

TIMNATH RESERVOIR OPERATIONAL MANAGEMENT PLAN



Prepared for



Town of
TIMNATH
ESTABLISHED 1882

Town of Timnath, Colorado, USA

Prepared by



AATA International Inc.

Fort Collins, Colorado, USA

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Timnath Reservoir

Operational Management Plan

INTRODUCTION - The Timnath Reservoir Operational Management Plan has been developed to give the Town of Timnath a framework for the ongoing management of the reservoir, to identify the important functional limnological aspects of the reservoir, and to identify key issues that will or may require attention from time to time during the natural annual limnological/hydrological cycle. Some recommendations for active management are provided for consideration of physical, chemical, biological and social factors. Most of the principal reservoir management functions have already evolved, and are functioning well under the currently prescribed system. This includes a user registration program, boating permits, limits on active boats, rotational use (motorized vs non-motorized), safety and security, and onsite observational management/control throughout the summertime. As use days increase, there will be a continuing need for adaptive management by the Town of Timnath. Careful continuing assessment of potential conflicts, complaint responses, and adjustments will be required from time to time.

The Timnath Reservoir Usage Statistics for 2018 are provided as reference in Appendix C and indicate a broad, well balanced use profile that includes motorized and non-motorized water craft, fishing, cycling, hiking, and bird watching, all of which are being accommodated at this multiuse facility. Outdoor access for walking and running, picnicking, and general recreational activities is good. A Timnath Reservoir Master Plan has been developed and is being incrementally implemented.

The Timnath Reservoir Operational Management Plan has been developed to outline the key physical, chemical, biological, and social elements which present challenges and opportunities to maintain and improve the overall status and related uses of the reservoir. Of particular interest is the monitoring and management of potential harmful algal blooms (HABs) which may occur during warm summer months when recreational use is highest. In the past, some reservoir closures have been recommended, required, and posted due to occurrence of HABs.

PHYSICAL - The Timnath Reservoir has an area of approximately 580 to 600 acres with a 6 mile perimeter, and an estimated volume of approximately 10985 acre feet (at elevation 35.5), providing for a mean depth of approximately 18.3 feet. It is a highly managed irrigation reservoir which has a relatively short residence time (the average time that water stays in the reservoir based upon inflow, outflow, evaporation, and seepage). The water level is obviously dependent upon inflows and outflows from outside sources, with a minor amount due to local drainage from nearby watersheds. The highest water levels occur in late Spring and early Summer, and lowest water levels in late Summer, through Fall and Winter. The reservoir

usually freezes over in winter if ambient temperatures are low enough. As the Springtime progresses and the reservoir fills, usually in late March or April, the reservoir can reach full irrigation pool with optimal access from two boat ramps. The short residence time is a positive element in the management of the reservoir. Although the large withdrawals in late summer for irrigation do impact the total surface area and cause rapid decline in area and depth, this flushing also help prevents harmful algal blooms which have occurred in the reservoir. The exposure of the reservoir's sediments as water levels declines also limits production of benthic organisms which live in the upper sediment layer.

CHEMICAL – The water quality of the Timnath Reservoir is considered to be excellent, as the water source(s) are of high quality. However, there is no routine water quality monitoring program conducted for any cations, anions, trace metals, herbicides, pesticides, nutrients, or other parameters. **Water quality monitoring is recommended at least once at the beginning of the summer use season, after the reservoir has filled, to provide a broad scan of key parameters** (See Appendix A Recommendations), and which could be expanded later in the year if anything seems out of the ordinary, especially those parameters in exceedance of recognized water quality standards. This type of monitoring would provide the Town of Timnath with some indication and clarification should any water quality parameter be found to be outside of normal limits.

BIOLOGICAL - The Timnath Reservoir undergoes a natural ecological succession of plants and animals throughout the normal growing season. There is a high biodiversity of aquatic plants and animals that occur in the reservoir including bacteria, phytoplankton, periphyton, aquatic plants, zooplankton, benthic macroinvertebrates, fishes, birds, turtles, and other species. There have not been reported to be any fish kills or winter kill at the reservoir.

