average flow expected to occur once every three years (30E3). All flow rates are listed in cubic feet per second (cfs).

It is recognized that the draft permit renewal for the Drake facility includes a compliance schedule for conducting a mixing zone study at the point where the

Fossil Creek Reservoir Inlet Ditch enters the reservoir itself. This study may result in more dilution and less restrictive limits for the Fossil Creek Reservoir discharge option. However, potentially less stringent limits for discharges from Drake WRF to Fossil Creek Reservoir would not be relevant to potential environmental impacts of NISP on the Poudre River.

Table WWTP-2													
Regulatory Low Flows Upstream of the Fort Collins WWTPs (in cfs)													
Low Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	IWC Range
Mulberry WRF Discharging to Cache la Poudre Segment COSPCP11													
1E3	1.5	0.5	0.5	1.3	1.8	14	3.9	2.7	1.6	1.8	1.0	2.2	40-95%
30E3	1.5	1.5	1.5	1.5	1.8	14	11	4.8	2.2	2.2	2.2	2.2	40-86%
Drake WRF Discharging to Cache la Poudre Segment COSPCP11													
1E3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	>99%
30E3	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.1	0.1	0.1	0.1	0.1	>99%
Drake WRF Discharging to Fossil Creek Reservoir (Segment COSPCP13a)													
1E3	0	0	0	0	0	0	0	0	0	0	0	0	100%
30E3	0	0	0	0	0	0	0	0	0	0	0	0	100%
Abbreviations:													
cfs – cubic feet per second, IWC – in-stream waste concentrations													
IWC = Effluent Flow Limit of the WRF/(Regulatory Low Flow + Effluent Flow Limit of the WRF)													

For reference, Table WWTP-2 shows the range of in-stream waste concentrations (IWCs) for each Fort Collins facility based on the regulatory low flows upstream of each discharge point. Based on current conditions (i.e. without NISP), the WQA anticipates that (once every three years) the 30-day average flows in the Poudre River can be 40 to 86 percent treated wastewater immediately downstream of the Mulberry WRF, and ≥ 99 percent treated wastewater below the Drake facility. Under acute regulatory evaluation conditions, the WQA estimates that (once every three years) the one day wastewater effluent flows in the Poudre River can be as high as 95 percent at the Mulberry WRF, and remains at 99 percent for the Drake plant. Note that actual flows in the river may vary from these regulatory low flows; however, WWTP

effluent limits are based on the CDPHE determined regulatory low flows and not the actual flow that may be present on any given day.

The high degree of effluent domination means the WWTPs cannot currently rely on dilution flow to help meet applicable in-stream water quality standards. Accordingly, NISP will not have any impact on Fort Collins WWTP permit requirements or their abilities to meet these requirements. For example, Figures WWTP-5 and WWTP-6 show how current monthly average regulatory low flows for the two Fort Collins WWTPs compare to projected dry year flows with and without NISP. Note that based on water rights considerations, NISP diversions must stop well before flows in the Poudre River drop to what is listed as the highest 30E3 for the Mulberry WRF, which is 14 cfs in June. Figures WWTP-7 and WWTP-8 illustrate that in-stream flow requirements will cause NISP diversions to stop when stream flows are well above the regulatory low flows established by CDPHE.

Based on past CDPHE practice, if future nutrient quality limits are established, it is likely that effluent standards for Total-P and Total-N will be set as annual loads (i.e. pounds per year), with a relatively high daily maximum concentration. If this practice holds true in the future, it will not matter what value is established as the regulatory low flow.

4.0 Future Facility Requirements

Based on the information presented in Section 3.0, NISP will not have an impact on future effluent quality standards nor the degree of treatment that must be provided by the City of Fort Collins. With or without NISP, the WWTPs will be operating at the "limits of technology" with respect to meeting effluent standards.

It can be assumed that future WWTP upgrades will be required to meet future ammonia, Total-P, and Total-N removal requirements. However, these upgrades will be required with or without NISP and NISP will not impact the cost of construction or operation of these facilities. Heavy metal requirements may also be stricter in the future. However, the existing facilities plus future facilities installed to meet ammonia, Total-P, and Total-N requirements along with source reduction through industrial pretreatment programs, would be sufficient to meet heavy metal limits, again with or without NISP.

To the nearest round number, the projected range in AMMTOX effluent ammonia limits for both Fort Collins WWTPs is presented in Table WWTP-3. These limits are slated to become effective on January 1, 2012.

Table WWTP-3		
Projected Range in Fort Collins Effluent Ammonia Limits		
Facility	Chronic Monthly Average Limit (mg-N/L)	Acute Daily Maximum Limit (mg-N/L)
Mulberry WRF Discharge to Cache la Poudre	4 to 9	15 to 36
Drake WRF Discharge to Cache la Poudre	3 to 7	13 to 26
Drake WRF Discharge to Fossil Creek Reservoir	3 to 4	7 to 14

The monthly average and daily maximum limits can be met through conventional biological nitrification facilities. The projected effluent standards are relatively stringent, although not as low as some other WWTPs along Colorado's Front Range. Given the high existing IWCs, Fort Collins must essentially meet stream standards at the point of discharge. This is evident in the chronic monthly average effluent ammonia limits, which are no different on the low end of the range whether effluent discharge is to the Poudre River or Fossil Creek Reservoir. Therefore, based on the current regulatory framework and low flows, there will be no difference in future facility construction requirements whether or not NISP is implemented.

5.0 Future Operation and Maintenance (O&M) Cost Impacts

Fort Collins uses activated sludge technology for biological wastewater treatment. Such facilities are typically designed either for no nitrification, or to fully nitrify. The difference between complete biological oxidation of ammonia to nitrate (nitrification), which will reliably produce an effluent ammonia residual of 0.5 to 1.0 mg-N/L, and the monthly regulatory limit can be called the "compliance cushion."

Looking at the upper range of monthly average ammonia limits for the Drake WRF, there is a significant compliance cushion between the limit of technology (1 mg-N/L) and the standard for that month (7 mg-N/L). Fort Collins may be considering operating within this compliance cushion to save some aeration power costs by reducing dissolved oxygen (DO) concentrations and/or mixed liquor levels to reduce the rate and degree of nitrification. It is important to note that since NISP will have no impact on the regulatory low flows and

associated effluent limits on the Fort Collins WRFs, the Fort Collins operators will have the same compliance cushion cost-saving opportunity whether or not NISP is implemented.

Note that should a strict Total-N standard be established due to CDPHE's nutrient quality rule, the Fort Collins WWTPs must fully nitrify, and at least partially denitrify the wastewater. That is, aquatic toxicity would not control nitrification requirements, rather Total-N removal would. In that case, Fort Collins would not be able to "back off" on aeration power demands. As noted above, if nutrient standards are set by CDPHE in 2010, compliance may be assessed on a total annual wasteload allocation (WLA), rather than an effluent concentration based on a regulatory low flow. In that case, the annual cost of Total-P and Total-N removal would be the same with or without NISP.

6.0 Summary and Conclusions

The principal findings and conclusions regarding the potential impact of NISP on Fort Collins area wastewater treatment facilities are summarized below:

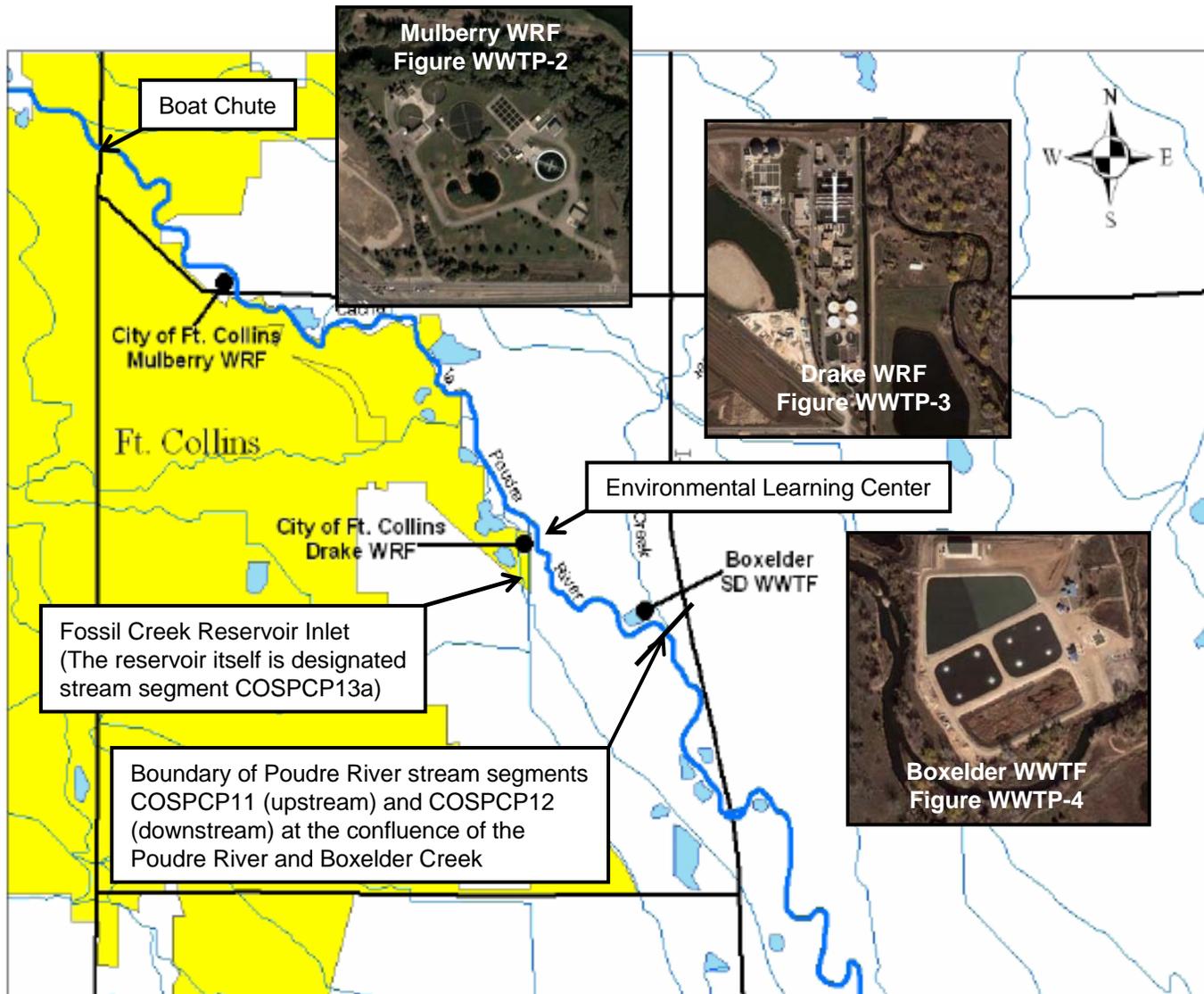
- WWTP facility requirements are based on the CDPHE determined regulatory in-stream low flows, not the actual flow that may be present in the stream on any given day. Due to water right constraints, NISP will not impact the regulatory low flows imposed on the Fort Collins WWTPs.
- Historically, there can be a high degree of effluent domination in the Poudre River and consequently Fort Collins must essentially meet stream standards at the point of discharge. Due to water right constraints, NISP will not have any impact on this permit condition.
- Based on the current regulatory framework, NISP will have no impact on existing or future WWTP infrastructure requirements or operating requirements.
- For water future quality-based effluent limits (e.g. ammonia), future upgrades to Fort Collins WWTPs may be required. However, these upgrades would be required with or without NISP and NISP will have no impact on capital or operations costs associated with meeting these future regulations.

- For future limits that are set by means of a WLA process, which has historically been utilized for Total-P discharge standards in the State of Colorado, annual costs are based strictly on influent WWTP flows. Consequently, WLA limits are not dependent upon the amount of dilution available in the stream and, again, NISP will not impact capital or operations costs for Fort Collins WWTPs.

7.0 References

Colorado Department of Public Health and Environment, (2008). *Water Quality Assessment, Cache La Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.

U.S. Army Corps of Engineers, Omaha District (2008). *Northern Integrated Supply Project Draft Environmental Impact Statement*, April 2008.