ALGAE – Periphyton and Phytoplankton

Microscopic analysis of periphyton (attached algae) and phytoplankton (floating algae) has been performed which indicated a low density of green algae (Chlorophyta) and diatoms (Bacillariophyta), all of which are considered as desirable species. High levels of the common green unicellular biflagellate *Chlamydomonas sp.* was found on April 1, 2019 following reservoir filling. This may reflect release of nitrogen from the newly inundated sediments. The principal species of periphyton and phytoplankton found over the past year of spot monitoring are provided in Appendix B.

During the summer of 2018, sampling of phytoplankton was taken approximately monthly to determine if there were any potentially harmful algae present in the water column. Samples were taken from the middle of the reservoir by boat and from the main boat dock. These samples were fixed with a modified Lugol's solution and returned to the AATA Phycology Lab for analysis using the Utermoehl inverted microscope technique, using a Wild M-40 inverted microscope. A total of 100 ml of sample was

placed in a settling chamber and allowed to set for a minimum of 24 hours. The sample was decanted and the settled residue analyzed at 100X to 1000X, recording the species present and relative abundance. A summary of a typical phytoplankton analyses is provided in Appendix B.

There were no harmful algal blooms detected in 2018. In fact, there were very few harmful algal species (Cyanophyta, blue green algae) found to exist in the samples. The phytoplankton was rather depauperate given the available nutrients, solar energy, and wind mixing. The summer phytoplankton biomass was low, comprised of species of *Chlamydomonas*, *Trachelomonas*, and *Cryptomonas*. The summer and late fall phytoplankton analysis showed significant amounts of resuspended sediment particles due to mixing from strong wind. There were some indicators of organic pollution such as Euglenoids (*Euglena acus*, *Euglena proxima*, *Euglena spp.*, and *Phacus sp.*). Spring 2019 sampling showed high concentrations of the green unicellular biflagellate *Chlamydomonas sp.*

AQUATIC PLANTS - A native species of aquatic vascular plant that is rooted at the shoreline and which then grows into the reservoir throughout the growing season is known as *Persicaria amphibia*, also known as *Polygonum amphibium*, with the common name of water smartweed or knotweed. This rapidly growing plant takes advantage of available shoreline habitat and actually grows well into the reservoir in the shallows. It is relatively good fish habitat, but can interfere sometimes seriously with boating, as its rhizomatous growth can get caught up in propellers. Control of this aquatic plant may require some spot applications of herbicide or physical removal early in the growing season. An evaluation was conducted during April 2019 which determined no control was warranted. This should be checked later in the 2019 drawdown season (requiring further authorization). It is especially prevalent in the central northern shallows of the reservoir, and in the southeast corner of the reservoir.

The rapid decline of water levels in late Summer and early Fall effectively limits this particular species, and is an effective control mechanism that helps avoid application of toxic herbicide. Another possible control mechanism would be physical removal to the shoreline by raking when water levels are high.



Persicaria amphibia

BACTERIA

During the summer months the reservoir is monitored for bacteria in accordance with primary body contact regulations. Class 1A provides for a maximum of 200 Fecal Coliform bacteria per 100 ml, and 126 E. coli per 100 ml. Both *Escherichia coli* (E. coli) and fecal coliforms are sampled and then monitored at the bacteriological testing lab, Colorado State University. This monitoring will continue. **Results should be communicated to the residents whatever the results are, with explanation about the regulatory action levels. Should the levels exceed the standards, then appropriate signage should be placed and public notification should be given.**

ZOOPLANKTON

The floating microscopic animals of the reservoir are known as zooplankton. These were sampled using a standard 0.5M zooplankton net with a mesh size of 50 microns. Samples were taken from the water column by casting the zooplankton net from the shoreline or dock, and towing it through the water. A concentrated sample of zooplankton was taken in a sample container and narcotized with Perrier (carbon dioxide) and returned to the AATA laboratory where the samples were analyzed with a compound microscope.