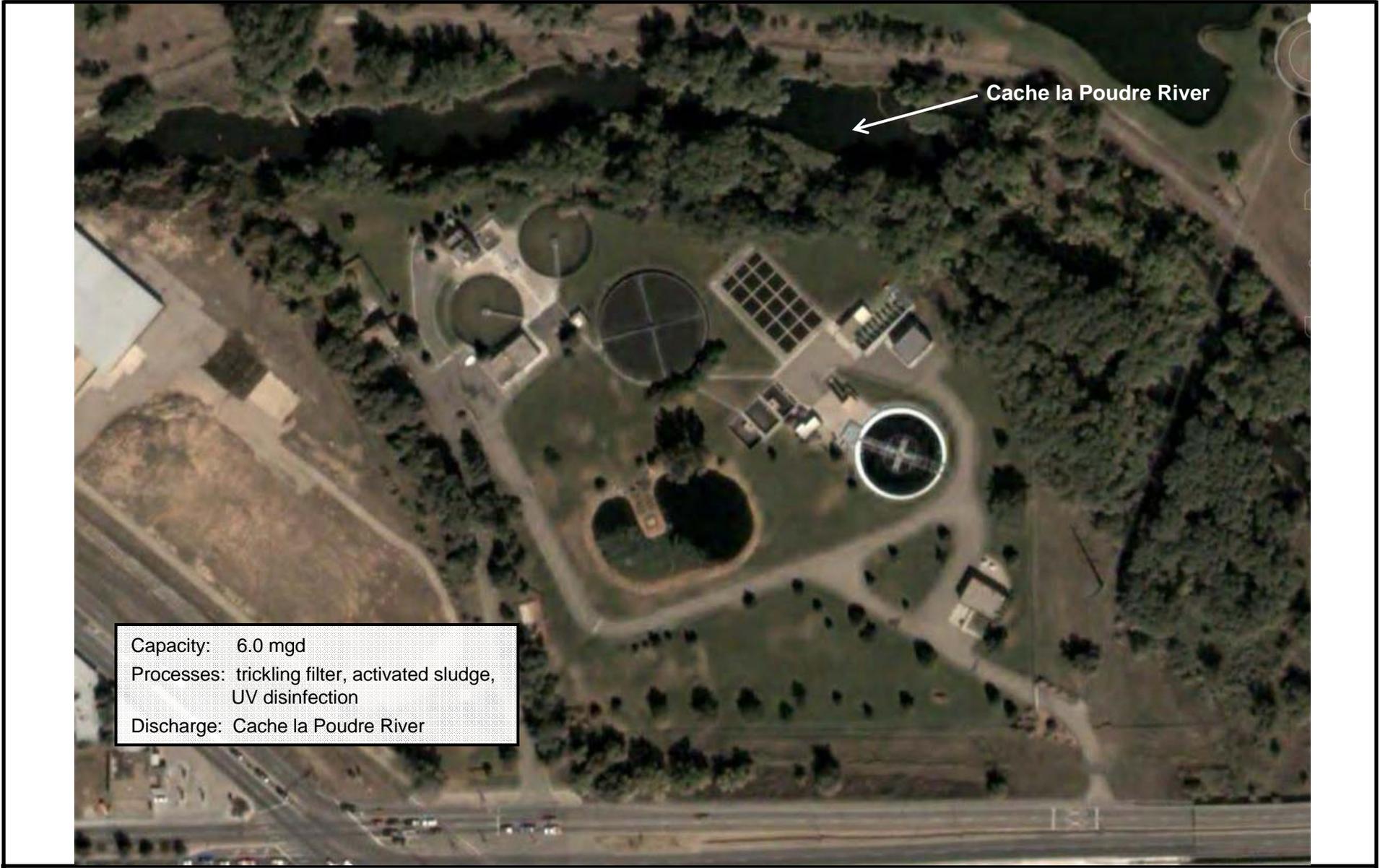
Source: Modified from *Water Quality Assessment, Cache La Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.



Northern Integrated Supply Project

Fort Collins Area Wastewater Treatment Plants

**Figure
WWTP-1**



Northern Integrated Supply Project

Fort Collins Mulberry Water Reclamation Facility

**Figure
WWTP-2**



Capacity: 23.0 mgd
 Processes: conventional activated sludge, disinfection
 Discharge: 1) Fossil Creek Reservoir Inlet
 2) Cache la Poudre River
 3) PRPA's Rawhide Power Plant Cooling Water Pond