The zooplankton population is diverse and abundant, which is highly desirable. Many of the zooplankton species are excellent food for young fry and fishes. Most of these species are particulate feeders and help control the phytoplankton standing crop. There

are large numbers of rotifers, cladocera, and copepoda. The zooplankton includes very large species of *Cyclops spp.* and *Diaptomus spp.* as well as many species of Rotifera, such as *Keratella cochlearis* a very common species that captures and filters particulates and phytoplankton from the water column.

ROTIFER



Keratella cochlearis

CLADOCERAN



Daphnia magna

COPEPOD



Cyclops sp.

COPEPOD



Diaptomus sp.

BENTHIC MACROINVERTEBRATES

Very little is known of the benthic macroinvertebrates of the reservoir. No formal sampling and analysis is known to have been conducted to date. It can be anticipated that the mixed sandy loam /organic mud substrate in this reservoir would be suitable for various benthic organisms, but significant areas of sediment are exposed to dessication when water levels decline substantially in Fall. Some freshwater snails have been observed in the nearshore environment, along with Chironomids (midges), Odonates (dragonflies), Ephemeropterans (Mayflies), and other insects being observed in the adult phase. Further information should be gathered with respect to the benthos of the reservoir by dredge sampling and microscopic analysis. Much of the substrate is exposed when the reservoir is drawn down in late Summer, which has a limiting effect on benthic production. Northern Crayfish (*Faxonius (syn Orconectes) virilis*) occur along the shoreline riprap and are actively reproducing in this habitat. This species is common to the South Platte River drainages. There have been reported to be up to 8 possible crayfish species in Colorado many of which can provide excellent food source for predatory fishes and birds. Largemouth bass and walleyed pike often feed on crayfish.



Northern Crayfish (*Faxonius (Orconectes) virilis*)

FISHES

The fish population of the reservoir is interesting for several reasons, including its diversity and desirable fishability with relatively low numbers of rough fish species, such as European carp (*Cyprinus carpio*) and White suckers (*Catostomus commersonii*). The reservoir has also been able to sustain stocked walleyed pike, rainbow trout and brown trout. The following is a list of fishes which are reported from the reservoir:

- Black Crappie (*Pomoxis nigromaculatus*)
- Common Carp (*Cyprinus carpio*)
- Brown Trout (*Salmo trutta*)
- Rainbow Trout (*Onchrhynchus mykiss*)
- Largemouth Bass (*Micropterus salmoides*)
- White Sucker (*Catostomus commersonii*)
- Black Bullhead (*Ameiurus melas*)
- Bluegill (*Lepomis macrochirus*)
- Smallmouth Bass (*Micropterus dolomieu*)
- Yellow Perch (*Perca flavescens*)
- Walleye/Saugeye (*Sander vitreus*, syn. *Stizostedion vitreum vitreum*)



Largemouth Bass (*Micropterus salmoides*)



Walleyed pike (*Sander vitreus* – syn. *Stizostedion vitreum vitreum*)

The Town and Colorado Parks and Wildlife (CPW) have been in discussions regarding public access and the disposition of the stocked CPW fish. The Town has provided additional Colorado angler access by opening up the reservoir to a limited number of fishing permits with a valid Colorado fishing license. This approach will continue until such time as final resolution is reached between the Town and the CPW. See latest CPW fisheries monitoring data (Appendix D).

RESIDENT AND MIGRATORY BIRDS

The resident and migratory avifauna of the reservoir is a strong ecological attribute that has very positive recreational and ecological importance. Bird watching can be practiced any time of year with good success and interesting observations. The reservoir is a magnet for migratory bird “stopovers”, and supports a diverse number of different species of resident birds. A resident and migratory bird list is maintained by the Fort Collins Audubon Society (FCAS) for the greater Timnath/Fort Collins area. **It would be a good idea to make the FCAS pocketguide available to residents to highlight the birding experience at this important birding area.**

(See <http://www.fortcollinsaudubon.org/pages/pocketguide.html>)



Great Blue Heron (*Ardea herodias*)

SOCIAL - The Timnath Reservoir offers a broad range of recreational and ecological oriented activities, uses, and functions including the following:

- Fish and fishing
- Observing migratory and resident birds
- Boating
- Water skiing
- Flotation water sports (canoe, paddleboards, kayaks, etc.)
- Hiking, biking, and sightseeing
- Nature photography – sunrise, sunset, wildlife, mountain vistas
- Picnicking, family outings
- Aesthetics

One of the most sensitive social issues concerns registration and access. Also, the limit of 10 on motorized boats may also present some conflict during peak use times. However, the rules seem reasonable given the resource size and area limitations. Continued monitoring and evaluation is warranted, especially as demands for more access increase.