Northern Integrated Supply Project

Fort Collins Drake Water Reclamation Facility

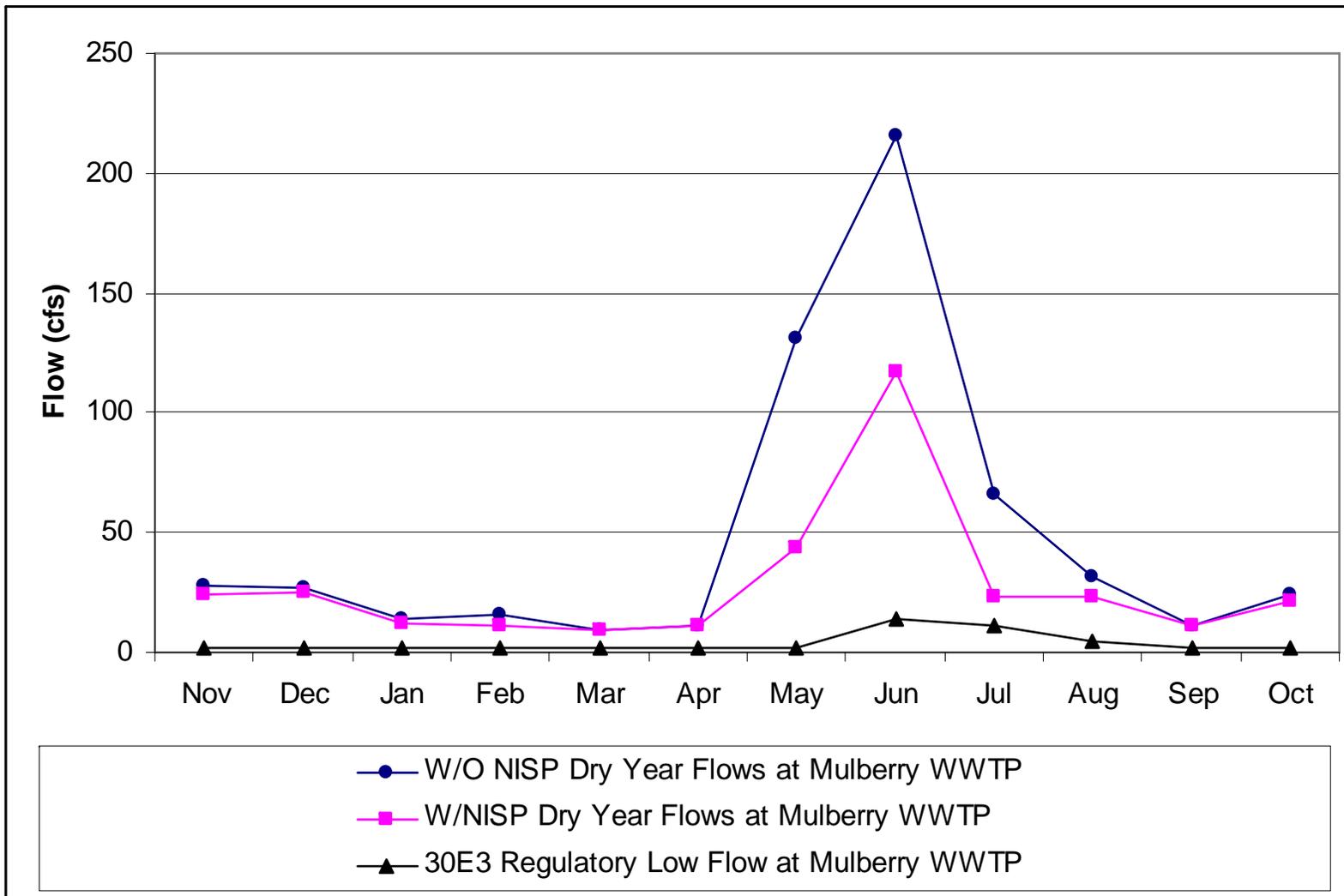
**Figure
 WWTP-3**



Northern Integrated Supply Project

Boxelder Sanitation District Wastewater Treatment Plant

**Figure
WWTP-4**