Some of the local homeowners have sought lake access directly from their properties, despite fencing and rules which attempt to prohibit such access. There is anticipated to be increasing pressure for direct access and this will continue to be a challenge given the situation. Regular communication about this situation and why the rules are there to protect the shoreline habitats should be continued. There may be pressure to establish at least one common launch point near to the walkway access on the east side of the lake, but this should be approached with caution and substantial evaluation.

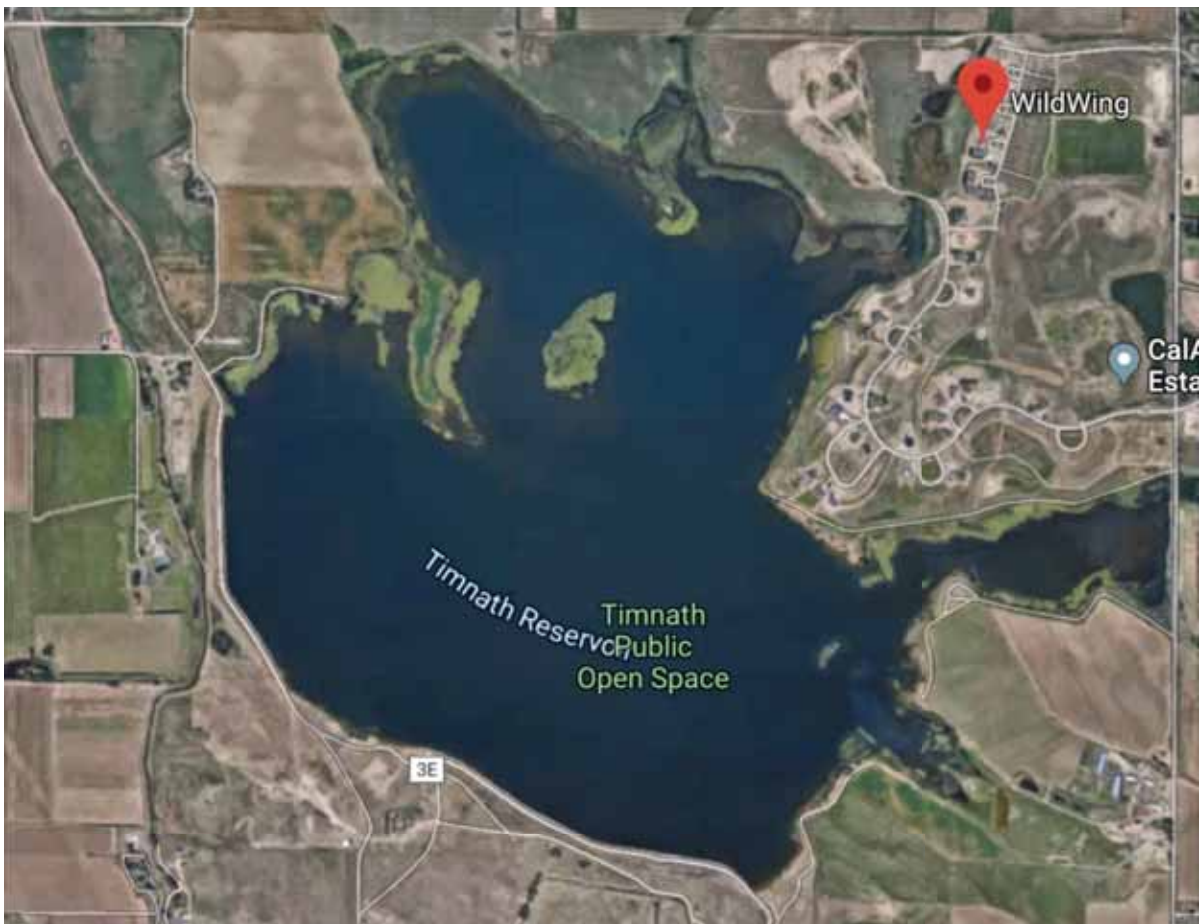


Figure 1. Timnath Reservoir Aerial Photo, Note Aquatic Vegetation (*Persicaria amphibia* as light green patches)



Figure 2. Timnath Reservoir Master Plan Schematic

NOTE: The prevailing wind direction is from the NNW, which induces mixing all the way to the bottom of the reservoir on a regular basis. The reservoir is polymictic and is expected to stratify only periodically during calm periods. There have been no fish kills due to winter kill or to low oxygen events. **Additional efforts to monitor water quality, especially pH, dissolved oxygen, and nutrients is warranted during summer growing season.**

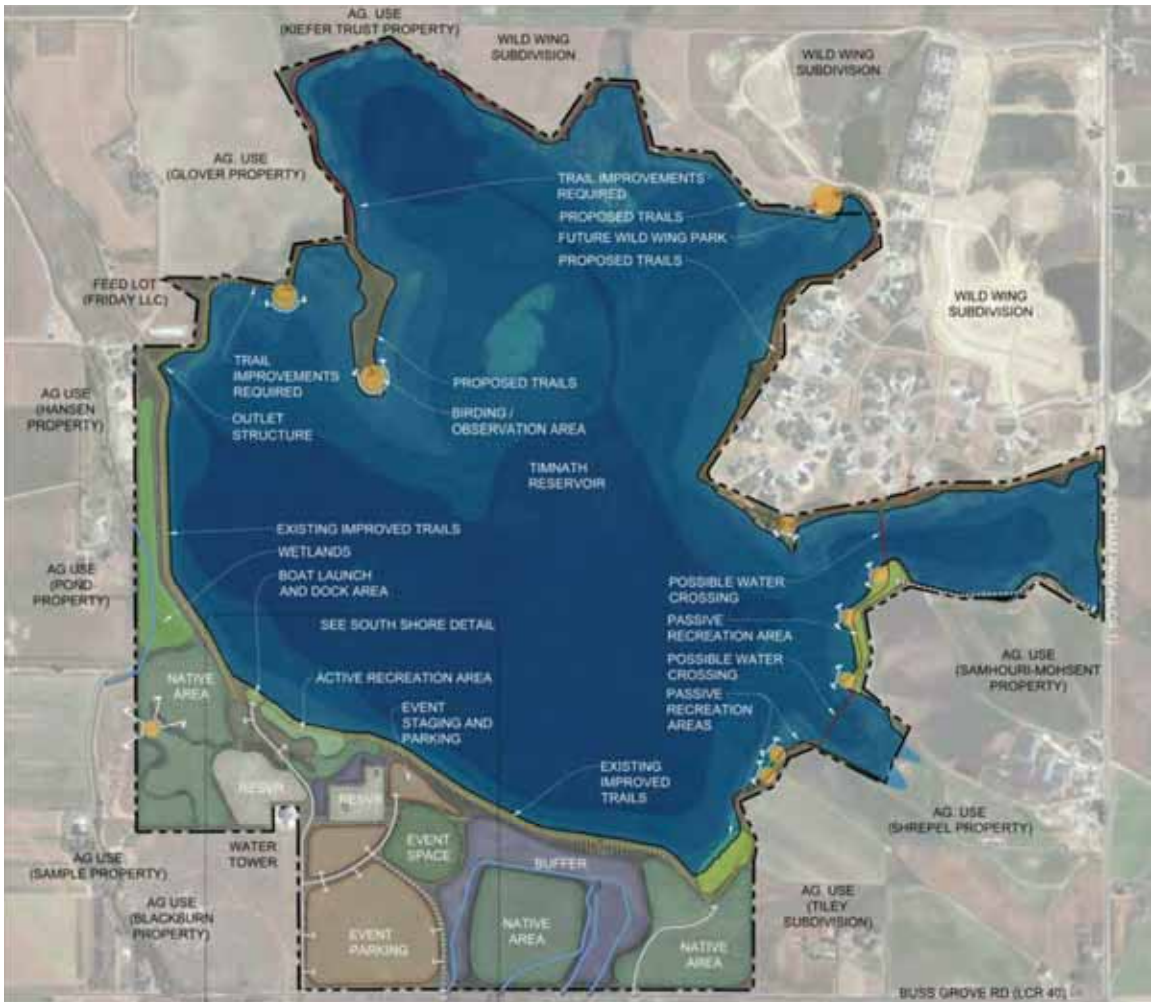


Figure 3. Timnath Reservoir Master Planning Document

NOTE: Monitoring and potential additional management of nonpoint source runoff from Agricultural areas may be required due to nutrient inputs. This entire area of nutrient dynamics has not been investigated to any extent. Contribution of nonpoint source nutrients to overall nutrient budget of the reservoir not known.

Appendix A

RECOMMENDATIONS

PHYSICAL

- 1) Install a water level indicator which can be linked via cell phone to a central website, to communicate the reservoir level to Town Staff and the public.
- 2) Organize regular reporting of inflows and outflow schedules
- 3) Observe hydrological conditions and runoff from surrounding farms, fields, and grassed areas
- 4) Control overland flow and sediment transport directly to the reservoir.
- 5) Continue to keep roadways well graded and graveled

CHEMICAL

- 1) Expand the water quality monitoring program to include nutrients and basic cations and anions, turbidity, alkalinity, pH, and perhaps other parameters.
- 2) Water quality sampling to occur monthly (April, May, June, July, August, September).
- 3) Establish a protocol to evaluate the use of any type of chemical (herbicides, pesticides, fertilizers, additives, etc.) which might be used in the management of the reservoir. Use of any chemicals should be approved in advance.
- 4) Be prepared to respond to a chemical spill of diesel or gasoline from motorboat mishaps, spills, accidents. Organize proper resources and protocol.