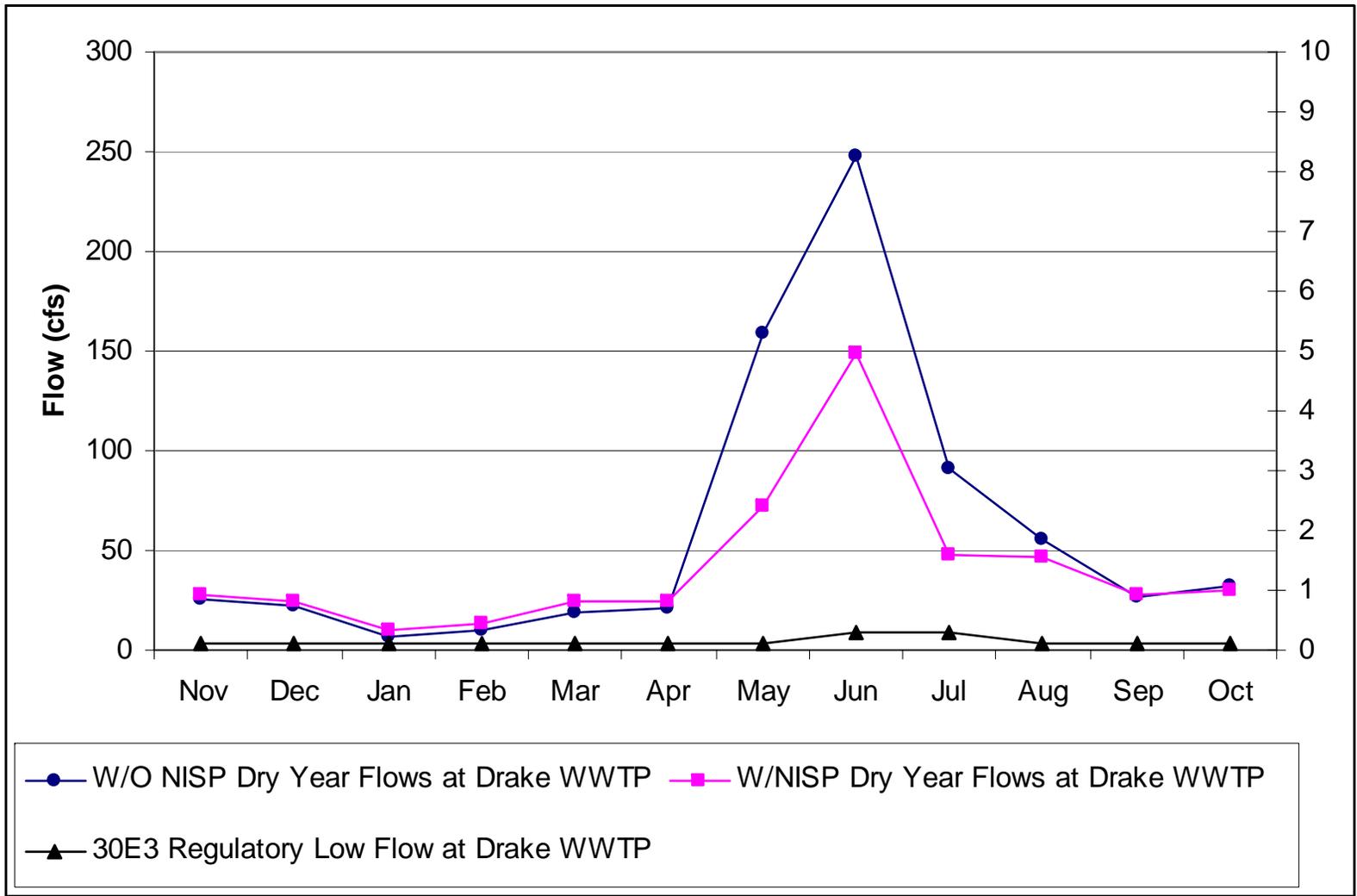
Source: Regulatory Low flows from *Water Quality Assessment, Cache la Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.
 NISP Dry Year Flows from *NISP EIS Water Resources Technical Report*, February 2008.