- 5) Water quality monitoring is recommended at least once at the beginning of the summer use season, after the reservoir has filled, to provide a broad scan of key parameters.
- 6) Additional efforts to monitor water quality, especially pH, dissolved oxygen, and nutrients is warranted during summer growing season.
- 7) Monitoring and potential additional management of nonpoint source runoff from Agricultural areas may be required due to nutrient inputs.

BIOLOGICAL

- 1) Finalize negotiations with the Colorado Parks and Wildlife concerning ownership of the stocked fishes
- 2) Continue biological monitoring of fecal coliform and *Escherichia coli* (E. Coli) at the boatramp using Colorado State University bacteriological laboratory.

- 3) Continue phytoplankton monitoring throughout summer months to check for Harmful Algal Blooms (HABs). Suggest 10 samples - May 15, June 12, June 26, July 10, July 17, July 24, July 31, August 7, August 14.
- 4) Perform a tri-annual fisheries inventory study, encourage anglers to report their catch to the reservoir observer.
- 5) Perform sampling and analysis of zooplankton, 4 monthly samples May, June, July, August
- 6) Perform sampling and analysis of benthic macroinvertebrates, crayfishes, once per summer season
- 7) Be prepared to post the lake with Harmful Algal Bloom (HAB) conditions if they are confirmed to occur
- 8) A fisheries management program is warranted given the value of the fishery
- 9) It would be a good idea to make the FCAS pocketguide available to residents to highlight the birding experience at this important birding area.

SOCIAL

- 1) Regular communication to the local residents and members is highly recommended to encourage positive stakeholder engagement.
- 2) Prepare annual reservoir status report for communication to the Town of Timnath and Residents.
- 3) Continue to monitor access points of residents to the reservoir, and develop a communication program to explain why the rules about access points have been developed.
- 4) Continue to monitor usage (types of activities, number of people, timing).
- 5) Conduct regular surveys (perhaps using drone technology) of shorelines to detect any deterioration, invasive species, illegal access, or other issues.
- 6) Based upon use statistics (See Appendix C) the management of motorized boat & water skiing use should remain as top priority. As this expands, it will require more man power and resources.
- 7) Bacteria monitoring results should be communicated to the residents whatever the results are, with explanation about the regulatory action levels. Should the levels exceed the standards, then appropriate signage should be placed and public notification should be given.
- 8) Implement Aquatic Nuisance Species inspections and tagging procedure for all users with boats and trailers according to State of Colorado regulations.

APPENDIX B
SUMMARY OF PHYTOPLANKTON, PERIPHYTON, ZOOPLANKTON

Found to be present in TIMNATH RESERVOIR

PHYTOPLANKTON

CYANOPHYTA Blue Green

Anabaena circinalis

Aphanizomenon flos-aquae

Merismopedia sp.

Small nano cyanobacteria

Small filamentous blue green

CHLOROPHYTA Green

Characium spp.

Chlamydomonas nr. clathrata

Chlamydomonas nr. angulosa

Chlamydomonas nr reinhardtii

Chlamydomonas nr. nivalis (pink)

Chlamydomonas spp.

Chlorella sp.

Closterium arcus

Cosmarium sp. (tiny)

Oocystis sp.

Pediastrum duplex

Scenedesmus acuminatus

Scenedesmus quadricauda

Scenedesmus sp.

Sphaerocystis sp.

Spirogyra sp. (filamentous fragments)

BACILLARIOPHYTA Diatoms

Cyclotella meneghiniana

Cyclotella sp.

Cymatopleura solea

Cymbella arcus

Cymbella minuta

Cymbella spp.

Diatoma vulgare

Fragilaria virescens

Melosira varians

Melosira sp. (extremely small diameter)

Navicula spp.
Nitzschia spp.
Stephanodiscus hantzshii
Synedra ulna

EUGLENOPHYTA Euglenoids

Euglena acus
Euglena spp.
Euglena nr. Proxima
Lepocinclus nr. Texta
Phacus spp.
Trachelomonas nr. hispida
Trachelomonas spp.

CRYPTOPHYTA/OCHROPHYTA

Cryptomonas sp.
Mallomonas sp.

PYRRHOPHYTA Dinoflagellates

Ceratium hirundinella
Gymnodinium nr. aeruginosum
Peridinium sp.

PERIPHYTON (500 valve count data)

Diatoma vulgare	246
Cocconeis pediculus	113
Fragilaria vaucheriae	18
Cymbella turgidula	2
Gomphonema sp.	78
Gomphonema affine	1
Achnanthis minutissimum	9
Navicula capitoradiata	1
Encyonopsis microcephala	16
Rhoicosphenia abbreviata	5
Nitzschia frustulum	1
Diatoma elongatum	1
Ctenophora pulchella	1
Gomphoneis cf. olivacea	4
Encyonema auerswaldii	4
	500

ZOOPLANKTON

ROTIFERA Rotifers

Bosmina longirostris

Brachionus sp.

Keratella cochlearis

CLADOCERA Water fleas

Daphnia magna

Daphnia pulex

Daphnia sp.

COPEPODA Microcrustaceans

Cyclops spp.

Diaptomus spp.

Nauplii larvae

APPENDIX C. SUMMARY OF TIMNATH RESERVOIR USE STATISTICS

2018 Timnath Reservoir Usage Statistics									
Date	Fishing	Trail Use	Bird Watching	Motorized Boats	Motorized Boat occupants	Non-Motorized Boats	Non-motorized occupants	Cycling	Other (picnic, photography, etc.)
May Total*:	76	95	3	21	113	56	74	2	4
June Total:	134	56	3	43	209	90	122	7	3
July Total:	107	120	19	73	403	155	205	24	63
August Total*:	4	9	9	9	48	19	24	1	7
September Total*:	36	20	3	0	0	2	4	0	0
Grand Totals:	357	300	37	146	773	322	429	34	77
Percentages:	18%	15%	2%		39%		21%	2%	4%
<p>* Note: May, August, and September stats are from weekends only. September water levels are such that the west boat ramp was unusable</p>									