Northern Integrated Supply Project

**Comparison of Monthly Average Regulatory Low Flows to
 NISP Flows at Mulberry WRF**

**Figure
 WWTP-5**



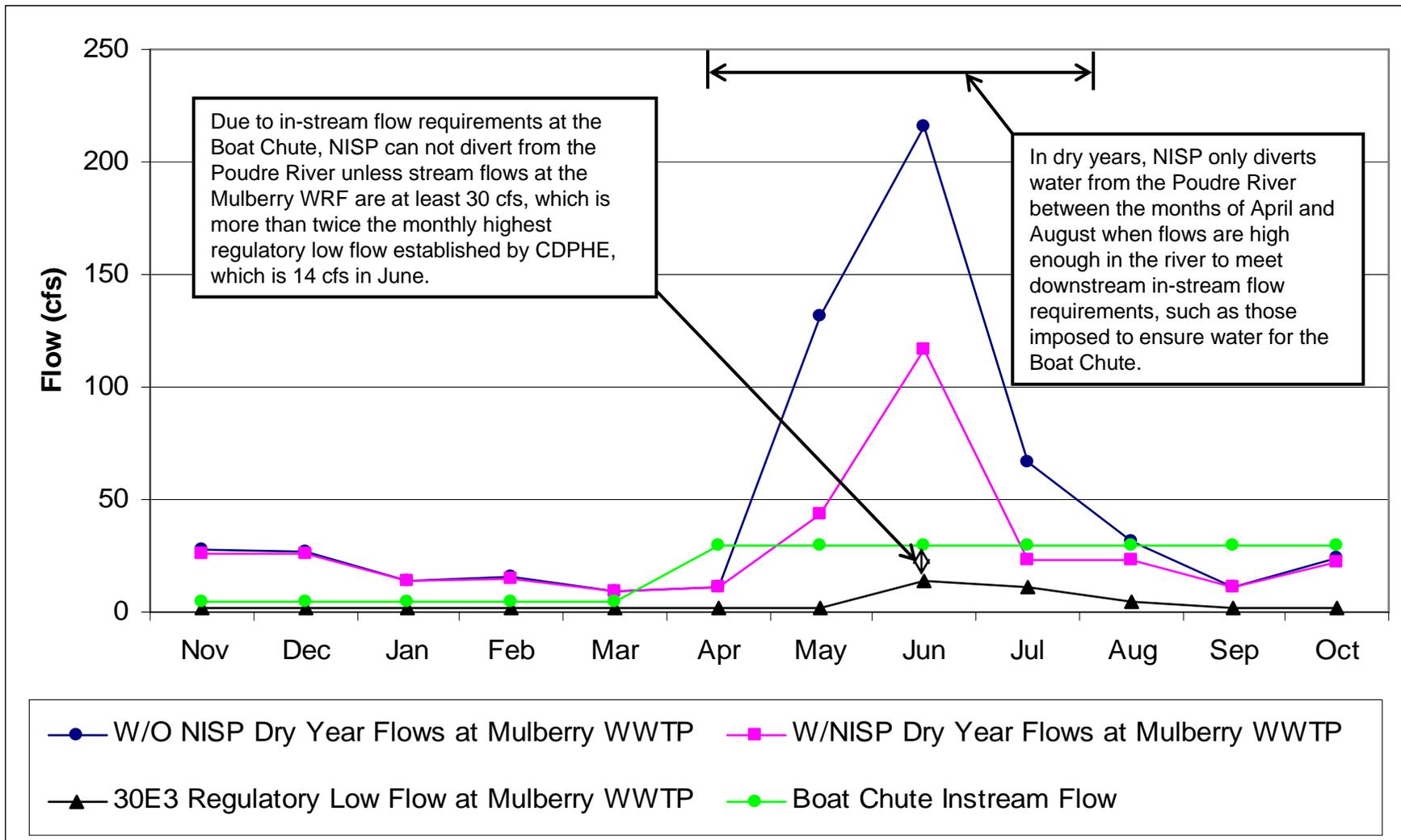
Source: Regulatory Low flows from *Water Quality Assessment, Cache La Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.
 NISP Dry Year Flows from *NISP EIS Water Resources Technical Report*, February 2008.