APPENDIX D. LAKE SAMPLING SUMMARY REPORT



Lake Sampling Summary Report

Water: 58417 TIMNATH RESERVOIR
Station: SP3538
Drainage: South Platte River
Date: 11/7/2014

Zone: 13
Effort: 84

Lake center coordinates
X: 503180
Y: 4488668
Elevation: 4910 ft

Metric: HOURS
Protocol: CPUE

PROPORTIONAL STOCK DENSITY and QUALITATIVE STOCK DENSITIES

Species	Total Number	Proportional Stock Density (%)	Percent Stock Size	Percent Quality Size	Percent Preferred Size	Percent Memorable Size	Percent Trophy Size	Maximum Size (inches)
BLACK CRAPPIE	1							4.02
COMMON CARP	140	15.09	84.91	13.21		1.89		28.23
GIZZARD SHAD	140	22.22	77.78		11.11	11.11		18.98
LARGEMOUTH BASS	9	33.33	66.67	33.33				13.70
GREEN SUNFISH	4	0.00	100.00					5.83
WALLEYE	75	0.00	100.00					11.42

MEAN, MINIMUM AND MAXIMUM VALUES FOR LENGTHS AND WEIGHTS

SPECIES	Total Sampled	Mean		Minimum		Maximum	
		inches	lbs	inches	lbs	inches	lbs
BLACK CRAPPIE	1	4.02	0.03	4.02	0.03	4.02	0.03
COMMON CARP	140	9.38	0.84	3.23	0.02	28.23	11.79
GIZZARD SHAD	140	6.26	0.12	5.04	0.04	18.98	3.22
LARGEMOUTH BASS	9	7.82	0.43	5.08	0.04	13.70	1.97
GREEN SUNFISH	4	5.62	0.11	5.43	0.09	5.83	0.13
WALLEYE	75	10.09	0.36	8.58	0.22	11.42	0.58



Lake Sampling Summary Report

Water: 58417 TIMNATH RESERVOIR	Lake center coordinates		
Station: SP3538	Zone: 13	X: 503180	Y: 4488668
Drainage: South Platte River			Elevation: 4910 ft
Date: 11/7/2014	Effort: 84	Metric: HOURS	Protocol: CPUE

RELATIVE ABUNDANCE and CATCH PER UNIT EFFORT

Species	Total sample	Population >= cutoff	Population all sizes	Weight Lb	Percent		Catch per Unit Effort	
					Number	Weight	Number/Effort	Lbs/Effort
BLACK CRAPPIE	1	1	1	0.03	0.27	0.04	0.01	0.00
COMMON CARP	140	140	166	0.65	37.94	0.86	1.67	0.01
GIZZARD SHAD	140	140	204	0.95	37.94	1.26	1.67	0.01
LARGEMOUTH BASS	9	9	12	0.24	2.44	0.32	0.11	0.00
GREEN SUNFISH	4	4	4	0.12	1.08	0.16	0.05	0.00
WALLEYE	75	75	75	0.58	20.33	0.77	0.89	0.01

RELATIVE ABUNDANCE and BIOMASS ESTIMATES

Species No/Acre >=T	Total sample T	Population estimate	Weight Lb	Percent		Biomass Lb/Acre	Num/ Acre	Num/Mile	Fish samples No/Acre < T
				Number	Weight				
BLACK CRAPPIE	1	1.00	0.03	0.27	0.04				100
COMMON CARP	140	140.00	0.65	37.94	0.86				150
GIZZARD SHAD	140	140.00	0.95	37.94	1.26				150
LARGEMOUTH BASS	9	9.00	0.24	2.44	0.32				150
GREEN SUNFISH	4	4.00	0.12	1.08	0.16				80
WALLEYE	75	75.00	0.58	20.33	0.77				150

Notes: One net was the uniform mesh net (G2), lake was full pool.

Gear/Methods: 6 gillnets, one Unifor