Northern Integrated Supply Project

**Comparison of Monthly Average Regulatory Low Flows to
 NISP Flows Near Drake WRF**

**Figure
 WWTP-6**



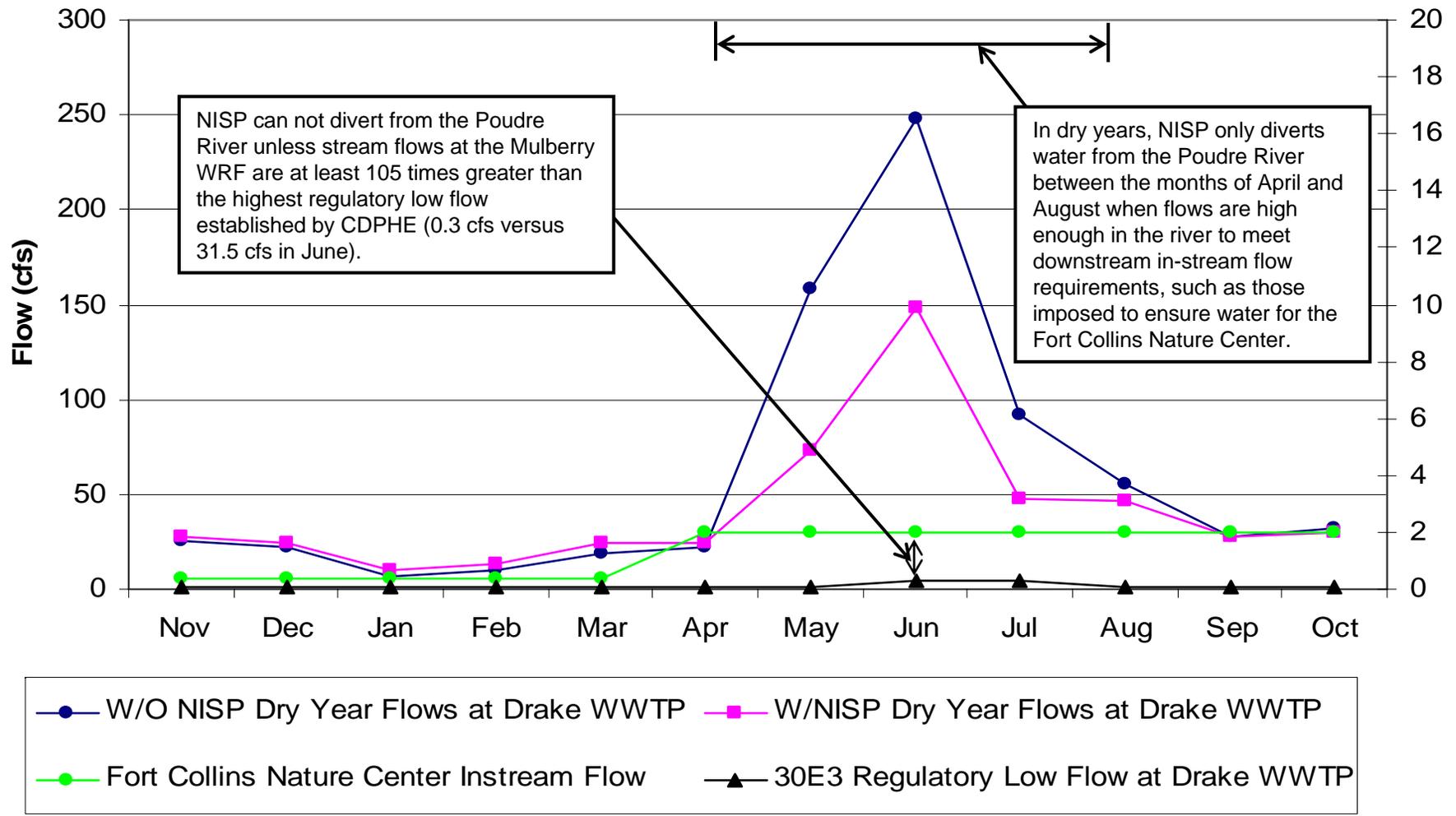
Source: Regulatory Low flows from *Water Quality Assessment, Cache la Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.
 NISP Dry Year Flows from *NISP EIS Water Resources Technical Report*, February 2008.
 Instream Requirements from *NISP EIS Water Resources Technical Report*, February 2008.



Northern Integrated Supply Project

**Comparison of Regulatory Low Flows to In-stream Flow Requirements
Near the Mulberry WRF**

**Figure
WWTP-7**



Source: Regulatory Low flows from *Water Quality Assessment, Cache la Poudre River, Fort Collins Wastewater Treatment Facilities*, June 18, 2008.
 NISP Dry Year Flows from *NISP EIS Water Resources Technical Report*, February 2008.
 Instream Requirements from *NISP EIS Water Resources Technical Report*, February 2008.



Northern Integrated Supply Project

**Comparison of Regulatory Low Flows to In-stream Flow Requirements
Near the Drake WRF**

**Figure
WWTP-8**